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Annual European Union greenhouse gas inventory 1990–2012 and inventory report 2014

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EXECUTIVE SUMMARY

ES.-1. BACKGROUND INFORMATION ON GREENHOUSE GAS INVENTORIES AND CLIMATE CHANGE

The European Union (EU), as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories for the years 1990 to t-2 for emissions and removals within the area covered by its Member States (i.e. domestic emissions taking place within its territory).

The present inventory also constitutes the EU-15 submission under the Kyoto Protocol and covers information and data from Member States available until 8 May 2014. Under the Kyoto Protocol's first commitment period, the EU-15 took on a common commitment to reduce emissions by 8 % between 2008 and 2012 compared to emissions in the 'base year' ([1]). The EU-28 does not have a common target under the Kyoto Protocol's first commitment period in the same way as the EU-15.

The legal basis for the compilation of the EU inventory is Regulation (EU) 525/2013 on a mechanism for monitoring and reporting GHG emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC ([2]).

This Regulation establishes a mechanism for:

(a) ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the Union and its Member States to the UNFCCC Secretariat;

(b) reporting and verifying information relating to commitments of the Union and its Member States pursuant to the UNFCCC, to the Kyoto Protocol and to decisions adopted thereunder, and evaluating progress towards meeting those commitments;

(c) monitoring and reporting all anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol on substances that deplete the ozone layer in Member States;

(d) monitoring, reporting, reviewing and verifying GHG emissions and other information pursuant to Article 6 of Decision No 406/2009/EC;

(e) reporting the use of revenue generated by auctioning allowances under Article 3d(1) or (2) or Article 10(1) of Directive 2003/87/EC, pursuant to Article 3d(4) and Article 10(3) of that Directive;

(f) monitoring and reporting on the actions taken by Member States to adapt to the inevitable consequences of climate change in a cost-effective manner;

(g) evaluating progress by the Member States towards meeting their obligations under Decision No 406/2009/EC.

The new Monitoring Mechanism Regulation has enhanced the reporting rules on GHG emissions to meet requirements arising from current and future international climate agreements, as well as the 2009 EU Climate and energy package. Starting in 2014, inventory reporting takes place under this new legal instrument, which replaces and expands the previous Monitoring Mechanism Decision

([1]) For the EU-15, the base year for CO_2, CH_4 and N_2O is 1990; for fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EU inventory is the sum of Member State inventories, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for the Netherlands, Portugal and the United Kingdom.

([2]) OJ L 165, 18/06/2013, p. 13–40 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:JOL_2013_165_R_0013_01

280/2004/EC ([3]). More information on the changes to the EU national system, including the legal base, can be found in Chapter 13.

The EU GHG inventory comprises the direct sum of the national inventories compiled by the EU Member States making up the EU-15 and the EU-28. Energy data from Eurostat are used for the reference approach for CO_2 emissions from fossil fuels developed by the Intergovernmental Panel on Climate Change (IPCC).

The main institutions involved in the compilation of the EU GHG inventory are the Member States, the European Commission Directorate-General Climate Action (DG CLIMA), the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), Eurostat, and the Joint Research Centre (JRC).

The process of compiling the EU GHG inventory is as indicated below.

1. Member States submit their annual GHG inventories by 15 January each year to the European Commission, DG CLIMA, with a copy to the EEA.
2. The EEA and its ETC/ACM, Eurostat, and JRC then perform initial checks on the submitted data. The draft EU GHG inventory and inventory report are circulated to Member States for review and comments by 28 February.
3. Member States check their national data and the information presented in the EU GHG inventory report, send updates if necessary, and review the EU inventory report itself by 15 March.
4. The EEA and its ETC/ACM prepare the final EU GHG inventory and inventory report by 15 April for submission by the European Commission to the UNFCCC Secretariat.
5. A resubmission is prepared by 27 May if needed.

The EU adopted the Climate and Energy Package in April 2009. The package underlines the objective of limiting the rise in global average temperature to no more than two degrees Celsius above pre-industrial levels. To achieve this goal, the EU committed to a unilateral emission reduction target of 20 % by 2020, compared with 1990 levels ([4]), and agreed to a conditional offer to move to a 30 % reduction provided that other developed countries commit themselves to comparable emission reductions and developing countries contribute adequately according to their responsibilities and respective capabilities.

The main instruments to reduce emissions under the Climate and Energy Package are: 1.) the EU Emissions Trading System ([5]), covering more than 11 000 power stations and industrial plants in 31 countries, as well as airlines; and 2.) the Effort Sharing Decision ([6]) for sectors not included under the EU emissions trading system (EU ETS). Both trading (i.e. EU ETS) and non-trading sectors are to contribute to the 20 % objective. Minimising overall reduction costs implies a 21 % reduction in emissions from EU ETS sectors compared to 2005 by 2020, and a reduction of approximately 10 % compared to 2005 by 2020 for non-EU ETS sectors. The non-trading sectors broadly include direct emissions from households and services, as well as emissions from transport, waste, and agriculture. The non-trading sectors currently represent about 60 % of total GHG emissions.

Information on Land Use activities and Land-Use Change and Forestry (LULUCF) activities is covered in the Kyoto Protocol under Art. 3.3 (afforestation, reforestation and deforestation) and Art. 3.4. (forest land management, cropland management, grazing land management, and revegetation). Detailed information on 3.3 and 3.4 LULUCF activities are provided in Chapter 11 of this report.

([3]) Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1397464097337&uri=CELEX:32004D0280, O.J. 49, 19/02/2004, p. 1–8

([4]) All emission information for EU-28 in this report uses 1990 as the starting point when addressing emission reductions. EU-28 does not have a common target under the Kyoto Protocol in the same way as EU-15.

([5]) See http://ec.europa.eu/clima/policies/ets/index_en.htm

([6]) See http://ec.europa.eu/clima/policies/effort/index_en.htm

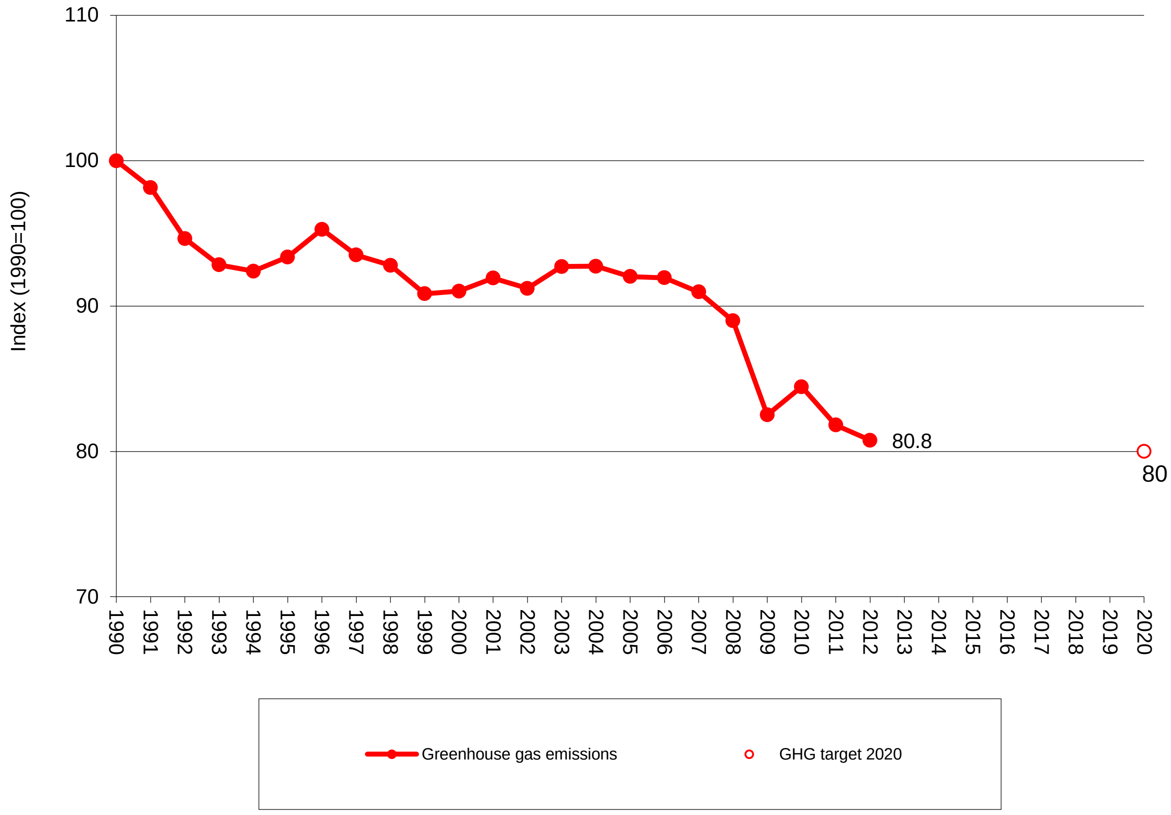
In addition, all parties to the Kyoto Protocol must provide information on how they are striving to implement their greenhouse gas commitments in such a way as to minimise potential adverse social, environmental and economic impacts on developing countries. This information is required under Article 3, paragraph 14 of the Protocol and is included in chapter 15.

ES.-2. SUMMARY OF GREENHOUSE GAS EMISSION TRENDS IN THE EU

EU-28

Total GHG emissions, without LULUCF, in the EU-28 decreased by 19.2 % between 1990 and 2012 (–1082 million tonnes CO_2 equivalents). Emissions decreased by 1.3 % (59 million tonnes CO_2 equivalents) between 2011 and 2012 (Figure ES.1).

Figure ES.1 EU-28 GHG emissions 1990–2012 (excl. LULUCF)



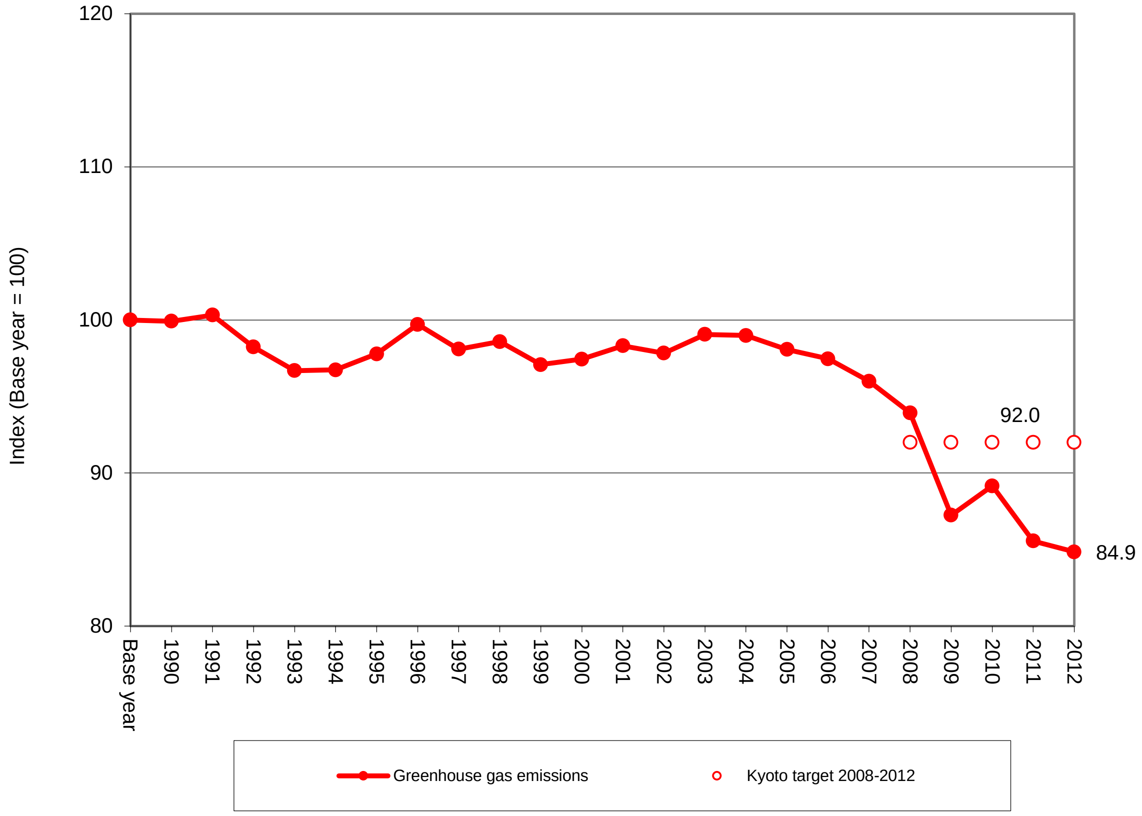
Notes: *GHG emission data for the EU-28 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and are not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories. Note that the 80 % EU target for 2020, under the EU Climate and Energy Package, includes international aviation and it is therefore not directly comparable with the 1990–2012 GHG emissions shown in the graph.*

EU-15

In 2012, total GHG emissions in the EU-15, without LULUCF, were 15.1 % (642 million tonnes CO_2 equivalents) below 1990 levels, and 15.1 % (646 million tonnes CO_2 equivalents) below its Kyoto base year levels. Emissions decreased by 0.8 % (30 million tonnes CO_2 equivalents) between 2011 and 2012.

The 15 EU Member States that were members of the EU when the Kyoto Protocol was agreed in 1997 decided to fulfil their commitments for the first commitment period jointly and to reduce the GHG emissions by 8 % by 2008–12 compared to the EU-15 'base year'. This can be achieved by a combination of domestic policies and measures, the use of carbon sinks, and the use of Kyoto mechanisms. Since 2009, total GHG emissions have been below the EU-15 Kyoto target (Figure ES.2). Over the entire first commitment period (2008–2012), the EU-15 average emissions stood at 11.8 % below base year levels. This reduction does not take into account carbon sinks from LULUCF activities, nor the additional use of flexible mechanisms.

Figure ES.2 EU-15 GHG emissions 1990–2012 compared with target for 2008–12 (excl. LULUCF)



Notes: *GHG emission data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.*

Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent. The EU-15 would need to reduce GHG emissions by about 341 million tonnes, on average between 2008–2012, in order to meet its 8 % Kyoto Protocol reduction target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks, and the use of Kyoto mechanisms.

Main trends by source category, 1990-2012

Table ES.1 shows the sources with the largest contribution to the change in total GHG emissions in the EU-15 and EU-28 between 1990 and 2012.

Table ES.1 Overview of EU-28 and EU-15 source categories whose emissions increased or decreased by more than 20 million tonnes CO_2 equivalents in the period 1990–2012

Source category	EU-15	EU-28
	Million tonnes (CO_2 eq.)	
Road Transportation (CO_2 from 1A3b)	72	123
Consumptions of halocarbons (HFC from 2F)	71	85
Enteric fermentation (CH_4 from 4A)	-21	-48
Cement Production (CO_2 from 2A1)	-23	-28
Production of halocarbons (HFC from 2E)	-27	-27
Nitric Acid Production (N_2O from 2B2)	-30	-42
Agricultural soils (N_2O from 4D)	-41	-74
Fugitive emissions from fuels (CH_4 from 1B)	-49	-73
Iron and Steel Production (CO_2 from 1A2a +2C1)	-54	-98
Manufacture of Solid fuels (CO_2 from 1A1c)	-58	-59
Adipic Acid Production (N_2O from 2B3)	-58	-59
Public Electricity and Heat Production (CO_2 from 1A1a)	-61	-214
Solid waste disposal on land (CH_4 from 6A)	-66	-61
Households and services (CO_2 from 1A4)	-78	-137
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-151	-258
Total	**-643**	**-1 082**

Notes: *As the table only presents sectors whose emissions have increased or decreased by at least 20 million tonnes CO_2 equivalent, the sum for each country grouping EU-15/EU-28 do not match the total change listed at the bottom of the table.*

Main trends by source category, 2011–2012

Table ES.2 shows the sources making the largest contribution to the change in GHG emissions in the EU-15 and EU-28 between 2011 and 2012.

Table ES.2 Overview of EU-28 and EU-15 source categories whose emissions increased or decreased by more than 3 million tonnes CO_2 equivalents in the period 2011–2012

Source category	EU-15	EU-28
	Million tonnes (CO_2 eq.)	
Public Electricity and Heat Production (CO_2 from 1A1a)	26	10
Households and services (CO_2 from 1A4)	20	20
Solid Waste Disposal (CH_4 from 6A)	-3	-3
Cement production (CO2 from 2A1)	-4	-5
Refineries (CO2 from 1A1b)	-4	-5
Agricultural Soils (N_2O from 4D)	-4	-5
Iron and Steel Production (CO_2 from 1A2a +2C1)	-6	-8
Manufacture of Solid fuels (CO2 from 1A1c)	-9	-10
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-11	-15
Road Transportation (CO_2 from 1A3b)	-30	-32
Total	**-30**	**-59**

Notes: *As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2 equivalents, the sum for each country grouping does not match the total change listed at the bottom of the table. Hydrofluorocarbons (HFCs) from refrigeration and air conditioning in EU-15 increased by less than 3 million tonnes and CH_4 emissions from 'solid waste disposal' decreased by less than 3 million tonnes in EU-28.*

Main reasons for emission changes, 2011–2012

The 30 million tonnes (CO_2 equivalents) decrease in GHG emissions in the EU-15 between 2011 and 2012 was mainly due to the factors outlined below.

- Decreasing CO_2 emissions in road transportation (– 30 million tonnes or – 4 %) — following a decreasing trend for the fifth consecutive year — were driven by reductions in both passenger and freight transportation. In 2012, emissions decreased in particular in the Member States that experienced persisting economic downturn or recession such as Italy, Spain and Greece: road freight transport declined by 16 % in Italy and Spain, and by 21 % in Greece.
- Reduced CO_2 emissions in the category 'manufacturing industries excluding iron and steel industry' (– 11 million tonnes or – 3 %) were mainly driven by a decline in industrial production and a decline in cement production — especially in Italy, Germany, the United Kingdom, Spain and Portugal.
- The overall decrease in CO_2 emissions from the manufacture of solid fuels and other energy industries (– 9 million tonnes or – 17 %) were mainly driven by decreases in Germany, Italy and the UK. In Italy, the main driver for the reduction in emissions was a decline in iron and steel production and the associated decline in coke production. In the UK, the main driver was the continued decline in oil and gas production. In Germany, the main driver was the reclassification of certain power production facilities in coal mining from this category to the category 'public electricity and heat production' (this partly explains increases mentioned below for public electricity and heat production).
- The decrease in CO_2 emissions from iron and steel production (– 6 million tonnes or – 4 %) reflects a further decline of crude steel production in the EU-15.

Substantial emission increases between 2011 and 2012 were reported for the source categories listed below.

- **CO_2 from public electricity and heat production (+ 26 million tonnes or + 3 %)** Increasing emissions occurred in particular in Germany, the UK and Spain. In Germany, power production from coal increased mainly due to lower nuclear power production as well as higher exports and lower imports of electricity. In the UK there was a substantial increase in the use of coal for power generation. In Spain, the main reasons are a decline in hydropower production and a considerable shift from natural gas to coal use in public power production.
- **CO_2 from households and services (+ 20 million tonnes or + 4 %)** Emissions increased in almost all EU-15 Member States. The colder winter and higher demand for heating can partly explain higher emissions in 2012 compared to 2011.

For the EU-28, GHG emissions decreased by 1.3 % in 2012. The strong decline in road transport emissions within the EU-15 is also reflected in the EU-28 emissions. In addition, the increase in emissions from public electricity and heat production is much smaller in the EU-28 than in the EU-15. The main reason for this is that CO_2 emissions from public electricity dropped sharply in Bulgaria, Poland, Romania and Estonia. In Bulgaria, power production from solid fuels decreased considerably. In Poland, a shift from solid fuels to biomass in power production can be observed. In Romania, one reason for the decline in emissions from electricity production was the increase in wind power production. Finally, Estonia compensated lower power production from solid fuels with higher electricity imports.

For a detailed analysis, see the EEA publications 'Why did greenhouse gas emissions decrease in the EU between 2011 and 2012? EEA analysis' and 'Why did greenhouse gas emissions decrease in the EU between 1990 and 2012? EEA analysis' ([7]).

[7] http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014

Table ES.3 GHG emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2012 (million tonnes)	2011–2012 (million tonnes)	Change 2011–2012 (%)	Change 1990-2012 (%)	Change base year–2012 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78.1	79.0	80.1	-2.7	-3.3%	2.5%	1.3%	-13.0%
Belgium	143.0	145.7	116.5	-3.6	-3.0%	-18.5%	-20.0%	-7.5%
Denmark	68.7	69.3	51.6	-4.9	-8.6%	-24.8%	-25.5%	-21.0%
Finland	70.3	71.0	61.0	-5.9	-8.8%	-13.3%	-14.1%	0.0%
France	557.4	563.9	490.1	0.1	0.0%	-12.1%	-13.1%	0.0%
Germany	1248.0	1232.4	939.1	10.4	1.1%	-24.8%	-23.8%	-21.0%
Greece	104.9	107.0	111.0	-3.7	-3.3%	5.8%	3.7%	25.0%
Ireland	55.2	55.6	58.5	0.8	1.4%	5.9%	5.3%	13.0%
Italy	519.1	516.9	460.1	-26.5	-5.4%	-11.4%	-11.0%	-6.5%
Luxembourg	12.9	13.2	11.8	-0.29	-2.4%	-8.2%	-10.1%	-28.0%
Netherlands	211.8	213.0	191.7	-3.4	-1.7%	-9.5%	-10.0%	-6.0%
Portugal	60.8	60.1	68.8	-0.6	-0.8%	13.1%	14.3%	27.0%
Spain	283.7	289.8	340.8	-5.1	-1.5%	20.1%	17.6%	15.0%
Sweden	72.7	72.2	57.6	-3.2	-5.2%	-20.8%	-20.2%	4.0%
United Kingdom	775.5	776.3	580.8	18.1	3.2%	-25.1%	-25.2%	-12.5%
EU-15	**4262.1**	**4265.5**	**3619.5**	**-30.5**	**-0.8%**	**-15.1%**	**-15.1%**	**-8.0%**
Bulgaria	109.1	132.6	61.0	-5.0	-7.5%	-44.1%	-54.0%	-8.0%
Croatia	31.9	31.3	26.4	-2.1	-7.4%	-17.3%	-15.7%	-5.0%
Cyprus	6.1	Not applicable	9.3	-0.4	-4.4%	52.1%	Not applicable	Not applicable
Czech Republic	196.1	194.2	131.5	-3.8	-2.8%	-33.0%	-32.3%	-8.0%
Estonia	40.6	42.6	19.2	-1.3	-6.3%	-52.8%	-55.0%	-8.0%
Hungary	97.6	115.4	62.0	-4.1	-6.1%	-36.5%	-46.3%	-6.0%
Latvia	26.2	25.9	11.0	-0.2	-1.4%	-58.1%	-57.6%	-8.0%
Lithuania	48.7	49.4	21.6	-0.1	-0.3%	-55.6%	-56.2%	-8.0%
Malta	2.0	Not applicable	3.1	0.1	3.7%	57.7%	Not applicable	Not applicable
Poland	466.4	563.4	399.3	-6.5	-1.6%	-14.4%	-29.1%	-6.0%
Romania	247.7	278.2	118.8	-2.7	-2.3%	-52.0%	-57.3%	-8.0%
Slovakia	73.2	72.1	42.7	-2.0	-4.4%	-41.7%	-40.7%	-8.0%
Slovenia	18.4	20.4	18.9	-0.6	-2.8%	2.5%	-7.1%	-8.0%
EU-28	**5626.3**	**Not applicable**	**4544.2**	**-59.0**	**-1.3%**	**-19.2%**	**Not applicable**	**Not applicable**

([a]) *As Cyprus, Malta and the EU-28 do not have targets under the Kyoto Protocol's first commitment period, they do not have applicable Kyoto Protocol base years.*

ES.-3. SUMMARY OF EMISSIONS AND REMOVALS BY MAIN GREENHOUSE GAS

EU-28

Table ES.4 gives an overview of the main trends in EU-28 GHG emissions and removals for 1990–2012. The most important GHG by far is CO_2, accounting for 82 % of total EU-28 emissions in 2012 excluding LULUCF. In 2012, EU-28 CO_2 emissions without LULUCF were 3 717 million tonnes, which was 16 % below 1990 levels. Compared to 2011, CO_2 emissions decreased by 1 %. Emissions of CH_4, N_2O, perfluorocarbons (PFCs) and SF_6 decreased in 2012, while HFCs increased in 2012.

Table ES.4 Overview of EU-28 GHG emissions and removals from 1990 to 2012 in CO_2 equivalents (million tonnes)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Net CO_2 emissions/removals	4 168	3 866	3 821	3 947	3 930	3 943	3 784	3 443	3 585	3 445	3 401
CO_2 emissions (without LULUCF)	4 437	4 169	4 136	4 262	4 274	4 224	4 123	3 788	3 908	3 767	3 717
CH_4	607	552	501	449	443	436	430	420	413	405	403
N_2O	533	474	430	402	389	389	380	359	350	348	341
HFCs	28	41	47	62	65	70	74	77	82	84	86
PFCs	21	14	10	6	5	5	4	3	3	3	3
SF_6	11	16	11	8	8	7	7	7	7	6	6
Total (with net CO_2 emissions/removals)	**5 368**	**4 963**	**4 819**	**4 874**	**4 840**	**4 850**	**4 679**	**4 309**	**4 439**	**4 292**	**4 241**
Total (without CO2 from LULUCF)	**5 637**	**5 266**	**5 134**	**5 190**	**5 185**	**5 131**	**5 017**	**4 654**	**4 762**	**4 614**	**4 556**
Total (without LULUCF)	**5 626**	**5 253**	**5 122**	**5 178**	**5 173**	**5 119**	**5 006**	**4 642**	**4 751**	**4 603**	**4 544**

EU-15

Table ES.5 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2012. In the EU-15, the most important GHG is also CO_2, accounting for 83 % of total EU-15 emissions in 2012. In 2012, EU-15 CO_2 emissions without LULUCF were 2 988 million tonnes, which was 11 % below 1990 levels. Compared to 2011, CO_2 emissions decreased by 1 %. As in the EU-28, CH_4, N_2O, and PFC emissions decreased in the last year, whereas HFC and SF_6 emissions increased in 2012.

Table ES.5 Overview of EU-15 GHG emissions and removals from 1990 to 2012 in CO_2 equivalents (million tonnes)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Net CO_2 emissions/removals	3 221	3 127	3 181	3 297	3 279	3 246	3 118	2 846	2 952	2 812	2 789
CO_2 emissions (without LULUCF)	3 369	3 307	3 375	3 477	3 470	3 412	3 333	3 064	3 156	3 011	2 988
CH_4	443	423	383	333	326	321	316	310	304	298	296
N_2O	402	383	344	313	301	299	292	281	272	269	264
HFCs	28	40	44	55	56	59	63	66	69	70	72
PFCs	17	12	8	5	5	5	4	3	3	3	3
SF_6	11	15	11	8	7	7	6	6	6	6	6
Total (with net CO_2 emissions/removals)	**4 123**	**4 000**	**3 971**	**4 010**	**3 974**	**3 937**	**3 799**	**3 511**	**3 606**	**3 458**	**3 429**
Total (without CO2 from LULUCF)	**4 270**	**4 180**	**4 165**	**4 191**	**4 165**	**4 104**	**4 014**	**3 729**	**3 811**	**3 658**	**3 628**
Total (without LULUCF)	**4 262**	**4 171**	**4 156**	**4 183**	**4 157**	**4 095**	**4 007**	**3 722**	**3 803**	**3 650**	**3 619**

More detailed information can be found in Chapter 2.

ES.-4. SUMMARY OF EMISSIONS AND REMOVALS BY MAIN SOURCE AND SINK CATEGORIES

EU-28

Table ES.6 gives an overview of EU-28 GHG emissions in the main source categories for 1990–2012. The most important sector by far is energy (i.e. combustion and fugitive emissions), accounting for 79 % of total EU-28 emissions in 2012. The second largest sector is agriculture (10 %), followed by industrial processes (7 %).

Table ES.6 Overview of EU-28 GHG emissions in the main source and sink categories 1990 to 2012 in CO_2-equivalents (million tonnes)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
1. Energy	4 325	4 058	4 004	4 103	4 107	4 044	3 961	3 678	3 783	3 642	3 604
2. Industrial Processes	462	441	394	403	401	412	388	324	335	332	321
3. Solvent and Other Product Use	17	14	14	12.288	12	12	11	10	11	10	10
4. Agriculture	617	533	521	493	490	490	489	478	475	475	469
5. Land-Use, Land-Use Change and Forestry	-258	-291	-302	-304	-333	-268	-328	-334	-312	-311	-304
6. Waste	206	207	190	166	164	160	156	152	147	144	141
7. Other	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5 368**	**4 963**	**4 819**	**4 874**	**4 840**	**4 850**	**4 679**	**4 309**	**4 439**	**4 292**	**4 241**
Total (without LULUCF)	**5 626**	**5 253**	**5 122**	**5 178**	**5 173**	**5 119**	**5 006**	**4 642**	**4 751**	**4 603**	**4 544**

EU-15

Table ES.7 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2012. More detailed trend descriptions are included in Chapters 3 to 9.

Table ES.7 Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2012 CO_2-equivalents (million tonnes)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
1. Energy	3 281	3 215	3 261	3 341	3 330	3 268	3 201	2 968	3 048	2 906	2 893
2. Industrial Processes	354	351	310	311	304	308	292	253	260	252	243
3. Solvent and Other Product Use	13	12	11	9.672	10	9	9	8	8	8	8
4. Agriculture	443	421	423	394	389	388	388	379	378	378	373
5. Land-Use, Land-Use Change and Forestry	-139	-171	-185	-173	-184	-158	-208	-210	-197	-192	-191
6. Waste	171	172	152	127	125	121	117	113	109	106	102
7. Other	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4 123**	**4 000**	**3 971**	**4 010**	**3 974**	**3 937**	**3 799**	**3 511**	**3 606**	**3 458**	**3 429**
Total (without LULUCF)	**4 262**	**4 171**	**4 156**	**4 183**	**4 157**	**4 095**	**4 007**	**3 722**	**3 803**	**3 650**	**3 619**

ES.-5. SUMMARY OF EU MEMBER STATE EMISSION TRENDS

Table ES.8 gives an overview of Member State contributions to EU GHG emissions for 1990–2012. Member States show large variations in GHG emission trends.

Table ES.8 Overview of Member States' contributions to EU GHG emissions excluding LULUCF from 1990 to 2012 in CO_2-equivalents (million tonnes)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	78	80	80	93	90	87	87	80	85	83	80
Belgium	143	150	146	142	138	133	136	123	131	120	117
Denmark	69	76	69	64	72	67	64	61	61	57	52
Finland	70	71	69	69	80	78	70	66	74	67	61
France	557	553	561	559	547	538	533	509	516	490	490
Germany	1 248	1 118	1 040	994	1 002	977	980	913	946	929	939
Greece	105	110	127	135	132	135	131	124	118	115	111
Ireland	55	59	68	70	69	68	68	62	62	58	59
Italy	519	530	551	574	563	555	541	490	499	487	460
Luxembourg	13	10	10	13	13	12	12	12	12	12	12
Netherlands	212	223	213	209	206	204	203	198	209	195	192
Portugal	61	71	84	88	83	80	78	75	71	69	69
Spain	284	322	380	431	424	432	398	360	347	346	341
Sweden	73	74	69	67	67	65	63	59	65	61	58
United Kingdom	775	723	690	675	672	662	643	590	606	563	581
EU-15	**4 262**	**4 171**	**4 156**	**4 183**	**4 157**	**4 095**	**4 007**	**3 722**	**3 803**	**3 650**	**3 619**
Bulgaria	109	76	59	64	65	68	67	58	60	66	61
Croatia	32	24	27	31	31	33	31	29	29	29	26
Cyprus	6	8	9	10	10	10	11	10	10	10	9
Czech Republic	196	152	146	146	147	147	142	134	137	135	131
Estonia	41	20	17	18	18	21	20	16	20	20	19
Hungary	98	78	77	78	77	76	73	67	68	66	62
Latvia	26	13	10	11	12	12	11	11	12	11	11
Lithuania	49	22	20	23	24	26	25	20	21	22	22
Malta	2	2	3	3	3	3	3	3	3	3	3
Poland	466	441	396	399	414	415	406	388	407	406	399
Romania	248	175	134	141	145	143	140	120	116	122	119
Slovakia	73	53	49	50	50	48	49	45	45	45	43
Slovenia	18	19	19	20	21	21	21	19	19	19	19
EU-28	**5 626**	**5 253**	**5 122**	**5 178**	**5 173**	**5 119**	**5 006**	**4 642**	**4 751**	**4 603**	**4 544**

The overall EU GHG emission trend is dominated by the two largest emitters, Germany and the UK, accounting for about one third of total EU-28 GHG emissions in 2012. These two Member States have achieved total domestic GHG emission reductions in 2012 of 504 million tonnes of CO_2 equivalents compared to 1990 ([8]), not counting carbon sinks and the use of Kyoto mechanisms.

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new *Länder* after German reunification. The reduction of GHG emissions in the UK were primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production, and N_2O emission reduction measures in the production of adipic acid.

France and Italy were the third and fourth largest emitters in 2012, with a share in the EU total of 11 % and 10 % respectively. Italy's GHG emissions were 11 % below 1990 levels in 2012. Italian GHG emissions increased from 1990, primarily due to increases in road transport, electricity and heat production, and petroleum refining. However, Italian emissions decreased from 2004 with significant

(8) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes in order to meet the Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

drops in 2009 and 2012, which were mainly due to the economic crisis and reductions in industrial output during these years. France's emissions were 12 % below 1990 levels in 2012. In France, large reductions were achieved in N_2O emissions from adipic acid production, but CO_2 emissions from road transport and HFC emissions from consumption of halocarbons increased considerably between 1990 and 2012.

Poland and Spain are the fifth and sixth largest emitters in the EU-28, accounting for 9 % and 7 % of total EU-28 GHG emissions in 2012. Spain increased emissions by 20 % between 1990 and 2012. This was largely due to emission increases from road transport, electricity and heat production, and households and services. Poland decreased GHG emissions by 14 % between 1990 and 2012. The main factors for decreasing emissions in Poland — as with other new Member States — were the decline of energy-inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport), where emissions increased.

ES.-6. INTERNATIONAL AVIATION AND MARITIME TRANSPORT

Emissions of GHGs from international aviation and shipping activities increased constantly between 1992 and 2007. Emissions decreased between 2007 and 2010 in the EU-28 — partly reflecting the economic recession — but increased again in 2011 and subsequently decreased again in 2012. EU GHG emissions from international aviation are lower than the emissions from international maritime transport, but they were increasing more rapidly until 2007. The average annual EU-28 growth rates in emissions since 1990 were 3 % for aviation and 1 % for maritime transport. Total GHG emissions from international transport reached 281 million tonnes of CO_2 equivalents in 2012.

For detailed information on emissions from international bunkers see Chapter 3.8 of this report.

ES.-7. INFORMATION ON RECALCULATIONS

The UNFCCC has permanently fixed the base year emissions for the EU-15 (at 4 266 million tonnes of CO_2 equivalents) based on reviews during 2007 and 2008. However, recalculations of past emissions data occur every year based on the inventory improvements that Member States are required to undertake for the whole time series.

Based on EU Member States' GHG inventories in 2014, total EU-15 GHG emissions for 2011 were 0.5% higher than those reported in the 2013 GHG inventories. Total EU-15 emissions in 1990 reported in 2014 GHG inventories were 0.2 % higher than the 1990 emissions reported in 2013 inventories.

Table ES.9 Overview of major recalculations in the EU-15 for 1990

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries N2O	Germany	-1077	-25	Correction of some emission factors in order to increase time series consistency. Final data available from the National Energy Balance.
1A2_Manufacturing Industries and Construction CO2	Spain	-2314	-5	Activity included (fuel consumption) in the revision of the inventory fuel balance.
1A2_Manufacturing Industries and Construction CO2	UK	1216	1	National energy statistics revised for many sectors from 2008 onwards. 1A2c: New source: refinery gas combustion in chemical industry. National energy statistics revised for many sectors from 2008 onwards. 1A2f: Correction to EUETS data has caused a change to OPG CEF for all years. Correction to allocation of petcoke to lime sector. Reallocation of reinery gas to chemical sector.
1A3_Transport CO2	Spain	3339	6	Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
4B_Manure management CH4	UK	5527	161	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for deep litter (previously solid storage and dry lot) in response to ERT 2013. Updated feed digestibility for dairy cows from 75.0 to 74.5234142710097.
4B_Manure management N2O	UK	1388	71	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for deep litter (previously solid storage and dry lot).

***Note**: Explanations for recalculations as provided by the Parties in their national GHG inventory reports*

Table ES.10 Overview of major recalculations in the EU-15 for 2011

		2011		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO2	Belgium	1056	5	1A1a solid fuels: Flemish region: difference mainly due to wrong allocation between solid fuel and biomass of one electric power installation in 2011. 1A1a other fuels: Flemish region: by finalizing the definitive energy balance for 2011, 1,1 PJ more other fuels was reported (+112 kton CO2) + RBC: AD revision (waste incinerated).
1A1_Energy Industries CO2	France	-1106	-2	1A1a: Completeness of data: improved accuracy and temporal coherence. 1A1b: Filtering method and improved allocation of emissions.
1A2_Manufacturing Industries and Construction CO2	France	-1921	-3	Updated energy balance SOeS statistics for several years (decrease of the quantity of petroleum products) and revision of the fuel split of petroleum products (-> impact on the consumption of petroleum coke and LPG). - Correction of a double counting of the new fuel category ``GNR`` (for off road machineries), i.e. non-road diesel oil, for the first introduction year 2011 (impact for all sector in the CRf code 1A2)
1A2_Manufacturing Industries and Construction CO2	Germany	2241	2	Final data available from the National Energy Balance.
1A2_Manufacturing Industries and Construction CO2	Spain	-11076	-19	Activity included (fuel consumption) in the revision of the inventory fuel balance.
1A2_Manufacturing Industries and Construction CO2	UK	-3164	-5	National energy statistics revised for many sectors from 2008 onwards. 1A2c: New source: refinery gas combustion in chemical industry. National energy statistics revised for many sectors from 2008 onwards. 1A2f: Correction to EUETS data has caused a change to OPG CEF for all years. Correction to allocation of petcoke to lime sector. Reallocation of reinery gas to chemical sector.
1A3_Transport CO2	France	1845	1	1A3a, 1A3c + 1A3d: Updated data: improved accuracy. 1A3b: Recalculation is due to revision of biofuels dataset : present use of actual volumes incorporated into the fuels (new available statistics from customs vs previous estimated ratios as energy).
1A4_Other sectors CO2	Belgium	-1029	-4	Energy balance update (final values 2011) 1A4a liquid fuels: reallocation of off-road activities in harbours, airports and transhipment companies in 1A3e and 1A5b (defence) instead of 1A4a before 1A4b liquid fuels: Flanders: for fuel oil, the data from 2002 were based on an estimate of the number of households from the latest census of 2001 using heating oil as main energy source, corrected with newly built homes (+) and demolished houses (-). The switch in existing houses from fuel oil to natural gas was so far not taken into account, leading to an accumulated overestimation of households using fuel oil as main energy source. This correction was made during the 2014 submission for the years 2002-2012. 1A4b biomass: Flanders en Wallonia: new methodology to estimate the woodconsumption for households.The methology uses the urbanisation degree and unweighted average uses of biomass as main heating source or as secondary heating source from the Eurostat survey to calculate the total biomass used for the period 1990 -2011. 1A4c liquid fuels: RBC : Offroad AD revision (energy)
1A4_Other sectors CO2	France	1512	2	Recalculations performed are due to changes in activity data : - update of energy balance statistics, - update of fuel type split for petroleum products (data from CPDP statistics).
1A4_Other sectors CO2	Germany	9831	8	Final data available from the National Energy Balance.
1A4_Other sectors CO2	Spain	7792	23	Light differences due to a revision of the significant digits of the emission factor for diesel/gas-oil. Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
1A4_Other sectors CO2	UK	3189	4	National energy statistics revised for many sectors from 2008 onwards. 1A4b: Revision to carbon balance apprach to use AD and EFS from ISSB/Tata in preference to DUKES stats and historic EF defaults.
1B2_Oil and natural gas CO2	France	1057	36	1B2a: Error correction: improved accuracy. New data: improving completeness. Change of use: improving transparency. 1B2b: Refinement of reporting: improving the completeness and transparency. 1B2c: Filtering method that takes into account new data: improved accuracy.
4B_Manure management CH4	UK	4098	163	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for deep litter (previously solid storage and dry lot) in response to ERT 2013. Updated feed digestibility for dairy cows from 75.0 to 74.5234142710097.
4B_Manure management N2O	UK	1033	63	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for deep litter (previously solid storage and dry lot).
6A_Solid waste disposal on land CH4	UK	5395	38	Methane recovery data for landfills now taken from monitored data.

Note: *Explanations for recalculations as provided by the Parties in their national GHG inventory reports*

For detailed information on recalculations see Chapter 10 and the sector-specific recalculations.

ES.-8. INFORMATION ON INDIRECT GREENHOUSE GAS EMISSIONS

Emissions of CO, NO_X, non-methane volatile organic compounds (NMVOCs) and SO_2 have to be reported to the UNFCCC because they influence climate change indirectly: the former three substances are precursor substances for ground-level ozone, which in itself is a GHG. Sulphur emissions can contribute to the formation of microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation.

Table ES.11 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990 and 2012. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 87%), followed by CO (– 67%), NMVOC (– 60 %) and NO_X (– 51 %).

Table ES.11 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2012 (1000 tonnes)

EMISSIONS	1990	1995	2000	2005	2010	2011	2012
NOx	13 769	12 087	10 533	9 501	7 214	6 902	6 685
CO	54 467	42 142	32 461	24 126	19 327	18 082	18 133
NMVOC	14 654	12 016	9 744	7 886	6 264	6 040	5 881
SO2	16 444	10 036	6 118	4 518	2 380	2 291	2 217

In the EU-28, SO_2 emissions decreased by 81 %, followed by CO (– 64 %), NMVOC (– 58 %) and NO_X (– 51 %) (Table ES.12).

Table ES.12 Overview of EU-28 indirect GHG and SO_2 emissions for 1990–2012 (1000 tonnes)

EMISSIONS	1990	1995	2000	2005	2010	2011	2012
NOx	17 473	14 842	12 807	11 620	9 171	8 827	8 516
CO	68 648	51 639	39 722	31 005	26 082	24 546	24 377
NMVOC	17 500	13 940	11 442	9 514	7 814	7 557	7 367
SO2	26 251	16 827	10 375	8 155	5 397	5 534	5 116

EU Member States also annually report emissions of these same substances to the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (LRTAP). Additionally, Member States also report emissions of NO_X, NMVOCs and SO_2 under the EU's National Emissions Ceilings Directive (NECD).

ES.-9. INFORMATION ON USING EU ETS FOR NATIONAL GHG INVENTORIES IN EU MEMBER STATES

This report also includes an analysis of the use of data and emissions reported under the EU ETS for preparing national GHG inventories. The analysis shows that most Member States used the ETS data to improve and refine the estimation and reporting of CO_2 emissions from energy and industrial processes. Twenty-seven Member States indicated that they used ETS data for quality assurance / quality control purposes and checked data consistency between both sources (Chapter 1.4.2 and Chapter 16.2.2). Croatia joined the EU in July 2013 and participates in the EU ETS since January 2013. For the 2014 submission, Croatia did not use any ETS data, but has plans to improve its GHG emission estimates with ETS data

Sixteen Member States indicated that they directly use the verified emissions reported by installations under the ETS. Twenty-two Member States used ETS data to improve country-specific emission factors and 22 Member States reported that they used activity data (e.g. fuel use) provided under the ETS in the national inventory. The use of ETS data improved the quality of GHG inventory data with respect to completeness (additional emission sources can be estimated for which no data were available before the EU ETS), accuracy (e.g. due to improved country-specific emission factors), and improved allocation of emissions to CRF source categories.

Annexes published on CD-ROM and the EEA website only:

Annex 1: Additional information for EU-15
Annex 1.1: Key category analysis
Annex 1.2: CRF tables
Annex 1.3: Status reports
Annex 1.4: CRF Table Summary 1A, Summary 2 and 8(a)
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Annex 1.7: CRF Tables Solvent use
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Annex 1.14: EU KP LULUCF tables

Annex 2: Additional information for EU-28
Annex 2.1: Key category analysis
Annex 2.2: CRF tables
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Annex 3: Annexes to registry

PART 1: ANNUAL INVENTORY SUBMISSION (EU-15)

1 INTRODUCTION TO THE EU GREENHOUSE GAS INVENTORY

This report is the annual submission of the European Union (EU) to the United Nations Framework Convention on Climate Change (UNFCCC). It presents the greenhouse gas (GHG) inventory of the EU, the process and the methods used for the compilation of the EU inventory as well as GHG inventory data of the individual EU Member States for 1990 to 2012. The GHG inventory data of the Member States are the basis of the EU GHG inventory. The data published in this report are also the basis for the progress evaluation report of the European Commission, required under Regulation No 525/2013/EU on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.

This report aims to present transparent information on the process and methods of compiling the EU GHG inventory. It addresses the relevant aspects at EU level, but does not describe detailed sectoral methodologies of the Member States' GHG inventories. Detailed information on methodologies used by the Member States is available in the national inventory reports of the Member States, which are included in Annex 1.12. Note that all Member States' submissions (common reporting format (CRF) tables and inventory reports), which are included in Annex 1.12 and made available at the European Environment Agency (EEA) website, are considered to be part of the EU inventory. Several chapters in this report refer to information provided by the Member States, where additional insights can be gained. In many cases this Member State information is presented in summary overview tables.

The EU greenhouse gas inventory has been compiled under Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (9). Decision No 280/2004/EC has been revised in order to enhance the reporting rules on GHG emissions to meet requirements arising from current and future international climate agreements as well as the 2009 EU Climate and energy package. The emissions compiled in the EU GHG inventory are the sum of the respective emissions in the respective national inventories, except for the Intergovernmental Panel on Climate Change (IPCC) reference approach for CO_2 from fossil fuels. Since the data are revised and updated for all years, they replace EU data previously published, in particular, the *Annual European Union greenhouse gas inventory 1990–2011 and inventory report 2012* (EEA, 2013).

This part of the EU GHG inventory report includes data for the EU-15 Member States. The EU-15 Member States are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. This part includes all the detailed information provided in previous reports for the EU-15.

1.1 Background information on greenhouse gas inventories and climate Change

The annual EU GHG inventory is required for two purposes.

Firstly, the EU, as the only regional economic integration organisation having joined the UNFCCC and the Kyoto Protocol as a Party, has to report annually on GHG inventories within the area covered by its Member States.

Secondly, under the EU GHG Monitoring Mechanism Regulation, the European Commission has to assess annually whether the actual and projected progress of Member States is sufficient to ensure fulfilment of the EU's commitments under the UNFCCC and the Kyoto Protocol. For this purpose, the Commission has to prepare a progress evaluation report, which has to be forwarded to the European Parliament and the Council. The annual EU inventory is the basis for the evaluation of actual progress.

(9)OJ L 165, 18.06.2013, p. 13.

The legal basis of the compilation of the EU inventory is Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (hereafter referred to as the Monitoring Mechanism Regulation or MMR) (10). The MMR establishes a mechanism for inter alia: (1 ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the Union and its Member States to the UNFCCC Secretariat; (2) reporting and verifying information relating to commitments of the Union and its Member States pursuant to the UNFCCC, to the Kyoto Protocol and to decisions adopted thereunder and evaluating progress towards meeting those commitments; (3) monitoring and reporting all anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol on substances that deplete the ozone layer in the Member States; (4) monitoring, reporting, reviewing and verifying greenhouse gas emissions and other information pursuant to Article 6 of Decision No 406/2009/EC; (5) evaluating progress by the Member States towards meeting their obligations under Decision No 406/2009/EC.

Under the provisions of Article 7 of the MMR, the Member States shall determine and report to the Commission by 15 January each year (year X) inter alia:

- anthropogenic emissions of greenhouse gases listed in Annex A to the Kyoto Protocol (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride SF_6)) during the year before last (X – 2);
- data on emissions of carbon $moNO_X$ide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_X) and volatile organic compounds (VOCs) during the year before last (year X – 2);
- anthropogenic greenhouse gas emissions by sources and removals of carbon dioxide by sinks resulting from land-use, land-use change and forestry as required under Convention and Kyoto Protocol reporting during the year before last (year X – 2);
- any changes to the information referred to in points above relating to the years between 1990 and the year three-years previous (year X – 3);
- information from their national registry on the issue, acquisition, holding, transfer, cancellation, retirement and carry-over of AAUs, RMUs, ERUs, CERs, tCERs and lCERs for the year X-1;
- the elements of the national inventory report necessary for the preparation of the EU greenhouse gas inventory report, such as information on the Member State's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed.

The reporting requirements for the Member States under the MMR are elaborated in an implementing act which is expected to be adopted in June 2014. Meanwhile Commission Decision 2005/166/EC laying down rules implementing Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol is still valid (11). According to the MMR and its implementing decisions the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EU and its Member States use the '*UNFCCC guidelines on reporting and review*' (Document FCCC/CP/2002/8), and prepare inventory information in the common reporting format (CRF) and the 'national inventory report' that contains background information.

In accordance with UNFCCC guidelines, the EU and its Member States use the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories* (IPCC, 2000), which is consistent with the *Revised 1996 IPCC guidelines for national greenhouse gas inventories* (IPCC, 1997).

1.2 A description of the institutional arrangements for inventory preparation

Figure 1.1 shows the inventory system of the European Union. The Directorate General Climate Action of the European Commission has overall responsibility for the inventory of the European Union (EU)

(10)OJ L 49, 19.2.2004, p. 1.

(11)OJ L 55, 1.3.2005, p. 57.

while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Union. DG Climate Action is supported in the establishment of the inventory by the following main institutions: the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) as well as the following other DGs of the European Commission: Eurostat, and the Joint Research Centre (JRC) (12).

Figure 1.1 Inventory system of the European Union

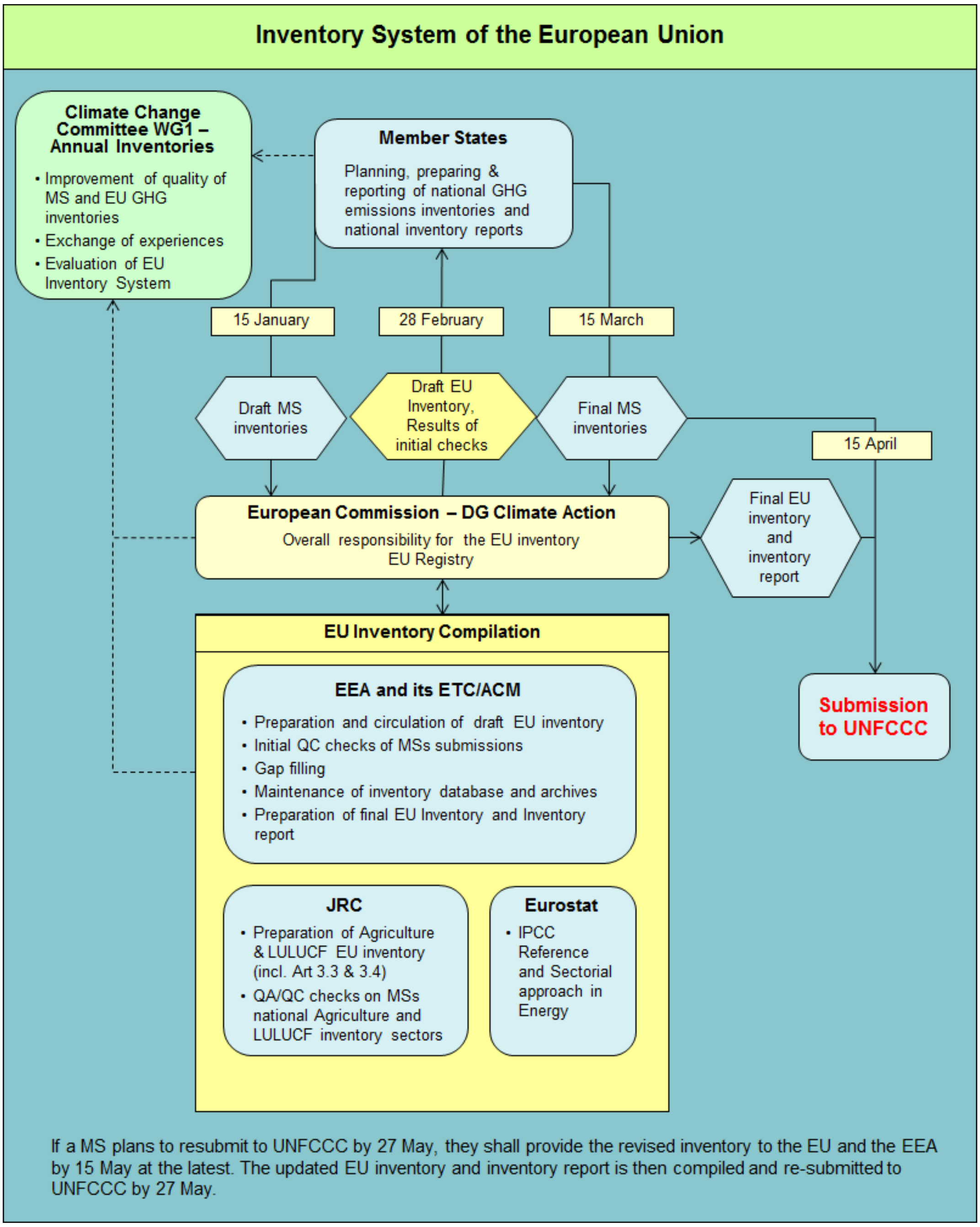

Table 1.1 gives and overview on responsibilities for the compilation of the EU GHG inventory submission in 2014.

(12) The Statistical Office of the European Communities (Eurostat) and the Joint Research Centre (JRC) are DGs of the European Commission. For simplicity reasons, these institutions are referred to as 'Eurostat' and the 'JRC' in this report.

Table 1.1 Responsibility list for the compilation of the EU GHG inventory submission in 2014

Name	EC GHG inventory/inventory report compilation				Quality management system			
	Overall responsibility	Project manager	Sector experts	Team members	Overall responsibility	QA/QC coordinator	Quality expert	Team members
Velina Pendolovska (DG Clima) velina.pendolovska@ec.europa.eu	X			Chapter 13 Changes national system	X		**QA NIR**: Executive summary, chapter 1	
Ronald Velghe (DG Clima) ronald.velghe@ec.europa.eu			Chapter 12 Kyoto units, Chapter 14 Changes to registry					
Cecile Pierce (DG Clima) cecile.pierce@ec.europa.eu				Chapter 12 Kyoto units, Chapter 14 Changes to registry			SEF tables	
Breffni Lynch (DG CLIMA) breffni.lynch@ec.europa.eu				Chapter 12 Kyoto units, Chapter 14 Changes to registry				
Adrian Leip (JRC) adrian.leip@jrc.ec.europa.eu			4					4
Janka Szemesova (JRC) janka.szemesova@shmu.sk				4			4 (initial checks + **QA NIR**: chapter 7 Agriculture)	
Gema Carmona (JRC) gema.carmona-garcia@jrc.ec.europa.eu				4				
Giacomo Grassi (JRC) giacomo.grassi@jrc.ec.europa.eu							**QA NIR:** chapter 7 (LULUCF) and chapter 11 (KP-LULUCF)	

Name	EC GHG inventory/inventory report compilation				Quality management system			
	Overall responsibility	Project manager	Sector experts	Team members	Overall responsibility	QA/QC coordinator	Quality expert	Team members
Viorel Blujdea (JRC) viorel.blujdea@jrc.ec.europa.eu Tibor Priwitzer			5 + Chapter 11 KP LULUCF				5 + KP LULUCF (initial checks)	
Tibor Priwitzer (JRC) tibor.priwitzer@jrc.ec.europa.eu				5 + Chapter 11 KP LULUCF (from end April onwards)				
Raul Abad-Vinas (JRC) raul.abad-vinas@jrc.ec.europa.eu				5 + Chapter 11 KP LULUCF			**QA NIR:** chapter 7 (LULUCF) and chapter 11 (KP-LULUCF)	5 + KP LULUCF (initial checks)
Michael Goll (Eurostat) Michael.Goll@ec.europa.eu			1A Reference approach				1A Reference approach	
Ricardo Fernandez (EEA) ricardo.fernandez@eea.europa.eu	X				X		**QA NIR**: Executive summary, chapter 1	
Spyridoula Ntemiri (EEA) spyridoula.ntemiri@eea.europa.eu				X			**QA NIR**: chapter 4 (industrial processes)	X
David Simoens (EEA) david.simoens@eea.europa.eu								ReportNet, Data checks
John Van Aardenne (EEA) john.aardenne@eea.europa.eu				Aviation bunkers				Aviation bunkers
Bernd Gugele (ETC-ACM, UBA-V) bernd.gugele@umweltbundesamt.at		X				X		
Michael Gager (ETC-ACM; UBA-V) michael.gager@umweltbundesamt.at				Data manager, SEF tables			Inventory compilation	

Name	EC GHG inventory/inventory report compilation				Quality management system			
	Overall responsibility	Project manager	Sector experts	Team members	Overall responsibility	QA/QC coordinator	Quality expert	Team members
Carmen Schmidt (ETC-ACM; UBA-V) carmen.schmidt@umweltbundesamt.at			1A1	Chapter 2, support UBA work			1A1	X
Stephan Poupa (ETC-ACM; UBA-V) stephan.poupa@umweltbundesamt.at			1A2, 1A4, 1A5				1A2, 1A4, 1A5	
Marion Pinterits (ETC-ACM; UBA-V) marion.pinterits@umweltbundesamt.at			1B	Chapters 1 & 10, support UBA work			1B	X
Heide Jobstmann(ETC-ACM; UBA-V) heide.jobstmann@umweltbundesamt.at				2C, 2D, 2G				2C, 2D, 2G
Lorenz Moosmann (ETC-ACM, UBA-V lorenz.moosmannr@umweltbundesamt.at			2C, 2D, 2G				2C, 2D, 2G	
Traute Köther (ETC-ACM; UBA-V) traute.koether@umweltbundesamt.at			3				3	
Andreas Zechmeister (ETC-ACM; UBA-V) andreas.zechmeister@umweltbundesamt.at				Chapter 1 Uncertainties + support sector 3				3
Hubert Fallmann hubert.fallmann@umweltbundesamt.at				EU-ETS verification				
Giorgos Mellios (ETC-ACM; Emisia) giorgos.m@emisia.com			1A3 + bunkers				1A3 + bunkers	
Matina Kastori (ETC-ACM; Emisia) matina.k@emisia.com				1A3 + bunkers				1A3 + bunkers
Barbara Gschrey (ETC-ACM; Oeko Recherche) b.gschrey@oekorecherche.de			F-gases				F-gases	
Winfried Schwarz (ETC_ACM; Oeko Recherche) w.schwarz@oekorecherche.de				F-gases				F-gases

Name	EC GHG inventory/inventory report compilation				Quality management system			
	Overall responsibility	Project manager	Sector experts	Team members	Overall responsibility	QA/QC coordinator	Quality expert	Team members
Margarethe Scheffler (ETC-ACM; Oeko) m.scheffler@oeko.de			6				6	
Anke Herold (ETC-ACM; Oeko) a.herold@oeko.de				Chapter 3.14 Coordinate Oeko work, QA/QC			QA/QC Oeko work	
Graham Anderson (ETC-ACM; Oeko) g.anderson@oeko.de			2A, 2B				2A, 2B	
Lukas Emele (ETC-ACM; Oeko) l.emele@oeko.de				EU ETS				
Kristien Aernouts (ETC-ACM; VITO) kristien.aernouts@vito.be							**QA NIR**: chapter 3 (Energy)	
Kaat Jespers (ETC-ACM; VITO) kaat.jespers@vito.be							**QA NIR**: chapter 8 (Waste)	

Table 1.2 shows the main institutions and persons involved in the compilation and submission of the EU-15 inventory.

Table 1.2 List of institutions and experts responsible for the compilation of Member States' inventories and for the preparation of the EU inventory

Member State/EU institution	Contact address
Austria	Manfred Ritter Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna
Belgium	Peter Wittoeck Federal Department of the Environment Place Victor Horta 40, B-1060 Brussels
Denmark	Ole-Kenneth Nielsen Aarhus University Frederiksborgvej 399, PO Box 358, DK-4000 Roskilde
Finland	Riitta Pipatti Statistics Finland PB 6 A, FIN-00022 Statistics Finland
France	Ministère de l'Écologie, de l'Énergie,du Développement Durable et de la Mer (MEEDDM) en charge des Technologies vertes et des Négociations sur le climat Direction Générale de l'Energie et du Climat (DGEC) Arche de La Défense Paroi Nord 92055 La Défense CEDEX Frédérique Millard Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 7 Cité Paradis, F-75010 Paris Jean-Pierre Fontelle
Germany	Michael Strogies Federal Environmental Agency Wörlitzer Platz 1, D-06844 Dessau-Roßlau
Greece	Ms Irini Nikolaou, Ministry of Environment, Energy and Climate Change Villa Kazouli, Kifisias 241 Athens, Greece
Ireland	Paul Duffy Environmental Protection Agency PO Box 3000, Johnstown Castle, Co. Wexford, Ireland
Italy	M. Contaldi, R. de Lauretis, D. Romano National Environment Protection Agency (ANPA) Via Vitaliano Brancati 48, I-00144 Rome
Luxembourg	Eric De Brabanter Département de l'Environnement Ministère du Développement durable et des Infrastructures L-2918 Luxembourg Dr Marc Schuman Administration de l'Environnement 16 rue Eugène Ruppert L-2453 Luxembourg
Netherlands	Wim van der Maas National Institute for Public Health and the Environment P.O. Box 1, 3720 BA Bilthoven, The Netherlands
Portugal	Teresa Costa Pereira Agência Portuguesa do Ambiente Rua da Murgueira — Bairro do Zambujal, P-2721-865 Amadora
Spain	Maj Britt Larka Abellán Dirección General de Calidad y Evaluación Ambiental y Medio Natural Ministerio de Agricultura, Alimentación y Medio Ambiente Plaza de San Juan de la Cruz s/n, E-28071 Madrid
Sweden	Ms. Stina Gustafsson Ministry of Environment Tegelbacken 2 S-103 33 Stockholm Sweden Mrs. Maria Lidén

Member State/EU institution	Contact address
	The Swedish Environmental Protection Agency S-106 48 Stockholm Sweden
United Kingdom	Joanna MacCarthy, Helen Champion Department of Energy and Climate Change 3 Whitehall Place, London SW1A 2AW, UK
European Commission	Velina Pendolovska European Commission, DG Climate Action Beaulieu, BU-24 4/042, Brussels, Belgium
European Environment Agency (EEA)	Ricardo Fernandez, Spyridoula Ntemiri, David Simoens European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM)	Bernd Gugele, Michael Gager, Manfred Ritter European Topic Centre on Air Pollution and Climate Change Mitigation Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna, Austria
Eurostat	Michael Goll Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg, Luxembourg
Joint Research Centre (JRC)	Giacomo Grassi, Adrian Leip Joint Research Centre, Institute for Environment and Sustainability, Climate Change Unit Via Enrico Fermi, I-21020 Ispra (VA), Italy

1.2.1 The Member States

All EU-15 Member States are Annex I parties to the UNFCCC. Therefore, all EU-15 Member States have committed themselves to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April. In addition, all EU Member States are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the European Commission by 15 January every year under Monitoring Mechanism Regulation (EU) No. 535/2013.

The European Union's inventory is based on the inventories supplied by Member States. The total estimate of the EU greenhouse gas emissions should accurately reflect the sum of Member States' national greenhouse gas inventories. Member States are responsible for choosing activity data, emission factors and other parameters used for their national inventories as well as the correct application of methodologies provided in the IPCC 1996 Guidelines, IPCC Good Practice Guidance and IPCC Good Practice Guidance for LULUCF. Member States are also responsible for establishing quality assurance/quality control (QA/QC) programmes for their inventories. The QA/QC activities of each Member State are described in the respective national inventory reports and summarised in the European Union inventory report.

Apart from submitting their national GHG inventories and inventory reports the Member States take part in the review and comment phase of the draft EU inventory report, which is sent to the Member States by 28 February each year. The purpose of circulating the draft EU inventory report is to improve the quality of the EU inventory. The Member States check their national data and information used in the EU inventory report and send updates, if necessary. In addition, they comment on the general aspects of the EU inventory report.

The Member States also take part in the Climate Change Committee established under the MMR. The purpose of the Climate Change Committee is to assist the European Commission in its tasks under the MMR.

Under the MMR all Member States are required to establish national systems. Table 1.3 summarises the information on national systems/institutional arrangements in the EU-15 Member States.

Table 1.3 Summaries of institutional arrangements/national systems of EU-15 Member States

MS	Institutional arrangements/national systems	Source
Austria	Austria has a centralized inventory system, with all the work related to inventory preparation being carried out at a single national entity. The most important legal arrangement is the Austrian Environmental Control Act (Umweltkontrollgesetz), which defines the main responsibility for inventory preparation and identifies the Umweltbundesamt as the single national entity with the overall responsibility for inventory preparation. Within the Umweltbundesamt the "Inspection Body for Emission Inventories" is responsible for the compilation of the greenhouse gas inventory. Within the inventory system specific responsibilities for the different emission source/sink categories ("sector experts") are defined. Sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts are also responsible for the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the quality management system, the head of the "Inspection body for GHG inventory"approves the methodological choices. Finally, sector experts perform Quality Assurance and Quality Control (QA/QC) activities. The Austrian Inventory is based on the SNAP nomenclature and has to be transformed into the UNFCCC CRF to comply with the reporting obligations under the UNFCCC. In addition to the actual emission data, the background tables of the CRF are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data are submitted to the UNFCCC. As part of the QMS"s documentation and archiving procedures a reliable data management system has been established to fulfil the data collecting and reporting requirements. This ensures the necessary documentation and archiving for future reconstruction of the inventory and con-sequently enables easy access to up-to-date and previously submitted data for the quantitative evaluation of recalculations. As part of the QMS (Corrective and Preventive Actions) an efficient process is established to grant transparency when collecting and analyzing findings by UNFCCC review experts or any other issues concerning the quality of activity data, emission factors, methods and other relevant technical elements of inventories. Any findings and discrepancies are documented; responsibilities, resources and a time schedule are attributed to each of these in the improvement plan. Measures, which include possible recalculations, are taken by the sector experts. The national energy balance is the most important data basis for the Austrian Air Emissions Inventory. The Austrian statistical office (Statistik Austria) is required by contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management and with the Federal Ministry of Economics and Labour to annually prepare the national energy balance. The compilation of several other relevant statistics is regulated by law. Other data sources include reporting obligations under national and European regulations and reports of companies and associations. The main data sources used for activity data were: Energy Balance from Statistik Austria; EU-ETS; Steam boiler database (for the sector Energy) Energy Balance from Statistik Austria (for the sector Transport) National production statistics, import/export statistics; EU-ETS; direct information from industry or associations of industry (for the sector Industry) Short term statistics for trade and services, Austrian foreign trade statistics, structural business statistics, surveys at companies and associations (for the sector Solvents) National Studies, national agricultural statistics obtained from Statistik Austria (for the sector Agriculture) National forest inventory obtained from the Austrian Federal Office and Research Centre for Forests (for the sector LULUCF) National agricultural statistics and land use statistics obtained from Statistik Austria Database on landfills (1998-2007) + Electronic Data Management (from 2008-2010). The main sources for emission factors are: (1) national studies for country specific emission factors, (2) plant-specific data reported by plant operators (3) IPCC GPG (4) Revised IPCC 1996 Guidelines (5) EMEP/EEA air pollutant emission inventory guidebook 2009 and 2013, (6) EMEP/CORINAIR Emission Inventory Guidebook, (7) Handbook emission factors for road transport (HBEFA), Version 3.2 (.	Austria's Annual Greenhouse Gas Inventory 1990-2012 Jan 2014 pp 26ff

MS	Institutional arrangements/national systems	Source
Belgium	In the Belgian federal context, major responsibilities related to environment lie with the regions. Compiling greenhouse gas emissions inventories is one of these responsibilities. Each region implements the necessary means to establish their own emission inventory in accordance with the IPCC guidelines. The emission inventories of the three regions are subsequently combined to compile the national greenhouse gas emission inventory. Since 1980, the three regions have been developing different methodologies (depending on various external factors) for compiling their atmospheric emission inventories. During the last years important efforts are made to tune these different methodologies, especially for the most important (key) sectors. Obviously, this requires some co-ordination to ensure the consistency of the data and the establishment of the national inventory. This co-ordination is one of the permanent tasks of the Working Group on « Emissions » of the Coordination Committee for International Environmental Policy (CCIEP), where the different actors decide how the regional data will be aggregated to a national total, taking into account the specific characteristics and interests of each region as well as the available means. This working group consists of representatives of the 3 regions and of the federal public services. The Interregional Environment Unit (CELINE - IRCEL) is responsible for integrating the emission data from the inventories of the three regions and for compiling the national inventory. The National inventory report is than formally submitted to the National Climate Commission, established by the Cooperation agreement of 14 November 2002, for approval, before its submission to the secretariat of the United Nations Framework Convention on Climate Change and to the European Commission, under the Council Decision 280/2004/EC concerning a Mechanism for Monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.	Belgium's GHG Inventory (1990 – 2012) National Inventory Report Jan 2014 p 19
Denmark	On behalf of the Ministry of the Environment and the Ministry of Climate,Energy and Building the Danish Centre for Environment and Energy (DCE)is responsible for the calculation and reporting of the Danish national emission inventory to the EU, the UNFCCC (United Nations Framework Convention on Climate Change) and UNECE CLRTAP (Convention on Long-Range Transboundary Air Pollution). Hence, the Danish Centre for Environment and Energy (DCE), Aarhus University, prepares and publishes the annual submission for Denmark to the EU and UNFCCC of the National Inventory Report and the GHG inventories in the Common Reporting Format, in accordance with the UNFCCC guidelines. Furthermore, DCE is responsible for reporting the national inventory for the Kingdom of Denmark to the UNFCCC. DCE is also the body designated with overall responsibility for the national inventory under the Kyoto Protocol for Greenland and Denmark. The work concerning the annual greenhouse gas emission inventory is carried out in cooperation with Danish ministries, research institutes, organisations and companies. The Government of Greenland is responsible for finalising and transferring the inventory for Greenland to DCE. The Faroe Islands Environmental Agency is responsible for finalising and transferring the inventory for the Faroe Islands to DCE. There are now data agreements in place with both Greenland and the Faroe Islands ensuring the data delivery. These agreements contain deadlines for when DCE is to receive the data and documentation. DCE has been and is engaged in work in connection to the meetings of the Conference of Parties (COP) to the UNFCCC and the meetings of the parties (COP/MOP) to the Kyoto protocol and its subsidiary bodies, where the reporting rules are negotiated and settled. Furthermore, DCE participates in the EU Monitoring Mechanism, Working Group 1 (WG1), where the guidelines, methodologies etc. on inventories to be prepared by the EU Member States are regulated.	Denmark's National Inventory Report 2012: Emission Inventories 1990-2012 Mar 2014 p41f

MS	Institutional arrangements/national systems	Source
Finland	According to the Government resolution of 30 January 2003 on the organisation of climate policy activities of Government authorities, Statistics Finland assumes the responsibilities of the National Authority for Finland's greenhouse gas inventory from the beginning of 2005. In Finland, the National System is established on a permanent footing and it guides the development of emission calculation in the manner required by the Kyoto Protocol. The national system is based on regulations concerning Statistics Finland, on agreements between the inventory unit and expert organisations on the production of emission estimates and reports as well as on cooperation between the responsible ministries. Statistics Finland is the general authority of the official statistics of Finland and is independently responsible for greenhouse gas emission inventory preparation, reporting and submission under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. In its activity as the National Authority for the greenhouse gas inventory, the Statistics Finland Act and the Statistics Act are applied. Statistics Finland defines the placement of the inventory functions in its working order. The advisory board of the greenhouse gas inventory set up by the Statistics Finland ensures collaboration and information exchange in issues related to the reporting of greenhouse gas emissions under the UNFCCC and the Kyoto Protocol. The advisory board reviews changes in inventory and the achieved quality. It approves changes to the division of tasks between the expert organisations preparing the inventory as specified in the reporting protocol. In addition, the advisory board promotes research and review projects related to the development of the inventory and reporting, as well as gives recommendations on participation in international co-operation in this area (UNFCCC, IPCC and EU). The advisory board is composed of representatives from the expert organisations and the responsible Government ministries. Statistics Finland is in charge of the compilation of the national emission inventory and its quality management in the manner intended in the Kyoto Protocol. As the National Entity Statistics Finland also bears the responsibility for the general administration of the inventory and communication with the UNFCCC, coordinates participation in the review of the inventory, and publishes and archives the inventory results. Finland's inventory system includes in addition to Statistics Finland some expert organisations: the Finnish Environment Institute, MTT Agrifood Research Finland and the Finnish Forest Research Institute. Statistics Finland also acquires parts of the inventory as purchased services from VTT (Technical Research Centre of Finland). The resources of the National System for the participating expert organisations are channelled through the relevant ministries' performance guidance (Ministry of the Environment and Ministry of Agriculture and Forestry). In addition, other ministries participating in the preparation of the climate policy advance in their administrative branch that the data collected in the management of public administration duties can be used in the emission inventory. In accordance with the Government resolution, the ministries produce the data needed for international reporting on the content, enforcement and effects of the climate strategy. Statistics Finland assists in the technical preparation of the policy reporting. Statistics Finland also compiles technically the National Communications under the UNFCCC and the Kyoto Protocol. Separate agreements have been made on the division of responsibilities and co-operation between Statistics Finland and the ministries. The agreement between Statistics Finland and the Ministry of the Environment was updated in 2008. The Energy Authority is the National Emissions Trading Authority in Finland, and supervises the monitoring and reporting of the emissions data under the European Emission Trading Scheme (EU ETS) and the Kyoto Protocol. Statistics Finland and the Energy Authority concluded an agreement in 2006 on collaboration between the national inventory system and registry, including a division of the responsibilities relating to reporting. The agreement between the Energy Authority and Statistics Finland was updated in 2010.	GHG Emissions in Finland 1990-2012 Draft Jan 2014, p 18 ff.

MS	Institutional arrangements/national systems	Source
France	The responsibility of the definition and control of the National Air Pollutant Emissions Inventory System (Système National d'Inventaires d'Emission et de Bilans dans l'Atmosphère (SNIEBA)) is pertained by the Ministère de l'Ecologie, du Développement Durable, et de l'Energie (MEDDE). The MEDDE is in charge of overseeing production of the inventories and overall coordination of the system. Other ministries and public bodies contribute to the emission inventories by providing data and statistics used in the preparation of the inventories. The MEDDE has entrusted CITEPA (Interprofessional Technical Centre for Studies on Air Pollution or Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) with the following tasks: preparing the emission inventories with regard to methods and preparing their updating, data collection and processing, data storage, production of the reports and various means of disseminating the information, control and quality management. CITEPA assists the MEDDE in overall coordination of the National Air Pollutant Emissions Inventory System. Mention should be specifically made of the coordination that must be ensured between the emission inventories and emitter registers such as the E-PRTR and the greenhouse gas emission allowance register in the frame of the ETS directive, not forgetting other aspects (guides published by the MEDDE, the annual pollutant emission reporting system, etc.). The MEDDE provides CITEPA with all information it has at its disposal under existing legislation and regulations, such as the annual notifications made by Classified Installations under the pollutant emission reporting system, as well as the results of different studies providing greater knowledge on emissions that it commissioned either internally (ie within its departments) or from other bodies, such as the National Institute for Industry, Environment and Risks (INERIS). The MEDDE steers the Emissions Inventories Consultation and Information Group (GCIIE) whose tasks are to: give its opinion on the results of estimates produced in the inventories, give its opinion on the changes made to the methodology for estimating emissions, give its opinion on the action plan for improving inventories for the future, issue recommendations on all subjects directly or indirectly linked to emission inventories in order to ensure consistency and smooth running of actions, and encourage synergies, etc., recommend actions for improving the estimation of emissions in the context of research programmes. The GCIIE is made up of representatives: of the Ministry of Ecology, Energy, Sustainable Development and Sea (MEDDE), and specifically the General Directorate for Energy and Climate (DGEC), General Directorate for Spatial Planning, Housing and Nature (DGALN), the General Directorate for Infrastructure, Transport and Maritime Affairs (DGITM), and the General Directorate for Civil Aviation (DGAC) of the Ministère de l'agriculture, de l'alimentation, de la pêche, de la ruralité et de l'aménagement du territoire (MAPRAT), particularly the Statistics and Forward Studies Department (SSP) and the General Directorate for Agricultural, Agri-food and Land Policies (DGPAAT), the Ministère de l'Economie, des Finances et de l'Industrie (MINEFI), and specifically the General Directorate of the National Institute of Statistics and Economic Studies (INSEE), the General Directorate of the Treasury and Economic Policy (DGTPE) and the General Directorate of Companies (DGE), of the General Sustainable Development Commission (CGDD), particularly the Observation and Statistics Department.	Short NIR France, Jan 2014 p5ff.

MS	Institutional arrangements/national systems	Source
Germany	In Germany, the National System has been institutionalised, in the main, at three levels: at the ministerial level, at the level of the Federal Environment Agency (UBA), and at a level outside of the federal administrative sector. At the ministerial level, the National System has been established under the leadership of the Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety (BMUB), via an agreement 5 June 2007 signed by state secretaries of the participating ministries that serves as a pertinent policy paper and is entitled "National Emissions Reporting System" ("Nationales System zur Emissionsberichterstattung"). With the inclusion of the Federal Ministry of Food and Agriculture (BMEL), the Federal Ministry for Economic Affairs and Energy (BMWi), the Federal Ministry of Transport and Digital Infrastructure (BMVI), the Federal Ministry of the Interior (BMI), the Federal Ministry of Finance (BMF) and the Federal Ministry of Defence (BMVg), all key institutions and organisations are now involved in preparing emissions inventories that are in a position to provide high-quality specialised contributions. The policy paper on emissions reporting defines the relevant responsibilities of the various participating federal ministries, and it mandates that the National System is to be built on the basis of existing data streams. Where the data streams are incomplete, the pertinent gaps are to be closed by the responsible ministries, via suitable activities. In support of the reporting process, the participating ministries established a co-ordinating committee (cf. Chapter 1.2.1.1). The "National Emissions Reporting System" policy paper also assigns the Federal Environment Agency the task of serving as the Single National Entity for Germany (cf. Chapter 1.2.1.2). At the level of the Federal Environment Agency, the Single National Entity integrates other specialised agencies within the National System and coordinates the contributions of the other institutions and organisations involved in emissions reporting. For co-ordination of pertinent work within the Federal Environment Agency, a working group on emissions inventories was established (cf. Chapter 1.2.1.3). For implementation of the IPCC Good Practice Guidance within the Federal Environment Agency, with regard to quality control and assurance, a Quality System of Emissions was established in 2005, via an inhouse directive. The National Co-ordinating Committee has the tasks of supporting the emissions-reporting process and clarifying open issues pertaining to the National System. In particular, the Committee carries out consultations with regard to gaps in data streams and settles issues pertaining to assigned responsibilities. The state secretaries' policy paper appointed the Federal Environment Agency to carry out tasks of the Single National Entity for emissions reporting (national co-ordination agency). The Federal Environment Agency's in-house directive (Hausanordnung) 11/2005 gave section "Emissions Situation" (FG I 2.6) responsibility for carrying out that function. The Single National Entity has developed two key instruments for carrying out those tasks: The Federal Environment Agency's Central System on Emissions (CSE) database is the national, central database for emissions calculation and reporting. It is used for central storage of all information required for emissions calculation (methods, activity data, emission factors). The CSE is the main instrument for documentation and quality assurance at the data level. Both within and outside of the Federal Environment Agency, the Quality System for Emissions Inventories (QSE) provides the necessary framework for good inventory practice and for routine quality assurance. Established within the Federal Environment Agency in 2005 via in-house directive 11/2005, it comprises the processes necessary for continually improving the quality of greenhouse-gas-emissions inventories. The framework it provides includes defined responsibilities and quality objectives relative to methods selection, data collection, calculation of emissions and relevant uncertainties and recording of completed quality checks and their results (confirmation that objectives were reached, or, where objectives were not reached, listing of the measures planned for future improvement). Ongoing quality improvement in the framework of the QSE is supported by a database that serves as the repository for all tabular documents emerging from the national QC/QA process (QC/QA plan, checklists, lists of responsibilities, etc.).	National Inventory Report, Germany – 2014, p 69 ff

MS	Institutional arrangements/national systems	Source
Greece	The Ministry of Environment, Energy and Climate Change, MEECC (former Ministry for the Environment, Physical Planning and Public Works) is the governmental body responsible for the development and implementation of environmental policy in Greece, as well as for the provision of information concerning the state of the environment in compliance with relevant requirements defined in international conventions, protocols and agreements. Moreover, the MEECC is responsible for the co-ordination of all involved ministries, as well as any relevant public or private organization, in relation to the implementation of the provisions of the Kyoto Protocol, according to the Law 3017/2002 with which Greece ratified the Kyoto Protocol. In this context, the MEECC has the overall responsibility for the national GHG inventory, and the official consideration and approval of the inventory prior to its submission. (Contact person: Irini Nikolaou, Address: Villa Kazouli, Kifisias 241, Athens, Greece, e-mail: **i.nikolaou@prv.ypeka.gr**, tel.: +30210 8089275, fax: +30210 8089239). An overview of the organizational structure of the National Inventory System is presented in Figure 1.1. The participating entities are: The Ministry of Environment, Energy and Climate Change (MEECC) designated as the national entity responsible for the national inventory, which keeps the overall responsibility, but also plays an active role in the inventory planning, preparation and management. The National Technical University of Athens (NTUA) / School of Chemical Engineering, which has the technical and scientific responsibility for the compilation of the annual inventory. Governmental ministries and agencies through their appointed focal persons, ensure the data provision. International or national associations, along with individual private industrial companies contribute to data providing and development of methodological issues as appropriate. The legal framework defining the roles-responsibilities and the co-operation between the MEECC Climate team, the NTUA Inventory team and the designated contact points of the competent Ministries was formalized by circular 918/21-4-08 released by MEECC (former MINENV) entitled “Structure and operation of the National Greenhouse Gases Inventory System-Roles and Responsibilities”. The above-mentioned circular includes a description of each entity’s responsibilities, concerning the inventory preparation, data providing or other relative information.This formal framework has improved the collaboration between the entities involved, assuring the timely collection and quality of the activity data required and solving data access restriction problems raised due to confidentiality issues. According to the Presidential Decree No 189 dated 5th November 2009 the new Ministry of Environment, Energy and Climate change retains the responsibilities regarding the Environment, and Physical Planning of the former Ministry for the Environment, Physical Planning and Public Works. Furthermore, the General Directorate of Energy and Natural Resources, previously belonging to the Ministry of Development as well as the General Directorate of Forest Development and Protection and Natural Resources, previously belonging to the Ministry of Rural Development and Food, are transferred to the Ministry of Environment, Energy and Climate Change. The Public Works General Secretariat was transferred to the new Ministry of Infrastructure, Transport and Networks.	Annual Inventory Submission Under Article 7(3) of the Regulation 525/2013 for the Years 1990-2012 Mar 2014, pp 7ff
Ireland	The Environmental Protection Agency is required to establish and maintain databases of information on the environment and to disseminate such information to interested parties (Section 52 of the Environmental Protection Agency Act of 1992 (DOE, 1992)). The Act states that the Agency must provide, of its own volition or upon request, information and advice to Ministers of the Government in the performance of their duties (Section 55). This includes making available such data and materials as are necessary to comply with Ireland's reporting obligations and commitments within the framework of international agreements. These requirements are the regulatory basis on which the EPA prepares annual inventories of greenhouse gases and other important emissions to air in Ireland. It is in this context that in 1995 the Department of the Environment, Community and Local Government (DECLG) designated the EPA as the inventory agency with responsibility for the submission of emissions data to the UNFCCC Secretariat and to the Secretariat for the Convention on Long-Range Transboundary Air Pollution (CLRTAP).	Ireland National Inventory Report 2014,GHG emissions 1990-2012 reported to the European Commission Jan 2014 p 1

MS	Institutional arrangements/national systems	Source
Italy	As indicated by art. 14 bis of the Legislative Decree, the Institute for Environmental Protection and Research (ISPRA), former Agency for Environmental Protection and Technical Services (APAT), is the single entity in charge of the preparation and compilation of the national greenhouse gas emission inventory. The Ministry for the Environment, Land and Sea is responsible for the endorsement of the inventory and for the communication to the Secretariat of the Framework Convention on Climate Change and the Kyoto Protocol. The inventory is also submitted to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism. The Institute prepares annually a document which describes the national system including all updated information on institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases and for reporting and archiving inventory information. The reports are publicly available at http://www.sinanet.isprambiente.it/it/sinanet/serie_storiche_emissioni. A specific unit of the Institute is responsible for the compilation of the Italian Atmospheric Emission Inventory and the Italian Greenhouse Gas Inventory in the framework of the Convention on Climate Change and the Convention on Long Range Transboundary Air Pollution. The whole inventory is compiled by theInstitute; scientific and technical institutions and consultants may help in improving information both on activity data and emission factors of some specific activities. All the measures to guarantee and improve the transparency, consistency, comparability, accuracy and completeness of the inventory are undertaken. ISPRA is responsible for the general administration of the inventory and all aspects related to its preparation preparation, reporting and quality management. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods consistent with the IPCC Guidelines, the IPCC Good Practice Guidance and Uncertainty management and the IPCC Good Practice Guidance for land use, land-use change and forestry, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National Inventory Report and the reporting through the Common Reporting Format, the response to the review process, the updating and data storage. Different institutions are responsible for statistical basic data and data publication, primary to ISPRA for carrying out emission estimates. These institutions are part of the National Statistical System (Sistan), which provides national official statistics, and therefore are required to periodically update statistics; moreover, the National Statistical System ensures the homogeneity of the methods used for official statistics data through a coordination plan, involving the entire public administration at central, regional and local levels. The National Statistical System is coordinated by the Italian National Institute of Statistics (ISTAT); other bodies, joining the National Statistical System, are the statistical offices of ministries, national agencies, regions and autonomous provinces, provinces, municipalities, research institutes, chambers of commerce, local governmental offices, some private agencies and private subjects who have specific characteristics determined by law.	Italian Greenhouse Gas Inventory 1990-2012 National Inventory Report 2013, Mar 2014, pp 25ff.
Luxembourg	A Grand-Ducal Regulation designates a Single National Entity, the National Inventory Compiler and the National GHG Inventory Focal Point. It also defines and allocates specific responsibilities for the realization of the GHG Inventories both within the Single National Entity and within the other administrations and/or services that are involved in the inventory preparation in the future. The previously cited regulation designates the Environment Agency (Administration de l'Environnement, AEV) as the "Single National Entity with overall responsibility for the GHG Inventory". Overall management of the Single National Entity is assigned to one staff member of the Environment Agency that is nominated GHG Inventory Focal Point. The Agency also acts as "National Inventory Compiler" compiling and checking the information and GHG emission estimates coming from sector experts working in other administrations or services. The Environment Agency has therefore the "technical" knowledge and responsibility for the GHG Inventories, but the "political" responsibility is staying with the Department of the Environment of the Ministry of Sustainable Development and Infrastructures – hereafter designated as MDDI-DEV – acting as UNFCCC National Focal Point. Thus, it is the Ministry that officially submits the inventories and their related reports to the UNFCCC Secretariat and the European Commission (see Article 8 of the Regulation). Luxembourg has, thus, adopted an "integrated approach" to avoid redundant and overlapping activities in different administrative services. This concentration of air emission reporting in one department also allows an improved consistency between different reporting schemes (UNFCCC, EU-MMD, EU-PRTR, EU-LCPD, EU-ETS, UNECE-CLRTAP and EU-NECD).	National Inventory Report 1990-2012 Luxembourg Mar 2014 pp 22ff

MS	Institutional arrangements/national systems	Source
Netherlands	The Ministry of Infrastructure and Environment (IenM) has overall responsibility for climate change policy issues including the preparation of the inventory. In August 2004, IenM assigned SenterNovem (now NL Agency) executive tasks bearing on the National Inventory Entity (NIE), the single national entity required under the Kyoto Protocol. In December 2005, NL Agency was designated by law as the NIE. In addition to co-ordinating the establishment and maintenance of a National System, the tasks of NL Agency include overall co-ordination of improved QA/QC activities as part of the National System and co-ordination of the support/response to the UNFCCC review process. The National System is described in more detail in the (Fourth and Fifth National Communication (VROM 2006b, 2009). Since 1 January 2010, RIVM has been assigned by IenM as co-ordinating institute for compiling and maintaining the pollutants emission register/inventory (PRTR system), containing about 350 pollutants including the greenhouse gases. The PRTR project system is used as basis for the NIR and for filling the CRF. After the general elections in the Netherlands in 2010, the responsibilities of the former VROM moved to the restructured Ministry of Infrastructure and Environment (IenM). The Dutch PRTR has been in operation in the Netherlands since 1974. This system encompasses data collection, data processing and registering and reporting emission data for about 350 policy-relevant compounds and compound groups that are present in air, water and soil. The emission data is produced in an annual (project) cycle (RIVM, 2012). This system is also the basis for the national greenhouse gas inventory. The overall coordination of the PRTR is outsourced by the ministry (IenM) to the RIVM. The main objective of the PRTR is to produce an annual set of unequivocal emission data that is up-to-date, complete, transparent, comparable, consistent and accurate. In addition to RIVM, various external agencies contribute to the PRTR by performing calculations or submitting activity data. These include: CBS (Statistics Netherlands), PBL (Netherlands Environmental Assessment Agency), TNO (Netherlands Organisation for Applied Scientific Research), NL Agency, Centre for Water Management, Deltares and several institutes related to the Wageningen University and Research Centre (WUR). The NIR part 1 is prepared by RIVM as part of the PRTR project. Most institutes involved in the PRTR also contribute to the NIR (including CBS and TNO). In addition, NL Agency is involved in its role as NIE. NL Agency also prepares the NIR part 2 and takes care of integration and submission to the UNFCCC in its role as NIE. Submission to the UNFCCC only takes place after approval by IenM.	Greenhouse Gas Emissions in the Netherlands 1990-2012 (Draft version) Jan 2014 P 29 f.

MS	Institutional arrangements/national systems	Source
Portugal	Changes to the institutional arrangements since the 2013 submission of the National Inventory report (NIR, 2013) refer to the restructuring of the Ministry for the Environment and Land Use Planning, which previously included Agriculture and Sea, and since August 2013 (Decreto do Presidente da República n.º 97/2013 de 21 de agosto) has encompassed the Energy and now is entitled: Ministry for the Environment, Land Use Planning and Energy (Ministério do Ambiente, do Ordenamento do Território e Energia - MAOTE). No major impact on the functioning of the national system and the inventory resulted from this rearrangement, since there was no reassignment of institutions or experts acting as Focal Points. The most relevant and problematic changes refer to new changes occurred within the inventory team, which implied a period of adaptation and learning of the new experts involved in the inventory compilation. Furthermore, the exceptional period that Portugal is facing due to the financial and economic crisis which led to strict financial constraints in Public Administration, is impacting the stability of the resources and availability of background information. The system was established through Council of Ministers Resolution 68/2005, of 17 March, which defines the entities relevant for its implementation, based on the principle of institutional cooperation. This clear allocation of responsibilities is essential to ensure the inventory takes place within the defined deadlines. For the sake of efficiency, the Portuguese national system has been broadened to include a wider group of air pollutants than just GHG not covered by the Montreal Protocol, allowing for improvements in information quality, as well as an optimisation of human and material resources applied to the preparation of the inventory. Three bodies are established with differentiated responsibilities. These are: The Portuguese Environmental Agency (APA)/ Ministry of Ministry for the Environment and Land Use Planning, is the Responsible Body responsible for: the overall coordination and updating of the National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants (INERPA); the inventory's approval, after consulting the Focal Points and the involved entities; and its submission to EC and international bodies to which Portugal is associated, in the several communication and information formats, thus ensuring compliance with the adopted requirements and directives. CAOS Sustentabilidade, was a private company contracted by APA to support the inventory unit on the development of a methodological approach and the implementation of a procedure to quantify KP-LULUCF activities. The sectoral Focal Points work with APA in the preparation of INERPA, and are responsible for fostering intra and inter-sectoral cooperation to ensure a more efficient use of resources. Their main task includes coordinating the work and participation of the relevant sectoral entities over which it has jurisdiction. It is also the Focal Points duty to provide expert advice on methodological choice, emission factor determination and accuracy of the activity data used. Focal Points play a vital role in sectoral quality assurance and methodological development. The involved entities are public or private bodies which generate or hold information which is relevant to the INERPA, and which actions are subordinate to the Focal Points or directly to the Responsible Body. All governmental entities have the responsibility to ensure, at a minimum, co-funding of the investment needed to ensure the accuracy, completeness and reliability of the emissions inventory. The RCM also includes a procedure for the official consideration of the inventory. This consideration is done at the level of the designated representatives of Focal Points and Involved Entities. The SNIERPA is composed of three technical elements: A Quality Control and Quality Assurance System (QA/QC System) A Methodological Development Programme (MDP), and An integrated IT system for the management (SIGA) of the SNIERPA (this last not yet implemented).	Short Portuguese National Inventory Report on Greenhouse Gases, 1990-2010, Jan 2012, pp 1-6 And Short NIR 1990-2012, Jan 2014, p 5

MS	Institutional arrangements/national systems	Source
Spain	The Directorate General of Environmental Quality and Assessment and Natural Affairs (DG-CEAMN) at the Ministry of Agriculture, Food and Environment (MAGRAMA) is the competent authority for the Spanish Inventory System (SEI). Within DG-CEAMN is the Subdirectorate General of Air Quality an Industrial Environment (SG-CAyMAI), the body charged with the execution of the inventory and processing the information collected from the various sources. The air pollutant emissions inventories are considered to be statistics for State purposes and as such, in accordance with article 149.1.31 of the Spanish Constitution, are performed on the basis of the exclusive responsibility of the State. In this sense, the regulatory frame of reference is provided by the Spanish Public Statistical Function Act (Law 12 dated May 9th, 1989) and by 2013-2016 National Statistical Plan, approved by Royal Decree 1658 dated December 7th, 2012. With regard to data collection, Law 12/1989 establishes two different regimes for the regulation of statistics depending on whether data are demanded in a compulsory manner or individuals are free to provide information voluntarily. Since they form part of the National Statistical Plan and their preparation represents an obligation for Spain under European Union regulations, emissions inventories fall into the first of these two regimes, i.e. the submission of data by individuals is compulsory. The DG-CEAMN is the competent authority of the SEI (Order MAM/1444/2006 and Royal Decree 401/2012). It is technically supported by the company Análisis Estadístico de Datos, S.A. (AED) as technical assistance for the execution and inventory development as well as STEPA-UPV for the agriculture sector. With regard to the participation of ministerial departments and according to the aforementioned quote about the concretion of responsibilities of the Contact Points within Ministerial Department and Autonomous Organisms for providing of information required for the preparation of the Inventory. - Ministry of Industry, Energy and Tourism - Ministry of Economy and Competitiveness - Ministry of Health, Social Services and Equality - Ministry of Public Works - Ministry of Defence - Home Office	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2012" March 2014 (submitted in Spanish, translated

MS	Institutional arrangements/national systems	Source
Sweden	The Swedish national system came into force on 1 January 2006 and its aim is to ensure that climate reporting to the secretariat of the Convention (UNFCCC) and the European Commission complies with specified requirements. This means, among other things, estimating and reporting anthropogenic GHG emissions and removals in accordance with the Kyoto Protocol, assisting Sweden in meeting its commitments under the Kyoto Protocol, facilitating the review of submitted information, ensuring and improving the quality of the Swedish inventory and guaranteeing that submitted data is officially approved. The Swedish Ministry of Environment is the single national entity and has overall responsibility for the inventory. The Swedish Environmental Protection Agency (EPA) is responsible for co-ordinating the activities for producing the inventory, maintaining the reporting system and also for the final quality control and quality assurance of the inventory. The Swedish EPA sends the inventory to Ministry of the Environment and – on behalf of the Ministry of Environment – submits the inventory to the EU and to the UNFCCC. Finally, the Swedish EPA is responsible for national publication of the greenhouse gas inventory. The Swedish EPA engages consultants with expert skills to conduct the inventory and reporting in the area of climate change. During the spring of 2005, the Swedish EPA completed a negotiated procurement of services under the terms of the Public Procurement Act. After procurement had been completed, a framework contract was signed with the consortium Swedish Environmental Emissions Data (SMED)2, consisting of the Swedish Meteorological and Hydrological Institute (SMHI), Statistics Sweden (SCB), the Swedish University of Agricultural Sciences (SLU) and the Swedish Environmental Research Institute (IVL). The contract between the Swedish EPA and SMED runs for nine years and thus covers the whole first commitment period under the Kyoto Protocol. SMED receives data and documentation from responsible authorities as described above and produces most of the data and documentation in the Swedish inventory. The regular inventory work is organized as a project involving all SMED organizations. The project is run by a project management team with one person from each organization. The Swedish Meteorological and Hydrological Institute is main re-sponsible for production of gridded emission data. Statistics Sweden is main responsible for the energy sector, the agriculture sector and parts of the waste sector, but is also involved in industrial processes since these are closely connected to the energy sector. The Swedish University of Agricultural Sciences is responsible for the LULUCF sector. The Swedish Environmental Research Institute is main responsible for the industrial process sector, the solvents and other products use sector and also parts of the waste sector and energy sector. On behalf of the Swedish EPA, SMED also conducts development projects necessary for improving the inventory.	National Inventory Report Sweden 2014 Jan 2014 p 44 ff.

MS	Institutional arrangements/national systems	Source
United Kingdom	The UK Greenhouse Gas Inventory is compiled and maintained by a consortium led by Ricardo-AEA – the Inventory Agency - under contract to the Climate, Energy, Science and Analysis (CESA) Division in the UK Department of Energy and Climate Change (DECC). Ricardo-AEA is directly responsible for producing the emissions estimates for CRF categories Energy (CRF sector 1), Industrial Processes (CRF sector 2), Solvent and Other Product Use (CRF sector 3), and Waste (CRF Sector 6). Ricardo-AEA is also responsible for inventory planning, data collection, QA/QC and inventory management and archiving. Aether, a partner within the consortium, is responsible for compiling emissions from railways and for the overseas territories and crown dependencies, and for reviewing, updating and making improvements to the QA/QC procedures that are in place. Agricultural sector emissions (CRF sector 4) are produced by Rothamsted Research, under contract to Defra. Land Use, Land-Use Change and Forestry emissions (CRF sector 5) are calculated by the UK Centre for Ecology and Hydrology (CEH), under separate contract to CESA (DECC). DECC is the Single National Entity responsible for submitting the UK's greenhouse gas inventory (GHGI) to the UNFCCC. Ricardo-AEA, in collaboration with Aether and other partners compiles the GHGI on behalf of DECC, and produces disaggregated estimates for the Devolved Administrations within the UK. Key Data Providers include other Government Departments such as Department for Environment, Food and Rural Affairs (Defra) and Department for Transport (DfT), Non-Departmental Public Bodies such as the Environment Agency for England and Wales (EA), Northern Ireland Environment Agency (NIEA) and the Scottish Environment Protection Agency (SEPA), private companies such as Tata Steel, BP Chemicals, and business organisations such as the UK Petroleum Industry Association (UKPIA) and the Mineral Products Association (MPA).	UK Greenhouse Gas Inventory 1990-2012 Short NIR, Jan 2014 pp 3-4

1.2.2 The European Commission, Directorate-General Climate Action

The European Commission's DG Climate Action in consultation with the Member States has the overall responsibility for the EU inventory. Member States are required to submit their national inventories and inventory reports under the Monitoring Mechanism Regulation to the European Commission, DG Climate Action; and the European Commission, DG Climate Action itself submits the inventory and inventory report of the EU to the UNFCCC Secretariat, on behalf of the European Union. In the actual compilation of the EU inventory and inventory report, the European Commission, DG Climate Action, is assisted by the EEA including the EEA's ETC/ACM and by Eurostat and the JRC.

The consultation between the DG Climate Action and the Member States takes place in the Climate Change Committee established under Article 26 of the MMR. The Committee is composed of the representatives of the Member States and chaired by the representative of the DG Climate Action. Procedures within the Committee for decision-making, adoption of measures and voting are outlined in the rules of procedure, adopted in November 2003. In order to facilitate decision-making in the Committee, working groups have been established, one of which is Working Group 1 on 'Annual inventories'.The objectives and tasks of Working Group 1 under the Climate Change Committee include:

- the promotion of the timely delivery of national annual GHG inventories as required under the monitoring mechanism;
- the improvement of the quality of GHG inventories on all relevant aspects (transparency, consistency, comparability, completeness, accuracy and use of good practices);
- the exchange of practical experience on inventory preparation, on all quality aspects and on the use of national methodologies for GHG estimation;
- the evaluation of the current organisational aspects of the preparation process of the EU inventory and the preparation of proposals for improvements where needed.

1.2.3 The European Environment Agency

The European Environment Agency assists the European Commission, DG Climate Action, in the compilation of the annual EU inventory through the work of the EEA's European Topic Centre on Air

Pollution and Climate Change Mitigation (ETC/ACM), which is an international consortium working with the EEA under a framework partnership agreement. The activities of the EEA's ETC/ACM include:

- initial checks of Member States' submissions in cooperation with Eurostat, and the JRC, up to 28 February and compilation of results from initial checks (status reports, consistency and completeness reports);
- consultation with Member States in order to clarify data and other information provided;
- preparation and circulation of the draft EU inventory and inventory report by 28 February based on Member States' submissions;
- preparation of the final EU inventory and inventory report by 15 April (to be submitted by the Commission to the UNFCCC Secretariat);
- assisting Member States in their reporting of GHG inventories by means of supplying software tools.

The tasks of the EEA and the ETC/ACM are facilitated by the European environmental information and observation network (Eionet), which consists of the EEA as central node (supported by European topic centres) and national institutions in the EEA member countries that supply and/or analyse national data on the environment (see http://eionet.eea.europa.eu). Member States shall report the information reported pursuant to Article 7 of the MMR to the Commission with a copy to the European Environment Agency. Member States should use the EEA's ReportNet's central data repository under the Eionet for making available their GHG submissions to the European Commission and the ETC/ACM (see http://cdr.eionet.europa.eu/).

1.2.4 The European Topic Centre on Air Pollution and Climate Change Mitigation

The EEA's European Topic Centre on Air and Climate Change Mitigation (ETC/ACM) was established by a contract between the lead organisation Institute for Public Health and the Environment (RIVM) in the Netherlands and EEA for the years 2014-2018. The EEA's ETC/ACM involves 14 organisations and institutions in eight European countries. The technical annex for the 2014 work plan for the EEA's ETC/ACM and an implementation plan specify the specific tasks of the EEA's ETC/ACM partner organisations with regard to the preparation of the EU inventory. Umweltbundesamt Austria is the task leader for the compilation of the EU annual inventory in the EEA's ETC/ACM, including all tasks mentioned above.

The EEA's ETC/ACM provides software tools for Member States to compile national GHG inventories and to convert their national inventory from Corinair-SNAP source category codes into the required CRF source categories. The main software tools are CollectER, for compiling and updating national emission inventories, ReportER, for reporting the emissions in the required format, e.g. CRF, and the CRF Aggregator, developed to ensure the EU submission is fully consistent with member state's (MS) submissions. From the CRF aggregator the aggregated EU inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission. In addition, separate software tools are available to prepare estimates of emissions from agriculture and road transport. These tools are being used by several Member States. The ETC/ACM adapts the tools regularly to the latest changes in reporting requirements.

1.2.5 Eurostat

Eurostat collects national energy statistics reported under the EU Energy Statistics Regulation on an annual basis. These data are used for the estimation of the IPCC Reference Approach and the Sectoral Approach. The EEA compares the results of the two approaches with MS CRF submissions. These comparisons are sent to MS during the consultation on the Draft EU GHG inventory by 28/02. The Energy Statistics Regulation (Regulation EC/1099/2008) as amended by Commission Regulation (EU) No 147/2013 of 13 February 2013 is the basis for MS reporting of energy data to Eurostat. Article 6(2) of the Energy statistics regulation stipulates: 'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'. The consistency of energy balances and CRF activity data is essential for good quality GHG estimates in the energy sector, and therefore it is at the core of the QA/QC activities at EU level.

1.2.6 Joint Research Center

The Joint Research Centre (JRC) performs the QA/QC of the LULUCF and Agriculture sectors and is responsible of the writing of the respective chapters. The QA/QC main activity is the annual checking of early versions of the each national GHG inventory. Focus is on errors and inconsistencies, with numerous interactions with national representatives for clarifications and improvements. Specific completeness and consistency checks are also carried out. For LULUCF, additional efforts to help member states in improving their reporting include annual technical workshops (**http://afoludata.jrc.ec.europa.eu/index.php/public_area%5Cevents_policy**), dedicated EU-funded projects, the AFOLU database (**http://afoludata.jrc.ec.europa.eu/index.php/public_area/data_and_tools**), and a forest growth model whose results which may be used by countries to compare with their estimates. More information is provided in the QAQC sections of the LULUCF and Agriculture chapters.

1.3 A description of the process of inventory preparation

The annual process of compilation of the EU inventory is summarised in Table 1.4. The Member States submit their annual GHG inventory by 15 January each year to the European Commission's DG Climate Action. Then, the ETC/ACM, Eurostat and the JRC perform initial checks of the submitted data up to 28 February. The ETC/ACM transfers the nationally submitted data from the xml-files into the CRF aggregator database which was developed for aggregating the EU submission from member state (MS) submissions. From the CRF aggregator the aggregated EU inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission.

Table 1.4 Annual process of submission and review of Member States inventories and compilation of the EU inventory

Element	Who	When	What
1. Submission of annual greenhouse gas inventories (complete common reporting format (CRF) submission and elements of the national inventory report) by Member States under Council Decision No 280/2004/EC	Member States	15 January	Elements listed in Article 3(1) of Decision 280/2004/EC as elaborated in Articles 2 to7 in particular: Greenhouse gas emissions by sources and removals by sinks, for the year n –2 And updated time series 1990- year n – 3, depending on recalculations; Core elements of the NIR Steps taken to improve estimates in areas that were previously adjusted under Article 5.2 of the Kyoto Protocol (for reporting under the Kyoto Protocol)
2. 'Initial check' of Member States' submissions	Commission (incl. Eurostat, the JRC), assisted by the EEA	As soon as possible after receipt of Member State data, at the latest by 1 April	Initial checks and consistency checks (by EEA). Comparison of energy data provided by Member States on the basis of the IPCC Reference Approach with Eurostat energy data (by Eurostat and Member States) and check of Member States' agriculture and land use, land-use change and forestry (LULUCF) inventories by DG JRC (in consultation with Member States).
3. Compilation of draft EU inventory	Commission (incl. Eurostat, the JRC), assisted by the EEA	up to 28 February	Draft EU inventory (by EEA), based on Member States' inventories and additional information where needed.
4. Circulation of draft EU inventory	Commission (DG Climate Action) assisted by the EEA	28 February	Circulation of the draft EU inventory on 28 February to Member States. Member States check data.

Element	Who	When	What
5. Submission of updated or additional inventory data and complete national inventory reports by Member States	Member States	15 March	Updated or additional inventory data submitted by Member States (to remove inconsistencies or fill gaps) and complete final national inventory reports.
6. Estimates for data missing from a national inventory	Commission (DG Climate Action) assisted by EEA	31 March	The Commission prepares estimates for missing data by 31 March of the reporting year, following consultation with the Member State concerned, and communicate these to the Member States.
7. Comments from Member States regarding the Commission estimates for missing data	Member States	8 April	Member States provide comments on the Commission estimates for missing data, for consideration by the Commission.
8. Final annual EU inventory (incl. EU inventory report)	Commission (DG Climate Action) assisted by EEA	15 April	Submission to UNFCCC of the final annual EU inventory. This inventory will also be used to evaluate progress as part of the monitoring mechanism.
9. Circulation of initial check results of the EU submission to Member States	Commission (DG Climate Action) assisted by EEA	As soon as possible after receipt of initial check results	Commission circulates the initial check results of the EU submission as soon as possible after their receipt to those Member States, which are affected by the initial checks.
10. Response of relevant Member States to initial check results of the EU submission	Member States	Within one week from receipt of the findings	The Member States, for which the initial check indicated problems or inconsistencies provide their responses to the initial check to the Commission.
11. Any resubmissions by Member States in response to the UNFCCC initial checks	Member States	For each Member State, same as under the UNFCCC initial checks phase Under the Kyoto Protocol: the resubmission should be provided to the Commission by 15 May at the latest	Member States provide to the Commission the resubmissions which they submit to the UNFCCC Secretariat in response to the UNFCCC initial checks. The Member States should clearly specify which parts have been revised in order to facilitate the EU resubmission. As the EU resubmission also has to comply with the deadlines specified in the guidelines under Article 8 of the Kyoto Protocol, the resubmission has to be sent to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, but not later than 15 May..
12. Submission of any other resubmission after the initial check phase	Member States	When additional resubmissions occur	Member States provide to the Commission any other resubmission (CRF or national inventory report) which they provide to the UNFCCC Secretariat after the initial check phase.

On 28 February, the draft EU GHG inventory and inventory report are circulated to the Member States for review and comment. The Member States check their national data and information used in the EU inventory report and send updates, if necessary, and review the EU inventory report by 15 March. This procedure should assure the timely submission of the EU GHG inventory and inventory report to the UNFCCC Secretariat and it should guarantee that the EU submission to the UNFCCC Secretariat is consistent with Member States' UNFCCC submissions.

The final EU GHG inventory and inventory report is prepared by the EEA's ETC/ACM by 15 April for submission to the UNFCCC Secretariat. Resubmissions of the EU GHG inventory and inventory report are prepared by 27 May, if needed. By 8 May, Member States provide to the Commission any resubmission in response to the UNFCCC initial checks which affect the EU inventory, in order to guarantee that the EU resubmission to the UNFCCC Secretariat is consistent with the Member States' resubmissions. By the end of May the inventory and the inventory report are published on the EEA website (http://www.eea.europa.eu) and the data are made available through the EEA data service (http://dataservice.eea.europa.eu/dataservice) and the EEA GHG data viewer (http://www.eea.europa.eu/pressroom/data-and-maps/data/data-viewers/greenhouse-gases-viewer).

1.4 General description of methodologies and data sources used

1.4.1 The compilation of the EU GHG inventory

The EU inventory is compiled in accordance with the recommendations for inventories set out in the 'UNFCCC guidelines for the preparation of national communications by parties included in Annex 1 to the Convention, Part 1: UNFCCC reporting guidelines on annual inventories' (FCCC/SBSTA/2004/8), to the extent possible. In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. Finally, for the compilation of the EU GHG inventory, the Monitoring Mechanism Regulation and its implementing legislation is applicable.

The EU-15 GHG inventory is compiled on the basis of the inventories of the 15 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 15 Member States. This is also valid for the base year estimate of the EU-15 as fixed in the initial review report. Table 1.5 shows the base year emissions for EU-15 Member States and EU-15 as fixed in the respective initial review reports.

Table 1.5 Base year emissions for EU-15 Member States and EU-15

EU-15 MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions[13]) (Tonnes CO_2 equivalents)
Austria	1990	1990	79 049 657
Belgium	1990	1995	145 728 763
Denmark 2)	1990	1995	69 323 336
Finland	1990	1995	71 003 509
France	1990	1990	563 925 328
Germany	1990	1995	1 232 429 543
Greece	1990	1995	106 987 169
Ireland	1990	1995	55 607 836
Italy	1990	1990	516 850 887
Luxembourg	1990	1995	13 167 499
Netherlands	1990	1995	213 034 498
Portugal	1990	1995	60 147 642
Spain	1990	1995	289 773 205
Sweden	1990	1995	72 151 646
United Kingdom 2)	1990	1995	776 337 201
EU-15	1990	1990 (AT, FR, IT) 1995 (other MS)	4 265 517 719

Source: Initial review reports of the EU-15 Member States (www.unfccc.int)
Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.
The base year emissions relate to the EU territory of Denmark and the UK.

Of the EU-15 Member States, 12 Member States have chosen 1995 as the base year for fluorinated gases while Austria, France and Italy have chosen 1990. Therefore, the EU-15 base year estimates

[13] Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent

for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for Ireland, the Netherlands, Portugal and the UK.

The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key category analysis (Section 1.5) is separately performed at EU-15 level (14).

Since Member States use different national methodologies, national activity data or country-specific emission factors in accordance with IPCC and UNFCCC guidelines, these methodologies are reflected in the EU GHG inventory data. The EU believes that it is consistent with the UNFCCC reporting guidelines and the IPCC good practice guidance to use different methodologies for one source category across the EU especially if this helps to reduce uncertainty of the emissions data provided that each methodology is consistent with the IPCC good practice guidance.

In general, no separate methodological information is provided at EU level except summaries of methodologies used by Member States. However, for some sectors quality improvement projects have been organised/are ongoing with the aim of further improving estimates at Member State level. These sectors include energy background data, emissions from international bunkers, emissions and removals from LULUCF, emissions from industrial processes, agriculture and waste.

The EU-15 CRF Table Summary 3 in Annex 1.2 provides information on methodologies and emission factors used by the Member States. These tables have been compiled on the basis of the information provided by the Member States in their CRF Table Summary 3. In addition, information on methods, activity data and emission factors was used which was provided by the Member States in accordance with the MMR. The sector-specific chapters list the methodologies and emission factors used by the Member States for each EU key source.

Detailed information on methodologies used by the Member States is available in the Member States national inventory reports, which are included in Annex 1.12. Note that all Member States' submissions (CRF tables and national inventory reports), which are included in Annex 1.12 and made available at the EEA website, are considered to be part of the EU submission.

1.4.1.1 Internal consistency of the EU CRF tables

In principle every single EU value is aggregated from the respective value of the EU Member States. However, sometimes there are consistency problems when compiling the EU CRF tables (i.e. the sum of sub-categories is not equal to the category total) in those categories where Member States have difficulties to allocate emissions to the sub-categories. Member States use notation keys like IE or C if they cannot provide an emission estimate for a certain sub-category. At Member State level, the use of the notation keys makes transparent the reason for not providing emission estimates. However, at EU-15 level, the sub-category emission value is the sum of Member States emission values and the information of the notation keys used by some Member States is lost in the EU-15 CRF submission. In order to make this more transparent, the CRF tables now include the values or notation keys reported by the MS as comments. In addition, Annexes 1.4-1.10 of this report include the CRF tables for the sectors for each EU-15 Member State. In order to address this problem, some source categories have been reallocated for the EU CRF tables.

A second problem is the reporting of Member States in "grey cells" which need to be included in the CRF reporter manually.

A third problem occurs where MS report potential fluorinated gas emissions but do not report actual emissions. In these cases the potential emissions are included in the national totals, but they are lost when aggregating the EU actual emissions. Therefore, the potential emissions are added manually into the CRF reporter for these Member States.

Table 1.6 lists the procedures applied for the EU-15 Member States.

(14) However, the choice of the emission calculation methodology is made at Member State level and is based on the key category analysis of each individual Member State.

Table 1.6 Manual changes in the CRF Reporter

CRF Table	Member State	Year	Sector	Source category	Parameter	Manual changes/inclusion in the CRF reporter
Table1B2	SE	1990-2012	Energy	1.B.2.a.5	N_2O	Add pollutant N_2O under 1B2a5 and include emissions from grey cells.
Table1B2	GB	1990-2012	Energy	1.B.2.b.1	N_2O	Add pollutant N_2O under 1B2b1 and include emissions from grey cells.
Table1s1	DE	1990-2012	Energy	1.B.2	CO	Add pollutant CO under 1.B.2.b.5.1 and include emissions from grey cells.
	EU	1990-2012	Energy	1.AB	all	CRF Reporter: Enter Reference Approach and delete MS comments
Table2(I)s1	DE, SE, PL	1990-2012	Ind. Processes	2.A.1	NO_X, NMVOC, CO	Add new gases under 2A1 and include emissions
Table2(I)s1	DE, PT	1990-2012	Ind. Processes	2.A.2	NO_X, NMVOC, SO_2	Add new gases under 2A2 and include emissions
Table2(I)s1	SE	1990-2012	Ind. Processes	2.A.2	SO_2	Add pollutant SO_2 under 2A2 and include emissions from grey cells
Table2(I)s1	PT	1990-2012	Ind. Processes	2.A.6	CH_4	Include PT CH_4 emissions from grey cells
Table2(I)s1	EU	1990-2012	Ind. Processes	2.A.7	CO_2, CH_4, NO_X, CO, NMVOC, SO_2	Exclude glass production from other non-specified and delete MS comments
Table2(I)s1	HU	1990-2003	Ind. Processes	2.B.2	CO_2	Add pollutant CO_2 under 2B2 and include emissions from grey cells (EEA finding).
Table2(I)s1	EU	1990-2012	Ind. Processes	2.B.5	CO_2, CH_4	Exclude 2.B.5.1 - 2.B.5.5 from other non-specified and delete MS comments
Table2(1).A-Gs2	DE	1990-2012	Ind. Processes	2.C.1.1	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	ES	1990-2012	Ind. Processes	2.C.1.5	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	GB	1990-2012	Ind. Processes	2.C.1.5	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	PL	2005-2011	Ind. Processes	2.C.1.5	N_2O	Add pollutant N_2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	SE	1990-2012	Ind. Processes	2.D.1	CH_4, N_2O	Add pollutants CH_4, N_2O under 2D1 and include emissions from grey cells.
Table2(1).A-Gs2	PL	2005-2011	Ind. Processes	2.D.1	CO_2	Add pollutant CO_2 under 2D1 and include emissions from grey cells.
Table2(II)	FR	1990-2012	Ind. Processes	2.E.2	HFC-365mcf	Include FR emissions from HFC-365mcf in CO_2 equivalents and delete MS comments
Table2(II).F	EU	1990-2012	Ind. Processes	2.F	all	CRF Reporter: Enter emissions from CRF table 2(II).F
Table2.F	FR	2003-2011	Ind. Processes	2.F.2.1	HFC-365mcf	Include FR emissions from HFC-365mcf under Unspecified mix of HFCs and delete MS comments
Table2(II)	EE	2004-2011	Ind. Processes	2.F.2	HFC-365mcf	Include EE emissions from HFC-365mcf under Unspecified mix of HFCs and delete MS comments
Table2(I)s1	BG, HR, MT	1990-2012	Ind. Processes	2.F.9	HFC-P, PFC-P	Make sure that potential emissions are accounted for (run CRF Aggregator report 'APE') and include them under 2.F.9
Table4s1	LU, NL	1990-2012	Agriculture	4.A.1	CH_4	Add LU, NL mature dairy cattle under dairy cattle and delete MS comments
Table4.A	EU	1990-2012	Agriculture	4.A	all	Enter additional information from SBDT4A, JRC (not population, except for cattle)
Table 4.As2	EU	1990-2012	Agriculture	4.A	all	Enter additional information from SBDT4As2, JRC (not population)

CRF Table	Member State	Year	Sector	Source category	Parameter	Manual changes/inclusion in the CRF reporter
Table4s1	LU, NL	1990-2012	Agriculture	4.B.1	CH_4	Add LU, NL mature non-dairy, young cattle under non-dairy cattle and delete MS comments
Table4.B(a)	EU	1990-2012	Agriculture	4.B	all	Enter additional information from SBDT 4B(a), JRC (not population, except for cattle)
Table4.B(a)s2	EU	1990-2012	Agriculture	4.B	all	Enter additional information from SBDT 4B(a)s2, JRC (not population)
Table4.B(b)	EU	1990-2012	Agriculture	4.B	all	Enter additional information from SBDT 4B(b), JRC (not population)
Table4s2	ES	1990-2012	Agriculture	4.D	NO_X	Add pollutant NO_X under 4D4 and include emissions from grey cells.
Table4.D	EU	1990-2012	Agriculture	4.D	all	Enter additional information from SBDT 4D, JRC (only additional information - fraction)
Summary1A	ES, PT	1990-2012	Agriculture	4.F.5	SO_2	Add pollutant SO_2 under 4F5 and include emissions from grey cells.
Table4.F	EU	1990-2012	Agriculture	4.F	all	Enter additional information from SBDT 4F, JRC (not crop production, not biomass burned)
Table5	FI	1990-2012	LULUCF	5.G	CO_2	Include additional information from 5.G
Summary1.A	FR	1990-2012	LULUCF	5.G	NMVOC, SO_2	Include additional information from 5.G
Table5	FR	1994-2011	LULUCF	5.G	CO_2, CH_4	Include additional information from 5.G
Table 5	LV	1990-2012	LULUCF	5.G	CO_2, CH_4, N_2O	Include additional information from 5.G
Summary1.A	IT	1990-2012	LULUCF	5.G	SO_2	Include additional information from 5.G
5(III)	DE	1990-2012	LULUCF	5.G	N_2O	Include additional information from 5.G
5(IV)	DE	1990-2012	LULUCF	5.G	CO_2	Include additional information from 5.G
5(IV)	NL	1990-2012	LULUCF	5.G	CO_2	Include additional information from 5.G
	EU	1990, 2009	KP.LULUCF	KP LULUCF	all	CRF Reporter: Enter KP.LULUCF data from EU MS manually
Table6	ES	1990-2012	Waste	6.A.1	N_2O	Add pollutant N_2O under 6A1 and include emissions from grey cells.

1.4.2 Use of data from EU ETS for the purposes of the national GHG inventories in EU Member States

1.4.2.1 Overview

In January 2005 the European Union Greenhouse Gas Emission Trading System (EU ETS) commenced operation as the largest multi-country, multi-sector Greenhouse Gas Emission Trading System world-wide. The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003.The European emissions trading system (ETS) covers around 10 500 installations across the 27 Member States of the European Union. Article 14 of the Emission Trading (ET) Directive requires Member States to ensure that emissions are monitored in accordance with specific monitoring and reporting guidelines (MRG)[15], which are legally binding. Since 1 January 2005, all installations covered by the ETS have been required to estimate and report their emissions. Data for the installations covered by the ETS are reported by plant operators to competent authorities since 2005 based on a monitoring plan elaborated by the company and agreed by the competent authority in accordance with the methodologies established in the monitoring and reporting guidelines. The monitoring plan covers the following elements:

(a) the description of the installation and activities carried out by the installation to be monitored;

(b) information on responsibilities for monitoring and reporting within the installation;

(c) a list of emissions sources and source streams to be monitored for each activity carried out within the installation;

(d) a description of the calculation based methodology or measurement based methodology to be used;

(e) a list and description of the tiers for activity data, emission factors, oxidation and conversion factors for each of the source streams to be monitored;

(f) a description of the measurement systems, and the specification and exact location of the measurement instruments to be used for each of the source streams to be monitored;

(g) evidence demonstrating compliance with the uncertainty thresholds for activity data and other parameters (where applicable) for the applied tiers for each source stream;

(h) if applicable, a description of the approach to be used for the sampling of fuel and materials for the determination of net calorific value, carbon content, emission factors, oxidation and conversion factor and biomass content for each of the source streams;

(i) a description of the intended sources or analytical approaches for the determination of the net calorific values, carbon content, emission factor, oxidation factor, conversion factor or biomass fraction for each of the source streams;

(j) if applicable, a list and description of non-accredited laboratories and relevant analytical procedures including a list of all relevant quality assurance measures, e.g. inter-laboratory comparisons;

(k) if applicable, a description of continuous emission measurement systems to be used for the monitoring of an emission source, i.e. the points of measurement, frequency of measurements, equipment used, calibration procedures, data collection and storage procedures and the approach for corroborating calculation and the reporting of activity data, emission factors and alike;

(l) if applicable, a comprehensive description of the approach and the uncertainty analysis, if not already covered by items (a) to (k) of this list;

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[15] Commission Decision 2007/589/EC of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. OJ L 229, 31.8.2007, p.1ff

(m) a description of the procedures for data acquisition, handling activities and control activities as well as a description of the activities;

(n) where applicable, information on relevant links with activities undertaken under the EU ecomanagement and audit scheme (EMAS) and other environmental management systems (e.g. ISO14001:2004), in particular on procedures and controls with relevance to greenhouse gas emissions monitoring and reporting.

Similar to the IPCC Good Practice Guidance, the ETS monitoring and reporting guidance is based on a tier system which defines a hierarchy of different ambition levels for activity data, emission factors and oxidation or conversion factors. The operator must, in principle, apply the highest tier level, unless he can demonstrate to the competent authority that this is technically not feasible or would lead to unreasonably high costs. The reported emissions of each installation are verified by independent verifiers for each plant in each reporting year.

Thus, the ETS generates an EU-28 data set on verified installation-specific CO_2 emissions for the sectors covered by the scheme. The ETS includes CO_2 emissions from energy industries and manufacturing industries, in particular combustion installations, mineral oil refineries, coke ovens, production and processing of ferrous metals, and mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials) if the installations exceed certain capacity thresholds. In 2008 the scope of the EU ETS has been expanded to include petrochemical cracking installations, mineral wool production and carbon black production. At the moment, the greenhouse gases covered under the EU ETS are CO_2 (since 2005) and N_2O (since 2010). However, other greenhouse gases and activities will be included in the scope of the EU ETS from 2013 onwards. In July 2006 the Climate Change Committee adopted unanimously the revised Monitoring and Reporting Guidelines for the ETS. The new Guidelines entered into force on 1st January 2008.

The plant-specific emissions data reported by operators under the EU ETS can be used in different ways for the purposes of the national GHG inventories:

1. Reported verified emissions can be directly used in the GHG inventory to report CO_2 emissions for a specific source category. This requires a number of careful checks, e.g. whether the coverage of the respective ETS emissions is complete for the respective source category and that ETS activities and CRF source categories follow the same definitions. If ETS emissions are not complete, the emissions for the remaining part of the source category not covered by the EU ETS have to be calculated separately and added to the ETS emissions.
2. Emission factors (or other parameters such as oxidation factors) reported under the EU ETS can be compared with emission factors used in the inventory and they can be harmonised if the EU ETS provides improved information.
3. Activity data reported under the EU ETS can be used directly for the GHG inventory, in particular for source categories where energy statistics face difficulties in disaggregating fuel consumption to specific subcategories, e.g. to specific industrial sectors.
4. Data from EU ETS can be used for more general verification activities as part of national quality assurance (QA) activities without the direct use of emissions, activity data or emission factors.
5. Data from EU ETS can improve completeness of the estimation of IPCC source categories when additional data for sub-categories become available from EU ETS.
6. ETS data can improve the allocation of industrial combustion emissions to sub-categories under 1A2 Manufacturing Industries and Construction;
7. The comparison of the data sets can be used to improve the uncertainty estimation for the GHG inventories based on the ranges of data reported by installations.

1.4.2.2 Differences in technical monitoring and reporting provisions between GHG inventories and the EU ETS

There are a number of detailed technical provisions that are different in the monitoring and reporting guidelines for the EU ETS and the IPCC guidelines. These differences can lead to different reported CO_2 emissions under the EU ETS and in the GHG inventory. Some of these issues may also prevent inventory compilers from using verified emissions reported under the ETS directly for emission reporting in the national GHG inventory or may also raise concerns by the expert review teams during the inventory review if Member States directly used verified emissions reported under the ETS for the reporting in the national GHG inventory. Some of these differences have been removed after the first phase of the EU ETS when the 2004 ETS MRG were replaced by the 2007 ETS MRG, however some new differences have been introduced in the second phase.

Scope of activities and installation boundaries

The ETS includes CO_2 emissions from energy industries and manufacturing industries, in particular combustion installations, mineral oil refineries, coke ovens, production and processing of ferrous metals, and mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials) if the installations exceed certain capacity thresholds. Such capacity thresholds are not used for the inventory reporting. In addition different understandings of installation boundaries (furthermore, completeness of the installations included in an industry sector group) and the interpretation as to what constitutes certain activities under the EU ETS, may be different to a source category for the inventory reporting. The scope of activities and the installation boundaries need careful consideration before ETS data are used for inventory purposes.

Determination of tiers

Both reporting guidelines are based on methodological tiers that require higher tier levels of accuracy for emission sources contributing to a significant extent to the total emissions in a country. However in the inventory reporting, the key category analysis determines which methodological tier should be used which is based on the contribution of a source category to the total emission level and the emission trend. If a source category is determined as key, all emissions from this source/sector have to be estimated based the same minimum tier methodology.[16]

In the ETS reporting tiers apply at installation level based on the emissions at the particular installation (thresholds are < 50 kt, ≥ 50 kt and ≤ 500 kt and > 500 kt CO_2). At sectoral level, e.g. for cement and lime production, verified emissions can result from small, medium and large emitters and are therefore based on different ETS tiers. For inventory key categories, it can happen that not all verified emissions reported (in particular those estimates that are based on default parameters) under the EU ETS fulfil the tier-level required for the GHG inventory.

In GHG inventories time series consistency is a mandatory requirement which has also implications on the choice of methodology. Plant-specific and measured data is often not available for the whole time series and it may be challenging. In GHG inventory reviews, the ERT has in some case recommended Parties not to use EU ETS data because challenges in producing a consistent times series back to 1990 based on the use of EU when the ETS data is used.

Fuel emission factors and net calorific values

The 2004 ETS MRG used default fuel emission factors from 1996 IPCC reporting guidelines[17] and net calorific values from 2000 IPCC Good Practice guidance which is consistent with the UNFCCC reporting guidelines under the Convention and the Kyoto Protocol. The revised 2007 ETS MRG use default fuel emission factors and net calorific values from 2006 IPCC Guidelines for national GHG inventories which have not yet been adopted for reporting under the UNFCCC and will not be made

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[16] The general rule is that if a subcategory represents less than 25-30% of the total emissions of the category, Tier 1 may be used. However, this is not explicitly stated in the IPCC GPG for all categories.

[17] With few exceptions such as shale oil for which IPCC guidelines don't provide a value

mandatory before the reporting year 2015. Thus, starting from 2008 the reporting under the ETS, emissions may have been estimated with fuel-specific default EF that are not acknowledged under the UNFCCC. However, this may not affect the reporting practice substantially as both IPCC and the ETS guidelines require countries and installations to use measured/ installation-specific or country-specific EFs and NCVs. For all fuels for which the reporting is based on installation-specific or country-specific EFs, the different default parameters have no impact (country-specific parameters are normally used for all major fuel types). As the inventory also covers small installations, average carbon contents of fuels and NCVs can vary between the inventory and the ETS data.

Oxidation factor

The Tier 1 method for combustion installations 2004 ETS MRG assumed an oxidation factor of 0.99 for conversion of C to CO_2 for all solid fuels and of 0.995 for all other fuels. IPCC 1996 Guidelines recommend 0.98 for coal, 0.99 for oil and oil products, 0.995 for gas and 0.99 for peat and electricity generation.[18] 2007 ETS MRG changed the Tier 1 requirement to use of an oxidation factor of 1.0 (i.e. default assumption of 100% oxidation).

18 Table 1-6 Revised 1996 IPCC Guidelines for national GHG Inventories, Reference manual, chapter energy

Table 1.7 Comparison of default oxidation factors used for GHG inventories and for ETS reporting

	Fraction of carbon oxidised, default parameters for tier 1		
Fuel type	**1996 IPCC Guidelines valid for GHG inventories until 2014**	**2004 ETS MRG**	**2007 ETS MRG**
Coal	0.98	0.99	1
Oil and oil products	0.99	0.995	1
Gas	0.995	0.995	1
Peat for electricity generation	0.99	0.99	1

The impact of these differences in the default assumptions for the oxidation factors on the emission estimation depends on the extent to which Member States and installations use tier 1 and the default parameters in their reporting.

Transferred CO_2

The 2004 version of the ETS MRG included a specific provision for "transferred CO_2" which allowed to subtract CO_2 which is not emitted from the installation but transferred out of the installation as a pure substance, as a component of fuels or directly used as a feedstock in the chemical or paper industry, from the calculated level of emissions for an installation.[19] CO_2 that is transferred out of the installation for the following uses could be considered as transferred CO_2:

- pure CO_2 used for the carbonation of beverages,
- pure CO_2 used as dry ice for cooling purposes,
- pure CO_2 used as fire extinguishing agent, refrigerant or as laboratory gas,
- pure CO_2 used for grains disinfestations,
- pure CO_2 used as solvent in the food or chemical industry,
- CO_2 used as feedstock in the chemical and pulp industry (e.g. for urea or carbonates).

In the reporting under the UNFCCC such subtraction is not allowed if the carbon is only stored for a short time (such as for beverages or dry ice) and consequently the intermediate binding of CO_2 in downstream manufacturing processes and products should not be subtracted from CO_2 emissions.[20]

Thus, for Member States applying the provisions for transferred CO_2 in the first phase of the ETS, this provision introduced some differences in accounting of CO_2 emissions. In quantitative terms this was not very relevant as the quantities deducted from transferred CO_2 under the EU ETS were rather small as indicated in the responses to the questionnaires provided by Member States in relation of Article 21 of the ETS Directive.

In the revised version of the ETS MRG from 2007, the application of the provision requires approval by the competent authority and is only applicable if "the subtraction is mirrored by a respective reduction for the activity and installation which the respective Member State reports in its national inventory submission to the UNFCCC." Thus, the revision of the ETS MRG made the reporting of transferred CO_2 more consistent with the GHG inventory.

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19 Decision 2004/156/EC, p. 7ff

20 The CO_2 capture and storage limestone in the Finnish pulp and paper industry for PCC production has been accepted in the UNFCCC reviews as a long-term storage for CO_2

With regard to carbon capture and storage, the rules for CCS are stricter under the ETS than under the UNFCCC, e.g. the EU ETS does not allow taking into account emission reductions due to CCS of biomass plants or carbon capture and storage when the CO_2 is stored in long-term products. With regard to the storage of CO_2 in products also 2006 IPCC Guidelines for GHG inventories include changes that will only enter into effect in the future.

1.4.2.3 Use of EU ETS data in 2014

Based on the information submitted in the national inventory reports (NIRs) in 2014 to the UNFCCC secretariat or the European Commission, 26 Member States indicated that they used ETS data at least for QA/QC purposes (see Table 1.8). Croatia joined the European Union in July 2013 and participates in the EU ETS since January 2013. For the NIR 2014, Croatia did not use any ETS data, but plans improve their calculation with ETS data. 16 Member States indicated to directly use the verified emissions reported by installations under the ETS. 22 Member States used ETS data to improve country-specific emission factors. 22 Member States reported that they used activity data (e.g. fuel use) provided under the ETS in the national inventory.

Table 1.8: Use of ETS data for the purposes of the national GHG inventory

Member State	Status of use of ETS data	Use of emissions	Use of Activity data	Use of emission factors	Use for quality assurance
Austria	Used	✓	✓		✓
Belgium	Used	✓		✓	✓
Bulgaria	Used	✓	✓	✓	✓
Croatia	Not Used				
Cyprus	Used	✓	✓	✓	✓
Czech Republic	Used	✓	✓	✓	✓
Denmark	Used	✓	✓	✓	✓
Estonia	Used				✓
France	Used	✓	✓	✓	✓
Finland	Used	✓	✓	✓	✓
Germany	Used		✓	✓	✓
Greece	Used		✓	✓	✓
Hungary	Used	✓	✓	✓	✓
Ireland	Used	✓	✓	✓	✓
Italy	Used		✓	✓	✓
Latvia	Used	✓	✓	✓	✓
Lithuania	Used		✓	✓	✓
Luxembourg	Used		✓		✓
Malta	Used	✓	✓	✓	
Netherlands	Used	✓			✓
Poland	Used	✓	✓	✓	✓
Portugal	Used		✓	✓	✓
Romania	Used			✓	✓
Slovakia	Used				✓
Slovenia	Used		✓	✓	✓
Spain	Used	✓	✓	✓	✓
Sweden	Used	✓	✓	✓	✓
United Kingdom	Used		✓	✓	✓

Source: NIR 2014 submissions

The following sections provide a detailed overview of the use of ETS data in the EU-28 Member States. The information is mainly based on the NIRs, as well as on the assessment conducted for this report.

1.4.2.4 Austria

General

At the moment, the greenhouse gases covered under the EU ETS in Austria are CO_2 (since 2005) and N_2O (since 2010). Austria unilaterally opted-in N_2O as of 2010. However, other greenhouse gases (N_2O and PFCs) and activities will be included in the scope of the EU-ETS from 2013 onwards. About one third of total Austrian GHG emissions currently result from installations under the EU-ETS (~28 Tg CO_2 in 2012).

Currently the following industrial branches are fully covered by the national ETS:

- Refineries,
- Iron and steel manufacturing industries,
- Non-metallic mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials),
- Pulp and paper manufacturing industries.

Combustion plants of other industrial branches (including power plants) are considered if their thermal plant capacity exceeds 20 MWth (excluding boilers < 3 MW, biomass-boilers and hazardous and municipal waste incineration boilers).

In Austria ETS data is submitted by means of a standard calculation sheet which includes numerical data about multiple fuels, processes and material flows. Additionally a written QA/QC report has to be submitted. For fuel combustion and industrial processes the following numerical data is reported:

- Activity data: mass or volume of fuel consumption/process input material.
- Net calorific value of fuel
- Oxidation factor of fuel/conversion factor of process material
- CO_2 emission factor of fuel or process material
- Share of non fossil CO_2 in case of "non-traded fuels"

For sites with complex material flows (e.g. refineries, iron and steel plants) carbon mass balance data is reported alternatively:

- Activity data: mass or volume of material flow
- Net calorific value of material
- Carbon content of material

Direct CO_2 measurements have not been submitted.

The ETS reports include data about "traded-fuels" (e.g. different types of coal and fuel oils, natural gas) as well as "non-traded fuels" (e.g. industrial wastes, biomass). For each of the "traded fuels" a national default NCV and a national default CO_2 emission factor may be selected for emission calculation. For "non-traded fuels" plant operators have to make their own estimate of carbon content and NCV.

The allocation of ETS emissions to CRF categories was based on NACE codes reported by installations and therefore harmonized with energy statistics. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Energy

ETS 'bottom up' data 2005–2010 are used for calculation of emission data in categories 1A1 Energy Industries, 1A2 Manufacturing Industries and Combustion and 1A4a Commercial/Institutional. About 200 plants reported 800 fuel and material flows yearly which have been considered in the inventory. ETS fuel masses/volumes and NCVs are used for activity data calculation. The remaining activity data is calculated by means of remaining fuel masses/volumes and averaged NCVs from the energy balance. ETS CO_2 emissions are considered by fuel. The remaining CO_2 emissions are calculated by remaining activity data and "national default" emission factors.

- 1A1a Public Electricity and Heat: For the years 2005–2012 CO_2 emissions from plants having a total boiler capacity of >= 20 MWth are taken from ETS reports and CO_2 emissions from plants < 20 MWth are calculated by means of national default emission factors and remaining fuel consumption of the energy balance. Coal consumption is fully covered by the ETS. Large point source activity data from 2005 onwards is considered from ETS reporting.

- 1A1b Petroleum refining: CO_2 emissions 2002 to 2005 are reported by the Austrian Association of Mineral Oil Industries, they are consistent with ETS 2005 data. For the year 2006 onwards reported ETS data is used.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: For 2005 to 2012 CO_2 emissions and activity data of natural gas storage compressors are taken from ETS data.
- 1A2c Chemicals: For the years 2005 to 2012 CO_2 ETS data are considered. CO_2 emissions from industrial waste: From 2005 on ETS data is considered with plant specific emissions and energy consumption.
- 1A2d Pulp, Paper and Print: For the years 2005 to 2012 CO_2 ETS data are considered. CO_2 emissions from industrial waste: From 2005 on ETS data is considered with plant specific emissions and energy consumption. In general ETS data shows slightly higher energy consumption (in terms of TJ) than current energy statistics, therefore ETS data is used from 2005 on.
- 1A2e Food Processing, Beverages and Tobacco: For the years 2005 to 2012 CO_2 ETS data are considered.
- 1A2f Manufacturing Industries and Construction – Cement Clinker Production (NACE 26.51): CO_2 emissions from 2004 to 2011 are taken from the ETS allocation plan survey and ETS data. From 2002 on a share of petrol coke use is allocated to magnesia production from dolomite by using ETS data. After 2005 the share of waste which contains 100% biomass has been taken from ETS data. For the years 2005–2012 ETS data are taken which covers 100% of cement plants.
- 1A2f Manufacturing Industries and Construction – Other: For 2005 to 2012 ETS data is considered for glass, bricks & tiles and lime manufacturing plants.

Industrial processes

Verified CO_2 emissions reported under the EU ETS were available for the years 2005-2012. These emissions have been incorporated in the inventory as far as possible. The relevant sources are 2.A.1 Cement Production, 2.A.2 Lime Production, 2.A.3 Limestone and Dolomite Use, 2.A.7.a Bricks production, 2.A.7.b Magnesia Sinter Plants, 2.A.7.c Glass production and 2.C.1 Iron and Steel. Special attention was given to time-series consistency. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

- 2A1 Cement production: For 2005–2012, verified CO_2 emissions (total of all plants) were checked against national emissions taken from studies – no deviations were identified.
- 2A2 Lime Production: For 2005–2011 verified CO_2 emissions reported under the ETS were used for the inventory. For the years from 2005 onwards, detailed, verified data from the ETS is available: some plants calculate emissions based on raw material data, most calculate emissions from lime produced; thus the activity data reported under the ETS for some plants is production volumes, others report the amount of raw materials used. The emission values for 2005 onwards are verified under the ETS. The IEF are compared with IPCC default values. The Association of the Stone & Ceramic Industry reported total CO_2 emissions, which were compared with the ETS data.
- 2A3 Limestone and Dolomite Use: For 2005–2011 verified CO_2 emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone use in the iron and steel and chemical industry. The use of limestone in chemical industry is included in the inventory since 2005. Under ETS, plant operators calculate the emissions on the basis of the Austrian Monitoring, Reporting and Verification Ordinance. From 2005 onwards, ETS background data provided more detailed information on the actual carbon content of the limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values.
- 2A7 Glass production: Starting with 2005, ETS background data provided more detailed information on the actual carbon content of the carbonates used. Therefore, the IEFs since 2005 are slightly different compared to the IPCC default values. For 2005–2012 verified CO_2 emissions

and activity data, reported under the ETS, were considered for the inventory. These data cover small amounts of other carbonates used in glass industry that have been included from 2005 onwards.

- 2A7 Bricks Production: For 2005-2012 verified CO_2 emissions, reported under the ETS, were used for the inventory. These data cover the whole brick industry in Austria.
- 2A7 Magnesia Sinter Production: For 2005-2011 verified CO_2 emissions reported under the ETS were used in the inventory. The single operator reported total CO_2 emissions, which were compared with the ETS data and found to accord.
- 2C1 Iron and Steel: For 2005-2012 verified CO_2 emissions, reported under the ETS, were taken for the inventory, which constitutes a similar – slightly more detailed - approach as for the years before. The ETS data cover CO_2 emissions from pig iron, basic oxygen and electric arc furnace steel production. The values for 2005-2012 correspond to the background data (for consistency reasons just carbonatious ore) given in the ETS report. For 2005–2012 CO_2 emissions from non-carbonatious ore – calculated by its carbon content – and other additives – including plastics and coal fines used as reducing agents – were taken into account additionally. This information became available from background data reported under the ETS. It has to be stressed that this additional accounting does not affect total CO_2 emissions, but only improves the accuracy of the split made between process and combustion specific emissions. From 2005 onwards, the IEF is quite stable, because background data reported under the ETS allowed accounting for reducing agents other than coke. For electric arc furnace steel production for 2005–2012 verified CO_2 emissions, reported under the ETS, were taken for the inventory. For 2005–2012 detailed information on the carbon mass balance applied by the company to calculate total emissions from pig iron and basic oxygen furnace steel were available from the ETS. Thus it was possible to validate CO_2 emissions with this background data.

1.4.2.5 Belgium

General

The Flemish region has taken into account the information from the EU-ETS data in a sense that reported sources in the EU-ETS framework are compared with the reported sources in the greenhouse gas emission inventory (integrated environmental reports, regional energy balance). When major changes are detected in the reported emissions of CO_2 and/or energy data between these two datasets, the involved industry is contacted and data are optimized if necessary. As a result more accurate emissions and/or energy data can be obtained. Since the beginning of 2010 this work started in a more organized way in the Flemish region. A study is conducted at that time to examine the differences more in detail between energy and CO_2 data reported under the ETS and the data used in energy balances (energy use) and in emission reporting (CO_2). Since 2005 EU-ETS data are integrated in the Flemish greenhouse gas inventory in the sectors of glass and ceramic (category 2A7) and in the iron and steel sector (categories 1A2a and 2C). The emissions of these sectors were recalculated for the historical years with the same methodology as the one used for EU-ETS-purposes. Because of the small emissions of CO_2 in the sector of glass and ceramic (below the threshold of 100 kton CO_2) no other reporting obligations than the ETS-reporting for these industries exist in the Flemish region.

The information related to GHG emissions in Walloon region is used to calculate the emissions of the most important emitters in the energy, industry and waste sectors. In particular, the information coming from the obliged reporting under the ETS-Directive is used in the preparation of the inventory of the greenhouse gases. Among others, data obtained from industrial companies concerned by the ETS-process are systematically cross-checked with certified reports in the framework of that mechanism.

Procedures have been implemented in Brussels region to cross-check the data used in the inventories with other data from the Institute. These data are coming from other departments which use them for other requirements (e.g. PRTR, ETS, environmental reports) and help to check the completeness of the inventory. Some data have been revised following these checks and this work will be continued in the future.

Energy

- 1A1a Public Electricity and Heat Plants: For the large power plants in the public electricity sector in the Flemish region, the CO_2 emissions are reported directly by the power plants and based on analyses of the fuels (through the individual Integrated Environmental Reporting which is tuned as much as possible with ETS-data). In Wallonia, since 2004, emission trading companies (included the power plants and coke oven plants) are obliged to report their energy consumptions and CO_2 emissions via a website (Regine). These data have been checked during the emission trading verifications.
- 1A1b Petroleum Refining: The emissions of CO_2 are reported to the responsible authorities by the Belgian Petroleum Federation and the petroleum refining companies. Since 2005 (emissions 2004) these emissions are reported by the companies on an obligatory basis via their annual environmental reports. These emissions are completely in line with the emissions reported under the ETS-Directive.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Since 2005, the CO_2 emissions in Wallonia have been giving directly by the plant under the ETS. It's difficult to use these ETS data (coke oven gas analyses) to make a recalculation for the complete time series as there were 5 coke plants in 1990, 4 of them are now closed and there is only one coke plant left since 2009 in Wallonia.
- 1A2 Manufacturing Industries and Construction: For some specific fuels, some industries perform analyses of these fuels and certainly since 2004, more analyses of the fuels are performed by the plants under the ETS-Directive on f.i. solid fuels, blast furnace gas, coke oven gas and waste fuels. These plant-specific emission factors are taking into account in the inventory as much as possible. The latter is the case for the iron and steel sector, cement and lime sectors. In the Flemish region the emissions of CO_2 for the biggest steel plant are revised for the complete time series during the 2011 submission mainly because of inconsistencies in emissions during the last years between the GHG inventory and the emissions reported under the ETS-Directive. As a consequence some missing fuels were added in the inventory from (cokes grid for the complete time series and anthracite from 2004 on). These changes resulted in a large increase of the emissions of CO_2 mainly for the last years. These emissions of CO_2 of the biggest steel plant are calculated by using specific emission factors obtained through analyses performed by the company (as recorded in the monitoring protocol of the ETS Directive). In the lime and cement plants, only located in the Walloon region, the CO_2 emission factors for liquid fuels and gaseous fuels are taken from the IPCC 1996 guidebook. Concerning the solid and waste fuels, an average emission factor has been calculated with plant analyses (2005 to 2008) and applied for the previous years. Since 2005, the CO_2 emissions from solid fuel and waste are reported directly by the companies through the ETS-obligation and based on their fuel consumption and fuel analyses. In the Walloon region, some QC-tests are performed in the course of 2012. In particular in the categories 1A2a, 1A2c, 1A2e and 1A2f, a recalculation with the ETS-data is performed.

Industrial Processes

- 2A7 Glass Production: In the meantime more companies in the Flemish region did revise their calculation methodology for estimating their emissions of CO_2 based on the methodology used in the framework of the EU-ETS Directive. During the 2009 submission, the process emissions of CO_2 were newly added for a company as a result of their emission reporting in the framework of the EU-ETS Directive. An estimation of the previous years (1990-2004) was performed by using the same methodology as used in the framework of the EU-ETS (C-content of raw materials used).

- 2C Metal Production: During the 2011 submission the emissions of CO_2 of the biggest plant in the iron and steel sector were completely revised in the Flemish region and based on the ETS-methodology instead of C-balance-approach in previous submissions. The company involved did recalculate the historical emissions for the complete time-series based on the ETS-methodology. This revision took place mainly because of inconsistencies in emissions between the GHG emission inventory and the emissions reported from the emission trading directive. The 2nd company involved in this category in the Flemish region produces stainless steel. During the 2013 submission this methodology is optimized and made consistent with the ETS-reporting data. Since 2005, CO_2 emissions in Wallonia have been obtained directly by the obliged reporting of the plants under the emission trading scheme.

1.4.2.6 Denmark

General

The EU ETS data account for 63 % of the CO_2 emission from stationary combustion.
In the Danish inventory plant or activity based CO_2 emission factors have been derived for power plants combusting coal and oil, refinery gas and flare gas in refineries, fuel gas and flare gas at off-shore installations, cement production, production of brick and tiles and lime production. For all these sources the EU ETS reports are only used in the Danish inventory for plants using high tier methods. The EU ETS data have been applied for the years 2006 onwards.

Energy

Fuel combustion

The CO_2 emission factors for some large power plants and for combustion in the cement industry and refineries are plant specific and based on the reporting to the EU Emission Trading Scheme (EU ETS). In addition emission factors for off-shore gas turbines and refinery gas is based on EU ETS data. The EU ETS data have been applied for the years 2006 - 2012. DCE performs QC checks on the reported emission data. Based on the QC checking DCE excluded the oxidation factor for coal for one stationary combustion plant for 2012.

- Power plants, coal: EU ETS data for 2012 were available from 15 coal fired power plant units. The plant specific information accounts for 98 % of the Danish coal consumption and 43 % of the total (fossil) CO_2 emission from stationary combustion plants. In 2012, only 2 % of the CO_2 emission from coal consumption was based on the emission factor, whereas 98 % of the coal consumption was covered by EU ETS data. The emission factors for coal combustion in Public electricity and heat production in the years 2006-2012 refer to the implied emission factors of the EU ETS data estimated for each year. For the years 1990-2005, the emission factor for coal in Public electricity and heat production refer to the average IEF for 2006-2009.

- Power plants, residual oil: EU ETS data for 2012 based on higher tier methodologies were available from 13 plants combusting residual oil. The EU ETS data accounts for 53 % of the residual oil consumption in stationary combustion. The emission factors for residual oil combustion in Public electricity and heat production in the years 2006-2012 refer to the implied emission factors of the EU ETS data estimated for each year. For the years 1990-2005, the emission factor for residual oil in Public electricity and heat production refer to the aver-age IEF for 2006-2009.

- Power plants or refineries, gas oil: EU ETS data for 2012 based on higher tier methodologies were available from 4 plants combusting gas oil. Plant specific EU ETS data have been utilised for a few plants in the 2006 - 2012 emission inventories. The EU ETS data accounts for 10 % of the gas oil consumption in stationary combustion.

- Industrial plants: Plant specific CO_2 emission factors have also been applied for some industrial plants including cement industry, sugar production, glass wood production, lime production, and vegetable oil production. The EU ETS data set also includes CO_2 emission factors for petroleum coke and waste applied in industrial plants.

- Off-shore gas turbines: EU ETS data have been applied to estimate an average CO_2 emission factor for natural gas applied in offshore gas turbines. EU ETS data for the fuel consumption and CO_2 emission for off shore gas turbines are available for the years 2006-2012. Based on data for each oilfield implied emission factors have been estimated for 2006-2012. The average value for 2006-2009 has been applied for the years 1990-2005.
- Refinery gas: The emission factor applied for refinery gas refers to EU ETS data for the two refineries in operation in Denmark. Since 2006, implied emission factors for Denmark have been estimated annually based on the EU ETS. The average implied emission factor (57.6 kg per GJ) for 2006-2009 have been applied for the years 1990-2005.
- Anodic carbon: Anodic carbon has been applied in Denmark in 2009-2011 in two mineral wool production units. EU ETS data are available for both plants and thus the area source emission factor (108 kg/GJ) have not been applied.
- Petroleum coke: The emission factor for petroleum coke has been recalculated in this invento-ry. The improved emission factor 93 kg per GJ is based on EU ETS data for 2006-2010. The data includes one power plant and the cement production plant. Plant specific EU ETS data have been utilised for the cement production for the years 2006 - 2012. This consumption represents more than 98 % of the consumption of petroleum coke in Denmark.
- Waste: Plant specific EU ETS data have been utilised for cement production in the 2006 - 2012 emission inventories.

Fugitive emissions

Reporting to the European Emission Trading Scheme (EU ETS) are available in the annual EU ETS reports for refineries, offshore oil and gas extraction facilities and the natural gas treatment plant, concerning fugitive emissions. EU ETS data are only included in the national emission inventory if higher tier methodologies are applied. The EU ETS data used are fully in line with the requirements in the IPCC good practice guidance and are considered the best data source on CO_2 emission factors due to the legal obligation for the relevant companies to make the accounting following the specified EU decisions.

- Flaring: Emissions from flaring are estimated from the amount of gas flared offshore, in gas treatment/storage plants and in refineries and from the corresponding emission factors. From 2006 data on offshore flaring (flared amounts, calorific values and CO_2 emission factors) are given in the reports under the EU ETS and thereby flaring can be split to the individual production units.
- Oil refining: The refineries deliver information on consumption of fuel gas and fuel oil. The calorific values are given by the refineries in the reporting for EU ETS from 2006.

Industrial Processes

- 2A1 Cement production: There is only one producer of cement in Denmark, Aalborg Portland Ltd. The activity data for the production of cement clinker is obtained from the company and the CO_2 emission is from the company report to EU ETS.
- 2A5: Bricks and Tiles: For 2006-2012 emission factors have been derived from CO_2 emissions reported by the brickworks to EU-ETS (confidential reports from approximately 20 brickworks) and production statistics. The company reporting to EU-ETS apply the following EF: 0.44 tonne CO_2 per tonne limestone consumed (different brickworks). This EF is in accordance with the stoichiometric factor.
- 2A5: Expanded clay products: During the prelimi-nary work to establishment of EU-ETS in Denmark the relevant companies reported energy and process related CO_2 emissions for the years 1998-2002. For 2006-2011 emission factors been derived from CO_2 emissions reported to EU-ETS and production statistics.

- 2A7 Other: Glass Production: The reference for activity data for the production of glass and glass wool are obtained from the producers published in their environmental reports. Emission factors are based on stoichiometric relations between raw materials and CO_2 emissions. This information is supplemented with company reports to EU-ETS.
- 2B Chemical Industry: The process emission has been adjusted to reflect the total emission reported in environmental reports minus the energy related emissions reported to EU-ETS.
- 2D Other Oroduction: Sugar production: From the year 2006-2012 the CO_2 emission compiled by the company for EU-ETS is used in the inventory. During the preliminary work to estab-lishment of EU-ETS in Denmark the relevant companies reported energy and process related CO_2 emissions for the years 1998-2002. Based on the process CO_2 emissions and statistical information the actual emission factors were determined.

Uncertainties

For coal and refinery gas combustion, the uncertainty of the CO_2 emission factor is lower in 2012 than in 1990 due to availability of EU ETS data. Fur-ther, the CO_2 emission factor for the fossil part of waste is less uncertain for 2012 than for 1990.

1.4.2.7 Finland

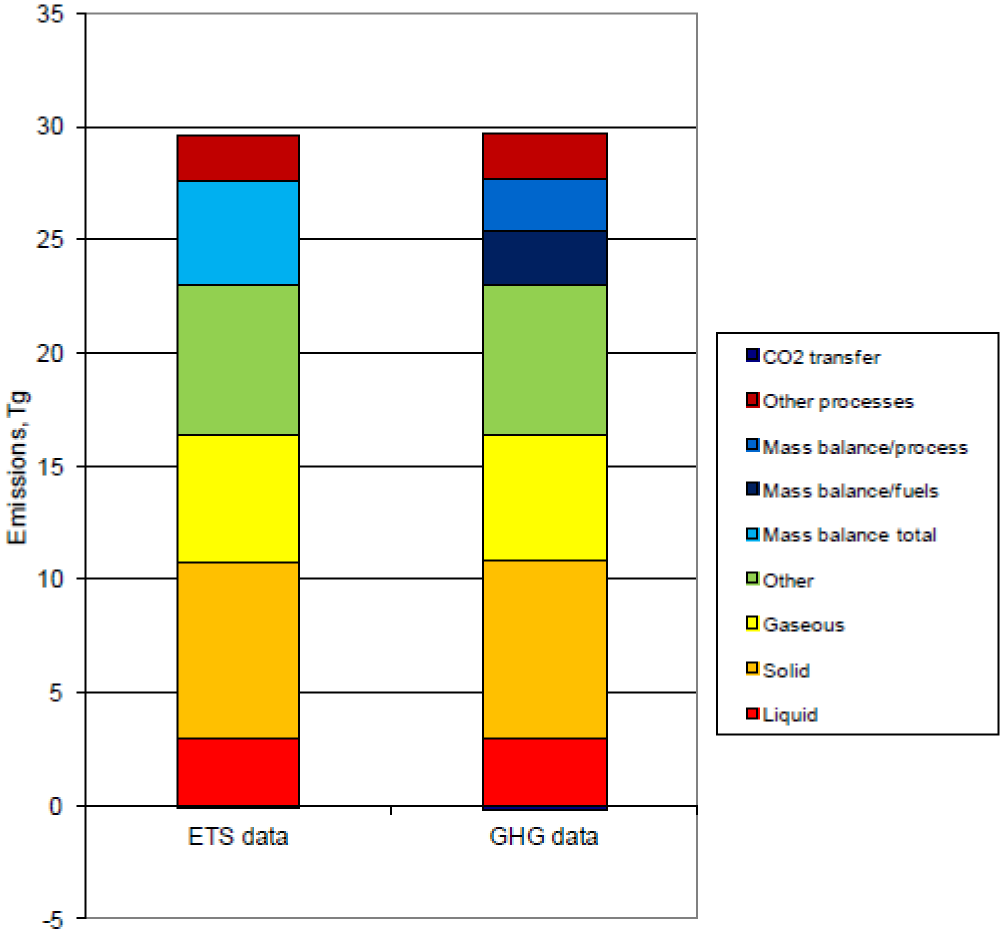
General

The EU ETS data obtained from the Energy Authority has become an increasingly important source of activity and emission data for the inventory. It has been used as prime source of activity data (especially for emissions in the industrial process sector) and for comparison of fuel consumption and CO_2 emissions of specific installations (mainly energy emissions).

CO_2 emission data taken from the EU ETS are annually compared with the calculated emission data in the ILMARI system. Both systems include point source (bottom-up) data. In the ILMARI system the plants included in the ETS are marked. Thus summaries of total ETS and non-ETS plants can be made easily. Total CO_2 emissions taken from the ETS data were 29.6 Tg in 2012. The corresponding amount taken from the GHG inventory data was 29.7 Tg. In the ETS data 143.8 Gg of CO_2 and in the GHG data 146.6 Gg of CO_2 was transferred out of the ETS plants. The reduced amount is different because the storage factor in the inventory is based on annual data and in the ETS a predetermined average storage factor is used. The difference between the ETS and GHG data is 0.5 Tg, 0.2% of total ETS. There are more differences in the allocation of emissions to CRF categories, which can be seen in Figure **1.2**.

The most important difference is in the Iron and steel sector, which is almost totally allocated to Industrial Processes in the ETS data. All iron and steel plants calculate and report their emissions according to the mass balance approach in the ETS. In the GHG inventory emissions are split between Energy and Industrial Processes. Another difference is the emissions of combustion of catalytic cracking coke in oil refineries, which is included in the Energy sector in the inventory and in Industrial Processes in the ETS.

Figure 1.2: CO_2 emissions of ETS plants compared with the corresponding emissions reported in the greenhouse gas inventory in 2012. From 2008 onwards ETS plants have been using mostly measured plant level calorific values and emission factors.



Source: NIR of Finland, submission 2014, p.82, Figure 3.2-2

NCVs, CO_2 emission factors and fuel consumption data taken from the ETS plants were aggregated to the most detailed fuel code level and compared with the corresponding data in the ILMARI system. If there were significant differences, corrections were done in the ILMARI data (either plant-specific NCVs of emission factors or both). Concerning the most common and the most important fuels, the differences in aggregated NCVs and EFs were generally less than +-1%. For wood fuels the differences in NCVs were somewhat larger (generally +-2-10%). This result was expected, mainly due to difficulties of plant operators in disaggregating different types of wood residues to existing fuel code system, but also due to variations in the moisture content of wood fuels. The difference in total amount of woodfuels in TJs was 0.6% in 2012.

Energy

Many point sources in this category are part of the EU Emission Trading Scheme. Monitored data for CO_2 emissions from these sources have become available from the emission trading system for the inventory years 2005 - 2012. In the Energy sector ETS data have been mainly used in:

- identifying missing point sources
- checking, updating or verifying fuel consumption data
- verifying emission data
- verifying NVCs and CO_2 emission factors by fuel type

- defining national NCV and CO_2 emission factor for hard coal, starting from 2008
- defining plant specific CO_2 emission factor for MSW/REF, starting from 2008
- defining national annual NCV and CO_2 emission factor for peat, only for 2012.

The work to input the data from the ETS system in the GHG database system (ILMARI) has started during 2010. At the moment the ETS plants and data are included in the ILMARI for plant level verification. In 2012 more routines were developed to flag differences in the plant level data. The actual corrections and imputations are still performed manually. Finland is looking for ways to use more automatic imputation routines.

Until 2007 the national CO_2 EF for hard coal is based on a research study. Starting from 2008 the installations in EU ETS are obliged to monitor the CO_2 EF. In this submission, the country specific CO_2 EF for hard coal has been determined based on the ETS data, starting from 2008.

The PCC production data has been crosschecked with other data sources. Statistics Finland has collected plant specific data on the production amounts by PCC plant for the relevant years from the VAHTI database (national environmental permit registry) and the production statistics (plant specific data from Statistics Finland's manufacturing industry surveys). The data have also been crosschecked with the amount of captured and transferred CO_2 reported under the EU ETS. These data exist for the years 2005-2012 and include the captured and transferred amount of CO_2 by plant. The differences in the PCC production data from the various sources have been very small. The amount calculated and reported by Statistics Finland in the greenhouse gas inventory has been approximately 97 per cent of the data reported to EU ETS 2005-20012. The difference is assumed to account for possible losses during transfer and production.

Industrial Processes

- 2A1 Cement Production: Data for clinker production for the years 1990-2006 are received directly from the company and for years 2007-2012 from EU ETS data. All activity data for years 1990-2006 have been received directly from the company, but as a result of comparison of this data and EU ETS data, it was decided to give up inquiries because data received from the company for year 2005-2007 and in EU ETS data were equal. The emissions of the most recent eight years have been compared with EU ETS data. Differences between those figures have been less than 3%. For five years calculated emissions are higher than reported in EU ETS and for three years lower.
- 2A2 Lime Production: Emissions from 2005 onwards have been calculated using production data reported to the EU ETS data. The total amount of produced lime has also been checked from industrial statistics. The calculation method was slightly updated for the 2013 submission due to new information of activity data in EU ETS, as only pure lime (=CaO+MgO amounts) are used as activity data (impurities have been written off the amount of lime). All other years (1990-2004) production amount was recalculated using assumption (Emissions permit, 2010) that about 6 per cent of product is impurities. The recalculated emission data for years 2005-2012 of all plants have been verified with ETS data (all plants are included in EU Emission Trading Scheme) and differences in emissions have been found to be about 1%.
- 2A3 Limestone and Dolomite Use: The consumption of limestone and dolomite has been used as activity data when calculating emissions from limestone and dolomite use. Most of the data for the whole time series have been received from individual companies and EU ETS and only a small part data of earlier years have been estimated using industrial statistics. The calculated emission data of 27 plants (out of 36) have been verified with ETS data and differences have been found to be 2-5%. Higher emissions have been formed because in EU ETS companies calculate emissions using default emission factors and in the inventory emission factors are based on assumption that not all limestone and dolomite are calcinated in the process.

- 2A7 Glass Production: The consumption of limestone and dolomite has been used as activity data when calculating emissions from limestone and dolomite use. Activity data for 2012 are collected directly from individual companies and the EU ETS data. Most of the data for the earlier years have been received from individual companies, EU ETS and a smallish part has been estimated using industrial statistics. The calculated emission data of 4 plants (out of 5) have been verified with ETS data and emissions have been found to be almost equal (+/-2%). Reason for difference is that in the inventory calculation not all carbonate is assumed to be calcinated in the production process.
- 2B5: Hydrogen Production: The calculated emission data of two plants (out of 7) have been verified with ETS data and emissions have been found to be equal. These two plants are biggest emitters in this category, amount of their emissions represents more than 90% of category's emissions.
- 2C1: Iron and Steel Production: From 2005 on, all four iron and steel plants in Finland report to the EU ETS. Starting from 2007 submission (2005 data), the total CO_2 emissions for GHG inventory have been taken from the ETS data, although the split between process and fuel-based emissions has been done in the same way as in the previous years' calculation.

1.4.2.8 France

General

France reports in its NIR that in the case where all facilities in a given sector are subject to the ETS, consistency is ensured by taking into account direct emission declarations under the ETS, audited by an approved body by the French administration. If only part of the facilities within the scope of the EU ETS , their reports are taken into account and the remaining emissions for the complete scope of the source category are calculated by additional data sources, in order to remain consistent with the ETS.

Energy

- 1A1 Energy industry: Energy consumption are known to each institution by fuel type and by type of equipment (boilers, turbines, motors) from annual reports of releases of pollutants.For CO_2 emissions are determined using emission factors related to each fuel. National values are applied except where specific factors justified by the operator are available (especially since 2005 and the introduction of the EU ETS). An emission factor is recalculated annually by fuel (IEF) between 2005 and last year. This average emission factor between 1990 and 2004 to ensure the consistency of the time series.
- 1A2 Manufacturing Industries and Construction: Large combustion plants are recorded on an individual basis. All these facilities are covered also by the EU ETS.
- 1A2f Combustion emissions from cement plants: Emissions data as reported under the ETS is used since 2004.
- 1A3a Aviation: With the introduction of the EU ETS for the aviation sector, it is envisaged to improve emissions from civil aviation on the basis of actual consumption that might arise flows of ETS data.
- 1A3e Pipeline compressors: The emission factor is determined based on data derived from the ETS since 2005.
- 1B2a Petroleum refining: CO_2 emissions are declared by the plants under the EU ETS.

Industrial Processes

- 2A1 Cement Production: France directly uses the emissions reported under the ETS since 2004. The data reported in the emission declarations are consistent with the EU ETS data and the data under E-PRTR since 2004.

- 2A2 Lime Production: ETS data are used for the inventory reporting since 2004, in particular to correct impurity of carbonate sources. corrections to take account of impurities according to the method applied in the context of ETS.
- 2A7 Glass Production: ETS data are used for the inventory reporting since 2004. They are completed with the remaining glass production not covered by the ETS. The national emission factors is derived from the ETS data which allows to reflect annual fluctuations in the materials used for glass production.

1.4.2.9 Germany

General

The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in the NIR.

In 2006 a research project compared ETS emissions and inventory emissions and developed allocation rules how the ETS emissions should be allocated to inventory categories. Then a formalized procedure was developed for the annual data exchange between ETS authority and the inventory system. ETS data are generally used for verification and QA purposes but not directly in the inventory. EFs from ETS data are also used. AD from ETS data are not used because these data are confidential and would decrease the transparency of the GHG inventory.

In the CRF table 1s1 (Energy) Germany reports additional source category that include the combustion emissions from source categories covered by the ETS (glass, cement and ceramics). This additional voluntary reporting considerably enhances the comparability of ETS emissions with inventory emissions at sectoral level.

Energy

The NIR generally indicates that ETS data are used for verification purposes. Both systems, the inventory and the ETS, refer to a list of “basic” CO_2 emission factors in the energy sector.

  - 1A3e: As a new data source for natural gas compressors in the transport grid fuel use is taken directly from the ETS since 2005.

Industrial Processes

- 2A1 Cement Production: EFs between inventory and ETS are largely consistent, deviation of 1%.
- 2A2 Lime Production: As the emissions in the inventory are lower than the emission in the ETS the ETS methodologies are currently further analysed. Probably different incorporations of impurities in the raw materials cause this issue.
- 2A7: Glass Production: Emissions were compared with ETS emissions and found to be insignificant different, as ETS data included emissions from water glass production, which is not included in the inventory calculation.

1.4.2.10 Greece

Energy

The energy data used for the calculation of emissions derived from the national energy balance and the reports of installations under the EU ETS.

Emission factors: The determination of emission factors was based on data derived from verified ETS reports and IPCC guidelines. The national energy balance and the verified ETS reports are the main sources of information regarding fuel consumption by sector and activity. For the period 2006-2012 plant specific values for CC were used, based on verified EU-ETS reports.

- ETS data of years 2005-2010 were used for the disaggregation of energy consumption into different activities / technologies. Average emission factors per fuel and source category / activity were estimated by combining ETS data and IPCC default emission factors per technology / activity and fuel. Emissions were calculated by multiplying the fuel consumption obtained from national energy balance per activity by the average emission factors of the respective source activity and fuel, which has been estimated as above-mentioned.

- 1A1a Public Electricity and Heat: For the public electricity and heat sector and for the years 2005-2011, a CO_2 EF of NG, based on plant specific data (ETS reports), was calculated (plant specific EF). The allocation of energy consumption by technology was made on the basis of Public Power Corporation (PPC) verified ETS reports on the installed capacity and the characteristics of electricity production plants.
- 1A1b Petroleum Refining: GHG emissions from refineries are calculated on the basis of fuel consumption (liquid and gaseous fuels only) which is obtained from the national energy balance and plant specific data derived from verified ETS reports and the estimated emission factors described previously. It is noted that only CO_2 and N_2O emissions from catalytic cracking are included in this sub-source category, while CH_4 emissions are supposed to be included in Fugitive emissions from fuels.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Data collected during the formulation of the NAP for the period 2005 – 2007 and verified ETS reports (for years 2005 - 2012) were used in this inventory. CO_2 EF of natural gas was estimated to comprise emissions from the processing of sour gas, based on data derived from verified ETS reports.
- 1A2 Manufacturing Industries and Construction: Data collected (through questionnaires) during the formulation of the NAP for the period 2005 –2007 and verified installation ETS reports of 2005 - 2012 provided significant information regarding the structure of energy demand in industry per activity / technology. Primary aluminium production and ferroalloys production are included, among others, in the energy balance sector of Non ferrous metals. The available plant specific energy consumption data (heavy fuel oil) refer only to primary aluminium production and cover the years 1990 and 1998 – 2003 and 2005 - 2012. On the basis of those data an average specific consumption is estimated (heavy fuel oil consumption per aluminium produced) which is used for the estimation of energy consumption for the period 1991 – 1997. The specific consumption for 2004 is kept constant at 2003 levels. For 2005 - 2012 plant specific energy consumption data were available through the verified ETS reports.
- Energy consumption in Non metallic minerals is disaggregated into energy consumption for cement production (SNAP 030311), lime production (SNAP 030312), ceramics production (SNAP 030319) and glass production (SNAP 030105) according to verified ETS reports of years 2005 - 2011.
- Data on the non-energy consumption of fuels derive from the national energy balance. However, plant specific data derived from verified ETS reports and information provided by specific Greek industries resulted to the improvement of reallocation of non-energy use fuels from the energy to the industrial processes sector: The non-energy use of natural gas for ammonia production production has been reallocated to the industrial processes sector, by using data from ETS reports and plant specific information. The non-energy use of natural gas for hydrogen production is included in the industrial processes sector, by using data from ETS reports and information from Public Gas Corporation.
- Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, by using data from ETS reports and plant specific information, emissions from solid fuels for ferroalloys production are reallocated to the industrial processes sector, as from 2010 submission.

Industrial Processes

CO_2 emissions from the majority of mineral and metal industries, as well as PFC emissions from aluminium production are estimated on the basis of country-specific emission factors. These emission factors derive of plant specific activity and emission data, in the context of the EU ETS, as well as from other information received by the plants and by the Hellenic Statistical Authority. Activity data for the calculation of emissions from industrial processes are provided by a variety of sources, including plant specific information from industrial processes collected through questionnaires for the formulation of the NAP and verified reports under the EU ETS (years 2005-2012).

- 2A1 Cement Production: For the years 2005-2012 detailed data have been accessed via the verified ETS reports of the plants. These data refer to the quantities of carbonate raw material ($CaCO_3$, $MgCO_3$) used for the production of clinker. Emissions prior to 2005 in the past were calculated using the Tier 2 methodology, based on clinker production. Following the change of the methodology to Tier 3, and according to the IPCC GPG (plant specific data became available in the context of EU ETS reports), the overlap methodology has been used in order to ensure the consistency of the time-series. The uncertainty of the current category's estimations is quite low (2% for EF and AD), since the emissions are plant-specific and the reports of the emissions are being verified by accredited verifiers (all the cement plants of Greece are members of the EU ETS).
- 2A2 Lime Production: The emissions are estimated making use of plant-specific data provided by the verified reports of the plants under the ETS. The IEF shows important fluctuations, as it has been already stated in previous NIRs. This can be attributed to the fact that activity data reported are calculated using ElStat data for hydrated, non-hydrated and hydraulic lime, as described in the IPCC GPG, although the emissions are calculated according to the verified ETS reports, as provided by the plants. The uncertainty of the estimate is medium, although data derive from plant-specific, detailed reports of the plants in the context of the EU ETS.
- 2A3 Limestone and dolomite use: Steel production: Data are generally plant specific, deriving from the EU ETS verified reporting of the plants (for the years 2005-2012); Ceramics production: Carbonates consumption data (in the context of the ETS reports) have been used to estimate emissions in the years 2005-2010. Activity data refer to CaCO3 and MgCO3 consumption (emission factors 0.44 and 0.522 respectively). SO_2 scrubbing: For years 2005-2012 data from verified installation ETS reports were used. The emission factor used (0.44 t CO_2 / t limestone) derives from the stoichiometry of the reaction. Emissions have slightly increased in 2012, having an annual increase in emissions of 3.25%. It should be noted however that all the reports made available in the ETS context have been additionally checked by external accredited verifiers, as defined by the Greek ETS system, and also that whenever available data are being cross-checked with information from different sources (i.e. in the case of magnesia production).
- 2A7 Glass Production: Since February 2006 there is only one plant operating in Greece, whereas since 2005 this plant used to have two factories. Production data have been given for both factories for years 2005- 2006 and for the only plant left for the years 2007-2012. Also for the years 2005-2012 the reports in the EU ETS context have been extensively used. Activity data for the period 2001 – 2004 were collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the NAP for the period 2005 – 2007, according to the EU Directive 2003/87/EC.
- 2B5 Production of other chemicals: CO_2 emissions for H2 production are estimated on the basis of the natural gas consumed for the process. Data are provided by DEPA for the whole time-series and by the verified EU ETS reports of the refineries for years 2005-2012. Data are provided by the Public Gas Company (DEPA) for the whole time-series and by the verified EU ETS reports of the refineries for years 2005-2012. For years where data from both DEPA and the EU ETS are available, namely years 2005-2012, the consumed quantities of natural gas are being cross-checked. In addition, the ETS reports used in the estimation of CO_2 emissions from Hydrogen Production are verified by the accredited verifiers of the Greek Emissions Trading System.
- 2C1 Iron and Steel: Activity data for 2005-2012 are plant specific and are based on the verified reports under the EU ETS context. According to information received by the ElStat, all the iron and steel plants of the country are included in the EU ETS. The uncertainty associated with the CO_2 EF is quite low (5%) since all the carbon content is reported by the plants. The same value has been used for the uncertainty of the activity data, accounting mainly for the weighting error in the plant specific reports of the ETS system.

- 2C2 Ferroalloys Production and primary aluminium production: Activity data for 2005-2012 derive of the verified reports of the industry under the EU ETS.

QA/QC

Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. Hellenic Statistical Authority and ETS reports) as well as time-series assessment in order to identify changes that cannot be explained. It should be noted that information and data collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the National Allocation Plan (NAP) for the period 2005 – 2007, according to the EU Directive 2003/87/EC (and its transposition to the national Law, JMD 2004) along with the data from the verified reports from installations under the EU ETS for years 2005-2012 constituted a significant source of information and an additional quality control check.

- Activity data comparison: Cross-checking between energy consumption data derived from national energy balance and plant specific energy consumption data of major industrial plants derived from verified ETS reports is performed.
- Emissions comparison: Verified ETS reports were used for the computation of plant specific CO_2 EFs and NCVs. For quality control purposes emissions calculated by applying PS EFs and NCVs are compared with the emissions calculated by using IPCC defaults EFs and NCVs derived from energy balance. By this way emission estimations were verified.

1.4.2.11 Ireland

General

The annual ETS compilation serves as an important source of activity-specific and company-specific data on CO_2 emissions, fuel use and emission factors for major combustion sources and industrial processes. The emission trading scheme covers approximately 100 installations in Ireland with combined CO_2 emissions of 16 852 Gg in 2012, accounting for 29.0 per cent of total greenhouse gas emissions. The ETS returns to the ETU provide for the complete coverage of CO_2 estimates in a number of sub-categories under 1.A.1 (Energy Industries) and 2.A. (Mineral Products

The Emissions Trading Unit (ETU), also within the Climate Resource and Research Programme of the OCLR, is a key component of the national system The ETU are responsible for administering the European Union Emissions Trading Scheme (ETS), under Directive 2003/87/EC (EP and CEU, 2003), in Ireland and, as such, provide annual verified emissions data to the inventory team. The ETS returns to the ETU provide for the complete coverage of CO_2 estimates for in a number of sub-categories under 1.A.1 Energy Industries and 2.A. Mineral Products. When the allocation to these categories from the ETS raw data is completed, the output is returned to the ETS administrator in OCLR for final checking against the source data. This ensures the efficient and consistent transfer of the verified ETS emissions estimates into the national inventory. Inventory development continues to benefit from the internal review procedures that are ongoing with regard to the EU and its Member States.

Energy

The incorporation of the ETS data in the Energy sector for the last several submissions is again considered an important step towards improved reliability and accuracy of the estimates for categories 1.A.1 and 1.A.2. Thorough checking of this input is achieved in collaboration with colleagues in the Climate Change and Environmental Research Programme (CCERP) of the EPA, which acts as the competent authority for the ETS in Ireland. Following receipt of the raw ETS data from CCERP, the inventory experts allocate the CO_2 estimates and corresponding energy amounts to the appropriate sub-categories for CRF reporting and then return the compilation to the CCERP contact person for final checking and accounting of any amendments following the ETS verification process. This ensures that where ETS emissions estimates cover a category completely, such as in 1.A.1, the verified CO_2 values are transferred directly to the national inventory and consistency of results is guaranteed. In the case where the CO_2 estimates from ETS do not completely cover the category, as for 1.A.2, the benefit is realised as better information on fuels and more representative emission factors, which improves the top-down estimates of emissions obtained using the energy balance.

As for all years since 2005, CO_2 estimates reported under the ETS for 2011 are used to achieve complete bottom-up results in respect of some important sub-categories in this sector for the 2014 inventory submission. This is a significant advance in terms of accuracy as the ETS estimates are verified and they represent a large proportion of the total emissions from the Energy sector.

The fuel combustion CO_2 emission factors for solid fuels used by participants under ETS take account of the fact that a very small fraction (typically less than 1 per cent) of fuel carbon may remain un-oxidised and IPCC oxidation factors appropriate to these fuels are applied when computing the emissions under the scheme.

- 1A1 Energy Industries: The Annual Installation Emissions Reports (AIER) submitted by ETS participants in respect of their CO_2 emissions and fuel combustion in 2011 under Directive 2003/87/EC were used to report the complete inventory for category 1.A.1. The emissions data from a total of 22 individual installations – 19 electricity generating stations in 1.A.1.a, one oil refinery in 1.A.1.b and two peat briquetting plants under 1.A.1.c – are the basis for compiling the results in this important category. In each of the three sub-categories, the verified CO_2 estimates reported by the ETS participants were used directly and the corresponding fuel use as given in the national energy balance was used to estimate CH_4 and N_2O emissions using the appropriate IPCC emission factors.
- 1A1a Public Electricity and Heat Production: The CO_2 emissions for sub-category 1.A.1.a obtained from AEIRs are estimated by ETS operators using tier 3 methodologies in accordance with the monitoring and verification guidelines for combustion activities set down in Decision 2004/156/EC, which were developed for the implementation of Directive 2003/87/EC.. The summarised CO_2 emissions compiled in the ETS database according to fuel type for all installations that constituted sub-category 1.A.1.a in 2012 are aggregated to report the CO_2 emissions for this category. The CO_2 emissions estimates compiled through ETS for sub-category 1.A.1.a are cross-checked with a separate long-standing data flow to the inventory agency covering plant-specific emissions for electricity generating stations that are used to report on the Large Combustion Plant Directive and the Convention on Long-Range Transboundary Air Pollution. The aggregated CO_2 emissions reported in the latter data-flow correspond to the compilation available under the ETS for all years since the ETS data became available.
- 1A1b Petroleum Refining: One small oil refinery accounts for the emissions reported under 1.A.1.b Petroleum Refining. The reported CO_2 emissions are those available from the ETS database. These emissions are estimated using tier 2 methodologies in accordance with the monitoring and verification guidelines for combustion activities set down in Decision 2004/156/EC. Because refinery gas (high-pressure gas and low-pressure gas) and LPG account for the bulk of the emissions in 1.A.1.b in all years and the emission factors for these fuels do not fluctuate significantly, the emissions reported using ETS data are consistent with the annual estimates for historical years.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Emissions for 1.A.1.c Manufacture of Solid Fuels and Other Energy Industries were reported for the first time in the 2006 submission and refer to the production of peat briquettes from milled peat in two plants. The 2011 values for CO_2 are also taken from ETS returns which are based on tier 2 methodologies in accordance with the monitoring and verification guidelines for combustion activities set down in Decision 2004/156/EC. A revision to energy data in sub-category 1.A.1.c for years 2005-2011: revised (increased) CO_2 emission factors (from ETS data) and revised peat consumption activity data from Energy Balance (decreased).
- 1A2 Manufacturing Industry and Construction: The combustion CO_2 emissions in a variety of installations across the CRF sub-categories 1.A.2.a through 1.A.2.f are covered by the ETS Directive 2003/87/EC but the total CO_2 emissions in any sub-category cannot be reported for

Ireland using ETS data alone, as in the case of the sub-categories under 1.A.1. The ETS data are instead used to compare fuel quantities reported under ETS with corresponding amounts given in the preliminary national energy balance and to determine improved country-specific emission factors that can be applied for particular fuels and sub-categories. Information provided from the ETS on fuel data have been used to develop an annual country-specific CO_2 emission factor for petroleum coke since 2005. Petroleum coke is used in sub-categories 1.A.2.b, e and f. The average of the five years between 2005 and 2009 of yearly specific emission factors is applied to years from 1990 to 2004, as ETS data is only available from 2005 onwards.

Industrial Processes

The process CO_2 emissions for the relevant source categories under *2.A Mineral Products* are largely covered by Directive 2003/87/EC (EP and CEU, 2003) on emissions trading in the EU and full use is made of this data source for the compilation of the national inventory. In general, the annual verified CO_2 emissions in respect of the installations concerned are used directly for the years covered by the ETS. The category-level emission factors indicated by EU ETS data are used together with the best available production data to obtain the emissions estimates for years previous to 2005.

- 2A1 Cement Production: As the EU ETS subsequently became operational, plant specific CO_2 emissions and corresponding clinker production data are also available for all cement plants for the years 2004 through 2011 and these data are used directly to report emissions for category 2.A.1 in Ireland. The revised estimates for category 2.A.1 were included in the 2006 submission and no further recalculations have been made since the EU ETS data were adopted as the best available for inventory purposes.
- 2A2 Lime Production: As in the case of cement production, lime producers provided their own estimates of CO_2 emissions from lime manufacture for the development of NAP1 under Directive 2003/87/EC on ETS. These were calculated in accordance with the methods described in the supporting Decision 2004/156/EC, thus providing detailed information on emission estimates and activity data for another important source of CO_2 emissions in *Industrial Processes*. The CO_2 estimates for lime production in 2011 have been obtained from the ETS returns to the EPA. EU ETS data for the years 2005 to 2011 are used to confirm the estimates for the years 1990-2004.
- 2A3 Limestone and Dolomite Use: The CO_2 emissions reported under this category refer to those emissions associated with the use of limestone (CaCO3) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO_2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO_2/t limestone, which is the stoichiometric ratio of CO_2 to CaCO3. A further minor use of limestone relevant to *2.A.3 Limestone and Dolomite Use* in Ireland is its application in the purification of sugar produced from sugar beet. However, sugar production ceased in 2006 and the only information on emissions is that obtained under ETS in respect of 2005 and 2006.
- 2A4 soda Ash Production and Use: The emissions associated with soda ash use by one company in Ireland are reported by the company under ETS for the years 2005-2012 and have been used directly in the inventory. Activity data for years prior to the ETS data were sourced by the inventory agency from the company. These data were combined with an emission factor of 0.41 t CO_2/t soda ash, indicated by the ETS data. This approach has allowed a full 1990-2012 time series of emissions to be included in the inventory.
- 2A7 Other Mineral Products: The emissions of CO_2 from glass production (which ceased in 2009) as well as the emissions arising from the use of clays and shale as a raw material in the manufacture of bricks and ceramics are reported under this CRF category. Similar to other categories under *2.A,* information from individual plants that are participants in the Emissions Trading Scheme is utilised to report the emissions estimates in the national inventory. Glass production is treated as a separate sub-category under 2.A.7, and a full time-series of CO_2

emissions has been developed. In the case of crystal glass, the CO_2 emissions are based on the use of potassium carbonate and sodium carbonate use (soda ash) as reported under ETS, using the emission factors of 0.415 t CO_2/t Na2CO3 and 0.267 t CO_2/t K2CO3, provided by the ETS monitoring and reporting guidelines. The company concerned has supplied estimates for all years up to and including 2009, when the plant closed. In the case of bricks and ceramics, the ETS data for two companies provide estimates of emissions for the years 2005-2012 and a further two companies for the years 2005-2008 which have now ceased trading, along with the corresponding quantities of carbonate input materials and the relevant emission factors. The emissions for the years prior to ETS are calculated from the companies' estimates of material use and their respective average ETS emission factors.

1.4.2.12 Italy

General

Data from the Italian Emissions Trading Scheme database are incorporated into the national inventory whenever the sectoral coverage is complete; in fact ETS data not always entirely cover energy categories whereas national statistics, such as the national energy balance and the energy production and consumption statistics, provide the complete basic data needed for the Italian emission inventory. Nevertheless, ETS data are entirely used to develop country-specific emission factors and to check activity data levels.

The inventory agency ISPRA collects data from the industrial associations under the ETS and other European directives, Large Combustion Plant and INES/E-PRTR, and makes use of these data in the preparation of the national inventory ensuring the consistency of time series.

From 2005 onwards, also the EU ETS "verifier's reports" cover almost the entire sector, for energy consumptions, combustion emissions and process emissions.

Energy

- 1A1 Public Electricity and Heat: From year 2005 onwards a valuable source of information is given by the reports prepared for each industrial installation subject to EU ETS scheme. Those reports are prepared by independent qualified verifiers and concern the CO_2 emissions, emission factors and activity data, including fuel used. ISPRA receives copy of the reports from the competent authority (Ministry of Environment) and has been able to extract the information relative to electricity production. The information available is very useful but not fully covering the electricity production sector or the public electricity production. The EU ETS does not include all installations, only those above 20 MWe, it is made on a point source basis so the data include electricity and heat production while the corresponding data from TERNA, concerning only the fuel used for electricity production, are commercially sensitive, confidential and they are not available to the inventory team. Anyway the comparison of data collected by TERNA with those submitted to the EU ETS allows identifying possible discrepancies in the different datasets and thus providing the Ministry of Economic Development experts with useful suggestions to improve the energy balance.
- 1A1b Petroleum Refining: From 2005, the weighted average of CO_2 emission factor reported by operators in the framework of the EU ETS scheme is used for petroleum coke, refinery gas and synthesis gas from heavy residual fuels.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Total CO_2emissions reported in the E-PRTR by the operators are equal to those reported under the EU ETS scheme.
- 1A2 Manufacturing Industries and Construction: From 2008, natural gas and fuel oil consumptions reported in the CRF for this sector, are those communicated by the operators of the plants included in the sector in the framework of the EU ETS scheme. Fuel consumption reported in the sector is subtracted from the total fuel consumption to produce energy, guaranteeing that over and under estimation are avoided. Data collected by other surveys that include EU ETS and E-PRTR, have been used to cross-check the energy balance data, fuels used and EFs. Other sources of

information are the yearly survey performed for the E-PRTR, since 2003, and EU ETS; both surveys include main industrial operators, but not all emission sources. In particular from 2005 onwards the detailed reports by operators subject to EU ETS constitute a valuable source of data. In general, in the industrial sector ETS data source is used for cross checking BEN data. Energy/emissions data from EU ETS survey of industrial sectors should be normally lower than the corresponding BEN data because only part of the installations / sources of a certain industrial sub sector are subject to EU ETS. In case of missing sources or lower figures in BEN than ETS, at fuel sector level, a verification procedure starts. Since 2007 data, ISPRA verifies actual data from both sources and communicate to MSE eventual discrepancies. This starts a verification procedure that eventually can modify BEN data. However, Italy underlines that EU ETS data do not include all industrial installations and cannot be used directly to estimate sectoral emissions for a series of reasons that will be analyzed in the following, sector by sector.

- 1A2a Iron and Steel: For this sector, all main installations are included in EU ETS, but not all sources of emission. Only part of the processes of integrated steel making is subject to EU-ETS, in particular the manufacturing process after the production of row steel was excluded up to 2007 and only the lamination processes have been included from 2008 onwards. Moreover, the recovered coal gases used to produce electricity and steam are not included. So the EU ETS data is only of limited use for this subsector and the procedure set up starting from the total carbon input to the steel making process, is still the most comprehensive one to estimate the emissions to be reported in 1.A.2.a. Of course, data available from EU ETS are used for cross-checking the BEN data, with an aim to improve the consistency of the data set. These plants are also reported in E-PRTR, but not all sources are included.
- 1A2b Non-Ferrous Metals: Those plants are mostly excluded from EU ETS; some aluminium producing plants will be included from 2013, but only for CO_2 and PFCs emissions from the production process.
- 1A2c Chemicals: The use of EU ETS data for this subsector is rather complex because generally chemical plants are excluded from EU ETS while petrochemical plants are included.
- 1A2d Pulp and Paper and Print: Most of the operators in the paper and pulp sector are included in EU ETS, while only a few of the printing installations are included. The problem for the EU ETS data source for this subsector is that the data are reported on a point source basis, including the production of electricity. The ETS data contain info on the energy and emissions relative to electricity, but this data are not subject to verification and appear not reliable. On the other hand, the inventory team has no access to the detailed, plant by plant, database of electricity producing plants so the emissions reported in the ETS survey cannot be divided between those belonging to table 1.A.1.a and table 1.A.2.d.
- 1A2f Other: This sector comprises emissions from many different industrial subsectors, some of which are subject to EU ETS and some not. Construction material subsector is energy intensive and it is subject to EU ETS. In the national energy database (BEN), the data for construction material are reported separately and they can be cross cheeked with ETS survey. However, in the construction material subsector, there are many small and medium size enterprises, so the operators subject to ETS are only a part of the total.
- 1B Refineries: Fugitive CO_2 emissions in refineries are mainly due to catalytic cracking production processes, sulphur recovery plants, flaring and emissions by other production processes processes including transport of crude oil and oil products. Total fugitive emissions from refineries are calculated on the basis of the total crude oil losses reported in the National Energy Balance. These emissions are then distributed among the different processes on the basis of average emission factors agreed and verified with the association of industrial operators (UP) and yearly updated, from 2000, on the basis of data supplied by the plants in the framework of the European Emissions Trading Scheme. In particular in the EU-ETS context, refineries report CO_2 emissions for flaring and for processes separately.

Industrial Processes

- 2A Mineral Products: Under the EU-ETS, operators are requested to report activity data and CO_2 emissions as information verified and certified by auditors who check for consistency to the reporting criteria. Activity data and emissions reported under EU-ETS and EPER/EPRTR are compared to the information provided by the industrial associations. In particular, comparisons have been carried out for cement, lime, limestone and dolomite, and glass sectors. The general outcome of this verification step shows consistency among the information collected under different legislative framework and the information provided by the relevant industrial associations.
- 2A1 Cement: Emission data reported under the different obligations are in accordance for all the facilities. In the framework of the EU-ETS as well as the EPRTR registry, 51 plants out of 58 reported in 2011 their data representing more than 98% of total national clinker production. Under the EU-ETS, cement plants communicate emissions and activity data split between energy and processes phases and specifying the amount of carbonates and additives; both activity data and emissions are independently verified and certified as requested by the EU-ETS directive.
- 2A2 Lime: CO_2 emissions from lime have been estimated on the basis of production activity data supplied by ISTAT (ISTAT, several years up to 2008) and by operators in the frame of the ETS reporting obligations , CO_2 emissions from lime production and used in other industrial processes (e.g. iron and steel production); emission factors have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association (CAGEMA, 2005). Since 2009, information available in the frame of the ETS reporting obligation has made activity data (including fuels and raw materials such as carbonates and additives, in compliance with a “lime kiln input” approach) available for the Italian lime industry at facility level together with CO_2 emissions data (both activity data and CO_2 emissions are certified).
- 2A3 Limestone and Dolomite Use: Detailed production, consumption, activity data and emission factors have been supplied in the framework of the European emissions trading scheme and relevant data are annually provided by the Italian bricks and tiles industrial association and by the Italian ceramic industrial associations.
- 2A7 Other – Glass: CO_2 emissions from glass production have been estimated taking into account activity data (ISTAT, several years) and emission factors estimated on the basis of information supplied by 53 facilities in the framework of the European emissions trading scheme.
- 2B5 Other – Carbon black:CO_2 emissions from carbon black production have been estimated on the basis of information supplied directly by the Italian production plants also in the framework of the EU ETS for the last years.
- 2C1 Iron and Steel: From 2000 CO_2 emissions and production data have been supplied by all the plants in the framework of the ETS scheme, for the years 2000-2004 disaggregated for sinter, blast furnace and BOF plants, from 2005 specifying carbonates and fuels consumption and related CO_2 emissions. The iron and steel sector emissions reported in the national EPER/E-PRTR registry and for the Emissions Trading Scheme are compared and checked. Reductants used in EAF and the average emission factor of CO_2 from electric arc furnaces have been checked with ETS data and the T2 methodology will be applied in the next submission.
- 2C2 Ferroalloys: Time series of ferroalloys activity data have been reconstructed from 2002 on the basis of statistical information (ISTAT, 2003), personal communication (Italghisa, 2011) and on the basis of production data communicated to EPRTR register and to ETS from the only plant of ferroalloys in Italy The comparison between EPRTR and ETS data revealed some differences: further investigation led to a direct contact with the plant and to rectify the incorrect activity data.
- 2C3 Aluminium Production: From 2005 certificated emission values and parameters, including anode effects, have been communicated under EU-ETS (ALCOA, 2010). Emissions from primary aluminium production have been also checked with data reported under EU-ETS.

1.4.2.13 Luxembourg

General

For large point sources – and after careful assessment of data plausibility – activity data that are reported by facilities are preferably used. Indeed, these data usually reflect the actual consumptions better than aggregated national statistics data, because the facility is supposed having the best information about its own emissions. Such plant specific data have been used for CRF sectors 1 and 2. Luxembourg's planned improvement for the future foresees to considerably extent the use of consumption and emission data provided by facilities either in the framework of the EU-ETS and of the E-PRTR in its inventories. Comparison of data is possible between figures reported by industry participating to the ETS, and the distributor's figures as well as emission reports of plant operators. This is the only country specific information on uncertainty that is available.

Energy

Activity data obtained through the Emission Trading System (ETS) were used for QA/QC procedures by comparing its data to the data reported by the plant operators. Activity data for large facilities is cross-checked from two sources: reports obtained directly from the operator under its operational permit obligations and the EU-ETS registry operator. Both are hosted at the Environment Agency. A list with the large energy consuming facilities along with their respective fuel consumption has been compiled and enables the Single National Entity to quickly cross-check this data with the EU-ETS data. Thus, completeness can be checked on a more systematic basis.

Industrial Processes

- 2A1 Cement Production,2A7 Glass Production and 2C1 Iron and Steel Production: ETS 2007 methods are applied.
- 2A4 Soda Ash Production and Use: The amount of soda ash used in 2011 in the glass production was 75461 t (Source: verified ETS data). There is no other soda ash use in Luxembourg.

1.4.2.14 The Netherlands

General

In 2014, a quantitative assessment was made of the possible inconsistencies in CO_2 emissions between data from ETS, NIR and national energy statistics. The figures that were analyzed concerned about 40% of the CO_2 emissions in the Netherlands in 2012. The differences could reasonably be explained (e.g. different scope) within the given time available for this action.

Energy

- 1A1 Energy industries: The CO_2 emissions from coal are CO_2 emissions occurring in the public electricity sector. The emissions are based on emission data from ETS. The CO_2 emissions from waste gas are CO_2 emissions occurring in the chemical industry and in refineries. The emissions are partly based on emission data from ETS.

- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Emission data from individual companies is used when companies report a different CO_2 EF for derived gases. For this, emission data from the Environmental Reports (MJV) and the Emission Trading Scheme (ETS) from selected companies is used. The data have been validated by the competent authority. If the data is not accepted by the competent authority, then the CO_2 emission data is not used for the emission inventory. Instead, country specific EFs are used. This situation only occurs as an exception and the emissions are recalculated when the validated data from these companies becomes available. Data from the environmental reports and the emission trading scheme are compared (QC check) and the data which provides the best amount of detail of the relevant fuels and installations is used. The reported CO_2 emission is combined with the energy use in the energy statistics to derive a company specific emission factor.

- 1A2 Manufacturing Industries and Construction: CO_2 emissions from coke oven gas, blast furnace gas and waste gas are based on emission data from ETS. Therefore, the IEF is different from the standard country-specific EF.

Industrial Processes

- 2A7 Glass Production: From next submission onwards the Netherlands will obtain the emissons directly from the verified EU ETS reports.
- 2B2 Nitric Acid Production: From 2008 onwards, the N_2O emissions of HNO3 production in the Netherlands were included in the European emission trading scheme (EU-ETS). For this purpose the companies developed monitoring plans that were approved by the Dutch Emissions authority (NEa), the government organization responsible for EU ETS in the Netherlands. In 2013, the companies again sent their verified emission reports to the NEa. The reported and verified (by an independent verifier) emissions (2012) by the companies to NEa were checked against those as reported in the CRF tables (2012). No differences were found between the emission figures in the CRF and the verified emissions in the emission reports under EU ETS. Since the N_2O emissions of HNO3 production in the Netherlands is included in the European emission trading scheme (EU-ETS), all companies have continuous measuring of their N_2O emissions. This has resulted in a lower annual emissionuncertainty of approximately 8 per cent.

1.4.2.15 Portugal

Energy

- Thermo-electricity power plants: Since EU-ETS data is available for inventory use plant specific Carbon content was used in those cases where fuel analysis were made by the plant operator.

- Desulfurization in Large Point Source Energy Plants in Mainland Portugal*:* Since both these energy plants are included in the EU-ETS the CO_2 ratio reported under this scheme was used in the inventory – 0.44 ton CO_2/ton Ca.

- Large Point Source Energy Plants: Plant specific CO_2 emission factors for hard coal, fuel-oil and natural gas factors obtained in the EU-ETS have been used. Data on fuel consumption, by fuel type, for LPS are available from different sources, including EU-ETS. For the latest years (mainly 2009 onwards) the EU-ETS completely replaced the other sources of information. Although different information sources have been used the consistency in time series is guaranteed considering that the same original source (power plant companies) is ultimately used.

- Desulfurization in Large Point Source Energy Plants in Mainland Portugal: Values for the total lime consumed for desulfurization in each plant were obtained in the EU-ETS. For confidentiality constrains and since there are only two plants in Portugal that use this kind of abatement system, the CaCO3 consumption cannot by reported.

- Energy Plants in Azores and Madeira Autonomous Regions: The quantity of residual fuel-oil, diesel oil and GPL used in Madeira and Azores in electricity production is available from the following two sources: Madeira and Azores Regional Environmental entities and EU-ETS.

- 1A1b Petroleum Refining: The quantities of fuel consumption from 1990 to 2004 in boilers and furnaces were collected directly from individual units under the Large Combustion Plants (LCP) directive and may be observed in the next figure for fuel oil and fuel gas. Since 2005 data source is EU-ETS. Consumption expressed in energy was calculated with a time series of Low Heating Values. This time series reflects actual information given by each refinery also under LCP directive (1990-2004) or EU-ETS (since 2005) and are weighted averages for all three plants. For Oporto and Sines refineries, CO_2 emission factors were obtained directly from EU-ETS data.

- 1A2 Manufacturing Industries and Construction: Data on fuel consumption for LPS were obtained from several sources including since 2009 inventory from EU-ETS. The most important improvement in this sector is the continuing streamline with EU-ETS and DGEG's energy balance, mainly for sectors like Steel production and Chemical industry. Other changes were made to the cement industry sector in the 2012 inventory. These changes concern the inclusion of Lime Production activities as LPS in the inventory. This improvement resulted from the ongoing integration of EU-ETS data in the inventory. Production data for Kraft paper pulp was obtained from EU-ETS – 2010 onwards. The most important improvement in this sector is the continuing streamline with EU-ETS and DGEG's energy balance, mainly for sectors like Steel production and Chemical industry.

- 1B2a.iv Refining and Storage: For FCC, and other processes where there happens recovery of catalysts, activity data is total coke burnt. From 2005 onwards, data is obtained directly from EU-ETS for both Sines and Oporto refineries.
- 1B2c Venting and Flaring in Oil Industry: Emission factors for CO_2 were derived from EU-ETS data for Sines and Oporto refineries and from US-EPA (1991) for Lisbon refinery. Total flare gas consumed in the three units and Low Heating Value was made available from PETROGAL for the period 1990-2004. Since 2005 data is obtained from EU-ETS.
- Further improvements: Better integration between activity data in the air emissions inventory and other surveys such as LCP directive, Autocontrolo program, EPER/E-PRTR, the EU-ETS and the energy surveys (co-generation) made annually by DGEG. Contacts are being made to implement it. Particular work is being done to streamline the collection of data and emission estimates between the inventory and the EU-ETS, following the promotion efforts that are being made by the European Commission.

Industrial Processes

- 2A1 Cement Production: EU-ETS method A from Annex VII of Decision 2007/589/EC and data on consumption of raw materials is used from 2005 onwards.
- 2A2 Lime Production: EU-ETS method A from Annex VIII of Decision 2007/589/EC is used from 2005 onwards. We estimated a national IEF (ton CO_2/ton lime) based on ETS CO_2 data in year 2005 and on national statistics lime production data in the same year. For the period 1990-2004 we made a back cast based on national statistics lime production data and on the national IEF for the year 2005. From 2005 onwards, data on consumption of raw materials was obtained from EU-ETS. Lime production was obtained from National Statistics (INE) IAPI industrial survey for 1990-2012 period.
- 2A3 Limestone, Dolomite and Carbonate Use: For this industry sector, although the consumption of carbonate bearing materials is not known for the whole period, a consumption factor was developed based on the information received under the European Emission Trading Scheme (EU-ETS), and production of construction ceramics and pavement ceramics, which is available from INE's industry surveys IAIT and IAPI, was used to obtain the full time series.
- 2A7 Glass Production: From 2005 onwards it is used ETS data on Na2CO3, MgCO3, CaCO3, BaCO3, coal and other carbonate raw materials consumption in the kilns. For flat glass and container glass the facilities that report data under ETS correspond to the national total. For crystal glass it is used the ETS data from the largest facility that reports data under ETS and extrapolate for the remaining crystal glass facilities based on crystal glass production.
- 2C1 Iron and Steel: The CO_2 emission factors for Electric Arc Furnace, and that were used for each one of the two iron and steel plants that are included in the European Union Emission Trading Scheme (EU-ETS), were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke from 2002 onwards. It was assumed that the same carbon content exists in both scrap and final steel produced in EAF furnaces and consequently no additional emissions are estimated apart from carbon in additives. The great majority of CO_2 emissions result from EAF and BOF furnaces with only a small contribution from coke oven and blast furnace, and hence furnaces data is what basically determines overall uncertainty. For year 1990 data information was collected directly from industrial plants and it is mostly probably of good quality. The same situation applies from 2002 onwards (plant specific and EU-ETS data).

1.4.2.16 Spain

General

ETS data have been used for verification purposes.

Energy

- CO_2 emissions from power plants in the inventory were compared with the verified reports from installations under the EU ETS for QA/QC purposes. Data from EU ETS were used to derive some EFs
- CO_2 emissions were also compared for refineries to detect unusual values and outliers.
- For the iron and steel industry such comparison could not yet be performed due to the access to the information. For coke oven plants not located at integrated steel plants, it has been found that data could not be used directly due to a more aggregated level of information provided under the ETS (no differentiation of processes, thus allocation of combustion and emissions to coke oven plants only is difficult).
- For the cement industry, the CO_2 EF from combustion of tyres was revised based on information provided under the EU ETS for the years 1997 to 2010.

Industrial processes

- 2A1 Cement production: Data on consumption of raw materials, emission factors and CO_2 emissions were obtained for the period 2005-2009 from EU-ETS and EFs derived from ETS data are used.
- 2A2 Lime Production: Emissions between the GHG inventory and ETS reports have also been compared for lime production and to complete information provided by the industrial association ANCADE. The emissions for one lime plant were recalculated in the 2014 submission to reflect data collected through the ETS.

1.4.2.17 Sweden

General

Energy

- 1A1b Petroleum Refining: As a result of a specific SMED study during 2006, data from ETS are used for four refinery plants for 2005 and later years. For the fifth plant data from environmental reports were used. In 2008 and later years, the quality of ETS data is considered to be very high for all five of the refineries, and thus this is the primary data source for the GHG inventory. However, one of the refineries reports refinery gas and natural gas aggregated in the ETS data, and for this facility, data from the environmental reports are used to allocate the proper amount of this fuel to gaseous fuels. For refinery gas, plant specific CO_2 emission factors reported to the ETS are used for 2008 and later, since they are considered to be more accurate then the older standard emission factor. For each of the five refineries, ETS data for the latest year are verified against the refineries' legal environmental reports.
- 1A2c Chemicals: For one of the largest facilities, including two plants, ETS data is the activity data source for 2008 and later. Before 2008, this facility was not fully covered by energy statistics or ETS data, so environmental reports and several energy surveys were used in order to get complete data for this important facility. One calcium carbide manufacturing facility uses coke both as a fuel and as a reductant in the production process. In submission 2013, it was revealed that the reporting of this coke consumption is not properly allocated in the energy statistics, and several years the total amounts reported were obviously too low. For this reason, activity data from environmental reports and in later years ETS are used for this coke consumption since submission 2013. The company also provided a time series of CO_2 emissions covering the period

2001-2010, which was used to calculate the year specific emission factors. These new emission factors were implemented in submission 2012. For the largest plants in terms of emissions and fuel consumption, both environmental reports and ETS data are used for verification of the estimates based on energy statistics.

- 1A2f Other Industries: For 2008 and later, activity data for the three plants within the cement production industry is taken from the EU ETS system.
- 1B2A1 Hydrogen production plants at refineries: Activity data as consumed amount of fuels (butane gas and naphtha, respectively for the two plants) and CO_2 emissions are taken from the company´s report to the EU ETS system.
- 1B2C2 Flaring: For the years 2005 and later, data from the EU ETS system has been used when possible. Data from the EU ETS system are verified against data from environmental reports and vice versa. In submission 2010 EU ETS data was analyzed carefully. It was concluded that the notation key for flaring of natural gas (NE in earlier sub-missions) could be changed, since no such flaring could be found in the EU ETS data and all plants that might be flaring are included in the EU ETS. The coherence between environmental reports and ETS data is checked when possible, and when differences occur, the facilities are contacted for verification. For a few plants that flare small amounts of gas, activity data as amount of flared gas is shown neither in the environmental reports, nor in the ETS data.

Industrial Processes

- 2A1 Cement production: Cement production occurs at three facilities in Sweden (owned by one company), with one being dominant. For process-related emissions, facility data are obtained from environmental reports, EU ETS (European Union Emission Trading Scheme) and by direct contacts with the facilities. From 2005, the company reports plant-specific data on CO_2 emissions to the EU ETS. The CO_2 emissions are based on production of clinker and CaO content of clinker, but also include CO_2 contained in released non-recycled dust (CKD and by-pass) as prescribed by the national guidelines for reporting to the EU ETS. Also CO_2 emissions from organic carbon of raw meal are included in the CO_2 emissions reported in the EU ETS. Activity data and CO_2 emissions are reported to the EU ETS and have thus been verified by an accredited verification body. Also CO_2 emissions from organic carbon of raw meal are included in emissions reported in EU ETS.
- 2A3 Limestone and Dolomite Use: Data on the use of limestone and dolomite have been acquired from environmental reports, the ETS and through direct contacts with the companies.
- 2A4 Soda Ash Production and Use: Data on the use of soda ash have been acquired from the ETS and through direct contacts with the reporting companies. The data used for national GHG estimations from soda ash use is believed to be more consistent and complete, compared with the data from national statistics, since the data for the inventory is collected from the ETS, from the environmental reports of the facilities or by direct contact with the plants.
- 2A7 Glass production: Activity data and emissions are mainly collected from the ETS or from the facilities yearly environmental reports.
- 2A7 Light expanded clay aggregates (LECA), roofing tile, brick and ceramic production: From 2005 and onwards, the equivalent data for light expanded clay (LECA) is acquired through the ETS and the Swedish LECA producer´s annual report. For roofing tile, brick and ceramics production, activity and emission data from 2005 and onwards is acquired through the ETS. The data in the ETS does not always separate between emissions from limestone/dolomite use and CO_2 emissions from other carbon containing raw material (i.e. from the clay and other carbonates used) needed for the production. In order to as far as possible report an accurate total process-related CO_2 emission for the facilities included in this 2A7 sub-code, Sweden have chosen to report all CO_2

emissions in 2A7. As there is a lack of data before 2005, the reported emissions for 2005 are extrapolated for 1990-2004.

- 2C1 Iron and steel production: All plants in this category report their emissions in environmental reports. For plants included in the EU-ETS the report data is scrutinized and compared to EU-ETS data. EU-ETS data is applied wherever it is judged to be appropriate in line with the Good Practice Guidance. Detailed carbon mass balances are compiled for plants included in the reporting according to EU ETS, but due to confidentiality reasons the mass balances cannot be included in the NIR.
- 2C1.1 Secondary Steel Production: In most cases, data from the Swedish enquiry for the Swedish national allocation plan (NAP) for the EU ETS could be used for the years 1998-2002. Data for 1990-1997 and 2003-2004 has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, from the facilities environmental reports and through contacts with the companies. Data in the ETS includes information concerning carbon bound in products, slag, etc, but also other sources for process related CO_2 emissions. Prior to submission 2010, these other emissions were not included for all facilities. Estimates of these missing CO_2 emissions were performed using ETS data for 2005 – 2008 and production data for years before 2005. All CO_2 emissions presented for the facilities in ETS 2005 – 2011 are included in 2C1.1 in submission 2013. Reported CO_2 emissions until year 2008 are for all facilities, except the one which closed down in 2004, based on data in the ETS.
- 2C1.2 Primary Iron and Steel Production: From 2005, ETS data is used and 1990-2004, information has been acquired from the plant. The emissions are verified using national statistics from Statistics Sweden on amounts of coke, anthracite and output material. Mass-carbon balances and associated CO_2 emissions are also reported to the EU-ETS since 2005. For some years, CO_2 emissions to the EU-ETS did not include all plant stations (rolling mills), and additional information from the plants was obtained in order to ensure that no omissions occurred. Since 2008 annual CO_2 emissions reported by the plants in their environmental reports are equal to those reported to the EU ETS.
- 2C1.3 Iron ore mining, dressing, sintering and iron ore pellets production: Amounts of bentonite and organic binder used for the production of iron ore pellets and the corresponding CO_2 emissions are for later years collected from the EU ETS. For earlier years the amounts of bentonite and organic binder were provided by the company and EFs for bentonite and organic binder from the EU ETS were used for the calculations.
- 2C5 Other metal production: Both plants in this category report their emissions in yearly environmental reports. For the one plant included in the EU-ETS the reported activity data and emissions are analysed and compared to EU-ETS data. Where EU-ETS data is judged to be appropriate and in line with the Good Practice Guidance, it is applied.

1.4.2.18 United Kingdom

Energy

- During 2013, an extensive review of the information on non energy use of fuels was commissioned by DECC including a review of available data sources (such as EUETS) and consultation with industry, regulators, trade associations and statistical agencies to assess the best available data to inform UK inventory estimates. This study led to a number of revisions to the approach to reporting the UK GHG inventory, although the impact on the Sectoral Approach inventory totals was very low. The recalculations from this research are highlighted within the individual chapters of the NIR.1A1 Energy Industries: The activity statistics used to calculate the emission are fuel consumption statistics taken, mainly from DUKES, with supplementary data from other UK data sources such as EU ETS reporting and process operators' data. Emission factors are taken from data sources including UK-specific, site-specific data sets (EU ETS, EEMS, operators' data). The factors in Baggott et al, 2004 are supplemented by emission factors based on high quality site-specific emissions data available from the EU ETS data set, covering 2005-2012, and from the EEMS dataset (1997-2012). EU ETS data are used for the most significant sources of carbon in 1A1. CO_2 emission factors for coal, fuel oil, petroleum coke, natural gas and sour gas use in power stations and fuel oil, petroleum coke, and refinery fuel gas (OPG) use in refineries are based on data reported to the EU Emissions Trading System (EU ETS) for the years 2005-2012. These data are of high quality, and available for all significant UK power plants and refineries - some very small power stations, e.g. on remote islands, will not report to EU ETS but their fuel use will be negligible. Emission estimates for 2005 onwards are based on factors derived from EU ETS data. For petroleum coke, fuel oil, gas oil and burning oil, statistics that are available through sources such as EU ETS returns indicate higher fuel use in the UK energy sector than is reported in the UK energy statistics. For oils consumed in power stations DUKES reports less fuel burnt by power producers than is reported by operators either directly to the inventory agency or via the EU Emissions Trading System (EU ETS). Therefore fuel oil, gas oil, and burning oil are reallocated from industry to power stations to ensure consistency with operator data, while maintaining consistency with the overall fuel consumption data in DUKES. For OPG, analysis of EU ETS data from refineries for the 2012 submission identified a discrepancy in activity data between EU ETS and DUKES. Based on data from EU ETS and the refinery trade association, UKPIA, a systematic under-report was identified in the UK energy balance data for the refinery sector from 2004 onwards. The estimates for 2004 in the UK GHGI are therefore based on UKPIA data, whilst the data for 2005 onwards are based on EU ETS data. Furthermore, analysis of EU ETS data for chemical and petrochemical production sites has identified where feedstock-derived process gases and residues are used as a fuel on-site. Significant differences have been found between petroleum coke consumption derived from EU ETS data for 2005-2010 compared with the petroleum coke use given in DUKES. Therefore the emission estimates are based on the EU ETS total, and the activity data for this fuel is then calculated for 2005 onwards based on the reported EU ETS emission and an emission factor provided by the refinery sector. Mismatches were identified between EEMS emissions and DECC DUKES data from PPRS, with gaps in DUKES: From 2003 onwards for LPG/OPG use in oil terminals, and prior to 2001 for gas use in onshore terminals. These gaps have been filled using EEMS and EU ETS activity data for these facilities. EU ETS data also indicates that more natural gas is used by the downstream gas industry in gas compressor stations than is available in DUKES for the sector. So, for the year 2005 onwards, an adjustment is made to the gas consumption data in the inventory with gas transferred from 1A2 to 1A1c to ensure that the inventory figure matches the figure given in EU ETS. In the DUKES published in 2002, DECC (formally DTI) stopped collecting the activity data about oil and gas extraction previously used to estimate these emissions. EU ETS data have been used for the years 2008 to 2012, and EEMS activity data trends have been used to derive estimates for 2003 to 2007 for this activity. Emissions from petroleum coke consumption in refineries are based on DUKES data and an emission factor from 1990 to 2004 and 2011-2012, and EU ETS emissions data from 2005 to 2010. The EU ETS emissions data are not consistent with the data presented in DUKES for this sector, but data for 2011 and 2012 are very similar, and the use of DUKES data retained. Emission factors and activity data are kept under review and analysis of EU ETS data will continue.

- 1A2 Manufacturing Industries and Construction: The allocation of activities and emissions between combustion and process source categories for iron and steel and other "contact industries" in the UK GHGI are as consistent as possible with data provided directly from operators (e.g. integrated steelworks data from ISSB, Tata Steel and SSI Steel), UK energy statistics and EU ETS (where process emissions are reported separately from combustion emissions). Emission factors for carbon are almost exclusively derived from UK data. Site-specific data, (including both EU ETS data, and data provided by process operators directly or via industrial trade associations) is aggregated up to generate factors for a small number of sectors. The reallocation of fuel activity data from UK energy statistics is required to reconcile the inventory fuel data with other data for fuel users outside the industrial sector, for example data from EU ETS for gas distributors, and process operators in the case of power stations. In general, emission factors are taken from a consistent source across the time series so few time series consistency issues arise. Some EU ETS data are used for coal-fired autogenerators and other large combustion plant such as lime kilns and the use of factors from Baggott et al, 2004 for the earlier part of the time series does result in a step change in the factors for the period 2003-2005. In the case of lime kilns, the EU ETS-based factors show considerable variation over the period 2005-2011 and so the step change between non-ETS data in 2003 and ETS data in 2005 is considered an acceptable trend using the best available data for the source. For coal-fired autogeneration, the earlier factors are typically 5 to 10% higher; this may indicate that the time series of emission factors are inaccurate, or it may indicate that the impact of EU ETS has led to switching of fuel sources by the plant operators.

- 1A4 Other Sectors: Independent sources were used to estimate gas oil used by the rail sector while data provided by industrial sites reporting under emission trading schemes (EU ETS) were used to derive an allocation of gas oil consumption by stationary combustion sources in different industry, commercial and other sectors.
- 1B2 Oil and Natural Gas: The EU ETS data cover a smaller scope of installations and of sources within those installations (EU ETS data for upstream oil and gas facilities include combustion sources during 2005-7 (Phase 1 EU ETS) and combustion and flaring sources in 2008-12 (Phase II EU ETS). The EU ETS reporting scope excludes other GHG emission sources such as venting, process sources, fugitives, well testing emissions and methane from oil loading / unloading and oil storage.), but the EU ETS data are verified by third parties and are therefore useful to use as a quality check for the combustion and flaring emissions source estimates within the national inventory. Environmental reporting by oil and gas terminals in the UK includes from 2005 onwards, combustion CO_2 emissions at terminals have been reported under EU ETS, and from 2008 onwards combustion and flaring CO_2 emissions at terminals has been reported under EU ETS. The scope is not as comprehensive as EEMS or IPPC, but the data are useful to check carbon emission factors and to inform a de-minimis emission value for each site. Therefore, for oil and gas terminals the EU ETS data provides useful additional detail, where facilities may not report to EEMS but do report facility-wide (i.e. aggregated across all sources) emission estimates under IPPC/EPR. The EU ETS data provides emission estimates that can be broken down by fuel and between combustion and flaring sources, to augment the IPPC emissions data. The inventory agency combines UK energy statistics, the EEMS data, EU ETS and IPPC data to derive the oil and gas sector estimates. Where the EU ETS or IPPC data are inconsistent with the EEMS data, the inventory agency works with the DECC Offshore Inspectorate and facility operators to determine the best available data for each source
- Non-energy use: One large emission source known to occur in the UK is the use of carbon-containing process off-gases as a fuel within the chemical facilities. Whilst the exact source of the carbon cannot be traced directly to a specific feedstock commodity within the UK sectoral approach, the available information from EU ETS and from consultation with operators enables the inventory agency to derive estimates of the GHG emissions across the time series from this emission source. analysis of EU ETS data for a number of other chemical sites identified small additional emission sources that could be attributed to the combustion of process off-gases and residues derived from the chemical feedstock.
- Reference approach: The consumption estimates for industrial users of petcoke as a fuel or in anode use are associated with low uncertainty as they are primarily based on operator reported data within the EU ETS or other regulatory reporting mechanisms. Whilst it is conceivable that other sectors may also use petroleum coke as a fuel, there is no evidence from resources such as EU ETS and Climate Change Agreement reporting that this is the case in the UK. Carbon factors for petroleum coke use are derived from industry-specific data (including EU ETS fuel analysis) in the case of cement kilns, power stations and other industrial sites.

Industrial Processes

- 2A1 Cement Production: Emissions reported to the inventory agency by the Mineral Products Association have been cross checked with plant specific data reported in the EU ETS to ensure complete coverage of all emissions.
- 2A2 Lime Production: The UK method uses EU ETS data to determine emissions from 2005 onwards, Pollution Inventory (PI) data from 1994 to 2004 and British Geological Survey (BGS) data from 1990 to 1993. The EU ETS data consist of CO_2 emission estimates and activity data from 2005 onwards. Prior to 2005 there are no EU ETS data, and data are also missing for 2005-2006 for some lime kilns because of UK exemptions from the EU ETS for some sites in those years. Therefore, between 1994 and 2004, CO_2 emission estimates for lime production are based on emissions data published in the Pollution Inventory (PI). The PI data are mostly for total CO_2 i.e. include emissions from both decarbonisation and fuel combustion, but estimates of the CO_2 from decarbonisation only are made using EU ETS data and PI data for 2006-2008, both of which give fuel combustion emissions separately from decarbonisation.
- 2A3 Limestone and Dolomite Use: Data on gypsum produced in FGD plant has previously been taken from the British Geological Survey (2012), but these data are not always consistent with site-specific emissions data available from EU ETS, and so now a composite series of activity data is used with BGS data for 1994-2004, and EU ETS data for 2005-2012. BGS data for 2005 are in very good agreement with EU ETS data for that year, and so it has been assumed that BGS data for 1994-2004 are also comparable with the later EU ETS data. In the case of FGD plant, there is a change in methodology between 2004 and 2005 because of the availability of high quality EU ETS data from 2005 onwards, whereas previously BGS data have to be used. However, BGS and EU ETS-based emission estimates for 2005 are very close, and for 2006-2011 are within 8% of each other.
- 2C1 Iron and Steel Production: The carbon balance model has been improved for this version of the GHG Inventory by the greater use of EU ETS and other industry data, rather than defaults for carbon emission factors. In the process of updating the model, the consistency between the GHG Inventory and EU ETS/industry data has been examined in detail, and consistency between the two improved
- 6B1 Industrial Waste Water Treatment: There is some evidence from the EU ETS dataset that several UK food and industry facilities collect methane from anaerobic digestion systems and use the gas a fuel source.

1.5 Description of key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000). A key category is defined as an emission source that has a significant influence on a country's GHG inventory in terms of the absolute level of emissions, the trend in emissions, or both.

In addition to the key category analysis at EU-15 level, every Member State provides a national key category analysis which is independent from the assessment at EU-15 level[21]. The EU-15 key category analysis is not intended to replace the key category analysis by Member States. The key category analysis at EU-15 level is carried out to identify those categories for which overviews of Member States' methodologies, emission factors, quality estimates and emission trends are provided in this report. In addition, the EU-15 key category analysis helps identifying those categories that

21 A comparison of the EU key category analysis with the key category analysis of the Member States (without LULUCF) in 2006 showed that most EU key categories are also key categories in the Member States. The Member States' key categories covered 92 % of the emissions of the 78 EU key categories in 2006.

should receive special attention with regard to QA/QC at EU level. The Member States use their key category analysis for improving the quality of emission estimates at Member State level.

To identify key categories of the EU-15, the following procedure was applied:

- Starting point for the key category identification for this report were the CRF sectoral report tables and sectoral background data tables (for energy), i.e. CRF Tables 1A(a), 2(I), 3, 4, 5, 6 of the EU-15 GHG inventory. All categories where GHG emissions/removals occur were listed, at the most disaggregated level available at EU-15 level and split by gas.
- A level assessment was carried out for the years 1990 and 2011 and a trend assessment was performed for 1990 to 2011. The assessment was carried out for emissions excluding LULUCF and including LULUCF.
- The key category analysis excluding LULUCF resulted in the identification of 80 key categories for the EU-15 and cover 96 % of total EU-15 GHG emissions in 2012. The key category analysis including LULUCF resulted in 86 key categories (see Annex 1.1).

The results of the EU-15 key category analysis excluding LULUCF is presented in Table **1.9**. In addition, the table also shows for each key category the share of emissions estimated with higher tier methods. It shows that for most key categories more than 75 % of EU-15 emissions are calculated with higher methods.

More details related to the key category analysis are included in Annex 1.1. In Chapters 3 to 9 for each key category overview tables are presented which include the Member States' contributions to the EU-15 key source in terms of level and trend.

In addition, the eU has also carried out a key category analysis using the IPCC Tier 2 approach including LULUCF both level and trend. The results are also included in Annex 1.1. The analysis shows that N_2O from 4D agricultural soils is by far the most important key category dominating the Tier 2 level assessment because it is an important source (9 % of total GHG emissions) with a high uncertainty (158 %). The Tier 2 trend analysis is dominated by three categories: (1) HFC from 2F because of large emission increases since 1990; (2) N_2O from 4D agricultural soils; and (3) CO_2 from 5C grassland. Compared to the previous year the T2 level assessment yields very similar results whereas the T2 trend assessment has changed mainly due to revised uncertainty estimates for the LULUCF categories for Austria and Finland.

Table 1.9 Key categories for the EU-15 (Gg CO_2 equivalents)

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2012		1990	2012
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	60 397	185 905	T	L	L
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	123 579	28 368	T	L	L
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	12 899	37 373	T	L	L
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	752 525	636 917	T	L	L
1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)	3 868	17 390	T	0	L
1 A 1 b Petroleum refining: Liquid Fuels (CO_2)	96 162	91 810	T	L	L
1 A 1 b Petroleum refining: Solid Fuels (CO_2)	3 574	477	T	0	0
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)	15 525	17 807	T	L	L
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)	82 807	25 112	T	L	L
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	17 533	15 726	0	L	L
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	7 125	2 983	T	L	0
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	115 489	81 274	T	L	L
1 A 2 b Non-Ferous Metals: Solid Fuels (CO_2)	3 300	393	T	0	0
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	35 020	35 267	T	L	L
1 A 2 c Chemicals: Liquid Fuels (CO_2)	41 019	21 419	T	L	L

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2012		1990	2012
1 A 2 c Chemicals: Other Fuels (CO_2)	5 547	8 126	T	0	L
1 A 2 c Chemicals: Solid Fuels (CO_2)	8 052	3 753	T	L	0
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	12 464	18 762	T	L	L
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	9 852	2 536	T	L	0
1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)	5 104	977	T	0	0
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	16 168	24 582	T	L	L
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	16 755	3 801	T	L	0
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	6 393	2 225	T	0	0
1 A 2 f Other: Gaseous Fuels (CO_2)	92 289	105 459	T	L	L
1 A 2 f Other: Liquid Fuels (CO_2)	115 326	65 624	T	L	L
1 A 2 f Other: Other Fuels (CO_2)	3 507	14 176	T	0	L
1 A 2 f Other: Solid Fuels (CO_2)	113 386	25 310	T	L	L
1 A 3 a Civil Aviation: Jet Kerosene (CO_2)	12 975	15 356	T	L	L
1 A 3 b Road Transportation: Diesel oil (CO_2)	268 342	490 155	T	L	L
1 A 3 b Road Transportation: Diesel oil (N_2O)	1 572	5 504	T	0	L
1 A 3 b Road Transportation: Gasoline (CH_4)	4 051	672	T	0	0
1 A 3 b Road Transportation: Gasoline (CO_2)	362 939	210 274	T	L	L
1 A 3 b Road Transportation: LPG (CO_2)	7 323	7 682	0	L	L
1 A 3 c Railways: Liquid Fuels (CO_2)	7 816	4 866	0	L	0
1 A 3 d Navigation: Gas/Diesel Oil (CO_2)	12 434	10 131	0	L	L
1 A 3 d Navigation: Residual Oil (CO_2)	6 747	4 724	0	L	0
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	60 058	105 869	T	L	L
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	74 049	41 371	T	L	L
1 A 4 a Commercial/Institutional: Other Fuels (CO_2)	956	3 989	T	0	0
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	27 802	2 467	T	L	0
1 A 4 b Residential: Gaseous Fuels (CO_2)	161 967	230 084	T	L	L
1 A 4 b Residential: Liquid Fuels (CO_2)	169 703	105 964	T	L	L
1 A 4 b Residential: Solid Fuels (CO_2)	74 463	11 277	T	L	L
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)	8 716	11 118	T	L	L
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)	56 467	47 554	0	L	L
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)	3 712	362	T	0	0
1 A 5 a Stationary: Solid Fuels (CO_2)	4 667	8	T	0	0
1 A 5 b Mobile: Liquid Fuels (CO_2)	13 721	4 273	T	L	0
1 B 1 a Coal Mining: (CH_4)	42 976	6 784	T	L	L
1 B 2 a Oil: (CO_2)	8 199	9 590	T	L	L
1 B 2 b Natural gas: (CH_4)	25 547	17 175	T	L	L
1 B 2 c Venting and flaring: (CO_2)	7 015	5 522	0	L	L
2 A 1 Cement Production: (CO_2)	80 294	57 743	T	L	L
2 A 2 Lime Production: (CO_2)	17 207	15 075	0	L	L
2 A 3 Limestone and Dolomite Use: (CO_2)	8 059	5 581	0	L	L
2 B 1 Ammonia Production: (CO_2)	19 101	15 952	0	L	L
2 B 2 Nitric Acid Production: (N_2O)	35 723	5 231	T	L	0
2 B 3 Adipic Acid Production: (N_2O)	58 927	529	T	L	0
2 B 5 Other: (CO_2)	10 666	14 976	T	L	L
2 C 1 Iron and Steel Production: (CO_2)	47 093	33 345	T	L	L
2 C 3 Aluminium production: (PFC)	13 190	458	T	L	0
2 E 1 By-product Emissions: (HFC)	21 158	248	T	L	0

Source category gas	Gg CO_2 equ.		Trend	Level	
	1990	2012		1990	2012
2 E 1 By-product Emissions: (SF_6)	1 559	0	T	0	0
2 E 2 Fugitive Emissions: (HFC)	6 381	371	T	0	0
2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)	41	60 601	T	0	L
2 F 2 Foam Blowing: (HFC)	12	2 368	T	0	0
2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)	32	5 149	T	0	0
4 A 1 Cattle: (CH_4)	118 105	100 591	T	L	L
4 A 3 Sheep: (CH_4)	16 912	12 582	0	L	L
4 B 1 Cattle: (CH_4)	22 549	20 335	0	L	L
4 B 13 Solid Storage and Dry Lot: (N_2O)	20 923	16 129	0	L	L
4 B 8 Swine: (CH_4)	17 758	17 048	0	L	L
4 D 1 Direct Soil Emissions: (N_2O)	114 580	95 256	0	L	L
4 D 2 Pasture, Range and Paddock Manure: (N_2O)	33 001	27 407	0	L	L
4 D 3 Indirect Emissions: (N_2O)	80 474	64 535	T	L	L
6 A 1 Managed Waste disposal on Land: (CH_4)	125 187	67 687	T	L	L
6 A 2 Unmanaged Waste Disposal Sites: (CH_4)	13 948	5 409	T	L	L
6 B 1 Industrial Wastewater: (CH_4)	5 450	5 687	0	0	L
6 B 2 Domestic and Commercial Wastewater: (CH_4)	7 907	4 980	0	L	0
6 B 2 Domestic and Commercial Wastewater: (N_2O)	9 534	9 452	0	L	L

** Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. The use of plant-specific data reported and verified under the EU ETS by Member States can be considered as equivalent to a Tier 2 or Tier 3 method. It is difficult to calculate a specific share of EU emissions calculated with higher tier methods in the absence of such IPCC definitions and due to the fact that MS's estimates are mostly composed by several sources with independent estimation methods, using partly higher tiers, partly default methods.*

1.6 Information on the quality assurance and quality control plan

1.6.1 Quality assurance and quality control of the European Union inventory

The European Union GHG inventory is based on the annual inventories of the Member States. Therefore, the quality of the European Union inventory depends on the quality of the Member States' inventories, the QA/QC procedures of the Member States and the quality of the compilation process of the European Union inventory. The Member States and also the European Union as a whole implemented QA/QC procedures in order to comply with the IPCC good practice guidance.

The EU QA/QC programme describes the quality objectives and the inventory quality assurance and quality control plan for the EU GHG inventory including responsibilities and the time schedule for the performance of the QA/QC procedures: Definitions of quality assurance, quality control and related terms used are those provided in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Guidelines for National Systems under the Kyoto Protocol. The EU QA/QC programme is reviewed, modified and/or updated as appropriate.

The European Commission (Directorate General Climate Action) is responsible for coordinating QA/QC activities for the EU inventory and ensures that the objectives of the QA/QC programme are implemented and the QA/QC plan is developed. The European Environment Agency (EEA) is responsible for the annual implementation of QA/QC procedures for the EU inventory.

The overall objectives of the EU QA/QC programme are:

- To establish quality objectives for the EU GHG inventory taking into account its specific nature of the EU GHG inventory as a compilation of MS GHG inventories,
- To implement the quality objectives in the design of the QA/QC plan defining general and specific QC procedures for the EU GHG inventory submission taking into account the specific nature of the EU GHG inventory,

- to provide an EU inventory of greenhouse gas emissions and removals consistent with the sum of Member States' inventories of greenhouse gas emissions and removals submitted to the EU and covering the EU geographical area,
- to ensure the timeliness of MS GHG inventory submissions to the EU for the compilation of the EU's GHG inventory
- to ensure the completeness of the EU GHG inventory, inter alia by implementing procedures to estimate any data missing from the national inventories, in consultation with the MS concerned
- to contribute to the improvement of quality of Member States' inventories and
- to provide assistance for the implementation of national QA/QC programmes.

A number of specific objectives have been elaborated in order to ensure that the EU GHG inventory complies with the UNFCCC inventory principles of transparency, completeness, consistency, comparability, accuracy and timeliness.

The QA/QC Plan includes quality control procedures taken place before and during the compilation of the EU GHG inventory. In addition, QA procedures, procedures for documentation and archiving, the time schedules for QA/QC procedures and the provisions related to the inventory improvement plan are included.

QC procedures are performed at several different stages during the preparation of the European Union inventory. Firstly, a range of checks are used to determine the consistency and completeness of Member States' data so that they may be compiled in a transparent manner at EU level. Secondly, checks are carried out to ensure that the data are compiled correctly at EU level to meet the overall reporting requirements. Thirdly, a number of checks are conducted with regard to data archiving and documentation to meet various other data quality objectives.

Based on the EU QA/QC programme a quality management manual was developed which includes all specific details of the QA/QC procedures (in particular checklists and forms). The structure of the EU quality management manual has been developed on the basis of the Austrian quality management manual. The reason for using the Austrian manual as a template for the EU manual is that the EU GHG inventory is compiled by Umweltbundesamt Austria and the implementation of the annual QA/QC procedures are coordinated by Umweltbundesamt Austria. By using the Austrian quality manual as a template for the EU quality manual the EU can benefit from the experience made during the set-up of the Austrian quality management system which fulfils the requirements of EN ISO/IEC 17020 (Type A); procedures and documents from the Austrian system have been taken and adapted according to the need of the EU quality management system.

The EU quality management manual is structured along three main processes (management processes, inventory compilation processes, supporting processes) of the quality management system (Table 1.10).

Table 1.10 Structure of the EU quality management manual

Chapter		Chapter description
Management processes		
ETC 01	EU inventory system	Describes the organisation and responsibilities within the EU GHG inventory system
ETC 02	QA/QC programme	Describes the preparation and evaluation of the EU QA/QC programme by the European Commission
ETC 03	Quality management system	Describes the responsibilities and the structure of the quality management system and gives an overview of the forms and checklists used
ETC 04	Quality management evaluation	Describes the evaluation of the status and effectiveness of the quality management system
ETC 05	Correction and prevention	Describes the procedures for the correction and prevention of mistakes that occur in the EU inventory
ETC 06	Information technology systems	Describes the information technology systems used such as CIRCA, Reportnet and the systems set up at Umweltbundesamt Austria
ETC 07	External communication	Describes the communication with Member States and other persons and institutions
Inventory compilation processes		
ETC 08	QC MS submissions	Describes the quality control activities performed on the GHG inventories submitted by the EU Member States
ETC 09	QC EU inventory compilation	Describes the quality control activities performed during the compilation of the EU GHG inventory including checks of database integrity
ETC 10	QC EU inventory report	Describes the checks carried out during and after the compilation of the EU GHG inventory report
Supporting processes		
ETC 11	Documents	Describes the production, change, proofreading, release and archiving of quality management documents
ETC 12	Documentation and archiving	Describes the procedure for preparing documentation and archiving

The quality checks performed during inventory compilation process are the central part of the quality manual. Quality checks are made at three levels:

1.6.1.1 Quality control MS submissions

The QC activities of MS submissions include two elements; checking the completeness of the Member States CRF tables and checking the consistency of Member States GHG data. The completeness checks of Member States' submissions are carried out by EEA/ETC-ACM by using a similar status report form as used by the UNFCCC Secretariat. The completed status and consistency reports are sent to Member States by 28 February.

In particular, Member States are asked to check:

1. whether the status and consistency reports are correct, in particular with regard to the completeness checks (reporting of "NE") in sheet 3 of the status and consistency reports. Sheet 4 of the status and consistency report flags potential findings from the QA/QC checks performed using the web-based communication tool during February. The status and consistency reports of the Member States' submissions are included in Annex 1.3 of this report.
2. the QA/QC findings flagged in the web-based communication tool.
3. if the correct data/information has been included in the draft CRF tables/draft inven-tory report.

Member States are asked to respond to the findings included in the web-based communication tool and to provide comments to the Draft EU GHG inventory and inventory report by latest 15 March to the EU inventory team.

The consistency checks of Member States data primarily aim at identifying main problems in time series of emissions and implied emissions factors, implied emissions factors across Member States and sub-category sums. For the time series checks the algorithms of the UNFCCC secretariat are used. In addition, the ETC/ACM identifies potential problems by comparison with the previous year's inventory submission of the Member States and checks the completness of the CRF tables needed for the compilation of the EU inventory.

In addition an action plan was implemented for the first time in 2011 aiming at improving the completeness regarding NEs of the EU greenhouse gas inventory.

1) Given the fairly wide interpretations and applications of notation keys, the identification of a "real" gap needs expert assessment which is provided by the UNFCCC review and which cannot be automated by existing EU internal procedures. Thus any action plan implemented by the EU needs to continue to be based primarily on the UNFCCC review reports. This is in particular evident with regards to the KP LULUCF, where a carbon pool can be not reported (‘NR’ should be used) provided that transparent and verifiable information is provided indicating that the pool is not a source, while notation keys such as NO and NA may also sometimes be linked to incomplete estimates. In this respect it needs to be stressed that the late availability of the review reports complicates the follow-up with Member States related to potential missing GHG estimates before the next EU inventory submission.
2) The notation key ‘NE’ is not in all cases an indication of a problem and neither the IPCC guidelines nor the UNFCCC review guidelines foresee an automatic procedure of gap filling when NEs are reported. For example, the notation "NE" can be used if there are no methods available in the 1996 rev. IPCC Guidelines. Overall, a fair and complete analysis of the use of "NE" including the situations highlighted in point 1 above was considered to be indispensable.

Given the above considerations the specific steps of the action plan followed since 2011 are as follows:

1. Member States are required by the Monitoring Mechanism Regulation to submit their national GHG inventories electronically to the European Commission by 15 January of each year. A software program was created by the EEA so that upon submission of the relevant XML/CRF files a report is generated containing a list of all non-estimated source categories per Member State, specifying which of these source categories have been flagged in the Saturday Papers and for which ones IPCC methods are available. This report is then immediately notified to each Member State. During February the experts of the EU inventory team consulted and discussed with Member States’ experts inter alia:
    a) how MS have addressed and documented (or plan to address) the potential issues flagged in their Saturday Papers regarding missing estimates;
    b) the need for applying gap-filling procedures and the selection of the most appropriate methods;
    c) the need to use different notation keys.
2. The completeness of Member States' national submissions with regard to individual CRF tables is documented in the ‘status and consistency reports’ sent to the Member States on 28 February. In 2011, the EEA redesigned the ‘status reports’ to include a specific section on the provision of information relating to completeness, focusing on the latest inventory year. This new section is based on the automatic checks and the additional bilateral discussions with MS during January and February as specified above. It reflects the status of the consultation with the MS and lists the follow-up expected from the MS by 15 March. According to the procedures and time scales described in Annex VI of the Implementing Provisions, the Draft EU inventory is sent to MS by 28 February. Updated or additional inventory data submitted by MS (to remove inconsistencies or fill gaps) and complete final national inventory reports are submitted to the European Commission by 15 March.
3. In cases where, even after the two preceding steps a Member State's GHG inventory as submitted to the European Commission by 15 March still contained NEs for categories where IPCC methods exist, and/or if such reporting has been identified as a problem in previous reviews, then the EU inventory experts, in close cooperation with Member States, prepare the missing GHG source estimates in accordance with the gap-filling provisions in articles 13-16 of Commission Decision 2005/166/EC. Article 16 requires Member States to use the gap-filled estimates in their national submissions to the UNFCCC to ensure consistency between the EU inventory and Member States’ inventories.
4. A general assessment of completeness is included in the EU Greenhouse Gas Inventory Report (section 1.7 of the 2011 EU NIR). For transparency reasons, since 2011 the EU’s inventory submission contains an improved description of this section to reflect the additional improvements discussed above.

5. In addition to the steps detailed above the regular QA/QC procedures established to ensure the transparency, accuracy, comparability, consistency, and completeness of the EU inventory continue to be applied. The WG1 on annual inventories continues to address issues of completeness giving them priority and the EU internal reviews will further focus on identifying issues that may lead to an underestimation of emissions as we are approaching the end of the first commitment period.

Since 2012 the completeness checks have been extended to the use of the notation key NO and NA. All cases where less than seven Member States reported NO or NA and all other MS reported emission estimates were checked by the sector experts and clarified with Member States, if needed.

For the sectors energy, industrial processes, agriculture, LULUCF and waste sector-specific checks are performed by the EU sector experts using the UNFCCC outlier tools and other QA/QC tools. The results of the consistency and completeness checks as well as the main findings of the sector specific checks are documented in the web-based QA/QC communication tool. This tool is accessible for MS inventory coordinators and inventory experts. The Member States are asked to respond to findings in this tool and if needed provide revised emission estimates or additional information.

For every updated inventory submission provided by the MS by 15 March follow-up checks are performed by the sector experts and additional findings are documented in the QA/QC communication tool and the status and consistency reports are completed. In addition it is checked if issues identified in the status and consistency reports and in the QA/QC communication tool (initial checks), which are relevant for the EU inventory (report) have been clarified by the MS. If this is not the case MS are contacted for clarification.

1.6.1.2 Quality control EU inventory compilation

After the initial checks of the emission data, the ETC/ACM transfers the national data from the xml-files into the ETC/ACM CRF aggregator database. The version of the data received by ETC/ACM are numbered, in order to be traced back to their source. The ETC/ACM CRF aggregator database is maintained and managed by Umweltbundesamt Austria.

As the EU GHG inventory is compiled on the basis of the inventories of the EU Member States, the focus of the quality control checks performed during the compilation of the EU GHG inventory lays on checking if the correct MS data are used, if the data can be summed-up (same units are used) and that the summing-up is correct. Finally, the consistency and the completeness of the EU GHG inventory is checked. All the checks are carried out for the original submission by 15 April each year and for any resubmission. Two checklists are used for this purpose: 'Inventory preparation/consistency' and 'Data file integrity'.

1.6.1.3 Quality checks EU inventory report

The checks carried out during and after the compilation of the EU GHG inventory report are specified in the checklist 'EU inventory report'. They cover a.o. checks of data consistency between the inventory and the inventory report, data consistency between the tables and the text, but also checks of the layout.

The circulation of the draft EU inventory and inventory report on 28 February to the EU Member States for reviewing and commenting also aims to improve the quality of the EU inventory and inventory report. The Member States check their national data and information used in the EU inventory report and send updates, if necessary, and review the EU inventory report. This procedure should assure the timely submission of the EU GHG inventory and inventory report to the UNFCCC secretariat and it should guarantee that the EU submission to the UNFCCC secretariat is consistent with the Member States UNFCCC submissions.

Finally, also the detailed analysis of GHG emission trends of the EU and each EU Member State after the submission of the EU inventory to the UNFCCC also contributes to improving the quality of the EU GHG inventory. This analysis is carried out in the annual EU GHG trend and projections report which compares and analyses Member States' emission trends in the EU key sources and provides main explanations, either socio-economic developments or policies and measures, for these trends in some Member States.

1.6.1.4 EU internal review

A collaborative internal review mechanism is established within the European Union so that all participants (MS, EEA, Eurostat, and JRC) may contribute to the identification of shortcomings and propose amendments to existing procedures. The review activities with experts from Member States are coordinated by the ETC/ACM under Working Group I and take place during the period from April through September each year. The synthesised findings of collaborative reviews provide a basis for the planned progressive development of inventories both at Member state and at EU level.

The EU internal reviews 2010 and 2009 focussed on potential under-estimations of the MS inventories as identified in the UNFCCC review reports 2008 and on the use of EU-ETS data in the GHG inventories. In 2008, the internal review was a follow-up of the EU initial review assessed the completeness and comparability (consistent allocation) of Member States' emissions in the sector Industrial Processes. In addition, N_2O emissions from road transport were reviewed. In 2007, the internal review focused on the uncertainty estimates by identifying potential outliers of MS uncertainty estimates. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production', 1.B 'Fugitive emissions from fuels', 2.A 'Mineral products', 2B 'Chemical industry', 2C 'Iron and steel production' and fluorinated gases, 2.E 'Production of halocarbons and SF_6' and 2.F 'Consumption of halocarbons and SF_6'. In 2005, the EU internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'.

EU internal review 2012 (Review under the 'Effort Sharing Decision')

In 2012 a comprehensive EU internal review was carried out in order to determine the emission allocations 2013-2020 for the EU internal GHG emission reduction target 2020. In the climate and energy package the European Union has committed itself to reduce greenhouse gas emissions by 20% below 1990 levels by 2020. The package comprises two pieces of legislation related to GHG emissions:

1. A revision and strengthening of the Emissions Trading System (ETS), the EU's key tool for cutting emissions cost-effectively. A single EU-wide cap on emission allowances will apply from 2013 and will be cut annually, reducing the number of allowances available to businesses to 21% below the 2005 level in 2020. The free allocation of allowances will be progressively replaced by auctioning, and the sectors and gases covered by the system will be somewhat expanded.
2. An 'Effort Sharing Decision' (ESD) governing emissions from sectors not covered by the EU ETS, such as transport, housing, agriculture and waste. Under the Decision each Member State has agreed to a binding national emissions limitation target for 2020 which reflects its relative wealth. The targets range from an emissions reduction of 20% by the richest Member States to an increase in emissions of 20% by the poorest. These national targets will cut the EU's overall emissions from the non-ETS sectors by 10% by 2020 compared with 2005 levels.

The ESD sets out the 2020 emission limit of a Member State in relation to its 2005 emissions, and its emission limits from 2013 to 2020 form a linear trajectory. In accordance with Article 3.2 of the ESD, the starting point of the linear trajectory is defined as the average annual ESD emissions during 2008, 2009 and 2010 in 2009 (for Member States with positive limits under Annex II of the ESD) or in 2013 (for Member State with negative limits). The annual emission allocations shall be determined using reviewed and verified emission data. Thus, complete emission inventories for the reference years (2005, and 2008-2010) must be available and reviewed prior to determining the annual emission allocations in 2012.

The ESD review in 2012, coordinated by the EEA, was carried out by an independent review team comprising of four lead reviewers and 18 sector experts. This team reviewed all 27 EU Member States and Croatia (Croatia became EU member on 1 July 2013) in a desk review (May 2012) and a centralized review (June 2012). The review was coordinated by the EEA as the ESD review secretariat. The ESD review took into account both the existing quality assurance/quality control procedures for Member States' emission inventory submissions under Decision 280/2004/EC and the separate inventory review process occurring under the UNFCCC. The specific activities of the 2012 technical review included:

1. analysis of the Member States' implementation of recommendations related to improving inventory estimates in accordance with the 1996 IPCC Guidelines and the IPCC good practice guidance as listed in the UNFCCC Annual Review Reports from the 2010 and 2011 UNFCCC review processes (8)and where UNFCCC recommendations have not been implemented, assess that the Member State has provided adequate justification for these;
2. assessment of the time series consistency of the greenhouse gas emissions estimates with a particular focus on the 2005 and 2008-2010 estimates;
3. a check whether problems identified for one Member State in UNFCCC reviews also were problems for other Member States (whether identified by the UNFCCC expert review team or not);
4. an assessment of any recalculations made by a Member State in their inventory since the previous submission, and assess whether these are transparently reported and in accordance with IPCC good practice guidance;
5. a follow-up on any outstanding findings from existing and extended stage 1 and 2 checks;
6. provision of an estimate for any 'technical correction' to emission estimates reported by a Member State where it is believed that emissions reported by the Member State are underestimated and state the significance of these 'technical corrections' in comparison to the overall reported inventory estimates. An evidence-based justification for technical corrections was documented in the review reports of the relevant Member State. A record of correspondence with the Member State concerning the recommended 'technical correction' was retained by the review secretariat.
7. If available and appropriate, the TERT used additional technical information in the review process, such as EU-ETS data, information from Eurostat and other international organisations.

The 2012 initial review under the ESD can be seen as a more robust and consistent QA of MS GHG inventories that have lead to improvements in the quality of the EU and its Member States GHG inventory submissions to UNFCCC in 2013.

Specific activities for the LULUCF sector are described under Ch. 7.10 Quality Assurance and Quality control.

1.6.1.5 UNFCCC reviews

In addition, European Union QA procedures aim to build on the issues identified during the independent UNFCCC inventory review of Member States' inventories. Quality assurance procedures based on outcomes of the UNFCCC inventory review consist of the:

- Annual compilation of issues identified during the UNFCCC inventory review related to sectors, key source categories and the major inventory principles transparency, consistency, completeness, comparability and accuracy for all Member States;
- Identification of major issues from the compilation and discussion of ways to resolve them in Working Group 1 under the Climate Change Committee, including identification and documentation of follow-up actions that are considered as necessary within Working Group 1;
- Reviews of the extent to which issues identified through this procedure in previous years have been addressed by Member States;
- Ongoing investigations of ways to produce a more transparent inventory for the unique circumstances of the European Union.

1.6.1.6 Improvement plan

Based on the findings of the UNFCCC reviews, the EU internal review and other recommendations the improvement plan for the EU GHG inventory is compiled before the annual compilation process starts. After the finalisation of the annual EU GHG inventory it is evaluated if the improvements planned have been implemented.

1.6.2 Overview of quality assurance and quality control procedures in place at Member State level

As the EU GHG inventory is based on the annual inventories of the EU Member States, the quality of the EU inventory depends on the quality of the Member States' inventories and their QA/QC procedures. Table 1.11 gives an overview of QA/QC procedures in place for the EU-15 Member States. The information is taken from the Member State national inventory reports 2011, 2012, 2013 and 2014.

Table 1.11 Overview of quality assurance and quality control procedures in place for EU-15 MS at Member State level (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Austria	A quality management system (QMS) has been designed to achieve to the objectives of good practice guidance, namely to improve transparency, consistency, comparability, completeness and accuracy as well as confidence in national inventories of emissions estimates. The QMS is based on the International Standard ISO/IEC 17020 General Criteria for the operation of various types of bodies performing inspections. The QMS ensures that all requirements of a type A in-spection body as stipulated in ISO/IEC 17020 are met, which include strict independence, im-partiality and integrity. Since December 2005 the Umweltbundesamt has been accredited as in-spection body (Id.No.241) in accordance with the Austrian Accreditation Law (AkkG)41 by decree of the Minister of Economics and Labour42. The implementation of QA/QC procedures as required by the IPCC-GPG support the develop-ment of national greenhouse gas inventories that can be readily assessed in terms of quality and completeness. The QMS as implemented in the Austrian inventory includes all elements of the QA/QC system outlined in IPCC-GPG Chapter 8 "Quality Assurance and Quality Control", and goes beyond. It also comprises supporting and management processes in addition to the QA/QC procedures in inventory compilation and thus ensures agreed standards not only within (i) the inventory compilation process and (ii) supporting processes (e.g. archiving), but also for (iii) man-agement processes (e.g. annual management reviews, internal audits, regular training of person-nel, error prevention). In 2013, the organisation of the IBE personnel has been improved by replacing the originally designated 'sector deputy' by a "second, technically equally competent" sector expert, more ac-tively being involved in the inventory preparation. Now two sector experts (SE) per sector form a sector team, whereas one team member is nominated as the team leader ('sector lead' SL). Moreover, a new function within the IBE called 'cross-sectoral inventory support' has been es-tablished. By these measures the robustness of the system could be further strengthened. In May 2013 an external audit led by a representative appointed by the accreditation body has taken place to assess the QM system with regard to compliance with the underlying standard ISO 17020, to check its implementation in practice and to assure that measures and recom-mendations as set out in previous audits have been implemented accordingly. Such an audit is obligatory every 15 months. The final judgement of the auditor confirmed the compliance and practicability of the QM sys-tem. Some improvement measures, mainly small changes in the Quality Manual in adaption to the 2012 revised Accreditation Law, had to be implemented. Moreover a risk analysis was car-ried out by an external institution to identify and assess potential IT risks, finally confirming the robustness of the system.	Austria's Annual Greenhouse Gas Inventory 1990–2012 Jan 2014 -p 37-38
Belgium	Belgium did submit a full QA/QC plan of the Belgian national system for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol on the 20th of October 2008 to the UNFCCC-experts as a demand of the UNFCCC-centralized review carried out from the 1st to the 6th of September 2008. In the final Annual Review Report of UNFCCC (Report of the individual review of greenhouse gas inventories of Belgium submitted in 2007 and 2008) the ERT concluded that the QA/QC plan has been prepared and implemented in accordance with the IPCC good practice guidance. This plan is revised during the 2010 submission to the UNFCCC-secretariat. The overall QA/QC responsibilities on the Belgian GHG inventory are carried out at IRCEL/CELINE the Belgian interregional environment Agency which is the national inventory agency responsible for international obligations related to air emissions reporting. As a consequence, the quality and assurance controls already carried out within the responsible regions, are supplemented by the QA/QC performed to the national Belgian inventory. After completion of the Belgian greenhouse gas emission inventory by IRCEL/CELINE, the regions and IRCEL/CELINE carry out further quality control checks of the national inventory before the official submission takes place. IRCEL/CELINE is the final responsible for the national inventory, and any change at this stage is conducted only by IRCEL/CELINE, after co-ordination with the relevant regional contacts. The QC checks are described in section 1.6.1.5. of the BE NIR. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002 and results became available in 2003. The purpose of these audits was to analyse the difficulties encountered while compiling the regional emission inventories into the national inventory in order to improve the quality and completeness of the Belgian national emission inventory and to evaluate the differences between the process at that time and the obligations in the framework of the UNFCCC & IPCC Guidelines and the Kyoto Protocol. Technical working groups are set up since the beginning of 2003 to investigate in detail the implementation of the Good Practice Guidance for the different sectors in Belgium and to harmonise the 3 regional emission inventories in Belgium as much as possible. The overall conclusion in the different technical working groups was that appropriate methods are used for all sectors and in accordance with the IPCC Good Practice Guidance. All three regions perform their own QC procedures. The Tier 1 QC checks conducted at the regional and the national level are also included in the BE NIR.	Belgium's GHG Inventory (1990-2012) Jan 2014 pp 34-35

MS	Description of the national QA/QC activities	Source
Denmark	The Quality Control (QC) and Quality Assurance (QA) plan for greenhouse gas emission inventories performed by the Danish Centre for Environment and Energy (DCE) is in accordance with the guidelines provided by the UNFCCC (IPCC, 1997), and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The ISO 9000 standards are also used as important input for the plan. The QA/QC plan also covers Greenland. DCE receives the data corresponding to data processing level 3 and data storage level 4 and the data undergoes the same QA/QC procedure as the Danish data. The quality planning is based on the following definitions as outlined by the ISO 9000 standards as well as the Good Practice Guidance (IPCC, 2000): Quality management (QM) Coordinates activity to direct and control with regard to quality. Quality Planning (QP) Defines quality objectives including specification of necessary operational processes and resources to fulfil the quality objectives. Quality Control (QC) Fulfils quality requirements. Quality Assurance (QA) Provides confidence that quality requirements will be fulfilled. Quality Improvement (QI) Increases the ability to fulfil quality requirements. The QA/QC work is supported by an inventory file system, where all data, models and QA/QC procedures and checks are stored. The QA/QC plan will continuously improve these activities in the future. The Danish Quality Concept foresees quality management, quality planning, quality control, quality assurance and quality improvement. The strategy for process-oriented QC is based on setting up a system for the process of the inventory work.	Danish Annual EC GHG report 2012: Inventories 1990-2012 Mar 2014, p 58 ff

MS	Description of the national QA/QC activities	Source
Finland	Statistics Finland has the overall responsibility for the GHG inventory in Finland, including the responsibility for co-ordinating the quality management measures at the national level. The quality coordinator steers and facilitates the quality assurance and quality control (QA/QC) process. The expert organisations contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations. Experts on each inventory sector implement and document the QA/QC procedures. All the participating organisations are represented in the inventory working group set up to support the process of producing annual inventories and the fulfilment of reporting requirements. The working group advances collaboration and communication between the inventory unit and the experts in charge of the different reporting sectors and ensures the implementation of the QA/QC process of the inventory. Statistics Finland has also set up an advisory board that functions as a higher level forum for collaboration and communication with the parties involved in the national system. Issues related to QA/QC are discussed at the meetings of the inventory working group (3-7 meetings per year) and at the bilateral quality meetings between the inventory unit and the expert organisations (once a year). The main findings and conclusions concerning the inventory's quality and improvement needs are communicated to the advisory board. An electronic quality manual including e.g. guidelines, plans, templates and checklists is in place and available to all parties of the national inventory system via the Internet. Statistics Finland bears the responsibility for archiving the quality manual and for submissions of annual inventories (CRF tables and NIR). Expert organisations contributing to the sectoral calculations archive the primary data used, internal documentation of calculations (including the sector-specific QC checklists) and sectoral CRF tables. Statistics Finland co-ordinates the participation of the partners of the national system in the reviews, as well as responses to issues raised by the reviews of the UNFCCC Secretariat. The quality objectives and the planned general QC and QA procedures regarding all sectors are set in the QA/QC plan. This is a checklist that specifies the actions, schedules and responsibilities in order to attain the quality objectives and to provide confidence in the Finnish national system's capability to deliver high-quality inventories. The QA/QC plan is written in Finnish and updated yearly. The QA/QC plan is part of the electronic quality manual of the inventory and archived according to the inventory unit's archive formation plan. The QC procedures used in Finland's GHG inventory comply with the IPCC Good Practice Guidance. General inventory QC checks (IPCC GPG 2000, Table 8.1 and IPCC GPG LULUCF 2003, Table 5.5.1) include routine checks of the integrity, correctness and completeness of the data, identification of errors and deficiencies and documentation and archiving of the inventory data and quality control actions. Categoryspecific QC checks including technical reviews of the source categories, activity data, emission factors and methods are applied on a case-by-case basis focusing on key categories and on categories where significant methodological and data revisions have taken place. Once the experts have implemented the QC procedures, they complete the QA/QC form for each source/sink category, which provides a record of the procedures performed. Results of the completed QC checks are recorded in the internal documents for the calculation and archived in the expert organisations. Key findings are summarised in the sector-specific chapters of this NIR. Several QC checks are implemented at Statistics Finland during the compilation of the CRF Tables. Parallel with the 2011 inventory preparation, a specific excel workbook was established to improve the assessment of results, emission trends and to ease the detection of errors and inconsistencies. In addition, the QA/QC of member states' submissions conducted under the European Community GHG Monitoring Mechanism (e.g. completeness checks, consistency checks and comparisons across Member States) produces valuable information on errors and deficiencies, and the information is taken into account before Finland submits its final annual inventory to the UNFCCC. ISO 9001 certification has been under consideration. However, the advantages (e.g. the perspective of a third party assessment) and costs (e.g. the amount of resources required for registration) of certification have been evaluated, and it has been decided not to apply for the ISO 9001 compliance certification. Even without certification Finland continues to utilize the ISO 9001 as a benchmark for the general quality management system of the inventory.	GHG Emissions in Finland 1990-2012 Draft, Jan 2014 p 28 ff.

MS	Description of the national QA/QC activities	Source
France	The national emissions inventory system is set up, by incorporating the usual criteria applicable to Quality Management Systems (QMS). CITEPA, in charge of preparing the national emissions inventories from a technical viewpoint, has put in place a system for quality assurance and quality control based on the ISO 9001 standard . This approach has been confirmed by the fact that CITEPA was awarded a certificate issued by the French Quality Management Body (AFAQ) in 2004. This was renewed in 2007 and in 2010 and follow-up audits were conducted in between. The task of preparing the national emissions inventories is covered by the QMS via several specific processes (see Quality Manual – confidential in-house document). In this framework, several processes for quality assurance and quality control of the inventories are incorporated into the different processes and procedures implemented, corresponding to the different phases and actions. The overall objective of the quality assurance and quality control programme focuses on the production of national emissions and sinks inventories in line with requirements issued in the different national and international frameworks covered by the SNIEPA. These requirements concern the definition, implementation and application of procedures and methods aimed at meeting the criteria on traceability, exhaustiveness, consistency, comparability and punctuality required by international and EU institutions, as part of the commitments France has signed up to. Quality control is incorporated into the different phases of the processes and procedures developed by the bodies involved in the national system in order to achieve the objectives and targets set. The CITEPA, the body responsible for the technical coordination and compilation of the inventories is in charge of monitoring quality control and issues recommendations aimed at improving, completing and developing the necessary processes and procedures. These procedures can be automatic or manual, take the form of a check-list, feasibility, consistency, exhaustiveness, trend analysis and simulation tests, etc. They are implemented at several stages in the process of conducting the inventory. Quality assurance is provided through several measures designed to subject the inventories to reviews for the purpose of obtaining comments and assessments from stakeholders, generally with expert knowledge.	direct communication, March 2011
Germany	In 2005, via its in-house directive (Hausanordnung) 11/2005, the Federal Environment Agency established a Quality System for Emissions Inventories (QSE), within the Agency. The QSE provides the necessary framework for compliance with good inventory practice and for execution of routine quality assurance. This system is structured in accordance with the requirements of the IPCC Good Practice Guidance, and it has been adapted to national circumstances in Germany and to the internal structures and procedures of the Federal Environment Agency, the reporting institution. The in-house directive (Hausanordnung 11/2005) issues binding provisions on relevant competencies within the Agency, lists deadlines for the various inventory-preparation steps and describes the necessary relevant review actions for purposes of quality control / quality assurance. The directive has fulfilled requirements, pursuant to Paragraph 10 (a) of the Guidelines for National Systems, for specification of relevant procedures, and for definition, pursuant to Paragraph 12 (c), of specific responsibilities at the Agency level. The requirements pertaining to the system for quality control and quality assurance (QC/QA system) and to measures for quality control and quality assurance are defined primarily by Chapter 8 of the IPCC Good Practice Guidance. From those provisions, the Federal Environment Agency has derived its own "General minimum requirements pertaining to quality control and quality assurance in connection with greenhouse-gas-emissions reporting". Other National System participants adopted the minimum requirements after representatives of the participating federal ministries approved them in the framework of the National Co-ordinating Committee for the National System of Emissions Inventories.	National Inventory Report, Germany – 2014, 15.04.2014 p. 86

MS	Description of the national QA/QC activities	Source
Greece	A QA/QC system is being implemented since April 2004. It has been developed by the previous technical consultant (NOA) and is still being used by National Technical University of Athens (NTUA). The supervision of QA/QC system is performed by Ministry of Environment, Energy and Climate Change of Greece (MEECC). The system is based on the ISO 9001:2000 standard and its quality objectives, as stated in the quality management handbook, are the following: 1. Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals. 2. Continuous improvement of GHG emissions/removals estimates. 3. Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements. The accomplishment of the above-mentioned objectives can only be ensured by the implementation, from all the members of the Inventory Team of the QA/QC procedures included in the plan for: data collection and processing, applying methods consistent with IPCC Good Practice Guidance and LULUCF Good Practice Guidance for calculating / recalculating emissions or removals, making quantitative estimates of inventory uncertainty, archiving information and record keeping and compiling national inventory reports. The QA/QC system developed covers the following processes: QA/QC system management, comprising all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the above-mentioned quality objectives. Quality control that is directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. Archiving inventory information, comprising activities related to centralised archiving of inventory information and the compilation of the national inventory report. Quality assurance, comprising activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public. Estimation of uncertainties, defining procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory. Inventory improvement, that is related to the preparation and the justification of any recalculations made. All the procedures described there, are followed by both the MEECC and the NTUA staff members. As described in the chapters of the NIR entitled "Source-specific QA/QC and verification", source-specific Tier 2 QC procedures are applied in the majority of source categories for quality control and verification purposes. Furthermore, annual internal audits take place by MEECC/NTUA between January and March of each year and audits by independent local experts are planned and implemented. In 2013, a Bilateral QA exercise between the Spanish and the Greek Inventory teams was performed. The Spanish inventory team reviewed the Agriculture, Waste and IP (F-gases) sectors of the Greek inventory. On the other hand, the Greek inventory team reviewed the industrial combustion, industrial processes and waste sectors of the Spanish inventory.	Climate Change Emissions Inventory, Information under Article 3(1) of the Decision 280/2004/EC, Jan 2014, p 4 f.
Ireland	In early 2005, the inventory agency in Ireland commissioned a project with UK consultants NETCEN to establish formal QA/QC procedures that would meet the needs of the UNFCCC reporting requirements. The project developed a QA/QC system including a documented QA/QC plan and procedures along with a QA/QC manual. The manual provides a general overview of the QA/QC system. In addition, the manual provides guidance and templates for appropriate quality checking, documentation and traceability. The selection of source data, calculation methodologies, peer and expert review of inventory data and the annual requirements for continuous improvement for the inventory are also outlined in the manual. The QA/QC plan identifies the specific data quality objectives related to the principles of transparency, consistency, completeness, comparability and accuracy required for Ireland's national inventory and provides specific guidance and documentation forms and templates for the practical implementation of QA/QC procedures. The QA/QC procedures cover such elements as data selection and acquisition, data processing and reporting.	Ireland National Inventory Report 2012,GHG emissions 1990-2020 reported to the UNFCCC Mar 2014 p 16

MS	Description of the national QA/QC activities	Source
Italy	ISPRA has elaborated an inventory QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, facilitates the overall QA procedures to be conducted, to the extent possible, on the entire inventory and establishes quality objectives. Particularly, an inventory QA/QC procedures manual (ISPRA, 2013) has been drawn up which describes QA/QC procedures and verification activities to be followed during the inventory compilation and helps in the inventory improvement. Furthermore, specific QA/QC procedures and different verification activities implemented thoroughly the current inventory compilation, as part of the estimation process, are figured out in the annual QA/QC plan (ISPRA, 2014 [b]). These documents are publicly available at ISPRA website Quality control checks and quality assurance procedures together with some verification activities are applied both to the national inventory as a whole and at sectoral level. Future planned improvements are prepared for each sector by the relevant inventory compiler; each expert identifies areas for sectoral improvement based on his own knowledge and in response to the UNFCCC inventory reviews and taking into account the result of the key category assessment. The quality of the inventory has improved over the years and further investigations are planned for all those sectors relevant in terms of contribution to total CO_2 equivalent emissions and with a high uncertainty. In addition to routine general checks, source specific quality control procedures are applied on a case by case basis focusing on key categories and on categories where significant methodological and data revision have taken place or on new sources. Checklists are compiled annually by the inventory experts and collected by the QA/QC coordinator. These lists are also registred in the 'reference' database. General QC procedures also include data and documentation gathering. Specifically, the inventory analyst for a source category maintains a complete and separate project archive for that source category; the archive includes all the materials needed to develop the inventory for that year and is kept in a transparent manner. All the information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors as well as methodologies are referenced to their data sources. Particular attention is paid to the archiving and storing of all inventory data, supporting information, inventory records as well as all the reference documents. To this end, a major improvement which increases the transparency of the inventory has been the development of a 'reference' database. After each reporting cycle, all database files, spreadsheets and official submissions arearchived as 'read-only' mode in a master computer.	Italian Greenhouse Gas Inventory 1990-2012 National Inventory Report 2014, March 2014, pp 37-41
Luxembourg	Luxembourg's Quality Management System (QMS) follows a Plan-Do-Check-Act-Cycle (PDCA-cycle), which is an accepted model for pursuing a continual improvement of performance according to international standards and is in line with procedures described in decision 19/CMP.1 and in the IPCC Good Practice Guidance. Due to Luxembourg's clear extent, its QMS deals with a manageable quantity of documents. Fol-lowing are the specifications of Luxembourg's Quality Management System: - firm build-up with a quality manual consisting of a chart with all relevant documents, handling instructions and deadlines for check; - good manageability (instead of a complex system); - usable and effective quality control procedures (user-friendly, clearly arranged). Since the QMS has been implemented in the year 2008, further developments and improvements have been implemented. The QMS ensures and continuously improves the quality (measured by transparency, accuracy consistency, comparability, completeness (TACCC) and timeliness) of Luxembourg's GHG Inventory in order to fulfil the party's obligations according to articles 3, 5 and 7 of the Kyoto Protocol. Luxembourg's Quality Management System (QMS) of the GHG Inventory is organised in three layers: - Performance processes which directly concern the compilation of the GHG Inventory. They comprise input data, data acquisition, calculations, and generation of CRF tables and NIR as well as quality control checks and the outcomes of the NIR and CRF-tables. - Management processes which control the system's performance by defining quality objectives, responsibilities, quality assurance procedures, improvement plans and the personnel's qualifications and obligations. - Supporting processes which assist the system's performance by providing technical requirements and standards. Further details on Luxembourg's QMS and relating QA/QC procedures are described in detail in Luxembourg's NIR 2014.	National Inventory Report 1990-2012, Mar 2014 pp 44

MS	Description of the national QA/QC activities	Source
Netherlands	As part of its National System, the Netherlands has developed and implemented a QA/QC program (NL Agency, 2011). This program is yearly assessed and updated, if needed. The QA/QC programme (NL Agency, 2012) that has been developed and implemented as part of the National System. This programme includes quality objectives for the National System, the QA/QC plan and a time schedule for implementation of the activities. It is updated annually as part of an 'evaluation and improvement cycle' for the inventory and National System and held available for review. The adaptation of the PRTR project to the quality system of RIVM (ISO 9001:2008 system), completed in 2012. The annual project plan of RIVM (RIVM, 2011). The work plan describes the tasks and responsibilities of the parties involved in the PRTR process, such as products, time schedules (planning) and emissions estimation methods (including the monitoring protocols for the greenhouse gases), as well as those of the members of several Task Forces. The annual work plan also describes the general QC activities to be performed by the Task Forces before the annual database is fixed. The responsibility for the quality of data in annual environmental reports (AER) lies with the companies themselves, while validation of the data is the responsibility of the competent authorities. It is the responsibility of the institutes involved in the PRTR to judge whether or not to use the validated data of individual companies to assess the national total emissions. (CO_2 emissions, however, are based on energy statistics and standard EFs and only qualified specific EFs from environmental reports are used.) Agreements/covenants between RIVM and other institutes involved in the annual PRTR process. The general agreement is that by accepting the annual work plan, the institutes involved commit themselves to deliver capacity for the products specified in that work plan. The role and responsibility of each institute have been described (and agreed upon) within the framework of the PRTR work plan. Specific procedures that have been established to fulfil the QA/QC requirements as prescribed by the UNFCCC and Kyoto Protocol. General agreements on these procedures are described in the QA/QC programme as part of the National System. The specific procedures and agreements have been set out and described in the QA/QC plan and the annual PRTR work plan. Those persons involved in the annual inventory tasks are invited once a year to evaluate the process. In this evaluation, the results of any internal and external review and evaluation are taken into account. The results are used for the annual update of the QA/QC programme and the annual work plan. Source-specific QC: The comparison of emissions with independent data sources was one of the study topics in the inventory improvement programme. Because it did not seem possible to considerably reduce uncertainties through independent verification (measurements) – at least not on a national scale – this issue has received less priority. However, the theme is taken up in the PRTR project to re-assess and update the assessment of uncertainties and the sector-specific QC activities. In the coming years this will lead to a revised uncertainty assessment of Dutch GHG emissions.	Greenhouse Gas Emissions in the Netherlands 1990-2012 Jan 2014 p39 ff.
Portugal	APA has the overall responsibility for the national inventories in Portugal, including the competence for the coordination of the Quality Assurance (QA) and Quality Control System (QC). The inventory staff is responsible for the implementation of QA/QC procedures related to data gathering, handling, processing, documenting, archiving and reporting procedures related to the inventory, namely QC1 Each Involved Entity (IE) within the Portuguese national system (SNIERPA) contributing with data to the inventory is responsible for the quality of their own data. A request for information on the specific QC or QA procedures is to be sent to IEs in order to document such procedures, its results and also the uncertainty calculations. A QA/QC coordinator is designated in order to ensure that the objectives of the QA/QC plan are met and to guarantee the good implementation of the QA\QC procedures defined. The QA/QC system is composed of two main elements: • QA/QC Plan; • Procedures Manual. The first schedules the application of the general (QC1) and specific (QC2) as well as QA procedures, described in detail in a Manual (in Portuguese language), to be applied to defined source/sink categories. The procedures were defined according to Good Practice and Uncertainty Management Guide (IPCC, 2000) and adapted to the specific National Inventory (INERPA) characteristics. QC1 procedures defined in the QA/QC Manual include a series of checklists, which consider basic checks on the accuracy of data acquisition processes (including, e.g, transcription errors) and checks on calculation procedures, data and parameters. It includes also cross-checking among subcategories in terms of data consistency, verification of NIR and CRF tables. Documentation and archiving procedures include checks on information handling which should enable the recalculation of the inventory. QC2 procedures, on the other hand, include technical verifications of emission factors, activity data, comparison of results among different approaches. Both QC1 and QC2 procedures are to be applied by the inventory team during the inventory calculation and compilation following a yearly defined QA/QC plan. The results of quality control of national submissions under the EC GHG Monitoring Mechanism (e.g. completeness checks, consistency checks), and the issues raised during the annual review process of the UNFCCC or other reviews, constitute additional processes of technical verification and represent valuable sources of error detection and methodological improvement.	Portuguese National Inventory Report on Greenhouse Gases, 1990-2012 Mar 2014, p 18

MS	Description of the national QA/QC activities	Source
Spain	The QA/QC plan is an internal document with the aim to improve the inventory. It is revised periodically and adapted to changes in the procedures of inventory preparation. The objectives of the QA/QC plan are: Timeliness: to reach this target a time schedule for specific tasks and respective check points are established. Completeness: an exhaustive analysis is done of the Inventory's basic SNAP nomenclature (which corresponds to the nomenclatures used in the rest of the Inventory formats), all the cross-tab activities with pollutants for which references for emission estimates are provided, and with reference to these methods, an analysis is made and the basic data necessary for the application of selected estimation method is collected. Consistency: a parameter or variable is only introduced once in the data base. This assures that a parameter that is used several times in the inventory is always the same. Consistency of time series is achieved by subjecting primary data to quality control. Outliers in the time series are identified and checked. Comparability: the Spanish Inventory should be comparable with inventories from other countries. To achieve this goal definitions and nomenclature are based on SNAP and CRF. Accuracy: priority for the use of methods of higher tier is given to key categories. Transparency: the reproducibility of the inventory should be granted. For this aim processes that generate emissions, the variables of activities and their origins, the algorithms and emission factors and the estimated emissions are documented in SNAP format. Improvement of the inventory: all the preceding objectives lead to this final objective of Inventory improvement and as such contribute to the shame, with all the quality assurance and control elements mentioned. The DGCEA as single national entity of the NIS is responsible for the quality control and quality assurance system. For this task DGCEA receives technical assistance from AED.	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2012" March 2014 (submitted in Spanish, translated)
Sweden	In order to fulfill the obligations of reporting to the UNFCCC and the EU, the Swedish EPA has set up a quality system as part of the national system. The struc-ture of the quality system follows the PDCA cycle (Plan, Do, Check, Act). This is an adopted model for how systematic quality and environmental management activity is to be undertaken according to international standards to ensure that quality is maintained and developed. The quality system includes several procedures such as training of staff, inventory planning and preparation, QA/QC procedures, publication, data storage, and fol-low-up and improvements. All QA/QC procedures are documented in a QA/QC plan. The QA/QC plan also includes a scheduled time frame describing the differ-ent stages of the inventory from its initial development to final reporting. The qual-ity system ensures that the inventory is systematically planned, prepared and fol-lowed up in accordance with specified quality requirements so that the inventory is continuously developed and improved. The responsibilities of the Swedish EPA and the other government agencies for the quality system are described in Ordinance (2005:626) Concerning Climate Reporting. The responsibility of SMED to maintain and develop an internal quality system is described in the framework contract between the Swedish EPA and the consultants. The SMED quality system is described in a detailed manual including several appendices. It is updated annually and lists all quality control steps that must be undertaken during inventory work (Tier 1 and where appropriate Tier 2). It also includes descriptions of roles and responsibilities, of databases and models, work manuals for each CRF category and documented procedures for uncertainty and key source analyses, as well as procedures for handling and responding to UNFCCC´s review of the Swedish inventory. It also handles follow-up and improvement by procedures of non-conformity reporting and collection of improvement needs from all stages of the annual inventory cycle. This results in a planning document, which is used as a basis for planning and selecting further actions to improve the inventory. Quality control: Quality control is the check that is made during the inventory on different types of data, emission factors and calculations that have been made. The quality control takes place according to general requirements (Tier 1) which apply to all types of data used as support material for the reporting, and specific requirements for quali-ty control (Tier 2) which are applied to certain types of data and/or emission sources. All QC measures performed are documented by SMED in QC checklists for each CRF code or group of codes. After completion of the initial compilation of the inventory, a QC-team within SMED reviews all QC checklists. In addition, the project management team performs checks of submission data using the functional-ity of the CRF Reporter (i.e. checks of completeness, time-series consistency and recalculation explanations). Quality assurance: Key categories should be subject to external peer review according to the Tier 2 of the Good Practice Guidance. The Swedish QA/QC system includes national peer reviews by sectoral authorities. The peer review is defined in the Ordinance (2005:626) Concerning Climate Reporting and is, for all sectors, conducted by a person who has not taken part in the inventory preparation. The Swedish EPA is responsible for coordinating the annual peer review. This means, among other things, ensuring that the peer reviewers have received the necessary training. The peer review includes methodology and emissions factors used, as well as comparisons of activity and emission data with other national statistics. The reviewers also identify areas for improvement, which consolidates the basis for improve-ments in coming submissions. Results from the national peer review are docu-mented in review reports. Recommendations from the review reports are collected to the list of suggested improvements described in section 1.3.5.5. of the NIR.	National Inventory Report Sweden 2014 Jan 2014 pp 47-48, 53ff

MS	Description of the national QA/QC activities	Source
United Kingdom	The National Atmospheric Emissions Inventory and the UK Greenhouse Gas Inventory are compiled and maintained together by Ricardo-AEA (the Inventory Agency), on behalf of the Department for Energy and Climate Change (DECC) and the Department for Food and Rural Affairs (DEFRA). Ricardo-AEA prepares the GHG submissions to the EC under the EUMM and to the UNFCCC. The data compilation for some source sectors of the UK inventory are performed by other contractors (i.e. Rothamsted Research compile the agriculture sector, CEH compile the land use, land-use change and forestry sector). Much of the data received by Ricardo-AEA for the UK GHGI compilation come from other government departments, agencies, research establishments or consultants working on behalf of UK government or for trade associations. Some of the organisations (e.g. DECC, the Office of National Statistics and British Geological Survey) qualify as the UKs National Statistical Agencies referred to in the Guidance and abide by strict statistical QA/QC standards. Other organisations (e.g. CEH, providing the LULUCF estimates and the Environment Agency, providing regulated point source data) supply important datasets for the Inventory and have their own QA/QC systems. CEH is implementing a QA/QC system for LULUCF following the methodology of Ricardo-AEA (detailed below). Whilst these organisations have their own QA/QC systems, Ricardo-AEA is responsible for co-ordinating inventory-wide QA/QC activities relating to the submitted datasets. In addition, Ricardo-AEA is working continuously with organisations supplying data to the GHG inventory to encourage them to demonstrate their own levels of QA/QC that comply with either IPCC Good Practice Guidance or the UK's National Statistics standards. An overview of the UKs GHGI QA/QC system is illustrated in Figure 1.4 below. The QA/QC system includes three core components. 1. The QA/QC Plan is a document maintained by the GHGI's QA/QC manager (at Ricardo-AEA) and defines the specific Quality Objectives and QA/QC activities required in undertaking the compilation and reporting of GHG estimates. The plan also assigns roles, responsibilities and a timeline for completion of QA/QC activities. 2. QA/QC implementation includes the physical undertaking of the QA/QC activities throughout the data gathering, compilation and reporting phases of the annual emission estimation cycle and in accordance with the QA/QC plan. 3. Documentation and Archiving. Documentation is embedded within the UK's compilation tools. The NIR transparently describes the data sources, methods, assumptions and QA/QC implementation used in producing the GHG inventory including records of activities undertaken, findings/issue logs, recommendations and any necessary actions taken or planned. Archiving ensures a complete backup and storage of all material used for the compilation of the estimates.	UK Greenhouse gas Inventory 1990-2012: Short NIR, Jan 2014, p 23 ff.

1.6.3 Further improvement of the QA/QC procedures

One of the most important activities for improving the quality of national and EU GHG inventories is the organisation of workshops and expert meetings under the EU GHG Monitoring Mechanism. Sector-specific workshops are conducted under the Monitoring Mechanism that aim to address specific inventory issues and develop follow-up activities with the aim to address problems, clarify approaches and to improve the quality of Member States' inventory submissions. The follow-up activities are subsequently addressed in meetings of WG 1 under the Climate Change Committee.

In September 2004 a 'Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems' was organised. The Workshop facilitated the exchange of experience of Member States in the implementation of Quality Control (QC) and –Assurance (QA) procedures and the implementation of the National Inventory System. The workshop brought together experts from 17 Member States, the European Commission (DG ENV, JRC), EEA, ETC/ACM and an observer from the UNFCCC secretariat. For details of the workshop see the workshop report available on the website of the ETC/ACM:
http://air-climate.eionet.europa.eu/docs/meetings/040902_GHG_MM_QAQC_WS/meeting040902.html

A number of other workshops and expert meetings have been organised in recent years with a focus on sector-specific quality improvements. Table 1.12 lists the most important workshops.

Table 1.12 Overview of workshops and expert meetings organised under the EU GHG Monitoring Mechanism

Workshop/expert meeting	Date and venue
Energy balances, ETS and CRF activity data	27-28 June 2013, Eurostat, Luxembourg
Improvement of Fluorinated-gas inventories	21 May 2013, EEA, Copenhagen
LULUCF and KP-LULUCF technical workshop	27 February – 01 March 2013, JRC, Ispra
JRC technical workshop on LULUCF reporting under the Kyoto Protocol	21 November 2011, Brussels, Belgium

Workshop/expert meeting	Date and venue
Technical workshop on projections of GHG emissions and removals in the LULUCF sector	27-28 January 2010, Ispra, Italy
JRC technical workshop on LULUCF issues under the Kyoto Protocol	9-10 November 2010, Brussels, Belgium
Reporting on supplementary information under the Kyoto Protocol starting in 2010	2 March 2009, Berlin, Germany
Technical workshop on LULUCF reporting issues under the Kyoto Protocol	13-14 November 2008, JRC, Ispra, Italy
Workshop on the implications of the implementation of the 2006 IPCC Guidelines for national GHG inventories	30 - 31 October 2008, EEA, Copenhagen, Denmark
2nd workshop on data consistency between National GHG inventories and reporting under the EU ETS	13-14 September 2007, EEA, Copenhagen, Denmark
Expert meeting on the estimation of CH_4 emissions from solid waste disposal sites with the First Order Decay method	8-9 March 2006, EEA, Copenhagen, Denmark
Workshop on data consistency between National GHG inventories and reporting under the EU ETS	9-10 February 2006, EEA, Copenhagen, Denmark
Training workshop on the use of CRF Reporter for the experts of the European Union	12-13 September 2005, EEA, Copenhagen, Denmark
EU workshop on uncertainties in greenhouse gas inventories	5-6 September 2005, Helsinki, Finland
Workshop on Inventories and projections of greenhouse gas emissions from waste	2-3 May 2005, EEA, Copenhagen, Denmark
Expert meeting on improving the quality of. greenhouse gas emission inventories for category 4D	21-22 October 2004, JRC, Ispra, Italy
Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems	2-3 September 2004, EEA, Copenhagen, Denmark
Workshop on emissions of greenhouse gases from aviation and navigation	17-18 May 2004, EEA, Copenhagen, Denmark
Enlargement Training Workshop on Emission Inventory Improvement and Uncertainty Assessment	27-28 November 2003, JRC, Ispra, Italy
2003/06/24 Workshop on energy balances and energy related GHG emision inventories	24-25 June 2003, EEA, Copenhagen, Denmark
Workshop on Inventories and Projections of GHG and Ammonia Emissions from Agriculture	27-28 February 2003, EEA, Copenhagen, Denmark

Most of the workshop reports are available at the website of the EEA/ETC-ACM: **http://acm.eionet.europa.eu/meetings/past_html**

LULUCF workshops organized by Joint Research Center of the European Comission are all available at: **http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/**

Finally, in 2012 DG CLIMA launched a project to support the Member States The purpose of the project is to provide technical assistance and capacity building support to EU MS during the preparation of 2013 and 2014 GHG inventory submissions. For the 2013 inventory compilation 13 MS received in-depth support, where in 2014 seven Member States were selected. Limited ad-hoc support was provided to remaining EU Member States. The focus of the project is the support of KP LULUCF inventories. In 2013, 13 country visits were carried out and two workshops were organized (see table above). In 2014, six country visits were carried out.

1.7 Uncertainty evaluation

The EU-15 uncertainty analysis was made on basis of the Tier 1 uncertainty estimates, which were submitted from the Member States in their GPG Table 6.1. In response to previous findings of the review team the coverage of the MS uncertainty estimates has improved again this year: just one country submits data for their key sources only (Luxembourg) which is negligible for the calculation of the EU uncertainties. Nevertheless due to this fact, the sectoral EU and EU total of emissions in the following tables might not always meet exactly the value which is reported as “true” total compare to the values in the individual trend chapters.

Uncertainties were estimated at detailed level and aggregated to six main sectors ‘Energy’, ‘Fugitive emissions’, Industrial processes’, ‘Agriculture’, ‘LULUCF’ and ‘Waste’. Within these sectors the available MS uncertainty estimates were grouped by source categories. Then for each source category a range of uncertainty estimates was calculated: the lower bound of the range was calculated by assuming that all uncertainty estimates within a source category are uncorrelated; the upper bound of estimates was calculated by assuming that all uncertainty estimates within a source category are correlated. Then a single uncertainty estimate was calculated for each source category based on the assumption that MS uncertainty estimates are correlated if they use Tier 1 methods and/or default emission factors. After having calculated the uncertainty estimates for each source category, the uncertainty estimates for the sectors and for total GHG emissions were calculated. This is a more sophisiticated approach than required under the IPCC guidelines. The EU team adopted this approach in order to obtain a more accurate uncertainty estimates than with the “simple” approach included in the IPCC guidelines.

Estimation of trend uncertainty: The EU uncertainty estimate is rather complicated due to potential correlations between MS uncertainties. Therefore, an analytical method, which allows more flexibility than IPCC Tier 1, was compiled.

Trend in MS n category x was defined as

$$\mathbf{Trend_{n,x} = E_{n,x}(t) - E_{n,x}(0)} \qquad \textbf{(1)}$$

Where E(t) denotes emissions in the latest inventory year and E(0) emissions in the base year.

Variance for each MS and source category was calculated by using the perceptual uncertainty estimates reported by MS, and assuming normal distributions. Uncertainties in trends of different MS and source categories were then calculated using first order approximation of error propagation.

The assumptions of correlation between years (0 and t) and between different MS are important for the estimation of trend uncertainty. However, there is not enough information about strengths of different correlations. Effect of correlation was tested both with the analytical method developed, and by using MC simulation, where Normal distribution was used in all the cases to ensure comparability with analytical estimates. Table 1.13 presents an example of such comparison made in 2006. The source category chosen for the example is 4D, N_2O emissions from agricultural soils, as this category has a major effect on inventory uncertainty in most MS. Both the effects of correlations between years and between Member States were tested.

Table 1.13 Trend uncertainty for EU-15 emissions 2006 of N_2O from agricultural soils by using different assumptions of correlation estimated using Monte Carlo simulation

Years correlate	MS correlate	Trend uncertainty
YES	YES	-27 to +26
YES	NO	±13
NO	YES	-294 to +292
NO	NO	-116 to +115

Note: “YES” denotes full correlation between years or Member States. Trend uncertainty is presented as percentage points.

The results of the comparison revealed that assumption on correlation between years has much larger effect on trend uncertainty than the assumption on correlation between MS. In the IPCC GPG 2000, it is suggested to assume that emission factors between years are fully correlated, and activity data are independent. However, in the EU uncertainty estimate, it is assumed that activity data uncertainties also correlate to some extent between years, because typically the same data collection methods are used each year. Therefore, for simplicity, in EU uncertainty estimate it was decided to assume that emissions between years are fully correlated, even though this may underestimate trend uncertainty to some extent.

In the example in Table 1.13, uncertainty decreased when correlation between MS was added to the correlation between years. However, this is not always the case; in another example considering EU-15 MS estimates for 1A1a CO_2, uncertainty was ±0.2% when it was assumed that years correlate and

MS estimates are independent. When a correlation between MS was added, the uncertainty decreased to ±0.1%.

Correlation between MS is difficult to quantify, especially in case of trend uncertainty, where correlation between different MS in different years should also be quantified. Furthermore, effect of correlation on uncertainty (increasing or decreasing) depends on the direction and magnitude of trend for each MS and each source category. Therefore, a simple conservative assumption cannot be made. Therefore, for simplicity, it was assumed in trend uncertainty estimate that MS are independent22.

In general, the caveats of the method used are the same as in IPCC Tier 1, i.e. the result gives the most reliable results when uncertainties are small, and it assumes normal distributions even though this cannot actually be the case when uncertainties are >100%. However, these issues do not seem to have any major effect on the results, as can be seen from Table 1.14, where waste sector uncertainties are presented both with analytical method and Monte Carlo simulation. When uncertainty increases, also the difference between the two methods increases.

[22] When the correlation assumptions were simplified, IPCC Tier 1 method could also have been used

Table 1.14 Comparison of trend uncertainty estimates 2005 for EU-15 Waste Sector using the modified Tier 1 method and Monte Carlo simulation (Tier 2).

Sector	GHG	Tier 1	Tier 2
6A. Landfills	CH_4	±12	±12
6B. Wastewater	CH_4	±27	-28 to +27
6B. Wastewater	N_2O	±9	±9
6C. Waste incineration	CO_2	±7	±7
6C. Waste incineration	CH_4	±23	-23 to +24
6C. Waste incineration	N_2O	±18	±18
Waste Other	CH_4	±990	-976 to +993
Total Waste Sector		±11	±11

Note: Trend uncertainty is presented as percentage points.

Furthermore, trend uncertainty was calculated as in Equation 1, and the resulting confidence intervals were divided by base year estimate (best estimate) to obtain the relative change. The results would have been somewhat different, if trend uncertainty were calculated as in Equation 2:

$$\mathbf{Trend_{n,x} = [E_{n,x}(t)-E_{n,x}(0)]/\ E_{n,x}(0)} \qquad \mathbf{(2)}$$

However, the effect of the choice between Eq 1 and 2 depends also on the direction and magnitude of trend in different MS, and without further consideration it cannot be stated whether choice of Eq 1 yielded a conservative estimate or not.

Lack of knowledge of different correlations, and many assumptions make the interpretation of EU trend uncertainty difficult, and therefore it should not be compared with uncertainty estimates of other countries. However, trend uncertainty calculations are internally consistent, and therefore the results can be used e.g. to assess which categories are the most important sources of trend uncertainty in the EU inventory.

Table 1.15 shows the main results of the Tier 1 uncertainty analysis for the EU-15. The lowest level uncertainty estimates are for fuel combustion activities (1.1 %), the highest estimates are for agriculture (80.0 %). Overall level uncertainty estimates including LULUCF of all EU-15 GHG emissions is calculated with 8.9 % and excluding LULUCF slightly lower with 8.3 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for fuel combustion activities (+/- 0.4 percentage points), the highest estimates are for LULUCF (26.5 percentage points). Overall trend uncertainty (including LULUCF) of all EU-15 GHG emissions is estimated to be 1.3 percentage points.

These results of the Tier 1 uncertainty analysis 2014 are very similar to the results of the previous year. More detailed uncertainty estimates for the source categories are provided in Chapters 3-8.

Table 1.15 Tier 1 uncertainty estimates of EU-15 GHG emissions for the main sectors

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A Fuel combustion activities	all	3 184 033	2 851 333	-10.4%	1.1%	0.4%
1.B Fugitive emissions	all	92 101	42 770	-53.6%	12.4%	6.9%
2. Industrial processes	all	349 866	240 566	-31.2%	8.8%	7.0%
3. Solvents and other product use	all	8 353	5 401	-35.3%	36.3%	5.3%
4. Agriculture	all	442 771	372 765	-15.8%	80.0%	6.2%
6. Waste	all	170 547	101 636	-40.4%	23.6%	11.7%
5. LULUCF	all	-128 466	-177 258	38.0%	27.5%	26.5%
Total (incl LULUCF)	**all**	4 119 206	3 437 214	-16.6%	8.9%	1.3%
Total (excl LULUCF)	**all**	4 247 672	3 614 472	-14.9%	8.3%	1.0%

Note: Emissions are in Gg CO_2 equivalents

Furthermore an uncertainty analysis for Tier 2 (Monte-Carlo-Simulation) was conducted for each sector. The analysis includes all uncertainty data, which were reported for the member states. In detail, these are nearly 1 500 individual data rows for all MS at subsector level and gas.

In all input and output parameters, uncertainty has been expressed as normal probability density function. Consistent with the IPCC requirements, the uncertainty range is presented as range with 95% probability of a given value being within boundaries. Thus the boundaries were given as the 2.5 and 97.5-percentiles from the mean value.

During the Monte-Carlo-Analysis the emissions and the combined uncertainty (uncertainty for emission factor and activity data) with normal distribution functions were simulated through 10.000 iterations. Therefore, for each individual level a standard derivation of emissions were generated. The results for this Tier 2 analysis can be found in the following tables (Table 1.16, Table 1.17). They are very similar to the results of the previous year.

Table 1.16 Tier 2 uncertainty estimates of EU-15 GHG emissions per main sector

Source category	Gas	Base year emissions 1990 (average simulation value)	Last Year 2012 emissions (average simulation value)	Level uncertainty estimates based on MS uncertainty estimates medium (2.5 - 97.5 percentile)
1.A Fuel combustion activities	all	3 183 976	2	1% (0.98 - 0.99)
1.B Fugitive emissions	all	92 065	42 825	10.9% (10.8 - 10.9)
2. Industrial processes	all	349 672	240 544	4.8% (4.8 - 4.9)
3. Solvents and other product use	all	8 355	5 383	31.7% (31.7 - 31.8)
4. Agriculture	all	443 394	373 724	32.9% (32.49 - 33.4)
6. Waste	all	-128 819	-177 075	24.4% (24.294 - 24.6)
5. LULUCF	all	170 287	101 689	19.8% (19.8 - 19.8)

Note: Emissions are in Gg CO_2 equivalents and are mean values of the Monte-Carlo-Analysis

Table 1.17 Tier 2 uncertainty estimates of EU-15 GHG emissions per gases

		CO_2	**CH_4**	**N_2O**	**PFC**	**HFC**	**SF_6**	**total GHG**
1990	Mean value	3 233.63	434.66	395.74	30.93	11.75	12.22	4 118.93
	Standard deviation	33.20	17.33	77.71	1.27	0.42	0.40	86.19
	2s	2.1%	8.0%	39.3%	8.2%	7.2%	6.6%	4.2%
2011	Mean value	2 808.74	292.43	258.05	71.33	2.43	5.52	3 438.50
	Standard deviation	25.49	10.85	63.18	5.61	0.10	0.18	69.37
	2s	1.8%	7.4%	49.0%	15.7%	8.5%	6.7%	4.0%

Table 1.18 gives an overview of information provided by EU-15 Member States on uncertainty estimates in their national inventory reports 2012 and presents summarised results of these estimates. For some Member States, either a national inventory report was available, which did not include quantitative uncertainty analysis, or no national inventory report was available at all.

Table 1.18 *Overview of uncertainty estimates available from EU-15 Member States*

Member State	**Austria**		**Belgium**	**Denmark**	**Finland**	**France**	**Germany**	**Greece**	
Citation	NIR Apr 2014, pp.47-48		NIR Apr 2014, pp.45-46	NIR May 2014, p.76	NIR Apr 2014, p.38	NIR, Mar 2014, p. 50	NIR Apr 2014 , p.119	NIR, Apr 2014, pp. 34-37	
Method used	Tier 1		Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes		Yes (Annex 2)	Yes	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex IV)	
Years and sectors included	emissions: 2011; trends: 1990-2011; including LULUCF		emissions: 2012; trends: 1990-2012; including LULUCF	emissions: 2012; trend:1990 - 2012; excluding LULUCF	emissions: 2012; trends: 1990-2012; including LULUCF	emissions: 2012; trends: 1990-2012; including LULUCF	emissions: 2012; trends: 1990-2012; including LULUCF	emissions: 2012; trends: 1990-2012; including LULUCF	
Uncertainty (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1 (e. L.)
CO_2				5.6%				2.8%	2.5%
CH_4				19%				46.0%	42.2%
N_2O				42%				96.5%	94.1%
F-gases				43%				170.1%	167.6%
Total	25.7%	6.1%	5.5%	5.6%	i. L.: 25.5% e. L.: 7.5%	i. L.: 19.2% e. L.: 16.7%	6.1%	9.94%	8.03%
Uncertainty in trend (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2				±2.4% points					
CH_4				±11.8% points					
N_2O				±12.6% points					
F-gases				±41% points					
Total	±2.96 % points	±2.23 % points	±2.35% points	±2.5% points	i. L.: ±32.6% points e. L.: ±6.2% points	i. L.: ±3.1% points e. L.: ±2.3% points	6.40%	±10.24 % points	±10.03 % points

Member State	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Citation	NIR Apr 2014, p. 25-27	NIR Apr 2014, p.41	NIR Apr 2014, p.84	NIR Apr 2014, p.31	NIR May 2014, pp.22-23	NIR Apr 2014, p.77	NIR May 2014, p.69	NIR Mar 2014, p.78
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes	Annex 1	Yes	Yes (Annex 7)	Yes (Annex B)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex 7)
Years and sectors included	emissions: 2012; trend: 1990-2012; all categories (i.L.)	emissions: 2012; trend: 1990-2012; all categories (i.L.)	emissions: 2012, trend: 1990-2012; all categories (i.L.)	emissions: 2012; trend: 1990-2012; all categories (e.L.)	emissions: 2012, trend: 1990-2012; all categories (i.L.)	emissions: 2012; trend: BY-2012; including LULUCF	emissions: 1990 and 2012; trend: 1990-2012; including LULUCF	emissions: 1990, 2010; trend: BY - 2010, including LULUCF
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2	1.12%			2%		-		
CH_4	1.72%			16%		-		
N_2O	6.46%			43%		-		
F-gases	0.38%			42%				
Total	6.8% (e.L.) 11.34% (i.L.)	4.9% (i.L.) 3.6% (e.L.)	3.64% (i.L.) 2.54% (e.L.)	3.3%	13.4%	12.5% (e.L.) 15.0% (i.L)	4.5% (e.L) 30% (i.L)	i. L.: 12.6% e. L.: 12.3%
Uncertainty in trend (%)	Tier1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2	1.4%			2%				
CH_4	0.9%			5%				
N_2O	2.1%			8%				
F-gases	0.5%			13%				
Total	i.L.:± 6.23% points e.L.:±2.71% points	i.L.:± 3.8% points e.L.:±2.5% points	i.L.: ±3.23% oints e.L.: ±0.89% points	2.6%		i.L.: ±10.8% points e.L.: ±9.3% points	e.L: ±1.8% points i.L: ±6.5% points	i. L.: ±2.61% points e. L.: ±2.59% points

1.8 General assessment of the completeness

1.8.1 Completeness of Member States' submissions

The EU GHG inventory is compiled on the basis of the inventories of the EU Member States. Therefore, the completeness of the EU inventory depends on the completeness of the Member States' submissions. Table 1.19 summarises timeliness and completeness of the EU-15 Member States' submissions in 2014. It shows that GHG inventories for 2012 were submitted by all EU-15 Member States by 8 May 2014 (cut off date for the 27 May submission). The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 1.3.

Table 1.19 Date, mode and content of submissions of EU-15 Member States in 2014 (status 09 May 2014)

Country	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
AT	15.01.2014	CDR	AUT-2014-v1.1	13.01.2014	1990-2012	2008-2012	Short NIR
AT	13.03.2014	CDR	AUT-2014-v1.3	-	1990-2012	2008-2012	x
AT	14.04.2014	CDR	AUT-2014-v1.4	-	1990-2012	2008-2012	x
BE	14.01.2014	CDR	BEL-2014-v1-1	-	1990-2012	2008-2012	x
BE	15.03.2014	CDR	BEL-2014-v1.3	10.01.2014	1990-2012	2008-2012	x
BE	10.04.2014	CDR	BEL-2014-v1.4	-	1990-2012	2008-2012	x

Country	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
DK	15.01.2014	CDR	DNM-2014-v1.1	v1.2.1	1990-2012	1990, 2008-2012	Short NIR
DK	14.03.2014	CDR	DNM-2014-v1.2	04.03.2014	1990-2012	1990, 2008-2012	x
DK	15.04.2014	CDR	-	-	-	-	x
DK	15.04.2014	CDR	DNM-2014-v1.4	-	1990-2012	1990, 2008-2012	-
DK	08.05.2014	CDR	-	-	-	-	x
FI	15.01.2014	CDR	FIN-2014-v1.2	10.01.2014	1990-2012	2008-2012	x
FI	14.03.2014	CDR	FIN-2014-v1.4		1990-2012	2008-2012	x
FI	15.04.2014	CDR	FIN-2014-v1.5	-	1990-2012	2008-2012	x
FR	15.01.2014	CDR	FRK-2014-v1.1	-	1990-2012	2008-2012	Short NIR (fr)
FR	14.03.2014	CDR	FRK-2014-v1.2	10.01.2014	1990-2012	2008-2012	x (fr)
FR	07.05.2014	CDR	FRK-2014-v1.3	-	1990-2012	2008-2012	-
DE	14.01.2014	CDR	DEU-2014-v1.1	10.01.2014	1990-2012	2008-2012	x (de)
DE	15.04.2014	CDR	-	-	-	-	x
GR	15.01.2014	CDR	GRC-2014-v1.1	13.01.2014	1990-2012	2008-2012	short NIR
GR	17.03.2014	CDR	GRC-2014-v1.2	-	1990-2012	2008-2012	x
GR	16.04.2014	CDR	GRC-2014-v1.4	-	1990-2012	2008-2012	x
IE	15.01.2014	CDR	IRL-2014-v1.1	10.01.2014	1990-2012	2008-2012	Short NIR
IE	14.03.2014	CDR	IRL-2014-v1.2	-	1990-2012	2008-2012	x
IE	15.04.2014	CDR	IRL-2014-v1.3	-	1990-2012	2008-2012	x
IE	09.05.2014	CDR	IRL-2014-v1.4	-	1990-2012	2008-2012	-
IT	16.01.2014	CIRCA	ITA-2014-v1.1	09.01.2014	1990-2012	2008-2012	-
IT	14.03.2014	CIRCA	ITA-2014-v1.2	-	1990-2012	2008-2012	x
IT	15.04.2014	CIRCA	ITA-2014-v1.3	-	1990-2012	2008-2012	x
LU	24.01.2014	CDR	LUX-2014-v1.1	-	1990-2012	2008-2012	-
LU	14.03.2014	CDR	LUX-2014-v1.4	09.01.2014	1990-2012	2008-2012	x
LU	15.04.2014	CDR	-	-	-	-	x
NL	15.01.2014	CDR	NLD-2014-v1.1	13.01.2014	1990-2012	2008-2012	x
NL	14.03.2014	CDR	NLD-2014-v1.2	-	1990-2012	2008-2012	x
NL	15.04.2014	CDR	NLD-2014-v1.3	-	1990-2012	2008-2012	x
PT	15.01.2014	CDR	PRT-2014-v1.1	09.01.2014	1990-2012	1990, 2008-2012	Short NIR
PT	15.03.2014	CDR	PRT-2014-v1.2	-	1990-2012	1990, 2008-2012	x
PT	16.04.2014	CDR	-	-	-	-	x
PT	09.05.2014	CDR	PRT-2014-v1.3	-	1990-2012	1990, 2008-2012	x
ES	27.01.2014	CDR	ESP-2014-v1.3	16.01.2014	1990-2012	1990, 2008-2012	x (es)
ES	14.03.2014	CDR	ESP-2014-v1.5	-	1990-2012	1990, 2008-2012	x (es)
ES	15.04.2014	CDR	ESP-2014-v1.8	-	1990-2012	1990, 2008-2012	x (es)
SE	14.01.2014	CDR	SWE-2014-v1.1	-	1990-2012	2008-2012	x
SE	14.03.2014	CDR	-	03.02.2014	-	-	x
SE	23.04.2014	CDR	-	-	-	-	x
SE	08.05.2014	CDR	-	-	-	-	x
GB	15.01.2014	CDR	GBE-2014-v1.2	09.01.2014	1990-2012	2008-2012	Short NIR

Country	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
GB	04.02.2014	CDR	GBE-2014-v1.3	-	1990-2012	2008-2012	-
GB	14.03.2014	CDR	GBE-2014-v1.4	-	1990-2012	2008-2012	x

In response to the Saturday paper 2010 the EU mobilized the mechanisms of its national system to further enhance its QA/QC programme and develop an appropriate action plan, in consultation with the MS, geared in particular towards complementing the existing procedures and improving the completeness regarding NEs of the EU greenhouse gas inventory in 2011 and beyond (see description above). During February and March intensive consultation between the EU inventory team and the Member States took place. In some cases the EU inventory team recommended Member States to provide estimates and/or change the use of notation keys. Annex 1.4 provides a list of all NEs and IEs and includes explanations taken from the Member States' CRF Tables 9. This information is equivalent to CRF Table 9 which cannot be filled-in automatically for the EU-15 due to the amount of information from the Member States.

The following table provides an overview of the general completeness sections of the Member States' National Inventory Reports.

Table 1.20 Description of completeness taken from EU-15 Member States submissions 2014

MS	Description of the completeness	Source
Austria	"NE" is used for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where "NE" is used in an inventory for emissions or removals, both the NIR and the CRF completeness table indicate why emissions or removals have not been estimated. For emissions by sources and removals by sinks of greenhouse gases marked by "NE" check-ups are in progress to establish if they actually are "NO" (not occurring). As part of the improvement programme of the inventory, it is planned that these source or sink categories are either estimated or allocated to "NO".	Austria's Annual Greenhouse Gas Inventory 1990–2012 Mar 2014 p. 51
Belgium	All sources and sinks included in the IPCC 1996 Guidelines are covered with the exception of the following (very) minor sources: - CO_2 from asphalt roofing (2A5), due to missing activity data; - CO_2 from road paving (2A6), due to missing activity data; All direct and indirect greenhouse gases and SO_2 are covered in the Belgian inventory. The geographic coverage is complete. There is no part of the Belgian territory not covered by the inventory.	Belgium's Greenhouse Gas Inventory (1990–2012) Mar 2014 p. 45
Gemany	In the area of industrial processes, some use is made of production data from association statistics and of manufacturers' information. In the interest of the inventory's completeness and reliability, where emissions reporting is based on such sources, checking of sourcecategory definitions and data-collection methods will continue to receive priority.The "Not Estimated" (NE) emissions, which are still reported, consist primarily of noncalculated emissions that, pursuant to IPCC GPG (2003, p.1.11), do not have to be calculated by a reporting country, since those emissions are listed in Appendices 3a.2, 3a.3 and 3a.4.. Some of the emissions data available to the Federal Environment Agency are confidential, due to data-protection requirements, and thus are reported only in aggregated form – although they are reported completely.	National Inventory Report, Germany – 2014, 15.04.2014 p. 121
Denmark	The Danish greenhouse gas emission inventories for 1990-2012 include all sources identified by the Revised 1996 IPCC Guidelines and the 2000 IPCC Good Practice Guidance. Some very minor sources have not been estimated due to lack of methodology, activity data or emission factors, i.e.: In the solvent and other product use sector currently only N_2O emissions from anaesthesia and some other minor uses are included in CRF category 3D, Denmark will try to obtain activity data for use of N_2O in aerosol cans. N_2O emissions from anaesthesia are only included from 2000 onwards. Direct and indirect CH_4 emissions from agricultural soils are not estimated. Direct and indirect soil emissions are considered of minor importance for CH_4. No methodology is available in the IPCC Guidelines. Emissions from harvested wood products are not reported due to lack of da-ta. Several possible sources of CH_4 in the LULUCF sector are also reported as not estimated. For more detail please see Chapter 7. In the Waste sector CO_2 emissions from managed waste disposal on land are not estimated. According to the 1996 IPCC Guidelines: "Decomposition of organic material derived from biomass sources (e.g., crops, forests), which are regrown on an annual basis is the primary source of CO_2 released from waste. Hence, these CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology." Emissions of N_2O from accidental fires are reported as not estimated due to lack of emission factors.	Denmark's National Inventory Report 2014 Mar 2013 Annex 5, p. 1161
Finland	Finland has provided estimates for all significant IPCC source and sink categories according to the detailed CRF classification. Estimates are provided for the following gases: CO_2, N_2O CH_4, F-gases (HFC, PFC and SF_6), NMVOC, NO_X, CO and SO_2. In accordance with the IPCC Guidelines, international aviation and marine bunker fuel emissions are not included in national totals. The geographical coverage of the inventory is complete. It includes emissions from the autonomic territory of Åland (Ahvenanmaa). The emissions for the territory of Åland are not reported separately. A complete set of CRF tables are provided for all years and the estimates are calculated in a consistent manner..	Greenhouse Gas Emissions in Finland 1990 - 2012 Mar 2014 p39

MS	Description of the completeness	Source
France	The reported inventory under the UNFCCC Kyoto Protocol covers the period 1990-2012 in annual steps. The year 1990 is the reference year for all substances. The geographic scope of the UNFCCC is constituted by the 96 departments of Metropolitan France and all French oversea territories. The latter are classified as following : • Oversea countries and territories not included in the European Union (French Polynesia, Wallis and Futuna, Mayotte, New Caledonia, Saint-Pierre and Miquelon and the French Southern and Antarctic Lands) • Oversea countries and territories included in the European Union (Guadeloupe, Martinique, Guyana and Reunion, the oversea communities Saint Berthélemy and Saint-Martin)	Rapport National d'inventaire pour la France au titre de la convention cadre des nations unies sur les changements climatiques et du protocole de Kyoto Mar 2014 p 46 (translated into English)
Greece	In the present inventory report, which supersedes all previous ones, estimates of GHG emissions in Greece for the years 1990-2012 are presented. Emissions estimates included in the CRF tables submitted and discussed in the present report, cover the whole territory of Greece. All major sources are reported including emissions estimates for indirect greenhouse gases and SO_2. Completeness gaps in the present inventory submission that will be discussed in more details in the relevant chapters include: CO_2 emissions from organic chemicals production and asphalt roofing-road paving with asphalt are not estimated due to lack of emission factors in the IPCC guidelines. NO_X emissions from glass production are not estimated due to lack of emission factors in the IPCC guidelines. Potential emissions of F-gases have not been estimated, due to the lack of data. The initial plan of Greece was to collect data concerning imports and exports of F–gases (in bulk) by the Hellenic Statistic authority. Nevertheless since these compounds were not reported per f-gas type but aggregately to the ElStat, the estimation of potential emissions was not possible. Moreover in line to the implementation of the improvement plan of 2012 the inventory team has been into close collaboration with National Association of Refrigeration Importing & Trading Companies and a form sent annually to all their members asking for the quantities of F-gases imported, exported and sold per blend and year. Since the respond of the companies for 2011 and 2012 was 50%, the inventory team couldn't use these data for the estimation of potential emissions. For the implementation of EC Regulation No 842/2006 a Common Ministerial Decision 18694 has been published in Greece on the 11th of April 2012. The above mention regulation defined among others the data collection procedures regarding the enterprises that produce, import, export, recover, recycle and trade F-gases on annual basis until every 31th of March of each year. The inventory team was planning to use the information that shall be gathered in the framework of the Common Ministerial Decision 18694. The inventory team was planning to use the information that will be collected in the framework of the Common Ministerial Decision 18694. With reference to this regulation the importers and exporters of f-gases communicate to the Commission and to the Competent Greek Authority (namely the Ministry of Environment, Energy and Climate Change) the above mentioned information. Considering the scheduled dates for gathering the data, this improvement was planned for the 2014 submission. The Inventory Team is in communication with the respective Directory and has already viewed some of the reports; however, the filing of the reports is in a rather non-consistent manner (hardcopies, missing information etc.). Additionally, the data are not complete since not all the companies responded. Thus, no safe conclusions can be drawn and the respective information has not proven useful so far. The inventory team is trying to resolve this issue by communicating with each of the company separately trying to encourage all the members to respond and complete the required data. In addition, an excel sheet has been resending to them. It should be mention that any available data will be examined by the inventory team if they are adequate according to the IPCC GPG, and how this information could be introduced in the next submissions.	Climate Change Emissions inventory Mar 2014 p40
Ireland	Table 1.14 gives an overview of the level of completeness of the 2014 GHG inventory submission with respect to the six greenhouse gases covered by the UNFCCC reporting guidelines, the IPCC Level 2 source-category split in operation since 2005 for reporting under the Convention and Article 3.3 activities under the Kyoto Protocol. Further detail on source/gas coverage at IPCC Level 3 is provided in the individual chapters describing the inventory methods and data for each Level 1 source-category. The availability of new, more detailed, input data has allowed some emission calculations to be undertaken at a more detailed level. This has improved the accuracy of the emission estimates, and in some cases the completeness of the inventory has been improved – although not at the sectoral level.	National Inventory Report 2014 Mar 2014 p.27

MS	Description of the completeness	Source
Italy	The inventory covers all major sources and sinks, as well as direct and indirect gases, included in the IPCC guidelines. Sectoral and background tables of CRF sheets are complete as far as details of basic information are available. For instance, multilateral operations emissions are not estimated because no activity data are available. Allocation of emissions is not consistent with the IPCC Guidelines only where there is no data available to split the information. For instance, for fugitive emissions, CO_2 and CH_4 emissions from oil and natural gas exploration and venting are included in those from oil production because no detailed information is available. CH_4 emissions from other leakage emissions are included in distribution emission estimates. N_2O emissions from oil and natural gas exploration and refining and storage activities are reported under category 1.B.2.C oil flaring. Further investigation will be carried out closely with industry about these figures. For industrial processes, emissions from soda ash use are included in glass production emissions because the use of soda is part of that specific production process.	Italian Greenhouse Gas Inventory 1990-2012 Mar 2014 p.43 f.
Luxembourg	All sources and sinks included in the IPCC Guidelines are covered. With regards to LULUCF, this submission contains new estimations for LULUCF, the three main sub-categories now being covered as well as the sub-categories wetlands, settlements and other lands, which were not estimated in the previous submission. Both direct GHGs as well as precursor gases are covered by Luxembourg's inventory. However, indirect GHG – NO_X, CO, NMVOCs – and SO_2 need to be re-evaluated in the light of the revision of the inventories Luxembourg is compiling for the UNECE CLRTAP. Generating better emission estimates for these gases are part of our planned improvements. The notation key NE is used for existing emissions by sources and removals by sinks of GHG which have not been estimated. Where NE is used in an inventory for emissions or removals, CRF table 9 indicates why emissions or removals have not been estimated. For emissions by sources and removals by sinks of GHG marked by NE, check-ups are in progress to establish if they actually are NO (not occurring). As part of the improvement programme of the inventory, it is planned that these source or sink categories are either estimated or allocated to NO.	National Inventory Report 1990-2012, Mar 2014 pp 74-75
Netherlands	the Netherlands' greenhouse gas emissions inventory includes almost all sources identified by the revised Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 1996). As of this submission we included new emission estimates for enteric fermentation and manure management for mules and assess. The following very minor sources are not included in the inventory: • CO_2 from Asphalt roofing (2A5), due to missing activity data; • CO_2 from Road paving (2A6), due to missing activity data; • CH_4 from Enteric fermentation of poultry (4A9), due to missing EFs; • N_2O from Industrial wastewater (6B1), due to negligible amounts; • part of CH_4 from Industrial wastewater (6B1b sludge), due to negligible amounts; • Precursor emissions (carbon moNO$_X$ide (CO), nitrogen oxide (NO_X), nonmethane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2)) from memo item 'International bunkers' (international transport), are not included.	Greenhouse gas emissions in the Netherlands 1990-2012 Mar 2014 p 24
Portugal	CRF Table 9 (Completeness) gives an overview of the level of completeness of the 2012 submitted inventories to the UNFCCC and EC. Additional information on this issue is given in the subchapters. The inventory covers the 6 gaseous air pollutants included in Annex A to the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), as well as estimates for indirect GHGs, including carbon moNO$_X$ide (CO), nitrogen oxides (NO_X), and non-methane volatile organic compounds (NMVOC). Data are also reported for sulphur oxides (SOx). As a general rule the inventory covers emissions realized in the whole Portuguese territory, i.e., mainland Portugal and the two autonomous regions of Madeira and Azores Islands.	Portuguese National Inventory Report on Greenhouse Gases, 1990-2012 Mar 2014 p1-24

MS	Description of the completeness	Source
Spain	Completeness has been evaluated according to the methodology recommended by the IPCC: NO (not occurring), NE (not estimated); NA (not applicable); IE (included elsewhere); C (confidential), 0 (less than half the unit used). In assessing the completeness by activity a conservative approach has been applied in the assignment of NE (not estimated), NO (not occurring) and NA (not applicable). Thus, NO is assigned only when there is certainty that the activity itself does not occur in the country, and NA is reserved for cases where there is a well-founded knowledge that no emission occurs in the corresponding sector in the country. NE is used in the remaining cases where estimates have not been made and no other notation keys have been assigned, though there may be emissions in some cases (but no information on emission factors, algorithms for estimating the emissions is available). A detailed presentation by gases and activities where notation keys are used are referred in the tables of the CRF Reporter. As a general assessment it can be said that the general completeness has been successfully achieved, with the following exceptions: - For the fluorinated gases (HFCs, PFCs, SF_6) it was not possible to estimate the potential emissions because of a lack of information on the foreign trade flows (imports and exports). In Annex 5 "Assessment of completeness" a detailed table on the completeness is presented for the potential emission of fluorinated gases. - In LULUCF categories: The main incompleteness is because flows of emissions and removals of deposits (dead wood, litter, soil organic carbon) in forests. In section 11.3.1.2 it has been argued that these deposits do not result in a source of emissions. In the tables of the CRF reported detailed information on this category is listed.	Inventario de emisiones de gases de efecto invernadero des Espana anos 1990-2012 Mar 2014 p. 1.55 (translated)
Sweden	GHG inventory The inventory covers emissions and sinks in Sweden. All greenhouse gases arecovered. The general completeness for each sector is discussed below. Detailed information is presented in Annex 5. ENERGY: Estimated emissions are considered to be complete for most sources. Emissions of CH_4 and N_2O from liquid bio fuels used in military transportation are however not estimated. There might also still be some lack in completeness as regards in-house generated fuels in the chemical industry and in smaller companies. INDUSTRIAL PROCESSES: For most sources, and particularly for the most important ones, the estimates are in accordance with the requirements concerning completeness as laid out in the Good Practice Guidance. However, some exceptions do exist. These are primarily in subsectors with a large number of smaller facilities with minor emissions and for which no IPCC default methodology exists. Data is complete for all greenhouse gases, possibly with the exception of CH_4 for a few sources, e.g. within the chemical industry. SOLVENT AND OTHER PRODUCT USE: The estimated emissions from solvent and product use are considered to be complete, since a new method was developed during 2005 in order to obtain all activity data concerning the sector from the Products register at the Swedish Chemicals Agency. The estimated emissions of N_2O are also considered to be complete, since national data from the Products register is used in the inventory. AGRICULTURE: All relevant agricultural emissions and sources are reported in the inventory. Reindeer, which are normally not considered as a part of the agricultural sector, are included in the inventory. There are, however, some marginal animal groups, which are not included, such as fur-bearing animals (minks, foxes and chinchillas). These groups are very small and there are no default methodologies developed for estimating their GHG emissions. All sales of fertilizers are included in the inventory, also quantities used in other sectors. N-fixing crops used in temporary grass fields, and sludge used as fertilizer is also included. This means that all anthropogenic inputs to agricultural soils are covered. LAND USE, LAND USE CHANGE AND FORESTRY: All land areas are inventoried in the field except high mountains, military impediments and urban land. We believe that their relative importance for the Swedish GHG inventory is small. The inventory of the LULUCF-sector is complete in the sense that all carbon pools and other sources, defined based on the IPCC GPG for LULCUF, are reported for land use categories that are considered managed. The reporting of woody biomass stocks refers to above and below ground parts of trees taller than 1.3 m. Other vegetation such as shrubs and herbs are not reported. Emissions/removals from below ground biomass of dead stump systems are from this submission included in the dead organic matter pool. WASTE: The effects of possible leakage of methane and nitrous oxide from the wastewater treatment processes have not been estimated. All other data are complete.	National Inventory Report Sweden 2014 Mar 2014 p. 73
United Kingdom	The UK GHG inventory aims to include all anthropogenic sources of GHGs. Annex 5 shows sources of GHGs that are not estimated in the UK GHG inventory, and the reasons for those sources being omitted.	UK Greenhouse Gas Inventory, 1990 to 2012 Mar 2014 p.79

1.8.2 Data gaps and gap-filling

1.8.2.1 Gap filling of emissions

The EU GHG inventory is compiled by using the inventory submissions of the EU Member States. If a Member State does not submit all data required for the compilation of the EU inventory by 15 March of a reporting year, the Commission prepares estimates for data missing in collaboration with the relevant Member State. In the following cases gap filling is made:

- To complete specific years in the GHG inventory time-series for a specific Member State
- for the most recent inventory year(s);
- for the base year;
- for some years of the time series from 1990 to the most recent year.
- To complete individual source categories for individual Member States that did not estimate specific source categories for any year of the inventory time series and reported 'NE'. Gap filling methods are used for major gaps when it is highly certain that emissions from these source categories exist in the Member States concerned;
- To provide complete CRF background data tables for the European Union when some Member States only provided CRF sectoral and summary tables. (In this case, the gap filling methods are used to further disaggregate the emission estimates provided by Member States.)
- To enable the presentation of consistent trends for the EU.

For data gaps in Member States' inventory submissions, the following procedure is applied by the ETC/ACM in accordance with the implementing provisions under the MMR for missing emission data:

- If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. As far as CO_2 emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO_2 emission estimates if appropriate.
- If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert review team as provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' is used without application of the conservativeness factor.
- If a consistent time series of reported estimates for the relevant source category is not available and if the source category has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, the estimation should be based on the methodological guidance provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' without application of the conservativeness factor.

The Commission prepares the estimates by 31 March of the reporting year, following consultation with the Member State concerned, and communicates the estimates to the other Member States. The Member State concerned shall use the estimates referred to for its national submission to the UNFCCC to ensure consistency between the EU inventory and Member States' inventories.

The methods used for gap filling include interpolation, extrapolation and clustering. These methods are consistent with the adjustment methods described in UNFCCC Adjustment Guidelines (Table 1) and in the IPCC GPG 2000.(23) On the basis of the general approaches mentioned above concrete methodologies were developed for each sector/gas (Table **1.20**).

1.8.2.2 Gap filling of emissions in GHG inventory submissions 2014

Since 2011 GHG inventory estimates have been complete for all EU Member States, and therefore no gap filling has been needed.

23 ETC ACC technical note on gap filling procedures , December 2006

1.8.2.3 Gap filling of activity data

In response to to recommendations of the UNFCCC review team the EU elaborated and implemented a gap filling procedure for gaps in activity data (see also chapter 1.8.5.2). Due to the large resource needs for gap filling the following rule was applied in 2014:

- Only activity data for key categories will be gap-filled.
- If more than 80% of the emissions are calculated on basis of consistent activity data.
- If the IEF has a reasonable degree of consistency (i.e. standard deviation devided by mean < 50%).
- Only for 2012.

1.8.2.4 Gap filling of activity data in GHG inventory submissions 2014

Applying the rules mentioned above activity data of the following categories have been gap-filled in the inventory submission 2014:

- Clinker production in 2A1
- Lime production in 2A2
- Ammonia production in 2B1
- Protein consumption and N-fraction for human sewage

1.8.3 Data basis of the European Union greenhouse gas inventory:

The 2012 EU-15 GHG inventory data consist of GHG submissions of the Member States to the European Commission in 2014; no gap filling was needed. Table **1.21** to Table **1.24** show the data basis of the 2014 EU GHG inventory.

Table 1.21 Data basis of CO_2 emissions excluding LULUCF (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	62	64	66	79	77	74	74	68	72	70	68
Belgium	119	124	125	124	122	117	119	107	113	104	101
Denmark	53	61	54	51	59	54	51	49	49	44	39
Finland	57	58	57	57	68	66	58	55	63	56	51
France	396	395	412	422	412	403	396	378	386	360	363
Germany	1 042	931	892	862	873	849	851	786	829	810	822
Greece	83	86	103	113	111	114	110	104	97	94	90
Ireland	32	35	45	48	47	47	47	42	41	38	38
Italy	435	445	462	488	484	475	464	415	425	413	387
Luxembourg	12	9	9	12	12	11	11	11	11	11	11
Netherlands	159	171	170	176	172	172	175	170	181	168	165
Portugal	45	54	66	69	65	62	60	57	52	51	50
Spain	228	263	308	365	357	364	333	294	280	281	277
Sweden	57	59	54	53	53	52	50	47	52	48	46
United Kingdom	589	551	554	558	558	551	534	484	502	461	480
EU-15	**3 369**	**3 307**	**3 375**	**3 477**	**3 470**	**3 412**	**3 333**	**3 064**	**3 156**	**3 011**	**2 988**

Table 1.22 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	8	8	7	6	6	6	6	6	6	5	5
Belgium	10	9	8	7	7	7	7	7	7	6	6
Denmark	6	6	6	6	6	6	6	6	6	6	5
Finland	6	6	5	4	5	4	4	4	4	4	4
France	61	64	61	56	55	55	56	54	54	53	53
Germany	109	92	75	59	57	54	53	51	50	49	49
Greece	11	11	11	10	10	10	10	10	10	10	10
Ireland	14	14	13	13	13	12	12	12	12	12	12
Italy	45	45	47	41	40	41	39	38	38	36	36
Luxembourg	0	0	0	0	0	0	0	0	0	0	0
Netherlands	26	24	20	16	16	16	16	16	16	15	15
Portugal	10	12	12	13	12	12	12	12	12	12	12
Spain	26	28	32	33	33	33	33	33	32	32	32
Sweden	7	7	6	6	6	5	5	5	5	5	5
United Kingdom	104	97	78	62	61	59	58	56	52	52	50
EU-15	**443**	**423**	**383**	**333**	**326**	**321**	**316**	**310**	**304**	**298**	**296**

Table 1.23 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	6	7	6	5	6	6	6	5	5	5	5
Belgium	11	12	11	9	8	8	8	8	8	7	7
Denmark	10	9	8	6	6	6	6	6	6	6	6
Finland	9	8	8	8	8	8	8	7	7	7	7
France	93	92	80	70	68	68	69	65	63	63	60
Germany	86	80	62	61	60	62	64	64	55	57	56
Greece	10	9	9	8	8	8	8	7	8	7	7
Ireland	9	10	10	8	8	8	8	8	8	7	7
Italy	38	39	40	38	32	32	30	28	27	27	28
Luxembourg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Netherlands	20	20	17	16	15	14	10	10	9	9	9
Portugal	6	6	6	5	5	5	5	5	5	5	5
Spain	27	25	31	27	28	28	25	25	26	25	24
Sweden	8	8	7	7	7	7	7	7	7	6	6
United Kingdom	70	59	48	43	41	40	39	37	38	36	36
EU-15	**402**	**383**	**344**	**313**	**301**	**299**	**292**	**281**	**272**	**269**	**264**

Table 1.24 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	HFC	23	340	647	997	1 004	1 043	1 082	1 134	1 286	1 349	1 431
	PFC	1 023	68	67	125	137	184	167	29	64	60	40
	SF_6	493	1 153	602	517	475	384	391	358	352	322	326
Belgium	HFC	NA,NO	449	933	1 460	1 562	1 744	1 839	1 916	1 999	2 076	2 140
	PFC	1 753	2 335	361	154	159	181	202	116	86	179	220
	SF_6	1 651	2 243	150	95	80	82	91	98	107	116	117
Denmark	HFC	NA,NE,NO	218	607	802	823	850	853	799	804	759	657
	PFC	NA,NO	1	18	14	16	15	13	14	13	11	9
	SF_6	44	107	59	22	36	30	32	37	38	73	118
Finland	HFC	0	29	492	863	747	903	993	889	1 170	1 032	926
	PFC	0	0	22	10	15	8	11	9	1	1	2
	SF_6	115	71	54	66	71	53	51	50	35	36	37
France	HFC	3 657	1 756	5 962	11 702	12 578	13 354	14 105	14 807	15 746	16 704	16 900
	PFC	4 293	2 562	2 488	1 433	1 169	928	569	370	387	432	400
	SF_6	2 282	2 713	2 442	1 374	1 240	1 116	1 095	926	849	663	671
Germany	HFC	4 592	7 008	7 430	8 448	8 605	8 656	8 782	9 307	8 877	9 153	9 346
	PFC	2 630	1 792	823	726	579	511	496	358	302	241	209
	SF_6	4 642	6 779	4 269	3 480	3 398	3 334	3 115	3 065	3 194	3 316	3 307
Greece	HFC	935	3 290	4 244	4 067	2 232	2 569	2 950	3 339	3 603	3 410	3 889
	PFC	163	54	105	74	71	81	94	74	106	78	110
	SF_6	3	4	4	6	8	10	8	5	6	5	5
Ireland	HFC	0	37	271	813	845	851	973	957	973	992	982
	PFC	0	75	305	168	148	131	106	66	37	13	8
	SF_6	36	83	54	102	63	66	57	41	35	48	39
Italy	HFC	351	680	1 838	5 148	5 834	6 546	7 162	7 769	8 299	8 804	9 246
	PFC	2 487	1 266	1 217	1 715	1 714	1 652	1 501	1 063	1 331	1 455	1 314
	SF_6	333	601	493	465	406	428	436	398	373	351	356
Luxembourg	HFC	12	16	29	53	57	61	63	65	66	67	67
	PFC	NA,NO	NA,NO	0.01	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	SF_6	1	2	2	5	6	6	7	7	7	8	8
Netherlands	HFC	4 432	6 019	3 891	1 511	1 743	1 862	1 929	2 070	2 257	2 132	2 055
	PFC	2 264	1 938	1 581	265	254	319	251	168	209	183	151
	SF_6	218	287	295	240	199	188	184	170	184	147	196
Portugal	HFC	NA,NE,NO	27	243	736	836	968	1 115	1 237	1 368	1 493	1 667
	PFC	NA,NE,NO	NA,NO	0.1	0.2	0.1	0.1	0.1	0.01	0.001	NA,NO	NA,NO
	SF_6	NA,NE,NO	7	10	26	26	37	36	41	44	44	45
Spain	HFC	2 441	4 880	8 448	5 959	6 559	6 897	7 327	7 520	8 203	7 790	7 574
	PFC	883	832	371	145	136	126	121	84	73	65	41
	SF_6	67	108	198	225	255	263	264	242	241	247	220
Sweden	HFC	4	132	568	791	819	840	868	870	848	820	775
	PFC	377	343	241	257	245	248	225	35	158	183	69
	SF_6	107	127	94	142	111	151	84	81	72	60	55
United Kingdom	HFC	11 384	15 317	8 818	11 175	11 847	12 124	12 679	13 083	13 464	13 722	13 886
	PFC	1 401	462	461	298	302	219	204	145	221	325	208
	SF_6	987	1 201	1 787	984	738	746	584	561	648	559	542
EU-15	HFC	27 832	40 197	44 419	54 526	56 090	59 268	62 722	65 762	68 963	70 304	71 540
	PFC	17 275	11 730	8 061	5 385	4 946	4 601	3 959	2 531	2 987	3 228	2 781
	SF_6	10 980	15 486	10 514	7 749	7 112	6 894	6 433	6 079	6 185	5 994	6 042

1.8.4 Geographical coverage of the European Union inventory

Table 1.25 shows the geographical coverage of the EU-15 Member States' national inventories. Note that not all Member States have signed and ratified the UNFCCC and the Kyoto Protocol with the same geographical coverage. In addition, the EU territory of a country is not always equivalent to the territory of the Party to the UNFCCC or the Kyoto Protocol. For three Member States there are differences in geographical coverage as UNFCCC Party, Kyoto Protocol Party and/or EU Member State (DK, FR and the UK).

If there are differences in geographical coverage the respective country needs to prepare several inventories. This is reflected in the country codes provided by the UNFCCC secretariat. For example Denmark uses the country code DNK for the inventory under the UNFCCC, the code DKE for the inventory under the Kyoto Protocol and the code DNM for the inventory for the EU territory.

As the EU-15 inventory is the sum of the Member States' inventories, the EU-15 inventory covers the same geographical area as the inventories of the 15 Member States for their respective EU territory. Note that the inventories of Denmark and the United Kingdom used for the EU-15 inventory differ from the inventories published on the UNFCCC website. All inventories used for the EU-15 inventory are published on the website of the EEA:

http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014

Table 1.25 Geographical coverage of the EU-15 inventory

Member State	Geographical coverage	EU-territory coverage (UNFCCC and Kyoto)	Party coverage (UNFCCC)	Party coverage (Kyoto Protocol)	Country code
Austria	Austria	√	√	√	AUT
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region	√	√	√	BEL
Denmark	Denmark (excluding Greenland and the Faeroe Islands)	√			DNM
	Denmark, Faroe Islands and Greenland		√		DNK
	Denmark and Greenland			√	
Finland	Finland including Åland Islands	√	√	√	FIN
France	Metropolitan France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion) and the overseas communities (Saint-Barthelemy and Saint-Martin), excluding the French overseas communities (French Polynesia, Wallis and Futuna, Mayotte, Saint-Pierre and Miquelon) and overseas territories (the French Southern and Antarctic Lands) and New Caledonia	√		√	FRK
	Metropolitan France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion), the overseas communities (French Polynesia, Saint-Barthelemy and Saint-Martin, Wallis and Futuna, Mayotte, Saint-Pierre and Miquelon) and overseas territories (the French Southern and Antarctic Lands) and New Caledonia,		√		FRA
Germany	Germany	√	√	√	DEU
Greece	Greece	√	√	√	GRC
Ireland	Ireland	√	√	√	IRE
Italy	Italy	√	√	√	ITA
Luxembourg	Luxembourg	√	√	√	LUX
Netherlands	The reported emissions include those that have to be allocated to the legal territory of the Netherlands. This includes a 12-mile zone from the coastline and also inland water bodies. It excludes Aruba, Curaçao and Sint Maarten that are constituent countries within the Royal Kingdom of the Netherlands. It also excludes the isles Bonaire, Saba and Sint Eustatius that are since 10 October 2010 public bodies (openbare lichamen) with their own legislation that is not applicable to the European part of the Netherlands. Emissions from offshore oil and gas production on the Dutch part of the continental shelf are included.	√	√	√	NLD
Portugal	Mainland Portugal and the two Autonomous regions of Madeira and Azores Islands. Includes also emissions from air traffic and navigation bunkers realized between these areas.	√	√	√	PRT
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla	√	√	√	ESP
Sweden	Sweden	√	√	√	SWE
United Kingdom	England, Scotland, Wales and Northern Ireland, and Gibraltar, excluding the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories (except Gibraltar).	√			GBE
	England, Scotland, Wales and Northern Ireland, the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories that have ratified the Kyoto Protocol (the Cayman Islands, the Falkland Islands, Bermuda, Monserrat and Gibraltar).		√	√	GBR
EU-15		√			EUC

1.8.5 Completeness of the European Union submission

1.8.5.1 National inventory report

The EU NIR follows – as far as posible - the annotated outline of the UNFCCC secretariat with the exception of the annexes. The main reason for this is the nature of the EU inventory being the sum of Member States' inventories. Therefore the main purpose of the annexes is to make transparent the EU emission estimates by providing the basic basic Member States tables for every CRF table. Table 1.26 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.26 Explanations for exclusion of annexes as outlied in the UNFCCC reporting guidelines

Annex required in the UNFCCC reporting guidelines	**Comment**
Annex 1: Key categories	Key category analyses Tier 1 and Tier 2 are included in Annex 1.2
Annex 2: Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion	Due to the nature of the EU inventory being the sum of Member States' inventories detailed methodologies for estimating CO_2 emissions from fossil fuel combustion are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EU NIR for the EU key categories.
Annex 3: Other detailed methodological descriptions for individual source or sink categories (where relevant)	Due to the nature of the EU inventory being the sum of Member States' inventories detailed methodological descriptions for other source or sink categories are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EU NIR for the EU key categories.
Annex 4: CO_2 reference approach and comparison with sectoral approach, and relevant information on the national energy balance	Information on the reference approach is included in the EU NIR. Due to the nature of the EU inventory being the sum of Member States' inventories there is no national energy balance which could be included in this annex.
Annex 5: Assessment of completeness and (potential) sources and sinks of greenhouse gas emissions and removals excluded	Information on completeness as reported by Member States in CRF Table 9 is included in Annex 1.4.
Annex 6: Additional information to be considered as part of the NIR submission (where relevant) or other useful reference information	The EU considers the Member States CRF and NIR as part fo the EU submission.
Annex 7: Tables 6.1 and 6.2 of the IPCC good practice guidance	Due to the nature of the EU inventory EU uncertainties are not estimated on basis of uncertainties of emission factors and activity data (see chapter 1.7). Therefore no Table 6.1 can be provided for the EU. Information on tier 1 uncertainty analysis is included in chapter 1.6 and in the sector chapters.
Annex 8: Other annexes - (Any other relevant information – optional).	

1.8.5.2 CRF tables in Annex 1.2

The European Union cannot provide all data in the sectoral background tables. The main reasons for not completing all sectoral background data tables are: (1) limited data availability partly due to confidentiality issues; and (2) the use of different type of activity data by Member States. Latter is due to the fact that the Member States are responsible for calculating emissions. If they use country-specific methods they may also use different types of activity data. At EU-15 level these different types of activity data cannot be simply added up. As at EU-15 level no emissions are calculated directly on the basis of activity data, the documentation of very detailed background data seems to be of lower importance. All the details for the calculation of the emissions are documented in the Member States' CRF tables, as part of their national GHG inventories, which also form part of the EU GHG inventory submission (see Annex 1.12, which is available at the EEA website http://www.eea.europa.eu) and in the sector annexes.

Table 1.27 provides an overview of sectoral report and sectoral background tables available in Annex 1.2, an explanation for each table which is not filled in at EU-15 level and activity data provided for the calculation of implied emission factors. Further information is provided in the relevant sector chapters.

Table 1.27 Inclusion of CRF tables in Annex 1.2

Table	**Included in Annex 1.2**	**Comment**
Energy		
Table 1	Yes	
Table 1.A (a)	Yes	
Table 1.A (b)	Yes	
Table 1.A (c)	Yes	
Table 1.A (d)	Yes	
Table 1B1	Yes	
Table 1B2	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview table for 1B2b included in the NIR

Table	Included in Annex 1.2	Comment
Table 1.C	Yes	
Industrial processes		
Table 2(I)	Yes	
Table 2(II)	Yes	
Table 2(I). A-G	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview tables for large key sources included in the NIR
Table 2(II). C,E	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; limited data availability; confidentiality issues
Table 2(II). F	Yes	For those MS which did not provide Table 2(II).F emissions are allocated to the sub-categories according to the aggregated average allocation of those MS which provided Table 2(II).F.
Solvent use		
Table 3	Yes	
Table 3. A-D	No	Type of activity data used by the MS varies
Agriculture		
Table 4	Yes	
Table 4. A	Yes	
Table 4. B(a)	Yes	
Table 4. B(b)	Yes	
Table 4. C	Yes	
Table 4. D	Yes	
Table 4. E	Yes	
Table 4. F	Yes	
LUCF		
Table 5	Yes	
Table 5. A	Yes	
Table 5. B	Yes	
Table 5. C	Yes	
Table 5. D	Yes	
Table 5. E	Yes	
Table 5. F	Yes	
Table 5 (I)	Yes	
Table 5 (II)	Yes	
Table 5 (III)	Yes	
Table 5 (IV)	Yes	
Table 5 (V)	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Waste		
Table 6	Yes	
Table 6. A, C	Partly	Emissions and some activity data are included
Table 6. B	Partly	Emissions are included, activity data is not estimated because of limited data availability
Summary Tables		
Summary 1.A	Yes	
Summary 1.B	Yes	
Summary 2	Yes	
Summary 3	Yes	
Other Tables		
Table 7	Yes	
Table 8(a)	Yes	
Table 8(b)	Partly	It is indicated in which MS recalculations were performed. In addition, the explanations for recalculations are provided in the EU NIR for the EU key sources together with the contribution of every MS to the EU recalculations. Summary information is also provided in Chapter 10 (Tables 10.1 and 10.2).

Table	Included in Annex 1.2	Comment
Table 9	Partly	Annex 1.4 provides a list of all NEs and IEs and includes explanations taken from the Member States' CRF Tables 9. In response to a recommendation of the UNFCCC review team the table includes an overview sheet which shows NE and IE which are visible in the EU-15 CRF tables for the year 2012. This information is equivalent to CRF Table 9 which cannot be filled-in automatically for the EU-15 due to the amount of information from the Member States. In addition, information on completeness is included in the NIR for the EU key sources explanations for the NE and IE are included in the sector chapters of the NIR, where relevant.
Table 10	Yes	

Table 1.28 provides for specific sectoral background tables an overview of activity data used by Member States in order to explain why this activity data cannot be reported at EU-15 level.

Table 1.28 Activity data reported by Member States in CRF background data tables

Table	Category		Activity data reported by MS
Table 1B2	1. B. 2. a. Oil (3)	I.Exploration	number of wells drilled crude oil number of wells drilled/tested
		ii. Production	Oil throughput PJ of oil produced Crude oil and NGL production Crude oil produced Oil and gas produced
		iii.Transport	oil loaded in tankers PJ Loaded Crude oil imports Transport of crude oil Offshore loading of oil only
		iv.Refining / Storage	Oil refined (SNAP 0401) PJ oil refined crude oil & products kt oil refined Refinery input (crude oil and NGL) Refery input: crude oil, NGL crude oil & products Oil refinery throughput
		v. Distribution of Oil Products	Gasoline Consumption (SNAP 0505) kt oil refined Domestic supply of gasoline Oil products
		vi.Other	Transfer loss gas works gas onshore loading of oil only
	1. B. 2. b. Natural Gas	i.Exploration	natural gas number of wells drilled/tested
		ii. Production (4) / Processing	Gas throughput PJ gas produced natural gas from crude oil extraction Natural gas production Mm3 gas produced
		iii.Transmission	Pipelines length (km) total amount of gas consumed PJ gas consumed Length of transmission pipeline Mm3 gas transported gas transported
			PJ gas (NCV) Pressure levelling losses
		iv.Distribution	Distribution network length consumption distribution net PJ gas distributed via local networks PJ gas consumed

			Length of distribution mains Mm3 gas transported
		v. Other Leakage	PJ gas consumed t of natural gas released from pipelines
	1. B. 2. c. Venting(5)	i.Oil	PJ oil produced kt oil refined Crude oil and NGL production
		ii. Gas	PJ gas produced Sour Natural gas production
		iii.Combined	
	Flaring	i.Oil	PJ gas consumption kt oil refined Consumed Crude oil and NGL production Mm3 gas consumption oil produced Refinery gas other liquid fuels
		ii. Gas	PJ gas consumption natural gas Natural gas production quantity of gas flared
		iii.Combined	
Table 2(I)	2.A Mineral products	1. Cement production	Clinker production AD confidential
		2. Lime production	Lime produced Lime and dolomite production Production of lime and bricks Limestone consumed
		3. Limestone and dolomite use	Limestone and dolomite used Limestone consumption Clay, shale and limestone use Carbonates input to brick, tiles, ceramic production
		4. Soda ash production	Soda ash production
		4. Soda ash use	Soda ash use Use of soda
		5. Asphalt roofing	Roofing material production Bitumen consumption
		6. Road paving with asphalt	Asphalt production Bitumen consumption Asphalt used in paving Asphalt liquefied
	2B Chemical industry	1. Ammonia production	Ammonia production Natural gas consumption
		2. Nitric acid production	Nitric acid production Nitric acid production: Medium pressure plants
Table 2(II) C	2C Metal production	1. Iron and steel production	
		Steel	Steel production Crude steel production Production of secondary steel
		Pig iron	Iron production Production of primary iron Pig iron production
		Sinter	Sinter production Sinter consumption
		Coke	Coke production Coke consumption Coke consumed in blast furnace
		2. Ferroalloys production	Ferroalloys production Laterite consumption Use of coal and coke electrodes
		3. Aluminium production	Aluminium production Primary aluminium production
	C.PFCs and SF_6 from MetalProduction	PFCs from aluminium production	Aluminium production Primary aluminium production
		SF_6 used in Aluminium and Magnesium Foundries	
		Aluminium foundries	Cast aluminium

			Consumption of aluminium foundries SF_6 consumption
		Magnesium foundries	Cast magnesium Consumption Mg-Production SF_6 consumption
Table 4D	1. Direct soil emissions	3. N-fixing crops	Nitrogen fixed by N-fixing crops Dry pulses and soybeans produced Area of cultivated soils
		4. Crop residues	Nitrogen in crop residues returned to soils Dry production of other crops
Table 5(V)	A. Forest land		Area burned (ha) Biomass burned (kg dm)
	B. Cropland		Area burned (ha) Biomass burned (kg dm)
	C. Grassland		Area burned (ha) Biomass burned (kg dm)
	E. Settlements		Area burned (ha) Biomass burned (kg dm)

In response to recommendations from the UNFCCC review team the EU has elaborated and applied a gap filling procedure for activity data in 2014 for the first time (see chapter 1.8.2).

2 EU-15 GREENHOUSE GAS EMISSION TRENDS

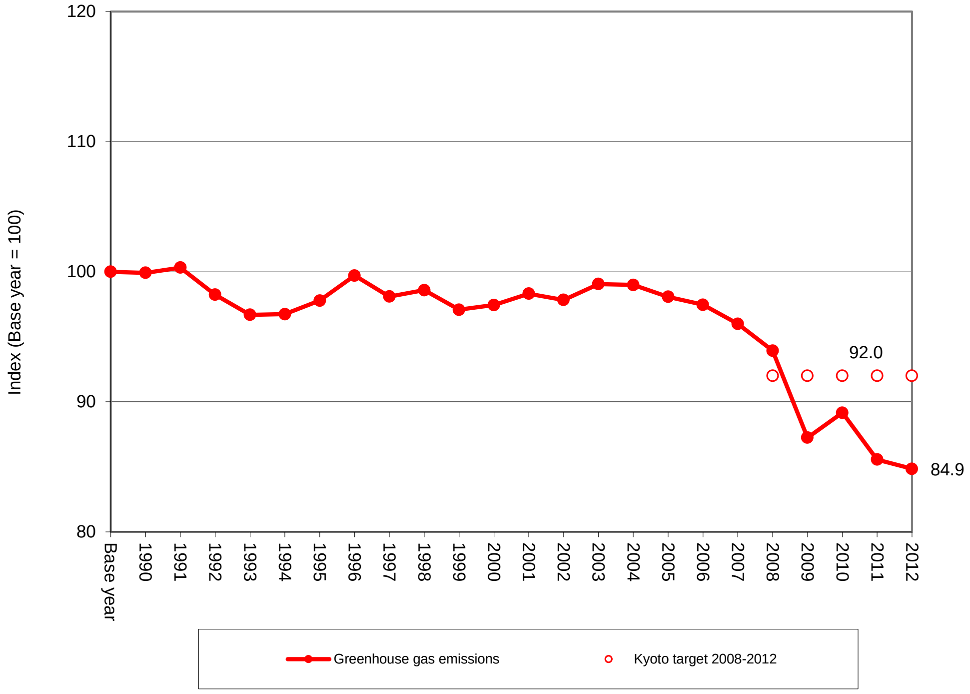
This chapter presents the main GHG emission trends in the EU-15. Firstly, aggregated results are described as regards total GHG emissions and progress towards fulfilling the EU Kyoto target (for EU-15 only). Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EU GHG trends is given. Finally, the trends of indirect GHGs and SO_2 emissions are presented.

2.1 Aggregated greenhouse gas emissions

In 2012 total GHG emissions in the EU-15, without LULUCF, were 15 % (643 million tonnes CO_2 equivalents) below 1990. Emissions decreased by 0.8 % (30 million tonnes CO_2 equivalents) between 2011 and 2012.

Under the Kyoto Protocol, the EU agreed to reduce its GHG emissions by 8 % by 2008–12 compared to the'base year'[24]. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms. Since 2009 emissions are below the EU-15 Kyoto target (Figure 2.1).

Figure 2.1 EU-15 GHG emissions 1990–2012 compared with target for 2008–12 (excl. LULUCF)



Notes: *GHG emission data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.*
Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent. The EU-15 would need to reduce GHG emissions by about 341 million tonnes, on average between 2008–2012, in order to meet its 8 % Kyoto Protocol reduction target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks, and the use of Kyoto mechanisms.

[24] Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent.

2.1.1 Main trends by source category, 1990-2012

Table 2.1 shows the source categories with the largest contributions to changes in greenhouse gas emissions between 1990 and 2012.

Table 2.1 EU-15: Overview of Top decreasing/increasing source categories 1990-2012 (+/- 20 Million tonnes CO_2 equivalents)

Source category	EU-15
	Million tonnes (CO_2 eq.)
Road Transportation (CO_2 from 1A3b)	72
Consumptions of halocarbons (HFC from 2F)	71
Enteric fermentation (CH_4 from 4A)	-21
Cement Production (CO_2 from 2A1)	-23
Production of halocarbons (HFC from 2E)	-27
Nitric Acid Production (N_2O from 2B2)	-30
Agricultural soils (N_2O from 4D)	-41
Fugitive emissions from fuels (CH_4 from 1B)	-49
Iron and Steel Production (CO_2 from 1A2a +2C1)	-54
Manufacture of Solid fuels (CO_2 from 1A1c)	-58
Adipic Acid Production (N_2O from 2B3)	-58
Public Electricity and Heat Production (CO_2 from 1A1a)	-61
Solid waste disposal on land (CH_4 from 6A)	-66
Households and services (CO_2 from 1A4)	-78
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-151
Total	**-643**

Notes: As the table only presents sectors whose emissions increased or decreased by at least 20 million tonnes CO_2-equivalents, the sum of the source categories presented does nott match the total change listed at the bottom of the table.

2.1.2 Main trends by source category, 2011-2012

Table 2.2 shows the source categories contributing the most to changes in greenhouse gas emissions between 2011 and 2012.

Table 2.2 EU-15: Overview of Top decreasing/increasing source categories 2010-2012 (+/- 3 Million tonnes CO_2 equivalents)

Source category	EU-15
	Million tonnes (CO_2 eq.)
Public Electricity and Heat Production (CO_2 from 1A1a)	26
Households and services (CO_2 from 1A4)	20
Solid Waste Disposal (CH_4 from 6A)	-3
Cement production (CO2 from 2A1)	-4
Refineries (CO2 from 1A1b)	-4
Agricultural Soils (N_2O from 4D)	-4
Iron and Steel Production (CO_2 from 1A2a +2C1)	-6
Manufacture of Solid fuels (CO2 from 1A1c)	-9
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-11
Road Transportation (CO_2 from 1A3b)	-30
Total	**-30**

Notes: As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2-equivalents, the sum of the source categories presented does nottmatch the total change listed at the bottom of the table

Main reasons for emission changes, 2011–2012

The 30 million tonnes (CO_2 equivalents) decrease in GHG emissions in the EU-15 between 2011 and 2012 was mainly due to the factors outlined below.

- Decreasing CO_2 emissions in road transportation (– 30 million tonnes or – 4 %) — following a decreasing trend for the fifth consecutive year — were driven by reductions in both passenger and freight transportation. In 2012, emissions decreased in particular in the Member States that experienced persisting economic downturn or recession such as Italy, Spain and Greece: road freight transport declined by 16 % in Italy and Spain, and by 21 % in Greece.
- Reduced CO_2 emissions in the category ‘manufacturing industries excluding iron and steel industry' (– 11 million tonnes or – 3 %) were mainly driven by a decline in industrial production and a decline in cement production — especially in Italy, Germany, the United Kingdom, Spain and Portugal.
- The overall decrease in CO_2 emissions from the manufacture of solid fuels and other energy industries (– 9 million tonnes or – 17 %) were mainly driven by decreases in Germany, Italy and the UK. In Italy, the main driver for the reduction in emissions was a decline in iron and steel production and the associated decline in coke production. In the UK, the main driver was the continued decline in oil and gas production. In Germany, the main driver was the reclassification of certain power production facilities in coal mining from this category to the category ‘public electricity and heat production’ (this partly explains increases mentioned below for public electricity and heat production).
- The decrease in CO_2 emissions from iron and steel production (– 6 million tonnes or – 4 %) reflects a further decline of crude steel production in the EU-15.

Substantial emission increases between 2011 and 2012 were reported for the source categories listed below.

- CO_2 from public electricity and heat production (+ 26 million tonnes or + 3 %) Increasing emissions occurred in particular in Germany, the UK and Spain. In Germany, power production from coal increased mainly due to lower nuclear power production as well as higher exports and lower imports of electricity. In the UK there was a substantial increase in the use of coal for power generation. In Spain, the main reasons are a decline in hydropower production and a considerable shift from natural gas to coal use in public power production.
- CO_2 from households and services (+ 20 million tonnes or + 4 %) Emissions increased in almost all EU-15 Member States. The colder winter and higher demand for heating can partly explain higher emissions in 2012 compared to 2011.

2.1.3 Overview of GHG emissions in EU Member States

Table 2.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2012 (million tonnes)	2011–2012 (million tonnes)	Change 2011–2012 (%)	Change 1990-2012 (%)	Change base year–2012 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78.1	79.0	80.1	-2.7	-3.3%	2.5%	1.3%	-13.0%
Belgium	143.0	145.7	116.5	-3.6	-3.0%	-18.5%	-20.0%	-7.5%
Denmark	68.7	69.3	51.6	-4.9	-8.6%	-24.8%	-25.5%	-21.0%
Finland	70.3	71.0	61.0	-5.9	-8.8%	-13.3%	-14.1%	0.0%
France	557.4	563.9	490.1	0.1	0.0%	-12.1%	-13.1%	0.0%
Germany	1248.0	1232.4	939.1	10.4	1.1%	-24.8%	-23.8%	-21.0%
Greece	104.9	107.0	111.0	-3.7	-3.3%	5.8%	3.7%	25.0%
Ireland	55.2	55.6	58.5	0.8	1.4%	5.9%	5.3%	13.0%
Italy	519.1	516.9	460.1	-26.5	-5.4%	-11.4%	-11.0%	-6.5%
Luxembourg	12.9	13.2	11.8	-0.29	-2.4%	-8.2%	-10.1%	-28.0%
Netherlands	211.8	213.0	191.7	-3.4	-1.7%	-9.5%	-10.0%	-6.0%
Portugal	60.8	60.1	68.8	-0.6	-0.8%	13.1%	14.3%	27.0%
Spain	283.7	289.8	340.8	-5.1	-1.5%	20.1%	17.6%	15.0%
Sweden	72.7	72.2	57.6	-3.2	-5.2%	-20.8%	-20.2%	4.0%
United Kingdom	775.5	776.3	580.8	18.1	3.2%	-25.1%	-25.2%	-12.5%
EU-15	**4262.1**	**4265.5**	**3619.5**	**-30.5**	**-0.8%**	**-15.1%**	**-15.1%**	**-8.0%**

([a]) *The base year under the Kyoto Protocol for each Member State and EU-15 is further outlined in Table 1.4 and 1.5.*

2.2 Emission trends by gas

Table 2.4, Figure 2.2 and Figure 2.3 give an overview of the main trends in EU-15 GHG emissions and removals for 1990–2012. In the EU-15 the most important GHG is CO_2, accounting for 83 % of total EU-15 emissions in 2012. In 2012, EU-15 CO_2 emissions without LULUCF were 2 988 Tg, which was 11 % below 1990 levels. Compared to 2011, CO_2 emissions decreased by 0.8 %.

Table 2.4 Overview of EU-15 GHG emissions and removals from 1990 to 2012 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Net CO_2 emissions/removals	3 221	3 127	3 181	3 297	3 279	3 246	3 118	2 846	2 952	2 812	2 789
CO_2 emissions (without LULUCF)	3 369	3 307	3 375	3 477	3 470	3 412	3 333	3 064	3 156	3 011	2 988
CH_4	443	423	383	333	326	321	316	310	304	298	296
N_2O	402	383	344	313	301	299	292	281	272	269	264
HFCs	28	40	44	55	56	59	63	66	69	70	72
PFCs	17	12	8	5	5	5	4	3	3	3	3
SF_6	11	15	11	8	7	7	6	6	6	6	6
Total (with net CO_2 emissions/removals)	**4 123**	**4 000**	**3 971**	**4 010**	**3 974**	**3 937**	**3 799**	**3 511**	**3 606**	**3 458**	**3 429**
Total (without CO2 from LULUCF)	**4 270**	**4 180**	**4 165**	**4 191**	**4 165**	**4 104**	**4 014**	**3 729**	**3 811**	**3 658**	**3 628**
Total (without LULUCF)	**4 262**	**4 171**	**4 156**	**4 183**	**4 157**	**4 095**	**4 007**	**3 722**	**3 803**	**3 650**	**3 619**

Figure 2.2 CO_2 emissions without LULUCF 1990 to 2012 in CO_2 equivalents (Tg)

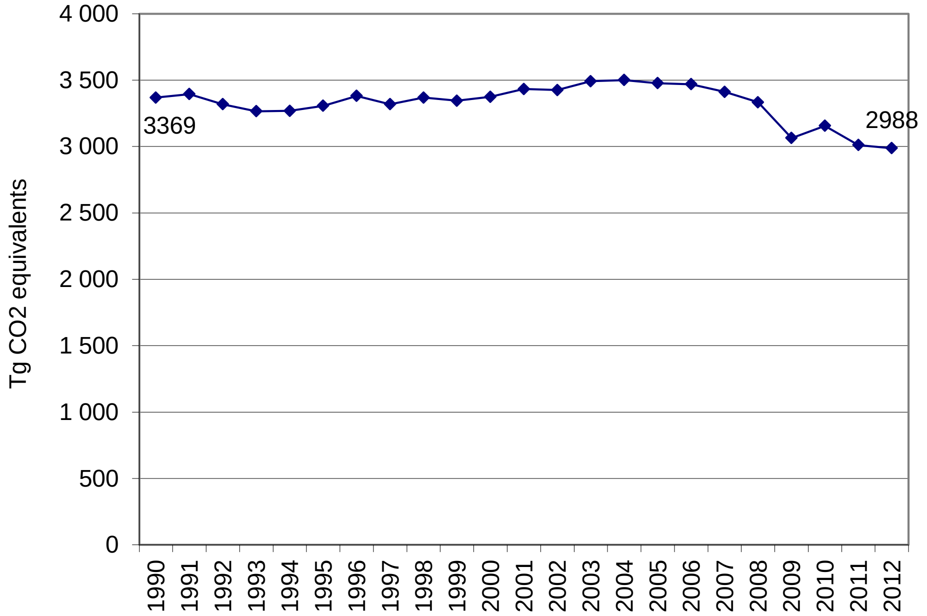
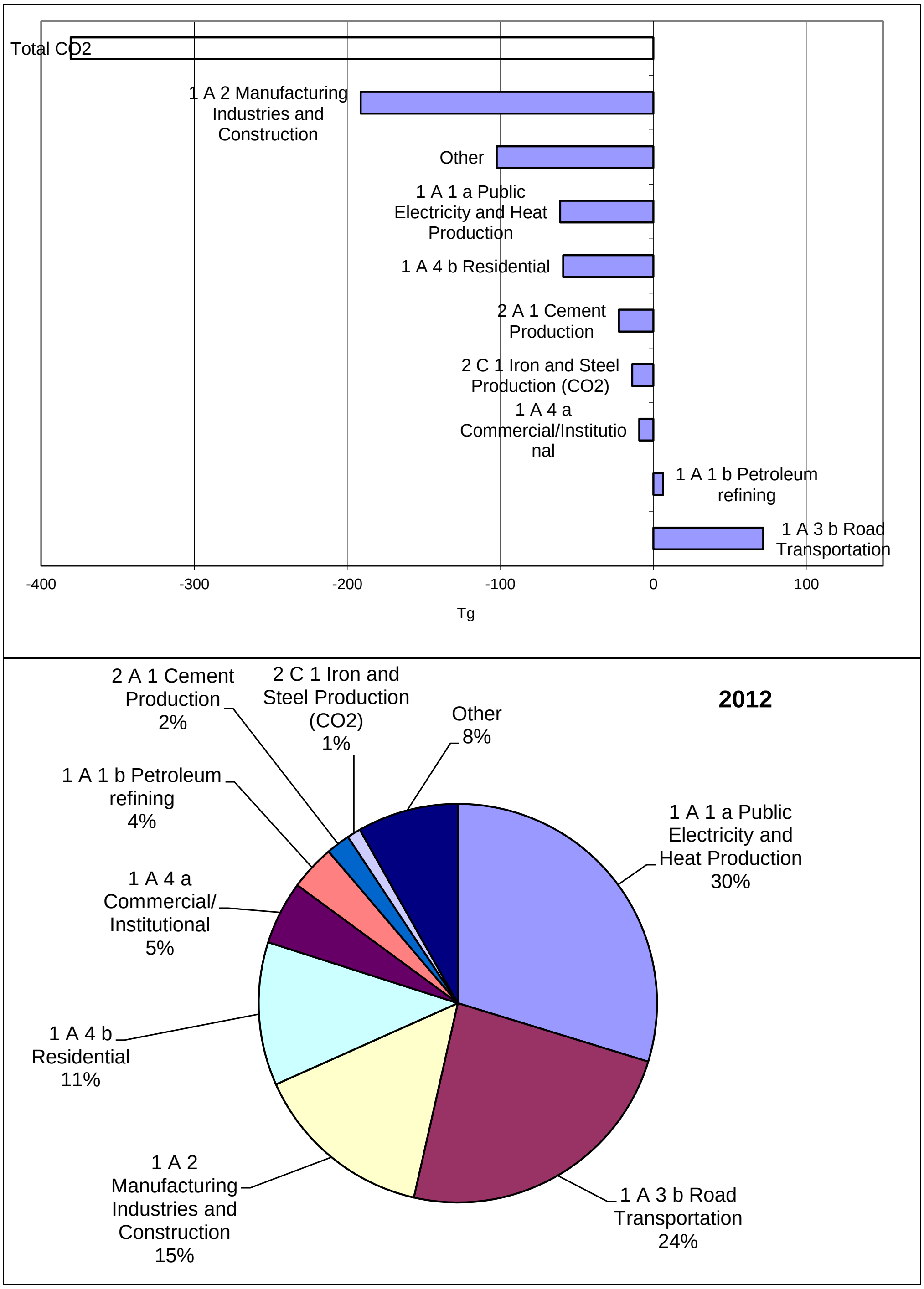


Figure 2.3 Absolute change of CO_2 emissions by large key source categories 1990 to 2012 in CO_2 equivalents (Tg) for EU-15 and share of largest key source categories in 2012 for EU-15



CH_4 emissions account for 8 % of total EU-15 GHG emissions in 2012 and decreased by 33 % since 1990 to 296 Tg CO_2 equivalents in 2012 (Figure 2.4). The two largest key sources account for 57 % of CH_4 emissions in 2012. Figure 2.5 shows that the main reasons for declining CH_4 emissions were reductions in managed waste disposal on land and coal mining.

Figure 2.4 CH_4 emissions 1990 to 2012 in CO_2 equivalents (Tg)

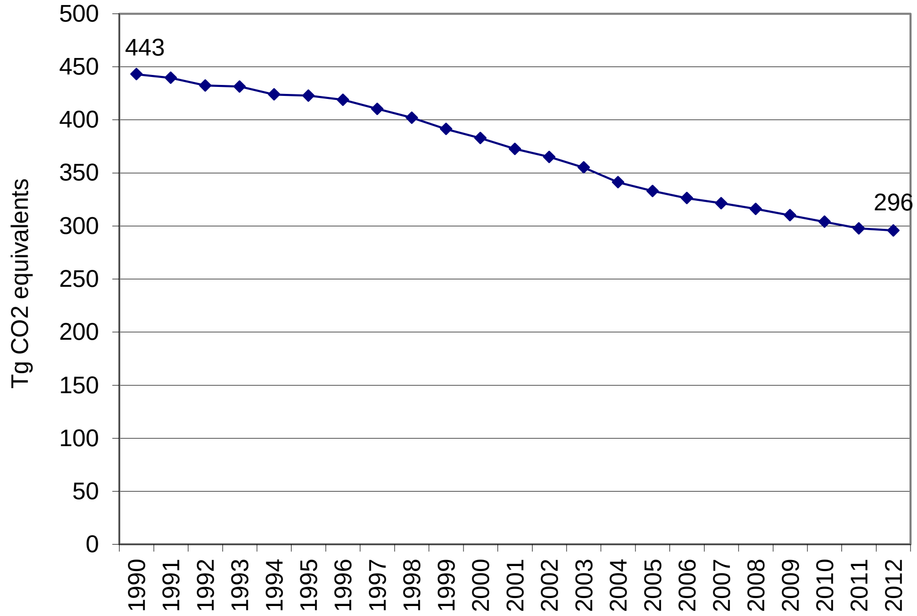
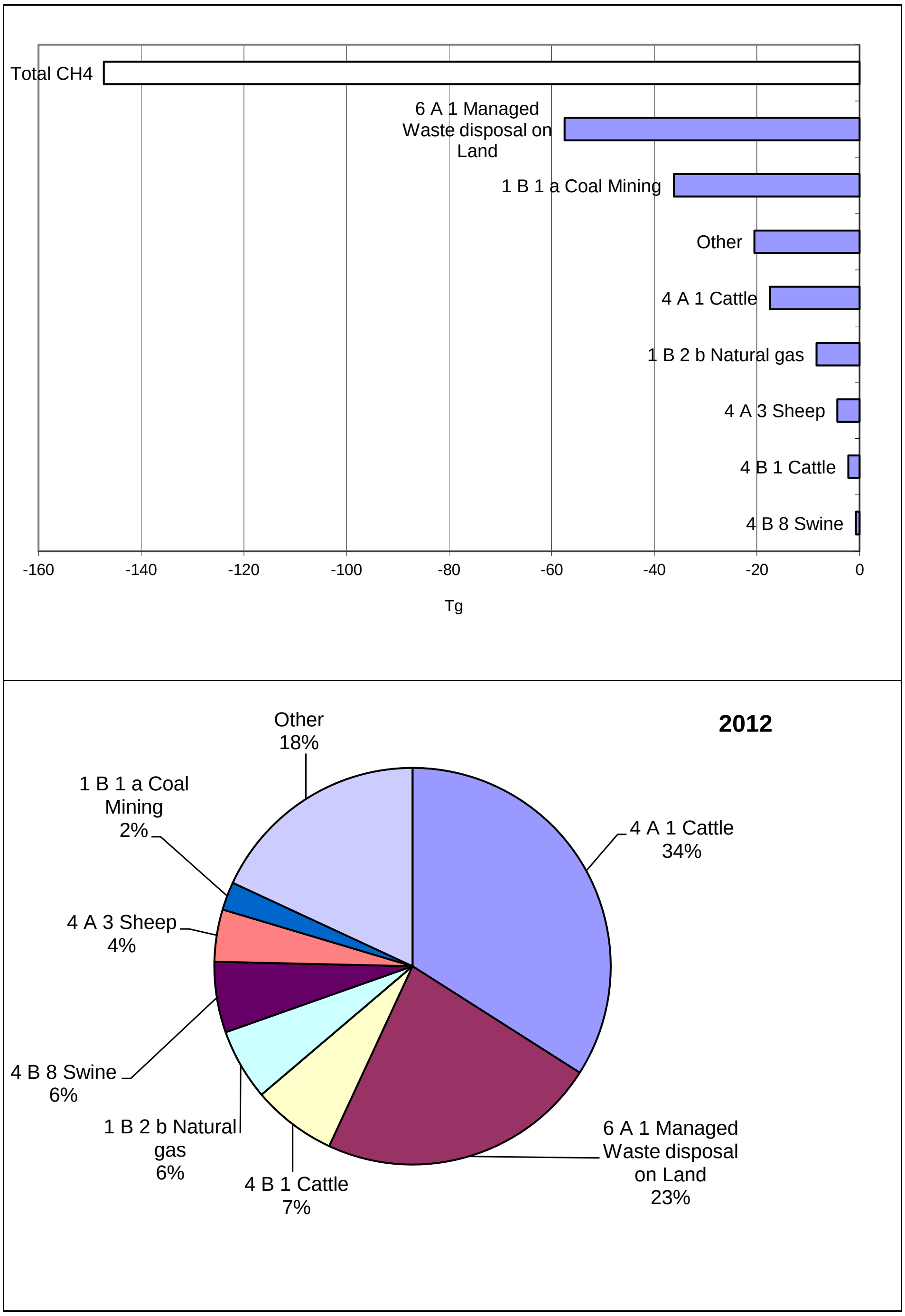


Figure 2.5 Absolute change of CH_4 emissions by large key source categories 1990 to 2012 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2012 for EU-15



N_2O emissions are responsible for 7 % of total EU-15 GHG emissions and decreased by 34 % to 264 Tg CO_2 equivalents in 2012 (Figure 2.6). The two largest key sources account for about 60 % of N_2O emissions in 2012. Figure 2.7 shows that the main reason for large N_2O emission cuts were reduction measures in the adipic acid production.

Figure 2.6 N_2O emissions 1990 to 2012 in CO_2 equivalents (Tg)

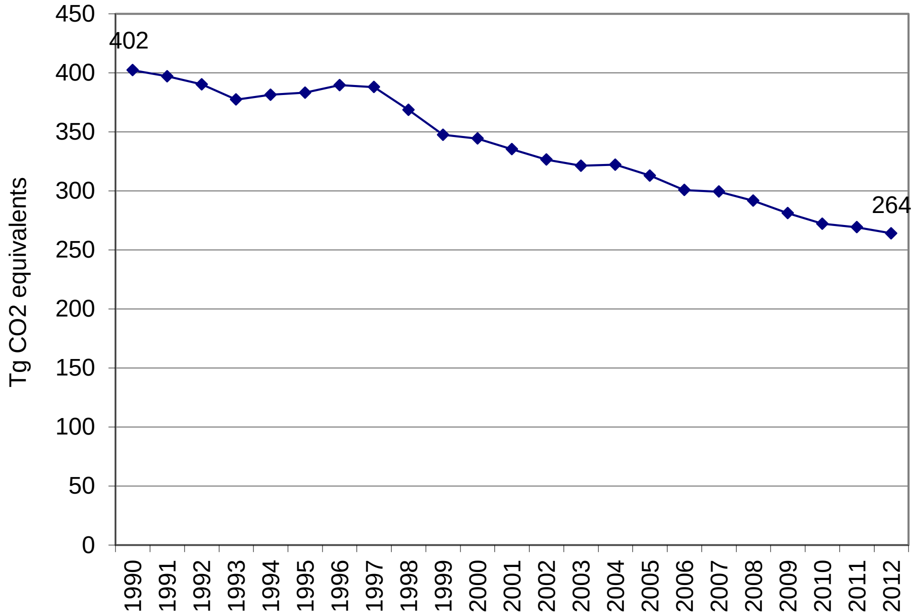
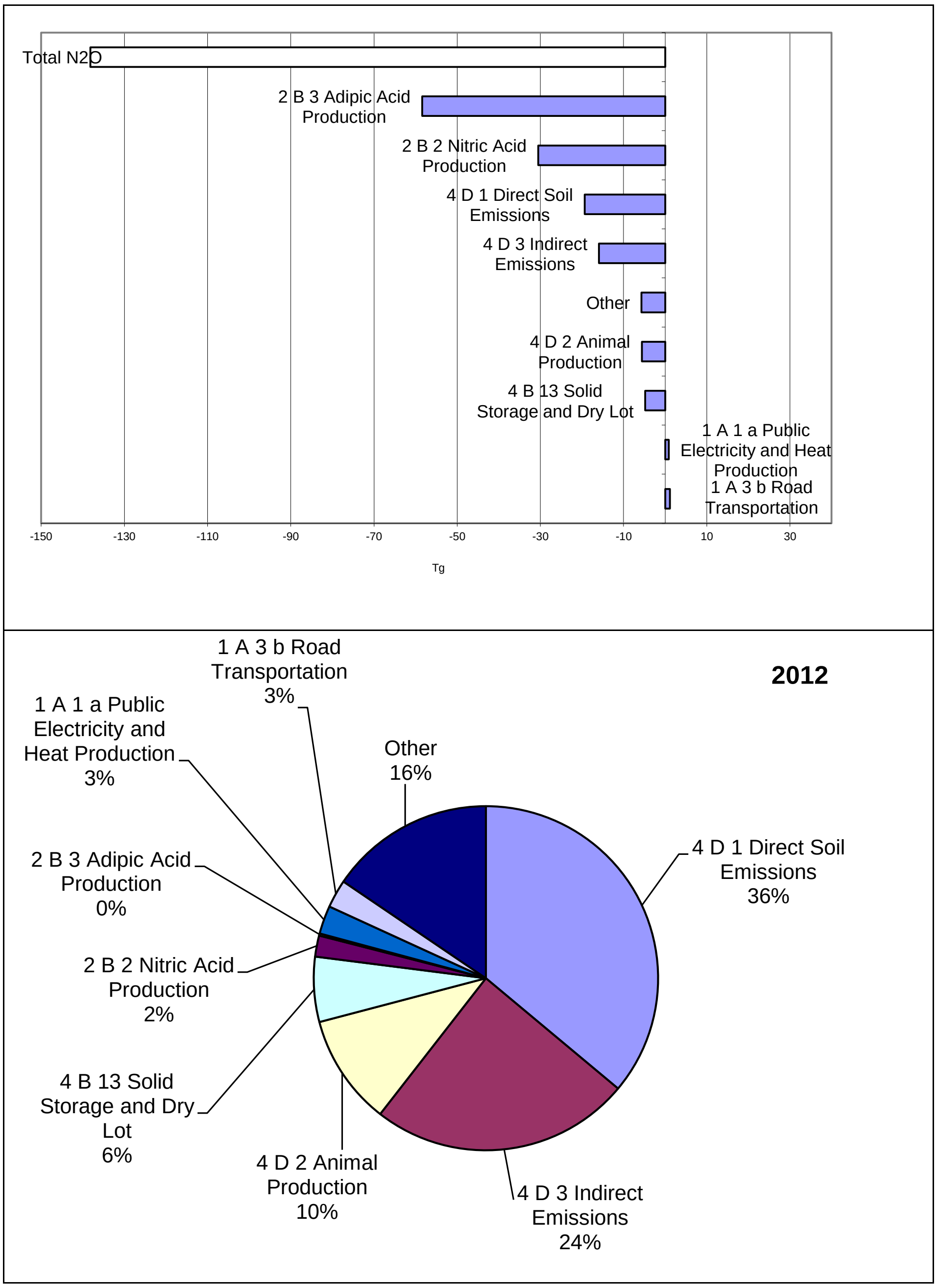


Figure 2.7 Absolute change of N_2O emissions by large key source categories 1990 to 2012 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2012 for EU-15



Fluorinated gas emissions account for 2 % of total EU-15 GHG emissions. In 2012, emissions were 80 Tg CO_2 equivalents, which was 44.4 % above 1990 levels (Figure 2.8). The largest key category accounts for 88 % of fluorinated gas emissions in 2012. Figure 2.9 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2012. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). On the other hand, HFC emissions from production of halocarbons decreased substantially. The decrease started in 1998 and was strongest between 1999 and 2001.

Figure 2.8 Fluorinated gas emissions 1990 to 2012 in CO_2 equivalents (Tg)

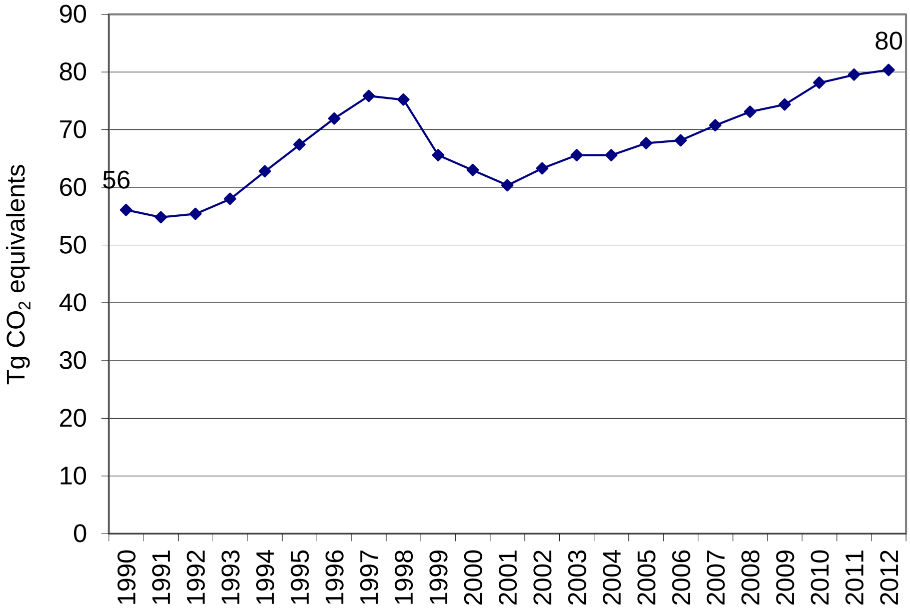
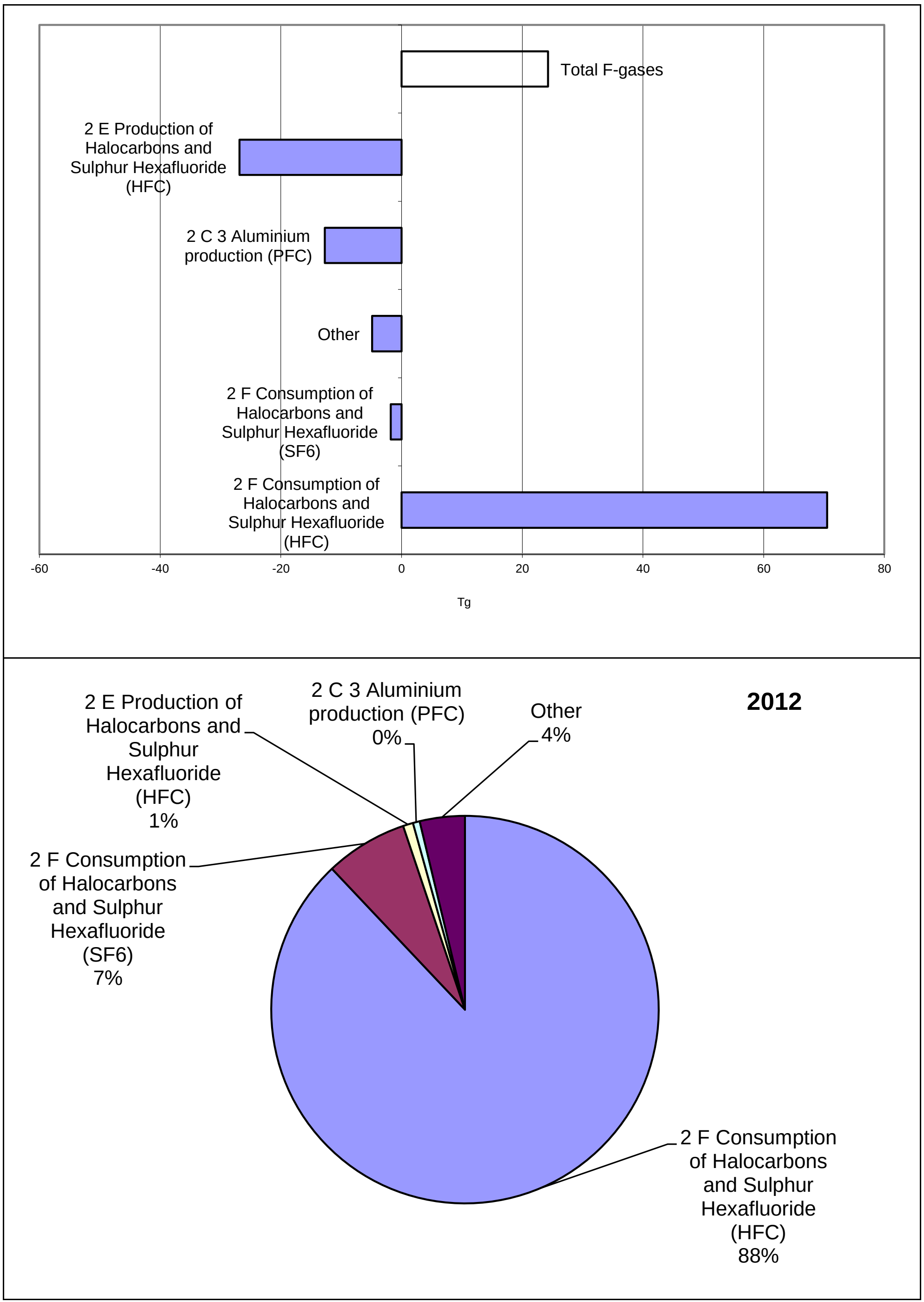


Figure 2.9 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2012 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2012 for EU-15



2.3 Emission trends by source

Table 2.5 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2012. More detailed trend descriptions are included in Chapters 3 to 9.

Table 2.5 Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2012 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
1. Energy	3 281	3 215	3 261	3 341	3 330	3 268	3 201	2 968	3 048	2 906	2 893
2. Industrial Processes	354	351	310	311	304	308	292	253	260	252	243
3. Solvent and Other Product Use	13	12	11	9.672	10	9	9	8	8	8	8
4. Agriculture	443	421	423	394	389	388	388	379	378	378	373
5. Land-Use, Land-Use Change and Forestry	-139	-171	-185	-173	-184	-158	-208	-210	-197	-192	-191
6. Waste	171	172	152	127	125	121	117	113	109	106	102
7. Other	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4 123**	**4 000**	**3 971**	**4 010**	**3 974**	**3 937**	**3 799**	**3 511**	**3 606**	**3 458**	**3 429**
Total (without LULUCF)	**4 262**	**4 171**	**4 156**	**4 183**	**4 157**	**4 095**	**4 007**	**3 722**	**3 803**	**3 650**	**3 619**

2.4 Emission trends by Member State

Table 2.6 gives an overview of EU-15 Member States' contributions to the EU GHG emissions for 1990–2012. Member States show large variations in GHG emission trends.

Table 2.6 Overview of Member States' contributions to EU-15 GHG emissions excluding LULUCF from 1990 to 2012 in CO_2 equivalents (Tg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	78	80	80	93	90	87	87	80	85	83	80
Belgium	143	150	146	142	138	133	136	123	131	120	117
Denmark	69	76	69	64	72	67	64	61	61	57	52
Finland	70	71	69	69	80	78	70	66	74	67	61
France	557	553	561	559	547	538	533	509	516	490	490
Germany	1 248	1 118	1 040	994	1 002	977	980	913	946	929	939
Greece	105	110	127	135	132	135	131	124	118	115	111
Ireland	55	59	68	70	69	68	68	62	62	58	59
Italy	519	530	551	574	563	555	541	490	499	487	460
Luxembourg	13	10	10	13	13	12	12	12	12	12	12
Netherlands	212	223	213	209	206	204	203	198	209	195	192
Portugal	61	71	84	88	83	80	78	75	71	69	69
Spain	284	322	380	431	424	432	398	360	347	346	341
Sweden	73	74	69	67	67	65	63	59	65	61	58
United Kingdom	775	723	690	675	672	662	643	590	606	563	581
EU-15	**4 262**	**4 171**	**4 156**	**4 183**	**4 157**	**4 095**	**4 007**	**3 722**	**3 803**	**3 650**	**3 619**

The overall EU GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom accounting for 42 % of total EU-15 GHG emissions in 2012. These two Member States have achieved total GHG emission reductions of 504 million tonnes CO_2-equivalents compared to 1990[25].

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new Länder after German reunification. The reduction of GHG emissions in the United Kingdom was primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production and N_2O emission reduction measures in the production of adipic acid.

France and Italy were the third and fourth largest emitters with a share of 14 % and 13 %, respectively. Italy's GHG emissions were 11 % below 1990 levels in 2012. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol refining. However, Italian emissions decreased significantly since 2004 with significant drops in 2009 and 2012, which were mainly due to the economic crisis and reductions in industrial output during these years. France's emissions were 12 % below 1990 levels in 2012. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport and HFC emissions from consumption of halocarbons increased considerably between 1990 and 2012.

(*25*) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes on the basis of the 2008 inventory in order to meet the Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

Spain is the fifth largest emitter in the EU-15, accounting for 9 % of total EU-15 GHG emissions. Spain increased emissions by 20 % between 1990 and 2012. This was largely due to emission increases from road transport, electricity and heat production, and households and services.

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_X, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_X and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 2.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990 and 2012. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-87 %), followed by CO (-67 %), NMVOC (-60 %) and NO_X (-51 %).

Table 2.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2012 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
	(Gg)										
NOx	13 769	12 087	10 533	9 501	9 192	8 886	8 115	7 409	7 214	6 902	6 685
CO	54 467	42 142	32 461	24 126	22 634	23 127	20 628	18 692	19 327	18 082	18 133
NMVOC	14 654	12 016	9 744	7 886	7 680	7 185	6 713	6 299	6 264	6 040	5 881
SO2	16 444	10 036	6 118	4 518	4 307	4 080	3 023	2 599	2 380	2 291	2 217

Table 2.8 shows the NO_X emissions of the EU-15 Member States between 1990–2012. The largest emitters, the United Kingdom, Spain, Germany, France and Italy made up 78 % of total EU-15 NO_X emissions in 2012. All EU-15 Member States reduced their NO_X emissions between1990 and 2012.

Table 2.8 Overview of Member States' contributions to EU-15 NO_X emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	195	181	205	236	221	217	205	189	193	183	178
Belgium	371	347	316	288	275	265	234	208	216	202	193
Denmark	277	270	207	185	186	172	154	136	132	125	115
Finland	295	245	211	176	193	184	169	155	167	156	147
France	1 923	1 782	1 646	1 478	1 401	1 342	1 240	1 160	1 141	1 072	1 046
Germany	2 877	2 172	1 919	1 563	1 554	1 477	1 402	1 303	1 325	1 289	1 269
Greece	326	329	360	417	413	416	392	380	320	296	259
Ireland	122	122	135	128	122	120	108	86	79	71	73
Italy	2 068	1 910	1 453	1 229	1 171	1 157	1 058	990	965	947	882
Luxembourg	0.2	0.5	1	0.4	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	567	469	387	325	315	291	283	258	256	241	230
Portugal	247	280	276	274	248	242	216	205	191	180	172
Spain	1 349	1 421	1 410	1 437	1 386	1 369	1 180	1 045	966	960	930
Sweden	270	246	209	176	172	164	156	147	149	139	132
United Kingdom	2 882	2 312	1 797	1 588	1 535	1 469	1 318	1 148	1 114	1 041	1 059
EU-15	**13 769**	**12 087**	**10 533**	**9 501**	**9 192**	**8 886**	**8 115**	**7 409**	**7 214**	**6 902**	**6 685**

Table 2.9 shows the CO emissions of the EU-15 Member States between 1990–2012. The largest emitters, France, Germany, Italy and the United Kingdom that made up 68 % of the total CO emissions in 2012, reduced their emissions from 1990 levels substantially. But also all other EU-15 Member States reduced emissions.

Table 2.9 Overview of Member States' contributions to EU-15 CO emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	1 436	1 272	957	813	772	720	683	636	640	604	607
Belgium	1 319	1 013	897	755	660	662	666	439	531	422	390
Denmark	731	651	490	460	452	463	441	415	407	371	359
Finland	709	634	588	522	508	497	473	462	479	451	439
France	11 172	9 548	6 924	5 607	5 060	4 792	4 601	4 147	4 562	3 856	3 537
Germany	12 428	6 595	4 838	3 659	3 579	3 475	3 387	3 006	3 447	3 288	3 290
Greece	1 143	961	961	722	740	751	630	600	528	497	461
Ireland	401	313	246	186	177	168	155	148	136	125	117
Italy	8 870	7 408	5 730	3 585	3 236	4 731	3 093	2 921	2 724	2 885	3 447
Luxembourg	17	10	7	4	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	1 259	971	865	686	679	659	656	606	602	580	557
Portugal	889	912	750	685	485	439	414	402	430	371	385
Spain	3 732	3 223	2 769	2 239	2 332	2 125	2 004	1 953	2 026	2 019	1 980
Sweden	1 280	1 125	816	662	623	610	597	596	576	552	546
United Kingdom	9 081	7 506	5 623	3 540	3 331	3 035	2 827	2 361	2 239	2 063	2 017
EU-15	**54 467**	**42 142**	**32 461**	**24 126**	**22 634**	**23 127**	**20 628**	**18 692**	**19 327**	**18 082**	**18 133**

Table 2.10 shows the NMVOC emissions of the EU-15 Member States between 1990–2012. The largest emitters France, Germany and Italy that made up 57 % of the total NMVOC emissions in 2012, reduced their emissions from 1990 levels, together with all other EU-15 Member States.

Table 2.10 Overview of Member States' contributions to EU-15 NMVOC emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	274	223	175	165	175	161	152	123	135	129	136
Belgium	332	282	227	196	194	182	176	165	166	155	152
Denmark	164	166	138	114	109	104	99	92	89	82	79
Finland	229	192	165	140	137	133	119	112	116	107	104
France	3 327	2 992	2 519	2 120	2 084	1 752	1 640	1 628	1 565	1 536	1 484
Germany	3 066	1 768	1 371	1 122	1 112	1 049	996	910	1 023	980	952
Greece	269	260	266	221	231	220	228	212	185	159	152
Ireland	81	76	69	57	55	54	51	49	46	45	43
Italy	1 998	1 975	1 555	1 220	1 176	1 191	1 074	1 006	951	940	907
Luxembourg	6	6	5	6	5	5	5	4	4	4	3
Netherlands	479	340	237	170	162	160	158	148	166	147	144
Portugal	320	309	279	246	214	207	198	188	196	183	185
Spain	1 055	977	995	830	799	780	714	654	649	619	598
Sweden	360	277	222	198	194	191	187	188	188	189	186
United Kingdom	2 693	2 174	1 522	1 080	1 032	995	915	819	786	767	755
EU-15	**14 654**	**12 016**	**9 744**	**7 886**	**7 680**	**7 185**	**6 713**	**6 299**	**6 264**	**6 040**	**5 881**

Table 2.11 shows the SO_2 emissions of the EU-15 Member States between 1990–2012. The largest emitters, the United Kingdom, Spain and Germany, that made up 57 % of the total SO_2 emissions in 2012, reduced their emissions from 1990 levels substantially, together with all other EU-15 Member States.

Table 2.11 Overview of Member States' contributions to EU-15 SO_2 emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Austria	74	47	32	27	28	25	22	17	19	18	17
Belgium	359	258	174	144	134	125	97	76	61	54	49
Denmark	178	141	31	24	28	25	20	15	15	14	12
Finland	249	105	81	68	84	82	68	59	67	61	52
France	1 331	1 002	661	486	463	452	387	330	306	267	254
Germany	5 283	1 705	638	460	471	454	454	407	430	424	427
Greece	476	540	496	541	533	538	445	426	265	262	245
Ireland	182	161	139	72	61	54	45	32	26	25	23
Italy	1 805	1 327	756	407	384	346	286	235	215	196	182
Luxembourg	0.2	0.2	0.2	0.2	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	198	138	79	70	81	59	50	38	34	34	34
Portugal	324	331	263	195	170	163	114	79	70	64	59
Spain	2 170	1 855	1 496	1 279	1 168	1 136	513	460	425	459	408
Sweden	105	69	42	36	36	32	30	30	32	29	28
United Kingdom	3 709	2 357	1 230	708	667	588	490	397	415	385	426
EU-15	**16 444**	**10 036**	**6 118**	**4 518**	**4 307**	**4 080**	**3 023**	**2 599**	**2 380**	**2 291**	**2 217**

3 ENERGY (CRF SECTOR 1)

This chapter starts with an overview on emission trends in CRF Sector 1 Energy. For each EU-15 key category overview tables are presented including the Member States' contributions to the key category in terms of level and trend, information on methodologies and emission factors[26]. The chapter includes also sections on uncertainty estimates, sector-specific QA/QC, recalculations, the reference approach, and international bunkers.

3.1 Overview of sector (EU-15)

CRF Sector 1 Energy contributes 84 % to total GHG emissions and is the largest emitting sector in the EU-15. Total GHG emissions from this sector decreased by 12 % from 3281 Tg in 1990 to 2893 Tg in 2012 (Figure 3.1). In 2012, emissions decreased by 0.4% compared to 2011.

The most important energy-related gas is CO_2 that makes up 78 % of the total EU-15 GHG emissions. CH_4 and N_2O are each responsible for 1 % of the total GHG emissions. The key categories in this sector are as follows.

- 1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)
- 1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)
- 1 A 1 b Petroleum refining: Liquid Fuels (CO_2)
- 1 A 1 b Petroleum refining: Solid Fuels (CO_2)
- 1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)
- 1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)
- 1 A 2 a Iron and Steel: Liquid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Solid Fuels (CO_2)
- 1 A 2 b Non-Ferrous Metals: Solid Fuels (CO_2)
- 1 A 2 c Chemicals: Gaseous Fuels (CO_2)
- 1 A 2 c Chemicals: Liquid Fuels (CO_2)
- 1 A 2 c Chemicals: Other Fuels (CO_2)
- 1 A 2 c Chemicals: Solid Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Solid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)
- 1 A 2 f Other: Gaseous Fuels (CO_2)
- 1 A 2 f Other: Liquid Fuels (CO_2)
- 1 A 2 f Other: Other Fuels (CO_2)
- 1 A 2 f Other: Solid Fuels (CO_2)
- 1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Gasoline (N_2O)

[26] In a few cases overview tablesare also prepared for categories which are not key categories in 2014. These categories were key categories in previous years.

- 1 A 3 b Road Transportation: LPG (CO_2)
- 1 A 3 c Railways: Liquid Fuels (CO_2)
- 1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
- 1 A 3 d Navigation: Residual Oil (CO_2)
- 1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Other Fuels (CO_2)
- 1 A 4 b Residential: Gaseous Fuels (CO_2)
- 1 A 4 b Residential: Liquid Fuels (CO_2)
- 1 A 4 b Residential: Solid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)
- 1 A 5 a Stationary: Solid Fuels (CO_2)
- 1 A 5 b Mobile: Liquid Fuels (CO_2)
- 1 B 1 a Coal Mining: (CH_4)
- 1 B 2 a Oil: (CO_2)
- 1 B 2 b Natural gas: (CH_4)
- 1 B 2 c Venting and flaring: (CO_2)

Figure 3.1 CRF Sector 1 Energy: EU-15 GHG emissions in CO_2 equivalents (Tg) for 1990–2012

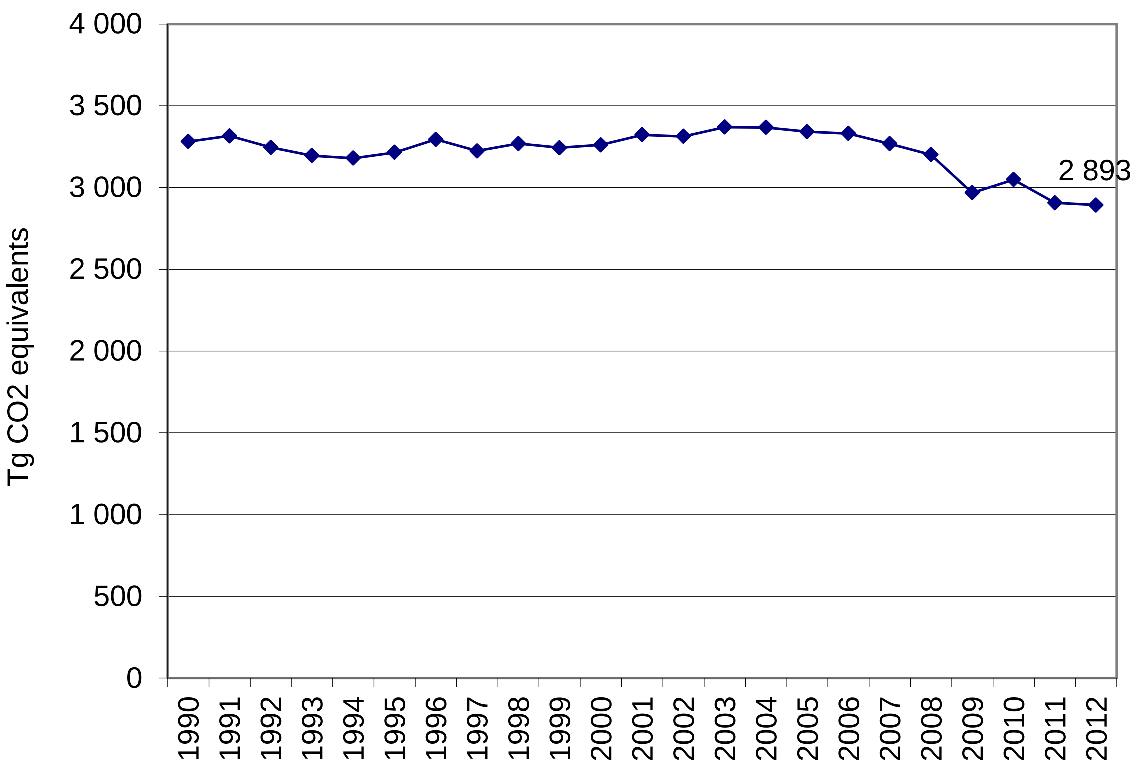
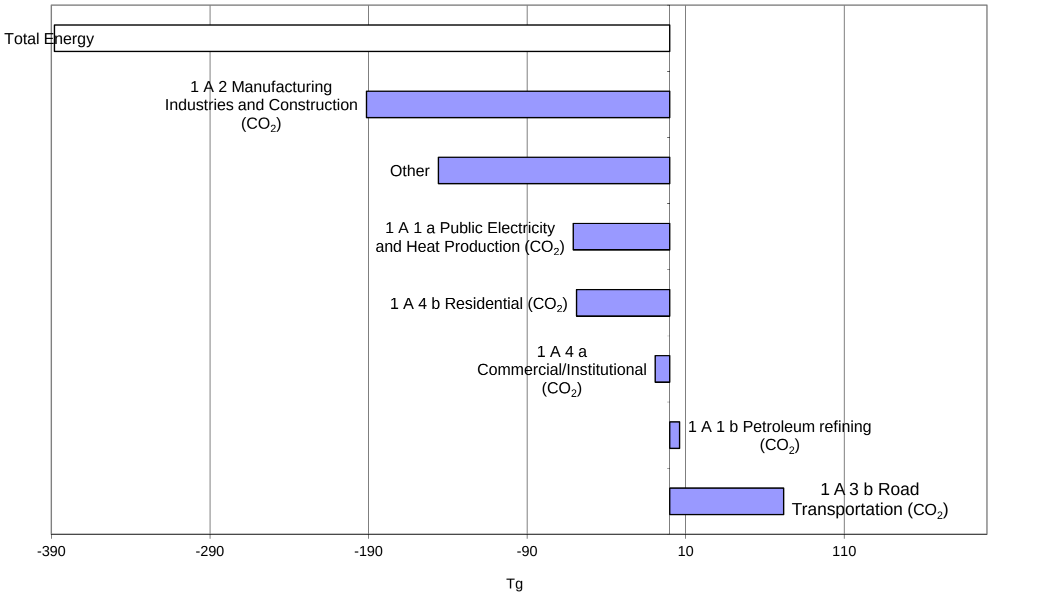
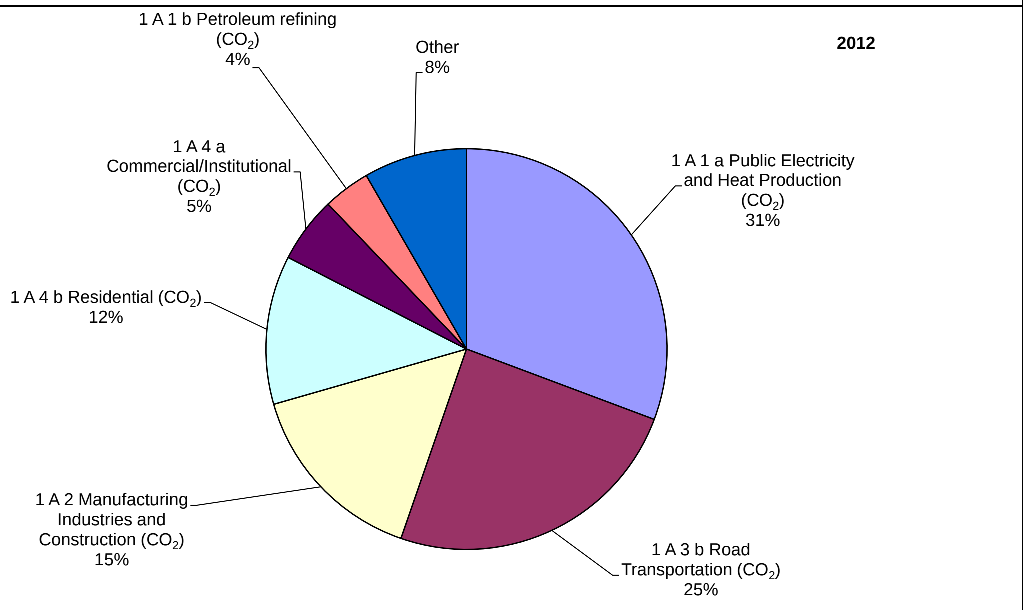


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries decreased substantially between 1990 and 2012. The increases in road transport occurred in almost all Member States, whereas the emission reductions from manufacturing industries mainly occurred in Germany after the reunification. The decline of coal-mining (CH_4) and decreasing CO_2 emissions from 1A1c Manufacture of Solid Fuels and Other Energy Industries are the main reasons for the large absolute

emission reductions from Other[27] in Figure 3.2. Figure 3.2 shows that the six largest key categories account for more than 90 % of emissions in Sector 1.

Figure 3.2 CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2012 and share of largest key source categories in 2012





[27] „Other“ includes total emissions of Sector 1 minus 1A1a, 1A1b, 1A2, 1A3b, 1A4a and 1A4b.

3.2 Source categories (EU-15)

3.2.1 Energy industries (CRF Source Category 1A1)

Energy industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producing industries. For the EU-15, this source category includes three key categories: CO_2 from 'Public electricity and heat production' (CRF 1A1a), CO_2 from 'Petroleum-refining' (CRF 1A1b), and CO_2 from 'Manufacture of solid fuels and other energy industries' (CRF 1A1c).

Figure 3.3 shows the trends in emissions in energy industries for the EU-15 between 1990 and 2012, which was mainly dominated by CO_2 emissions from public electricity and heat production. CO_2 from 1A1a currently represents about 84 % of greenhouse gas emissions in 1A1 (i.e. including methane and nitrous oxide).

Total greenhouse gas emissions from 1A1 decreased by 9 %, between 1990 and 2012. This was mainly due to a decrease of CO_2 emission from Public Electricity and Heat Production (-61 Tg CO_2) and the manufacturing of solid fuels (-58 Tg CO_2). CO_2 emissions from petroleum refining increased by 6 Tg in the period 1990-2012.

Figure 3.3 1A1 Energy Industries: Total GHG, CO_2 and N_2O emission trends and Activity Data

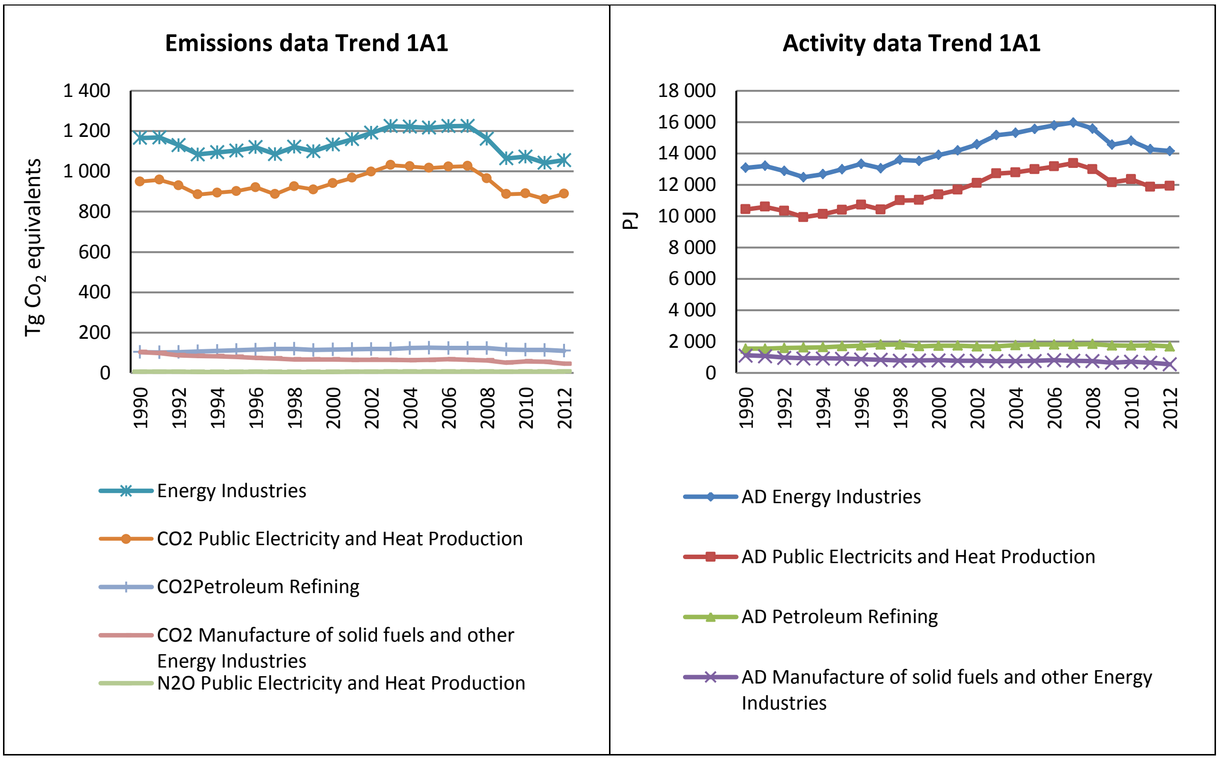


Table 3.1 summarises the information by Member State. Between 1990 and 2012, greenhouse gas emissions from energy industries increased in eight Member States and fell in seven. The highest absolute increase was accounted for by Spain, Greece and the Netherlands. Germany and the UK account for the largest part of reductions (-109 Tg).The change in the EU-15 was a net decrease of 110 Tg. The table also shows the emissions of CO_2 and N_2O separately.

Table 3.1 1A1 Energy industries: Member States' contributions to CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N2O emissions in 2012 (Gg CO_2 equivalents)
Austria	13 843	12 447	13 792	12 325	46	111
Belgium	29 993	22 879	29 792	22 695	184	148
Denmark	26 246	16 758	26 146	16 531	86	88
Finland	19 181	20 700	19 051	20 371	122	307
France	64 174	52 701	63 525	52 054	592	619
Germany	426 946	364 756	423 418	360 077	3 294	3 040
Greece	43 159	54 699	42 993	54 507	154	176
Ireland	11 239	12 794	11 159	12 647	74	141
Italy	137 214	126 298	136 503	125 639	516	545
Luxembourg	36	1 036	33	1 032	2	3
Netherlands	52 699	60 307	52 501	59 939	139	272
Portugal	16 326	17 425	16 261	17 290	61	127
Spain	77 656	91 919	77 355	91 150	277	604
Sweden	10 147	10 264	9 797	9 726	328	450
United Kingdom	236 623	190 206	234 408	188 349	2 049	1 644
EU-15	**1 165 481**	**1 055 189**	**1 156 733**	**1 062 307**	**7 922**	**8 276**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.4 shows the relative contributions of greenhouse gas emissions from energy industries in each Member State, ranging from relatively low shares in Luxembourg and France to relatively high in Finland, UK, Germany and Greece. Figure 3.5 shows the absolute contributions to EU-15 greenhouse gas emissions from energy industries, which are clearly dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from energy industries.

Figure 3.4 Share of greenhouse gas emissions from energy industries in total greenhouse gas emissions by Member State in 2012

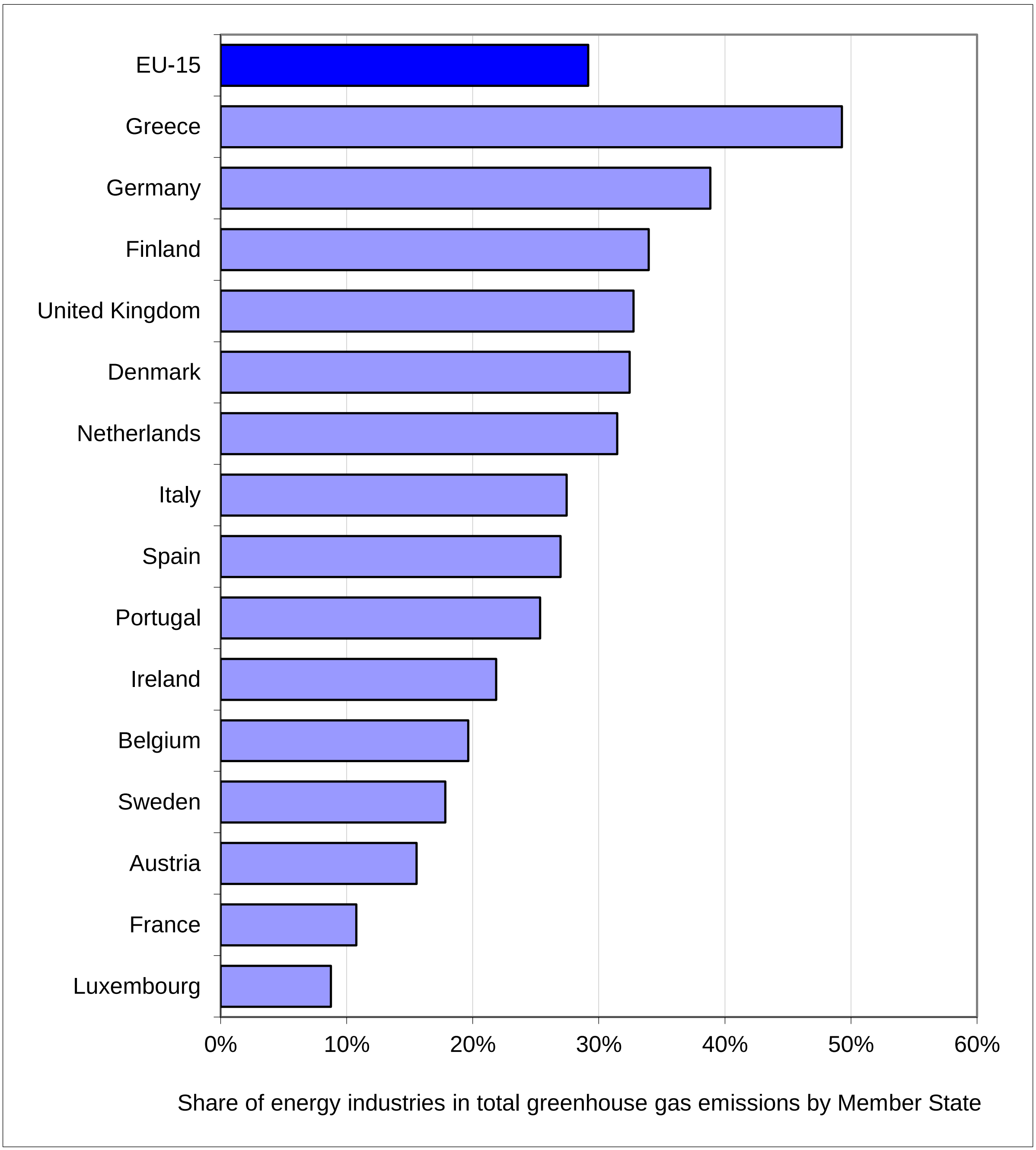
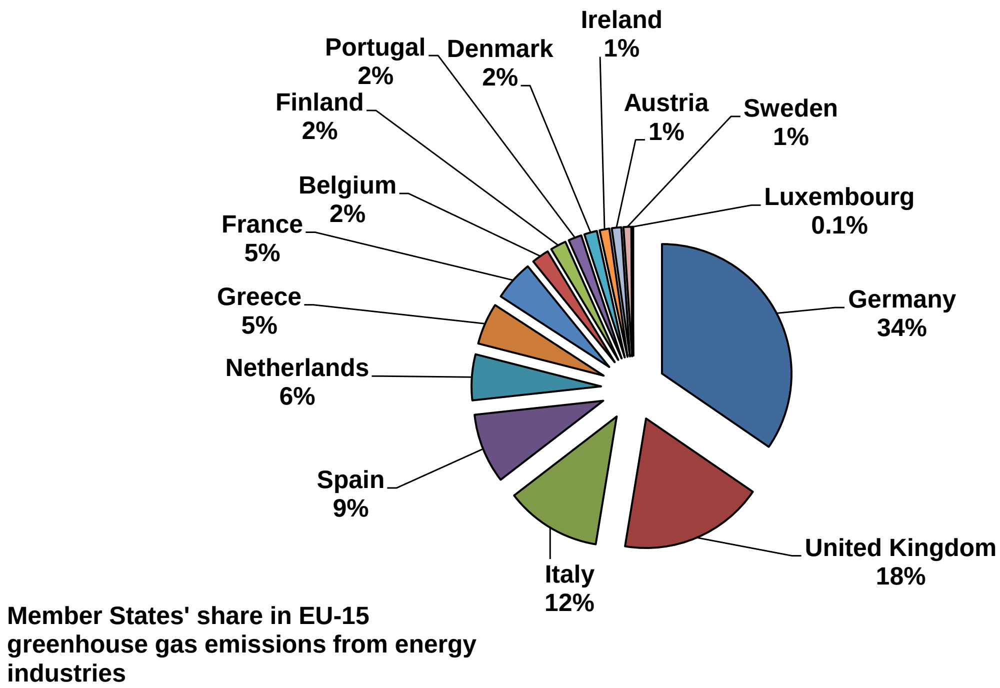


Figure 3.5 Member States' share of greenhouse gas emissions from energy industries in EU-15



Public heat and electricity production is the largest source category in the EU-15, as well as the main source of emissions from energy industries. Differences in the intensity of greenhouse gas emissions of heat and electricity production between the Member States are to a large extent explained by the mix of fuels. The relatively low share of greenhouse gas emissions from energy industries in France can be partly explained by the use of nuclear energy for power generation. Luxembourg is a net importer of electricity from neighbouring countries. Some countries rely more on coal than on gas. At the EU-15 level, 46 % of the fuel used in energy industries comes from solid fuels. Its contribution has been steadily declining in favour of relatively cleaner natural gas, whose share amounted to 28 % in 2012.

Table 3.2 provides information on the Member States' contribution to EU-15 recalculations in CO_2 from 1A1 Energy Industries for 1990 and 2011 as well as the main explanations for the largest recalculations in absolute terms.

Table 3.2 1A1 Energy Industries: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO_2 equiv.	Percent	Gg CO_2 equiv.	Percent	
Austria	0	0.0	-138	-1.0	Revised energy balance.
Belgium	2	0.0	1 056	4.8	1A1a solid fuels: Flemish region: difference mainly due to wrong allocation between solid fuel and biomass of one electric power installation in 2011. 1A1a other fuels: Flemish region: by finalizing the definitive energy balance for 2011, 1,1 PJ more other fuels was reported (+112 kton CO2) + RBC: AD revision (waste incinerated).
Denmark	0	0.0	8	0.0	For stationary combustion plants, the emission estimates for the years 1990-2011 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and trans-formation sectors as well as a source category update. The changes in the energy statistics are largest for the years 2009, 2010 and 2011.
Finland	-6	0.0	118	0.5	Corrections in activity data.
France	-17	0.0	-1 106	-2.1	1A1a: Completeness of data: improved accuracy and temporal coherence. 1A1b: Filtering method and improved allocation of emissions.
Germany	0	0.0	391	0.1	Final data available from the National Energy Balance.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-3	0.0	Update of natural gas emission factor.
Luxembourg	0	0.0	7	0.7	Revised energy balance.
Netherlands	0	0.0	362	0.6	Improved AD and emission factor.
Portugal	0	0.0	-40	-0.2	Reallocation of CO2 emissions from the use of limestone in the desulphurization occurring in the energy sector (1A1a) to the industrial processes sector (2A3 - Limestone and Dolomite Use).
Spain	0	0.0	477	0.6	Revision of the emission factor for liquid fuels consumed as auxiliary fuels in landifll and biomethanization plants with biogas recovery, after it was detected the incorrect input of the emission factors in the database.
Sweden	3	0.0	0	0.0	During submission 2013 it was concluded that one of the operators did not take into account any intermediate stock change of produced coke in the carbon mass balance used when calculating the CO2 emissions, i.e. large amounts of carbon assumed to be released into the atmosphere was actually stored in the coke stocks. For submission 2014 the operator has delivered a revised time series, 2005-2012, of CO2 emissions allocated on different subcategories (CRF 1.A.1.c, 1.A.2.a, 1.B.1.c and 2.C.1.2). The current calculation model (see section 4.4.1.2.2) has been updated according to the new information from the operator. Due to the fact that an average CO2 IEF 2003-2007 is used in the calculation model to calculate the CO2 emissions and the amounts of derived energy gases (CH4, N2O, NMVOC and CO emissions) for 1990-2002, the new information also affects the reported emissions for previous years.
UK	-6	0.0	-28	0.0	National energy statistics revised for many sectors from 2008 onwards. 1A1b: Correction to EUETS data has caused a change to OPG CEF for all years. 1A1c: Revision to carbon balance apprach to use AD and EFS from ISSB/Tata in preference to DUKES stats and historic EF defaults.
EU-15	**-23**	**0.0**	**1 105**	**0.1**	

Table 3.3 provides information on the Member States' contribution to EU-15 recalculations in N_2O from 1A1 Energy Industries for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 3.3 1A1 Energy industries: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	-0.2	Revised energy balance.
Belgium	0	0.0	-2	-1.5	1A1b liquid fuels: Re-allocation emissions refineries from liquid fuels to gaseous fuels. 1A1b gaseous fuels: Following EU QAQC, it is more accurate to report these emissions under the gaseous fuels rather than the liquid fuels.
Denmark	1	0.8	0	0.0	For stationary combustion plants, the emission estimates for the years 1990-2011 have been updated according to the latest energy statistics published by the Danish Energy Agency.
Finland	-0.1	-0.1	1	0.4	Corrections in activity data.
France	-1	-0.2	-3	-0.5	1A1a: Completeness of data: improved accuracy and temporal coherence. 1A1b: Filtering method and improved allocation of emissions.
Germany	-1 077	-24.6	45	1.6	Correction of some emission factors in order to increase time series consistency. Final data available from the National Energy Balance.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	-0.1	A revision to energy data in sub-category 1.A.1.c for years 2005-2011: revised (increased) CO2 emission factors (from ETS data) and revised peat consumption activity data from Energy Balance (decreased).
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0.0	0.2	Revised energy balance.
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	1.2	0.9	Recalculations for Energy Industries sector comprise the allocation of CO2 emissions from the desulfurization process, total CO2 emissions from this abatement system were included together with the Limestone, Dolomite and Carbonate Use in CRF 2.A.3.(1990-2011)
Spain	0	0.1	19	3.1	Revision of activity data according to new available information. Correction of input errors (fuel consumption and/or fuel characteristics) in the database.
Sweden	0	0.0	0	0.0	
UK	-14	-0.7	-2	-0.1	New EFs included for liquid biofuels used in powerstations. Change to data derived for offshore diesel consumption.
EU-15	**-1 093**	**-12.1**	**59**	**0.7**	

3.2.1.1 Public Electricity and Heat Production (1A1a) (EU-15)

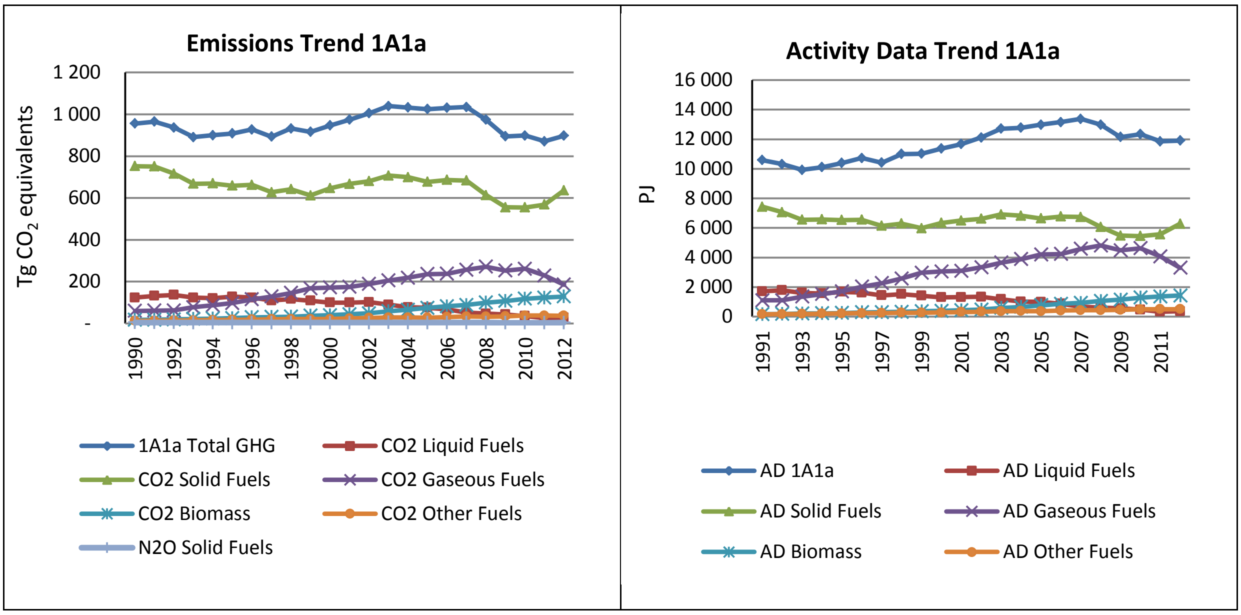
According to the IPCC, emissions from public electricity and heat production (CRF 1A1a) should include emissions from main activity producers of electricity generation, combined heat and power generation, and heat plants. Main activity producers (i.e. public utilities) are defined as those undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included. Emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity) should be assigned to the sector where they were generated and not under 1A1a. Autoproducers may be in public or private ownership.

CO_2 emissions from electricity and heat production is the largest key category in the EU-15 accounting for 25 % of total greenhouse gas emissions in 2012 and for 84 % of greenhouse gas emissions of the Energy Industries Sector. Between 1990 and 2012, CO_2 emissions from electricity and heat production decreased by 6 % in the EU-15.

Figure 3.6 (left) shows the trends in emissions originating from the production of public electricity and heat by fuel in the EU-15 between 1990 and 2012. Figure 3.6 (right) shows the underlying activity data[28].

[28] CO_2 emissions from the combustion of biomass fuels are reported as a memo item and are therefore not included in the emissions from public electricity and heat production. The biomass used as a fuel is however included in the national energy

Figure 3.6 1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends

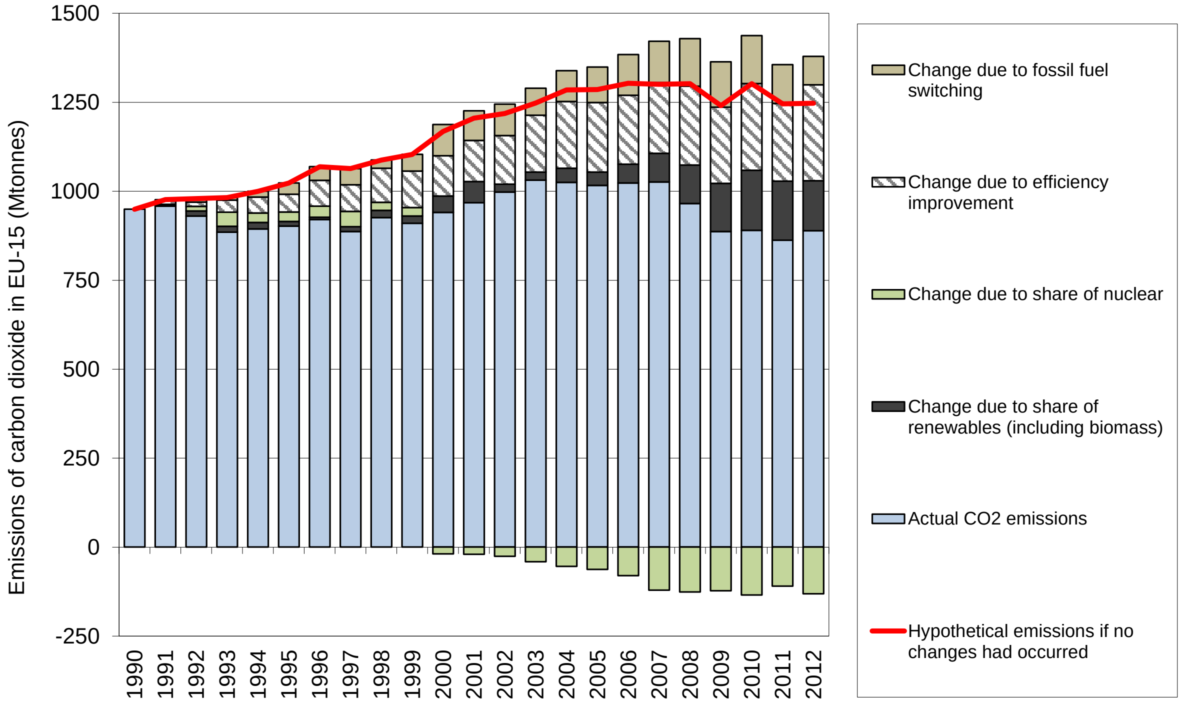


Fuel used for public electricity and heat production increased by 14 % in the EU-15 between 1990 and 2012. Solid fuels still represent almost half of the fuel used in public conventional thermal power plants, although its combustion has been declining (-15 %). Gas has increased very rapidly, by a factor of 3 between 1990 and 2012, but declined in the last years. In 2012 its share amounts to 28 % of all the fuel used for the production of heat and electricity in the EU-15. Liquid fuels still account for some 3 % but its use has declined gradually during the past 20 years. The use of biomass has increased even more rapidly than the use of gas, but its share in the fuel mix is relatively small, at around 12 %.

CO_2 emissions from public electricity and heat production did not increase in line with fuel consumption. There are several reasons for this. Figure 3.7 below shows the estimated impact of different factors on the reduction of CO_2 emissions from public heat and electricity generation in the EU-15 between 1990 and 2012. The main explanatory factors at the EU-15 level during the past 22 years have been improvements in energy efficiency and (fossil) fuel switching from coal to gas. However, the trend from coal to gas has reversed during the last years as a result of comparably high gas prices and lower coal prices.

consumption (i.e. activity data). The fact that CO_2 emissions from biomass are treated differently from other fuel emissions does not imply emissions from the production of heat and electricity are due to fossil fuel combustion only. Biomass CO_2 emissions are just reported elsewhere. Non-CO_2 emissions from the combustion of biomass (CH_4 and N_2O) are reported under the energy sector.

Figure 3.7 Estimated impact of different factors on the reduction in emissions of CO_2 from public electricity and heat production in the EU-15 between 1990 and 2012.



Note: *The chart shows the estimated contributions of the various factors that have affected emissions from public electricity and heat production (including public thermal power stations, nuclear power stations, hydro power plants and wind plants). The top line represents the hypothetical development of emissions that would have occurred due to increasing public heat and electricity production between 1990 and 2012, if the structure of electricity and heat production had remained unchanged since 1990, i.e. if the shares of input fuels used to produce electricity and heat had remained constant, and if the efficiency of electricity and heat production also stayed the same. However, there were a number of changes that tended to reduce emissions. The contribution of each of these changes to reducing emissions is shown by each of the bars. The cumulative effect of all these changes was that emissions from electricity and heat production actually followed the trend shown by the blue bars. This is a frequently used approach for portraying the primary driving forces of emissions. It is based on the IPAT and Kaya identities. The explanatory factors should not be seen as fundamental factors in themselves nor should they be seen as independent from each other. The underpinning energy data is based on Eurostat's energy balances.*

Based on the chart above, CO_2 emissions from public heat and electricity production decreased by 6 % during 1990-2012 (blue bar), but emissions would have risen by over 31 %, had the shares of input fuels used to produce electricity and heat and the efficiency remained constant, an increase which would be in line with the additional amount of electricity and heat produced (31 %). The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2012 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2012, there was an 17 % reduction in the fossil-fuel input per unit of electricity produced from fossil fuels.
- Changes in the fossil fuel mix used to produce electricity, i.e. fuel switching from coal and lignite to natural gas. There was an 8 % reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2012.
- The higher combined share of nuclear and renewable energy for electricity and heat production in 2012 compared to 1990[29]. During 1990-2012, the share of electricity from fossil fuels in total electricity production decreased by 7 %.

[29] The specific nuclear effect can be separated from the renewable effect in an additive way. These two factors will then be additive to each other and the combined renewable and nuclear effect will remain multiplicative to the already-mentioned

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.31 (increase in electricity and heat production) X 0.83 (efficiency improvement) X 0.92 (fossil fuel switching) X 0.93 (lower nuclear-renewable share) = 0.94. The combined effect was a decrease of 6 % in CO_2 emissions in 2012 compared to the 1990 level.

Returning to the 2014 inventory, Table 3.4 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in seven Member States and fell in eight compared to 1990. Of the seven countries where emissions were higher in 2012 than in 1990, more than 85% of the increase was accounted for by the Netherlands, Greece and Spain. Of the eight countries, where emissions fell, 75% of the total reduction was accounted for by the UK (47%), Italy (17%) and Denmark (11%). The change in the EU-15 between 1990 and 2012 was a net decrease of 61 Tg CO_{2eq}.

Table 3.4 1A1a Public Electricity and Heat Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	10 888	10 434	8 983	1%	-1 451	-14%	-1 905	-17%
Belgium	23 469	18 406	17 856	2%	-551	-3%	-5 614	-24%
Denmark	24 695	17 398	14 111	2%	-3 287	-19%	-10 584	-43%
Finland	16 444	21 369	17 560	2%	-3 809	-18%	1 116	7%
France	46 863	37 377	40 437	5%	3 060	8%	-6 426	-14%
Germany	339 018	314 368	329 567	37%	15 199	5%	-9 451	-3%
Greece	40 582	50 460	50 902	6%	442	1%	10 320	25%
Ireland	10 876	11 420	12 229	1%	809	7%	1 353	12%
Italy	107 136	91 397	90 666	10%	-732	-1%	-16 470	-15%
Luxembourg	33	998	1 032	0.1%	34	3%	998	2999%
Netherlands	39 932	50 514	48 110	5%	-2 404	-5%	8 177	20%
Portugal	14 319	14 217	15 145	2%	928	7%	827	6%
Spain	64 332	72 298	76 881	9%	4 583	6%	12 549	20%
Sweden	7 718	7 756	7 167	1%	-589	-8%	-551	-7%
United Kingdom	203 096	144 018	157 918	18%	13 900	10%	-45 178	-22%
EU-15	**949 401**	**862 431**	**888 563**	**100%**	**26 132**	**3%**	**-60 838**	**-6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Note that German CO_2 emissions from SO_2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.

Figure 3.8 shows the relative contributions of greenhouse gas emissions from public electricity and heat production in each Member State, ranging from relatively low shares in France and Luxembourg to relatively high in Finland, Denmark, Germany and Greece. Figure 3.9 shows the absolute contributions to EU-15 CO_2 emissions from this source category, dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from public electricity and heat production.

fuel-switching and efficiency factors. The reason for negative values of nuclear power is that - from 2000 onwards - the share of nuclear power in total electricity generation was below the share of 1990. During the period 1991-1999 the share of nuclear power was above the value of 1990 (34%) reaching 36% in 1993 and 1997. Therefore during this period nuclear power contributed to lower GHG emissions compared to 1990. In the figure this is reflected in the (positive) green bars. The positive value indicates that nuclear power had a positive effect with regard to GHG emission reductions between 1990 and 1999. From 2000 onwards the picture changed: the share of nuclear power was below the value of 1990 reaching 28% in 2012. In the figure this is reflected in the (negative) green bars. The negative value indicates that nuclear power had a negative effect with regard to GHG emission reductions between 2000 and 2011. This is also reflected by the red line in the figure: the red line assumes that the share of nuclear power stays at 34% over the whole time series. Therefore from 2000 onwards the red line is below the bars.

Figure 3.8 *Share of CO_2 emissions from public electricity and heat production in total greenhouse gas emissions by Member State in 2012*

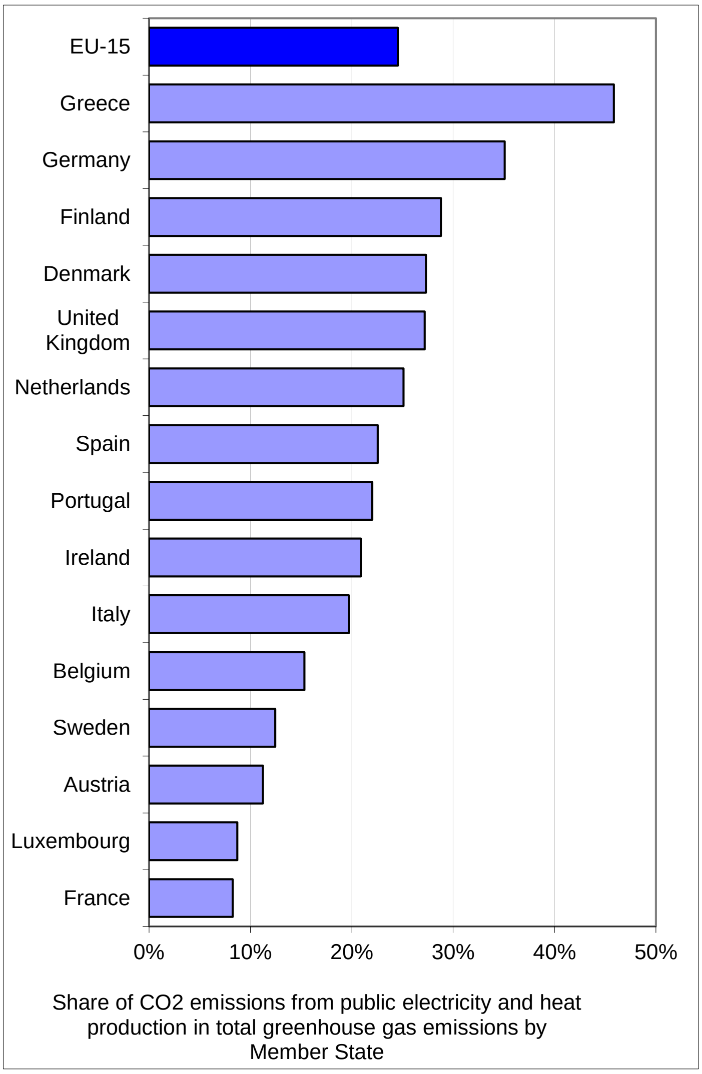
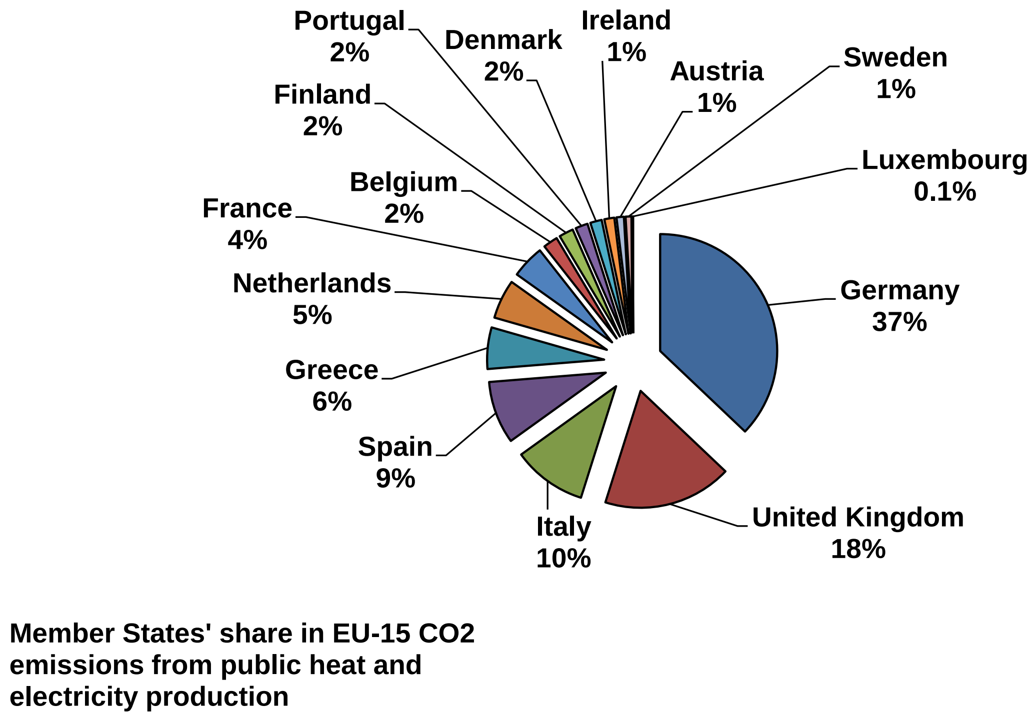


Figure 3.9   Member States' share of CO_2 emissions from public heat and electricity production in EU-15



Finally, N_2O emissions currently represent 0.8 % of greenhouse gas emissions from public electricity and heat production. Between 1990 and 2012, emissions increased by 14 % (Table 3.5). Emissions from this source category only declined in the United Kingdom. The biggest increases occurred in Spain and Germany.

Table 3.5 1A1a Public Electricity and Heat Production: Member States' contributions to N_2O emissions

Member State	N_2O emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	41	113	105	2%	-8	-7%	64	156%
Belgium	51	76	81	1%	5	7%	29	57%
Denmark	79	87	79	1%	-8	-9%	0.2	0.3%
Finland	104	309	281	4%	-27	-9%	177	170%
France	460	498	526	8%	29	6%	67	14%
Germany	2 504	2 676	2 804	40%	128	5%	300	12%
Greece	147	163	166	2%	3	2%	19	13%
Ireland	74	138	141	2%	3	2%	67	91%
Italy	326	315	331	5%	16	5%	5	1%
Luxembourg	2	3	3	0.04%	-0.01	-1%	1	67%
Netherlands	131	242	255	4%	13	5%	125	95%
Portugal	52	120	114	2%	-6	-5%	62	120%
Spain	197	502	482	7%	-20	-4%	285	145%
Sweden	304	423	421	6%	-2	-0.4%	117	38%
United Kingdom	1 669	929	1 208	17%	279	30%	-461	-28%
EU-15	**6 142**	**6 594**	**6 998**	**100%**	**404**	**6%**	**856**	**14%**

.Abbreviations explained in the Chapter 'Units and abbreviations'.

1A1a Electricity and Heat Production - Liquid Fuels (CO_2)

CO_2 emissions arising from the combustion of liquid fuels for public electricity and heat generation account for about 3 % of all greenhouse gas emissions from 1A1a. Within the EU-15, emissions fell by 77 % between 1990 and 2012 (Table 3.6).

Table 3.6 1A1a Public Electricity and Heat Production, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	1229	380	219	1%	-161	-42%	-1009	-82%	T2	CS,PS
Belgium	659	90	160	1%	70	78%	-499	-76%	CS,T1,T3	CS,D
Denmark	951	389	337	1%	-52	-13%	-614	-65%	T3,T2,T1	PS,CS,D
Finland	1235	755	812	3%	57	8%	-423	-34%	T3	CS,D,PS
France	7880	4866	5037	18%	171	4%	-2843	-36%	T2, T3	CS
Germany	8507	1988	2724	10%	737	37%	-5782	-68%	CS	CS
Greece	5375	3779	3808	13%	28	1%	-1567	-29%	T2	PS
Ireland	1087	158	153	1%	-6	-4%	-934	-86%	T3	PS
Italy	63047	1615	2910	10%	1295	80%	-60137	-95%	T3	CS
Luxembourg	NO	2	2	0%	0	-14%	2	-	T2	CS
Netherlands	207	909	1040	4%	132	14%	833	403%	T2	CS,D
Portugal	6405	907	899	3%	-8	-1%	-5506	-86%	T2	D, CR, PS
Spain	6006	7822	7911	28%	89	1%	1904	32%	T2	CS, PS
Sweden	1276	850	795	3%	-56	-7%	-481	-38%	T2	CS
United Kingdom	19716	1444	1560	6%	116	8%	-18155	-92%	T2	CS
EU-15	**123579.46**	**25955.04**	**28368.24**	**100%**	**2413.20**	**9%**	**-95211.22**	**-77%**		

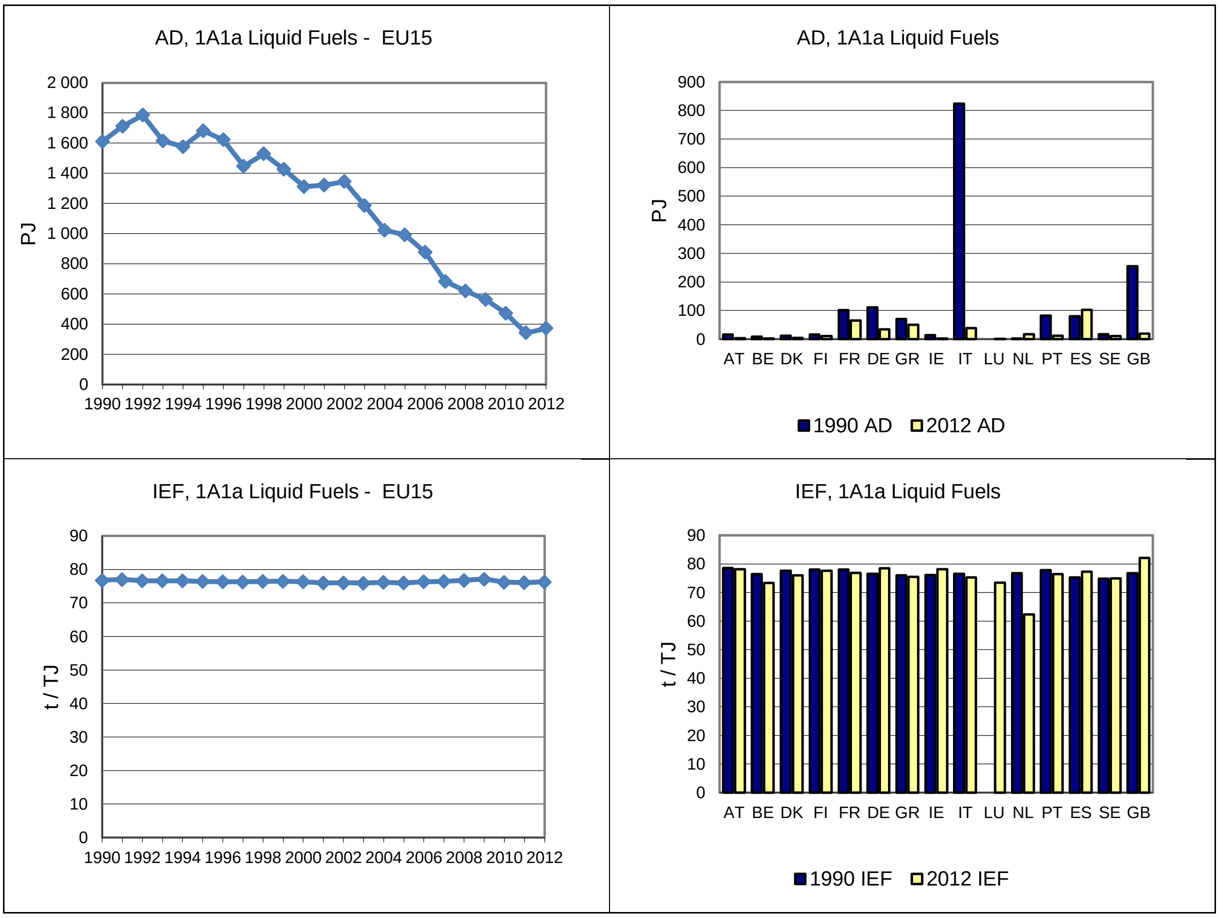
.Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.10 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels used in public electricity and heat production. The charts clearly show the importance of liquid fuels declined gradually since 1992. The implied emission factor has remained stable for the EU-15 (72.83 t/TJ in 2012). The largest emitters in 2012 were Spain, France and Greece together responsible for

60 % of the EU-15 emissions. In Italy, which is the 4th largest emitter, emissions have fallen markedly compared to 1990, but show an increase in 2012.

In the Netherlands, the IEF declined from 71 t/TJ in 1994 to about 60 t/TJ in 1995 and the years thereafter. This is explained by the sharp increase in the use of residual chemical gas. In the Netherlands in this sector, among others, residual gases from the chemical industry are combusted. The implied emission factor is low because these residual gases contain hydrogen gas. The IEF of the UK increased to 82.08 t/TJ and is the highest in 2012 among the EU-15 Member States. This results from the fact that UK power stations use relatively small amounts of liquid fuels, but these include petroleum coke as well as fuel oil and gas oil. Petroleum coke, which has a higher IEF than most other liquid fuels, contributed approximately 20 % of the energy input in liquid fuels to 1A1a in 2012.

Figure 3.10 1A1a-Public Electricity and Heat Production, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A1a Electricity and Heat Production - Solid Fuels (CO_2, N_2O)

CO_2 emissions from the combustion of solid fuels represented about two thirds of all greenhouse gas emissions from public electricity and heat production. Within the EU-15, emissions fell by 15 % between 1990 and 2012 (Table 3.7).

Table 3.7 1A1a Public Electricity and Heat Production, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	6 247	4 252	3 454	3%	-797	-19%	-2 793	-45%	T2	CS,PS
Belgium	19 345	6 875	7 327	1%	452	7%	-12 018	-62%	CS,T1,T3	CS,D
Denmark	22 225	12 318	9 599	2%	-2 719	-22%	-12 627	-57%	T3	PS,CS
Finland	9 281	9 144	7 454	1%	-1 690	-18%	-1 827	-20%	T3	CS,D,PS
France	36 214	18 224	23 073	4%	4 848	27%	-13 142	-36%	T2, T3	CS
Germany	307 928	263 244	281 603	44%	18 359	7%	-26 325	-9%	CS	CS
Greece	35 207	40 706	41 990	7%	1 284	3%	6 783	19%	T2	CS
Ireland	7 909	5 857	7 228	1%	1 371	23%	-681	-9%	T3	PS
Italy	28 148	38 284	41 395	6%	3 112	8%	13 248	47%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	25 776	23 333	25 909	4%	2 576	11%	133	1%	T2	CS
Portugal	7 913	8 302	10 887	2%	2 585	31%	2 973	38%	T2	D, CR, PS
Spain	57 778	43 359	52 332	8%	8 973	21%	-5 446	-9%	T2	PS
Sweden	5 404	4 126	3 960	1%	-166	-4%	-1 444	-27%	T2	CS
United Kingdom	183 150	90 578	120 708	19%	30 130	33%	-62 442	-34%	T2	CS
EU-15	**752 525**	**568 600**	**636 917**	**100%**	**68 317**	**12%**	**-115 608**	**-15%**		

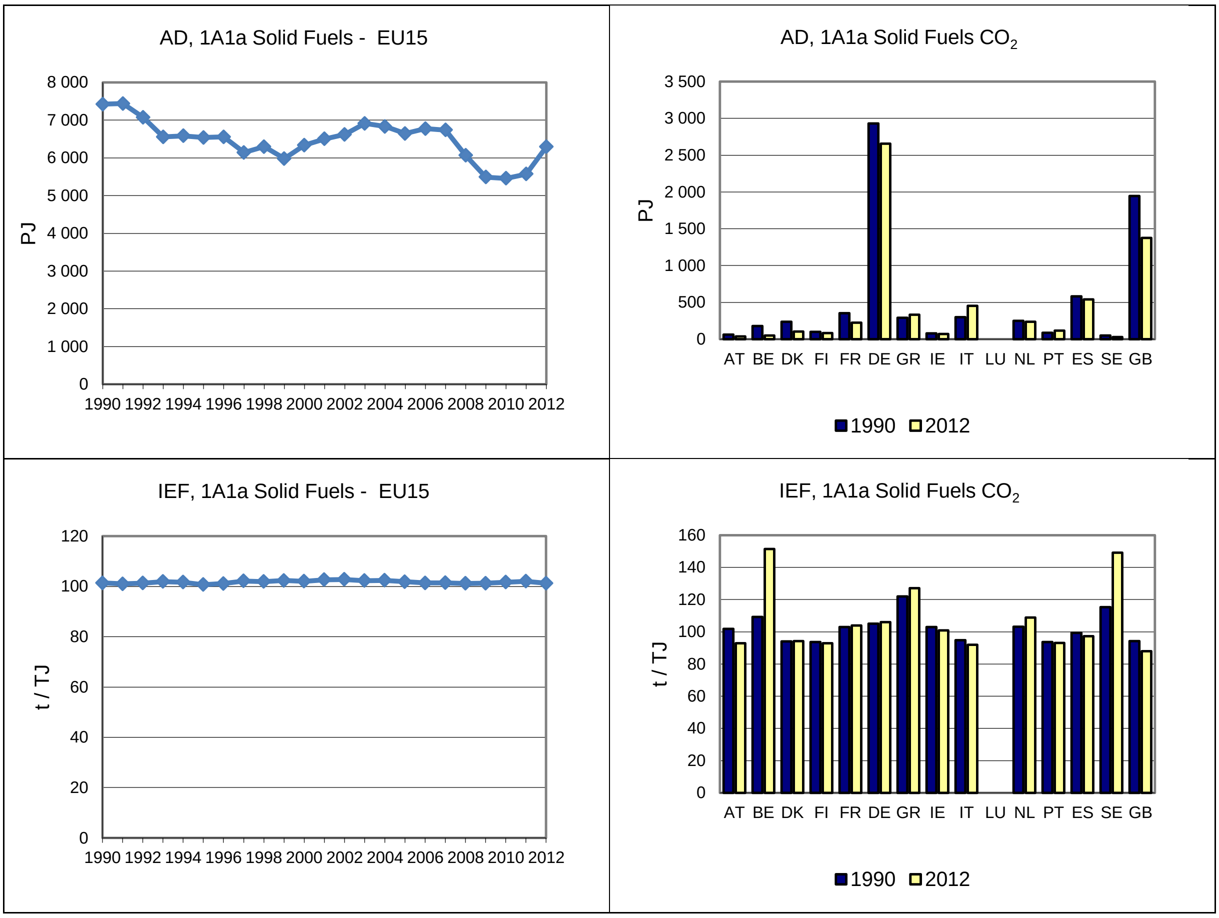
Note that German CO_2 emissions from SO_2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.11 shows the relevant activity data and implied emission factors for solid fuels. The amount of solid fuels used decreased gradually until 1999 and has increased again until 2003. In 2003 the upwards trend in solid fuel use in public electricity and heat production has stopped; the trend reversed in 2007. However, since 2010 the trend has changed again and coal consumption increased mainly driven by the UK where low prices are the reason for an increased demand for coal. But also Germany and Spain which are large consumers of coal report an increased consumption in recent years. The EU-15 implied emission factor has remained fairly stable (101.24 t/TJ in 2012). The largest emitters in 2012 were Germany and the UK, jointly responsible for 63 % of EU-15 emissions. In both countries, however, emissions have fallen compared to 1990.

In Belgium and Sweden, the emission factors increased sharply since the late 1990s due to the use of blast furnace gas. The comparatively high IEF of Greece is due to the large importance of domestic lignite use for electricity production.

Figure 3.11 1A1a- Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for CO_2



The related N_2O emissions from the use of solid fuels are responsible for 0.8 % of all greenhouse gas emissions in the heat and power sector. For the EU-15, emissions decreased by 17 % between 1990 and 2012 (Table 3.8).

Table 3.8 1A1a Electricity and heat production, solid fuels: Member States' contributions to N_2O emissions

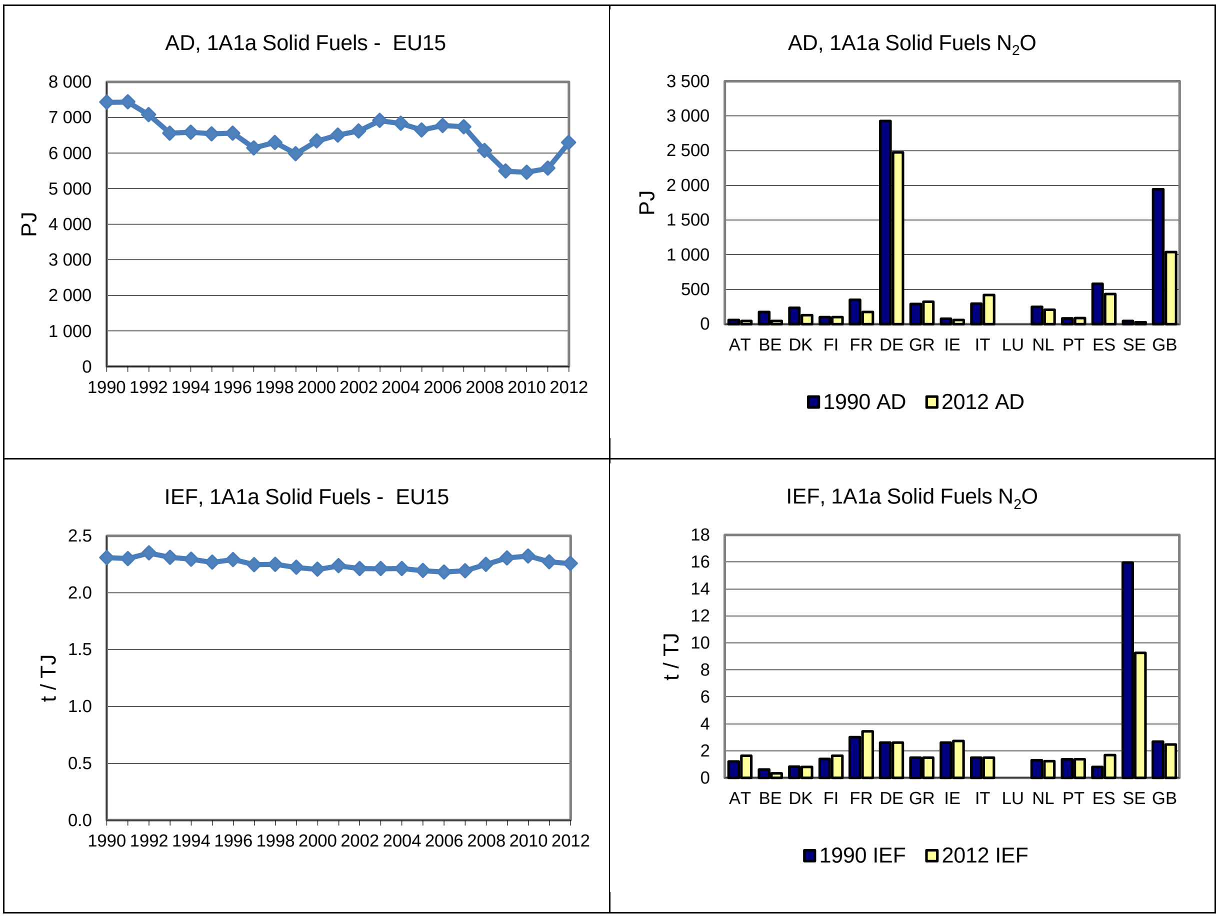
Member State	N_2O emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	23	23	19	0.4%	-4	-19%	-4	-19%
Belgium	33	5	5	0.1%	-0.1	-3%	-28	-86%
Denmark	60	32	25	1%	-7	-22%	-35	-58%
Finland	43	50	51	1%	1	1%	8	20%
France	329	189	237	5%	47	25%	-92	-28%
Germany	2 367	2 012	2 139	49%	127	6%	-228	-10%
Greece	134	150	154	3%	4	2%	19	14%
Ireland	62	49	57	1%	9	18%	-4	-7%
Italy	138	194	209	5%	15	8%	71	52%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	101	80	93	2%	13	16%	-8	-8%
Portugal	36	38	50	1%	12	32%	14	38%
Spain	146	227	238	5%	12	5%	93	64%
Sweden	232	82	74	2%	-8	-9%	-158	-68%
United Kingdom	1 610	791	1 050	24%	259	33%	-560	-35%
EU-15	**5 313**	**3 922**	**4 401**	**100%**	**479**	**12%**	**-912**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.12 shows the related activity data and implied emission factors for N_2O. The EU-15 implied emission factor remained stable at around 2.27 t/TJ between 1990 and 2012. The largest emitters in 2012 were Germany and the UK, accounting for 72 % of EU-15 emissions. The EU-15 IEF is dominated by the IEF of Germany which revised its IEF in its latest inventory submission for the years 1990-1994 as a result of a research project.

Sweden has the highest IEF (about 9.26 kg/TJ in 2012); it declined gradually between 1990 and 2012. This was due to the increased use of blast furnace gas and a lower use of coal. Since the IEF for coal is ten times higher than the IEF for blast furnace gas, the IEF for solid fuels declined overall during the period. This comparatively high implied emission factor is regularly reviewed and found to be correct for Swedish conditions.

Figure 3.12 1A1a Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for N_2O



1A1a Electricity and Heat Production - Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels accounted for 21 % of all greenhouse gas emissions from public electricity and heat generation in 2012. Emissions increased by a factor of three in the EU-15 between 1990 and 2012 (Table 3.9). In all EU-15 Member States the consumption of gas was higher in 2012 than in 1990.

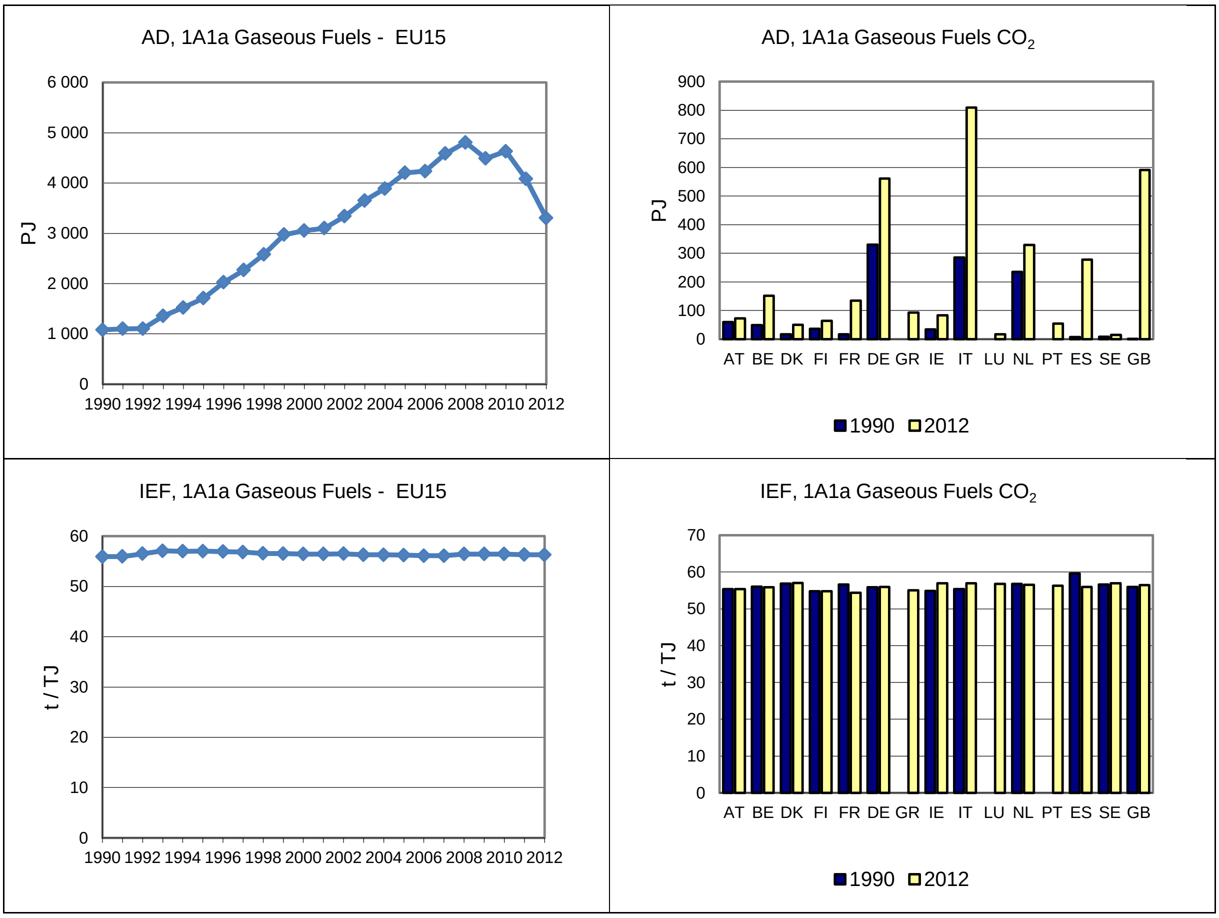
Table 3.9 1A1a Electricity and heat production, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	3 294	4 625	4 021	2%	-604	-13%	727	22%	T2	CS
Belgium	2 751	9 693	8 500	5%	-1 193	-12%	5 749	209%	CS,T1,T3	CS,D
Denmark	980	3 347	2 864	2%	-483	-14%	1 884	192%	T3	CS,PS
Finland	1 979	3 926	3 498	2%	-428	-11%	1 519	77%	T3	CS
France	977	9 348	7 295	4%	-2 053	-22%	6 318	647%	T2, T3	CS
Germany	18 462	35 306	31 434	17%	-3 872	-11%	12 973	70%	CS	CS
Greece	NO	5 974	5 104	3%	-870	-15%	5104	-	T2	PS
Ireland	1 881	5 388	4 755	3%	-634	-12%	2 874	153%	T3	PS
Italy	15 787	51 216	46 084	25%	-5 131	-10%	30 297	192%	T3	CS
Luxembourg	NO	930	966	1%	35	4%	966	-	T2	CS
Netherlands	13 348	23 701	18 566	10%	-5 136	-22%	5 217	39%	T2	CS
Portugal	NO	4 628	3 038	2%	-1 590	-34%	3 038	-	T2	D, CR, PS
Spain	437	20 105	15 570	8%	-4 535	-23%	15 133	3462%	T2	CS, PS
Sweden	486	1 288	867	0.5%	-421	-33%	381	79%	T2	CS
United Kingdom	16	50 256	33 344	18%	-16 912	-34%	33 328	209040%	T2	CS
EU-15	**60 397**	**229 731**	**185 905**	**100%**	**-43 826**	**-19%**	**125 507**	**208%**		

.Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.13 shows the activity data and implied CO_2 emission factors from gaseous fuels. Gas use in the power generating sector increased strongly after 1992 and reached its peak in 2008. Since then emissions are decreasing mainly because of increasing natural gas prices. In 2012 all Member states except Luxembourg report decreasing emissions. The EU-15 implied emission factor has remained fairly stable (56.27 t/TJ in 2012). The increase in the EU-15 factor observed in the early 1990s can be explained by the higher UK's gas share in the EU-15 and by an increase in the UK's implied emission factor. The latter is the result of the commissioning of the Peterhead power station in Scotland, which uses sour gas, a fuel with a much higher factor than natural gas. The largest emitters in 2012 were the Italy, UK and Germany, jointly responsible for almost 60 % of EU-15 emissions.

Figure 3.13 1A1a-Public Electricity and Heat Production, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A1a Electricity and Heat Production - Other Fuels (CO_2)

In 2012, the share of CO_2 emissions from other fuels amount to 4 % of total greenhouse gas emissions from public electricity and heat generation. Emissions increased by 190% at EU-15 level between 1990 and 2012 and increased in all countries where ‘other fuels’ are used in heat and power generation. Other fuels cover mainly the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.10).

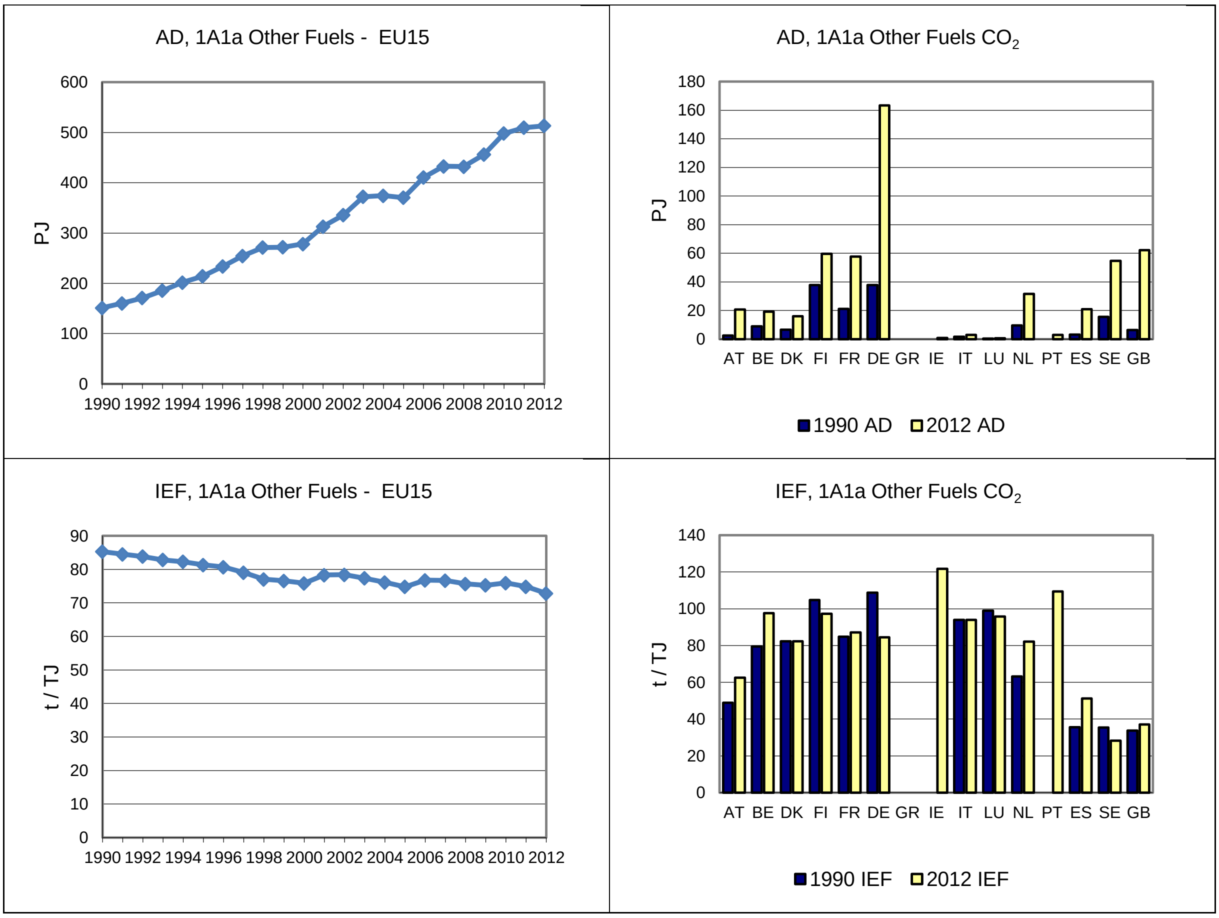
Table 3.10 1A1a Public Electricity and Heat Production, other fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	118	1 177	1 288	3%	112	9%	1 170	992%	T2	CS,PS
Belgium	714	1 749	1 869	5%	120	7%	1 155	162%	CS,T1,T3	CS,D
Denmark	539	1 345	1 312	4%	-33	-2%	773	144%	T3	CS
Finland	3 950	7 545	5 796	16%	-1 749	-23%	1 846	47%	T3	CS
France	1 792	4 938	5 032	13%	94	2%	3 241	181%	T2, T3	CS
Germany	4 121	13 830	13 806	37%	-24	0%	9 685	235%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	16	94	0.3%	77	471%	94	-	T2	PS
Italy	153	283	275	1%	-8	-3%	122	79%	T3	CS
Luxembourg	33	65	64	0.2%	-1	-2%	30	92%	T2	D
Netherlands	601	2 570	2 595	7%	24	1%	1 993	331%	T2	CS
Portugal	NO	380	322	1%	-59	-15%	322	-	T2	D, CR, PS
Spain	110	1 013	1 068	3%	56	5%	958	870%	T2	CS, PS
Sweden	553	1 492	1 546	4%	54	4%	993	180%	T2	CS
United Kingdom	215	1 740	2 306	6%	566	33%	2 092	974%	OTH,T1	CS
EU-15	**12 899**	**38 145**	**37 373**	**100%**	**-772**	**-2%**	**24 474**	**190%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.14 shows the activity data and implied emission factors. The EU-15 implied emission factor has fallen gradually since 1990, standing at 72.83 t/TJ in 2012. The largest emitters in 2012 were Germany, Finland and France, which together accounted for 65 % of EU-15 emissions.

Figure 3.14   1A1a Public Electricity and Heat Production, other fuels: Activity Data and Implied Emission Factors for CO_2



In Germany, the IEF declined continuously between 1990 and 2012 (from 10.79 to 84.51 t/TJ). This is because the combustion of industrial waste has been greatly reduced in the early 1990s whereas the combustion of residential waste for electricity and heat has increased in the complete reporting period; furthermore, the calorific value of the applied waste has increased due to a better national waste separation management.

Figure 3.14 also shows that the share of Finnish activity in the EU-15 is comparatively high. This is due to the reporting of 'peat' under 'other fuels' instead of under 'solid fuels' as recommended by the revised 1996 IPCC Guidelines. This apparent misallocation is clearly explained and argued[30] and is consistent with national energy statistics as well as with the IPCC 2006 Guidelines.

In the Netherlands, the IEF increases considerably after 2003 to reach 82.15 t/TJ in 2012. This was mainly due to the increase in the share of plastics (with a high carbon fraction) in combustible.

Ireland reported for the first time in 2011 municipal solid waste (MSW) used in a waste to energy plant which was commissioned in 2011.

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[30] There are several reasons for reporting peat separately from solid fuels in Finland. Solid fuels include hard coal, coke and other fuels derived from coal (BFG, coke oven gas). The origin of these fuels is totally from imported sources, whereas peat is totally a domestic energy source. This categorization follows the practice used in national energy statistics as well as in the IPCC 2006 Guidelines. Moreover, the CO_2 IEF of peat is higher than the IEF of hard coal. Combining both fuels would cause significant variation in the IEF of solid fuels. Finally, other properties of peat and hard coal are very different, and would justify the reporting under two different fuel categories. See also the 2008 Finnish NIR to the UNFCCC.

3.2.1.2 Petroleum Refining (1A1b) (EU-15)

According to the IPCC, petroleum refining (CRF 1A1b) should include all combustion activities supporting the refining of petroleum products including on-site combustion for the generation of electricity and heat for own use. It does not include evaporative emissions occurring at the refinery. These emissions should be reported separately under 1B2a.

CO_2 emissions from petroleum refining is the sixth largest key category in the EU-15 accounting for 3 % of total greenhouse gas emissions in 2012. Between 1990 and 2012, EU-15 CO_2 emissions increased by 6 % (Table 3.11). Emissions in 2012 were above 1990 levels in all Member States, with the exception of the UK, the Netherlands, France and Germany.

Table 3.11 1A1b Petroleum Refining: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	2 394	2 768	2 836	3%	68	2%	442	18%
Belgium	4 299	4 267	4 615	4%	347	8%	316	7%
Denmark	906	931	984	1%	52	6%	77	9%
Finland	2 260	2 755	2 556	2%	-199	-7%	296	13%
France	11 944	10 607	8 638	8%	-1 969	-19%	-3 306	-28%
Germany	20 006	18 849	18 523	17%	-326	-2%	-1 483	-7%
Greece	2 308	3 333	3 560	3%	227	7%	1 251	54%
Ireland	182	285	313	0.3%	28	10%	131	72%
Italy	16 337	26 885	25 746	23%	-1 139	-4%	9 409	58%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	11 041	9 920	9 761	9%	-160	-2%	-1 280	-12%
Portugal	1 867	2 128	2 145	2%	17	1%	278	15%
Spain	10 906	11 992	12 380	11%	388	3%	1 474	14%
Sweden	1 778	2 022	2 198	2%	176	9%	420	24%
United Kingdom	17 549	17 376	15 719	14%	-1 657	-10%	-1 830	-10%
EU-15	**103 778**	**114 119**	**109 973**	**100%**	**-4 146**	**-4%**	**6 195**	**6%**

Figure 3.15 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-15 between 1990 and 2012 and the activity data behind the emissions.

Fuel used for petroleum refining increased by 10 % in the EU-15 between 1990 and 2012, but shows a decreasing trend in the recent years. Liquid fuels represent 83 % of all fuel used in the refining of petroleum. Gaseous fuels almost fully account for the remaining part and their use in 2012 is more than four times higher than in 1990. There remains a small amount of solid fuels used in petroleum refining in France (blast furnace gas) and Germany (lignite and coke oven gas).

Figure 3.15 1A1b Petroleum Refining: Total and CO_2 emission trends

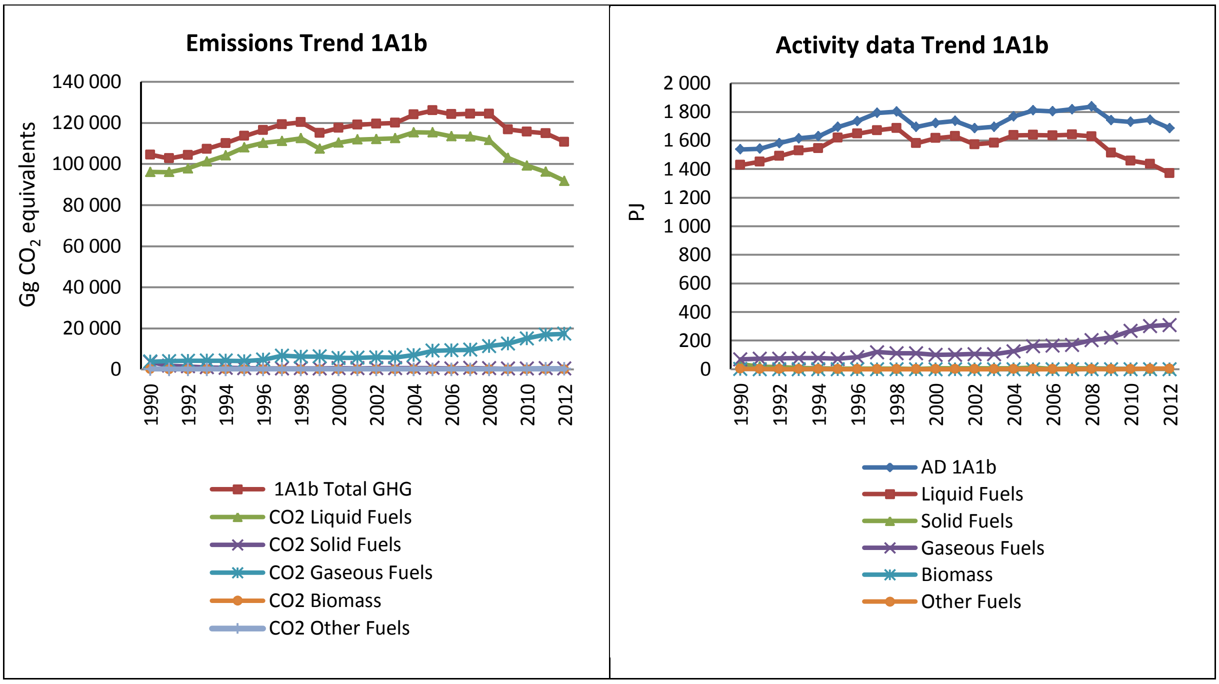


Figure 3.16 shows the relative importance of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State, ranging from the relatively low share in Ireland to relatively high shares in the Netherlands and Italy. Figure 3.17 shows the absolute contributions to EU-15 CO_2 emissions from petroleum refining. Italy was the largest EU-15 emitter in 2012, accounting for more than 20 % of all EU-15 emissions.

Figure 3.16 Share of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State in 2012

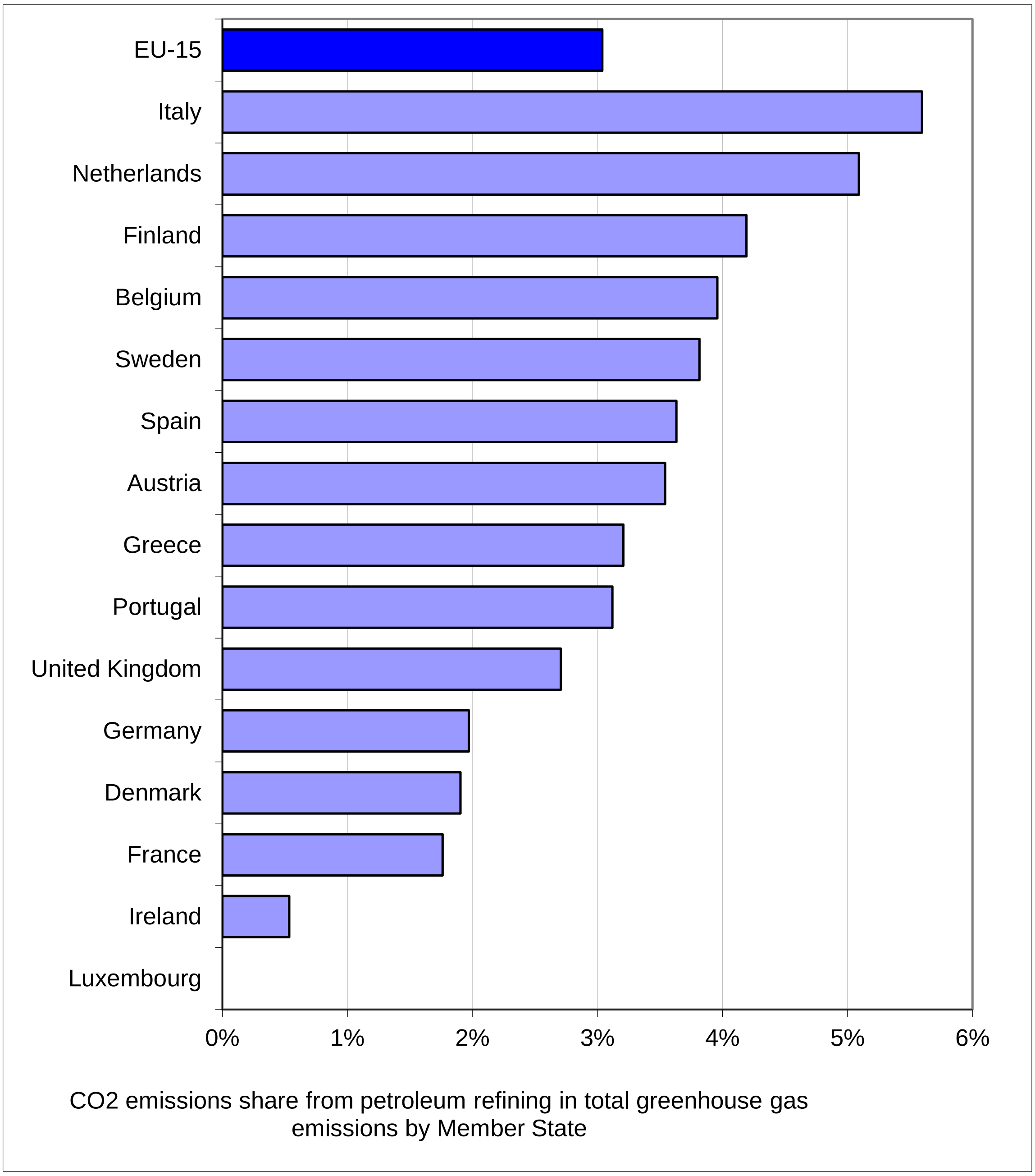
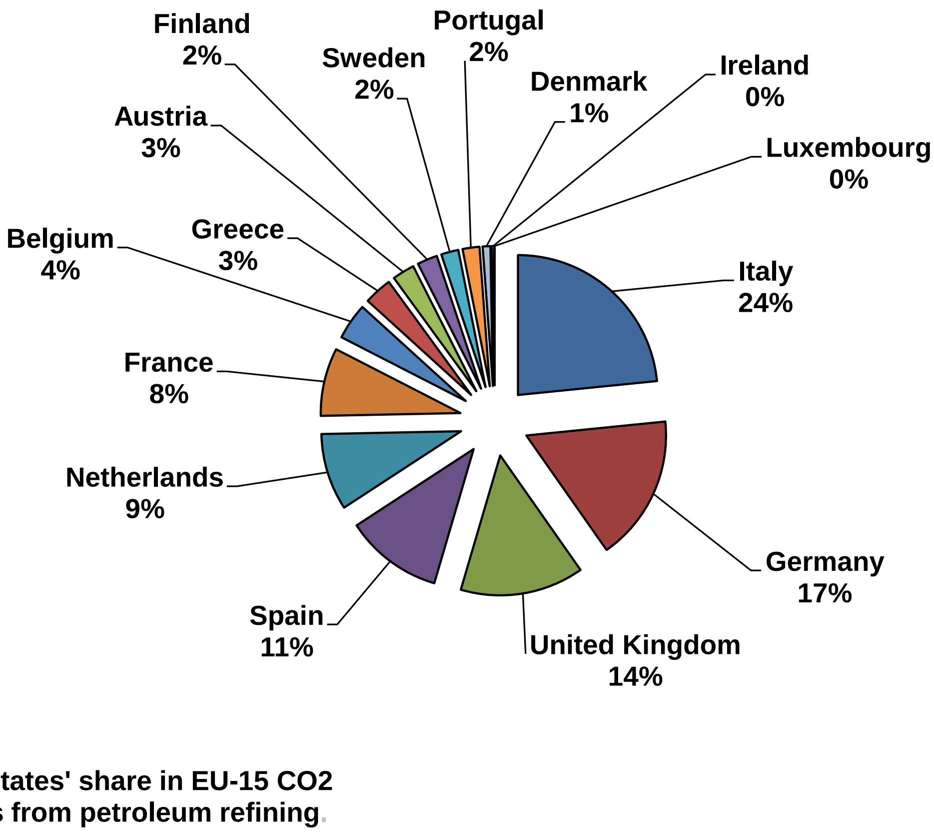


Figure 3.17 Member States' share of CO_2 emissions from petroleum refining in EU-15



1A1b Petroleum Refining - Liquid Fuels (CO_2)

CO_2 emissions from the combustion of liquid fuels used for petroleum refining accounted for 83 % of all greenhouse gas emissions from petroleum refining in 2012. Emissions decreased by 5 % between 1990 and 2012 (Table 3.12). Italy had by far the largest emission increase between 1990 and 2012 whereas France reports the largest decrease in emissions in this period.

Table 3.12 1A1b Petroleum Refining, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

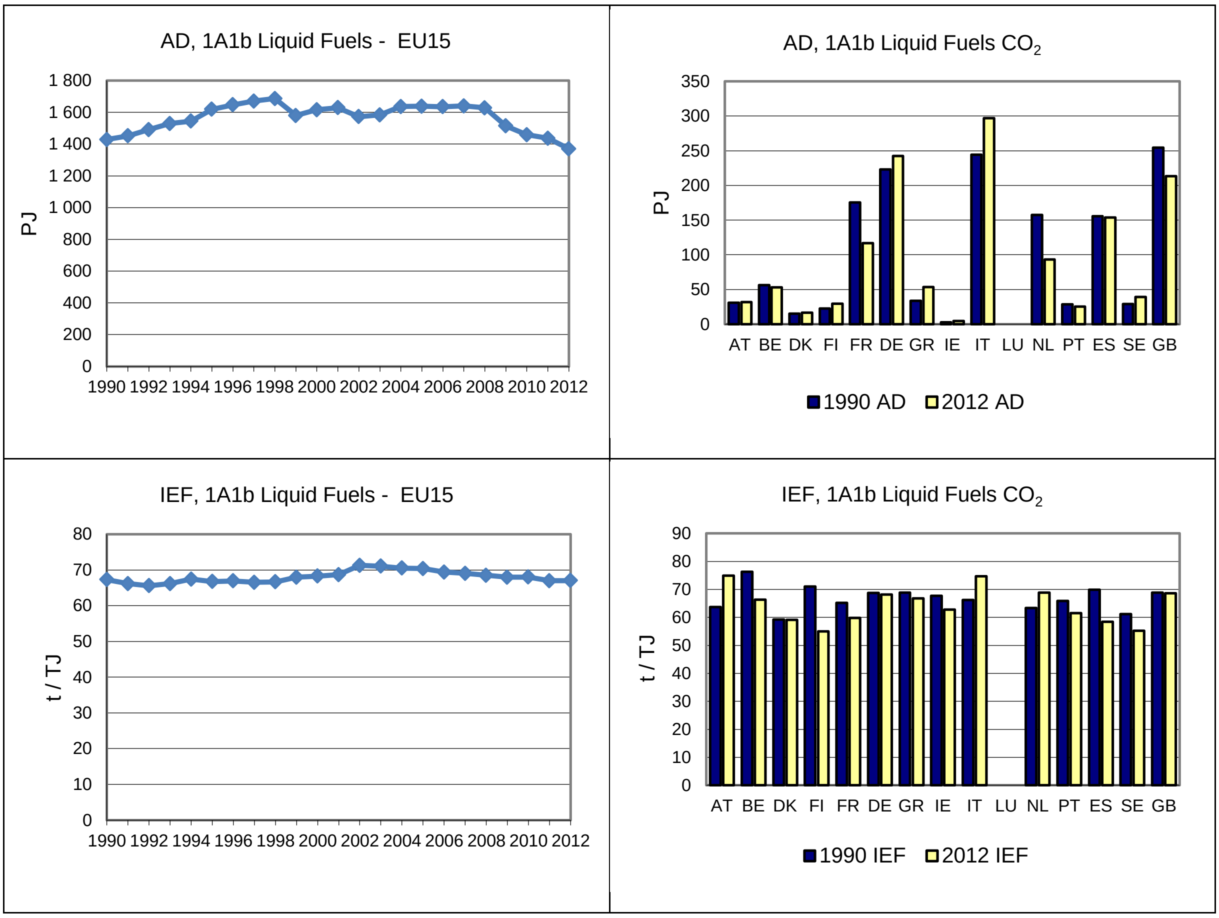
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	1 958	2 270	2 368	3%	98	4%	410	21%	T2	CS
Belgium	4 285	3 272	3 529	4%	257	8%	-757	-18%	CS,T3	PS
Denmark	906	931	984	1%	52	6%	77	9%	T3,T2,T1	PS,CS,D
Finland	1 603	1 810	1 620	2%	-191	-11%	16	1%	T3	CS,PS
France	11 422	8 654	6 983	8%	-1 671	-19%	-4 439	-39%	T2, T3	CS
Germany	15 315	16 889	16 503	18%	-385	-2%	1 188	8%	CS	CS
Greece	2 308	3 333	3 560	4%	227	7%	1 251	54%	T2	PS
Ireland	182	270	297	0.3%	26	10%	115	63%	T3	PS
Italy	16 178	23 606	22 199	24%	-1 407	-6%	6 021	37%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	9 999	6 320	6 422	7%	102	2%	-3 577	-36%	T2	CS,D
Portugal	1 867	1 595	1 550	2%	-45	-3%	-317	-17%	T2	D, CR, PS
Spain	10 861	9 034	8 984	10%	-50	-1%	-1 877	-17%	T2	CS, PS
Sweden	1 778	1 990	2 167	2%	176	9%	389	22%	T2	CS
United Kingdom	17 500	16 224	14 646	16%	-1 577	-10%	-2 854	-16%	T2	CS
EU-15	**96 162**	**96 198**	**91 810**	**100%**	**-4 388**	**-5%**	**-4 352**	**-5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.18 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels. The use of liquid fuels increased rapidly from 1990 to 1998 and had a decreasing tendency in particular after 2008. The EU-15 implied emission factor shows small variations between 65.62 t/TJ and 71.29 t/TJ. The variations are the result of variations in Member States' implied emission factors and variations of the share of Member States in EU-15 emissions. The largest emitters in 2012 were Italy, Germany and the UK, which together contributed 58 % of EU-15 emissions.

In general the fluctuating IEF is due to the annual variations of fuel consumption with different carbon content. For example in Italy the main fuel used are refinery gases, fuel oil and petroleum coke, which have very different emission factors, and every year their amount used changes resulting in an annual variation of the IEF. The increase in the last years with respect to the nineties of the consumption of fuels with higher carbon content, as petroleum coke and synthesis gas obtained from heavy residual fuels, explain the general growth of the Italian IEF for liquid fuel reported in the CRF for this sector.

Figure 3.18 1A1b Petroleum Refining, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A1b Petroleum Refining - Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels in petroleum refining represented less than 1 % of all greenhouse gas emissions from 1A1b in 2012. There are only two countries reporting emissions in the EU-15 in 2012 (Germany and France) which report decreasing emissions. EU-15 emissions fell by 87 % on average between 1990 and 2012 (Table 3.13).

Table 3.13 1A1b Petroleum Refining, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

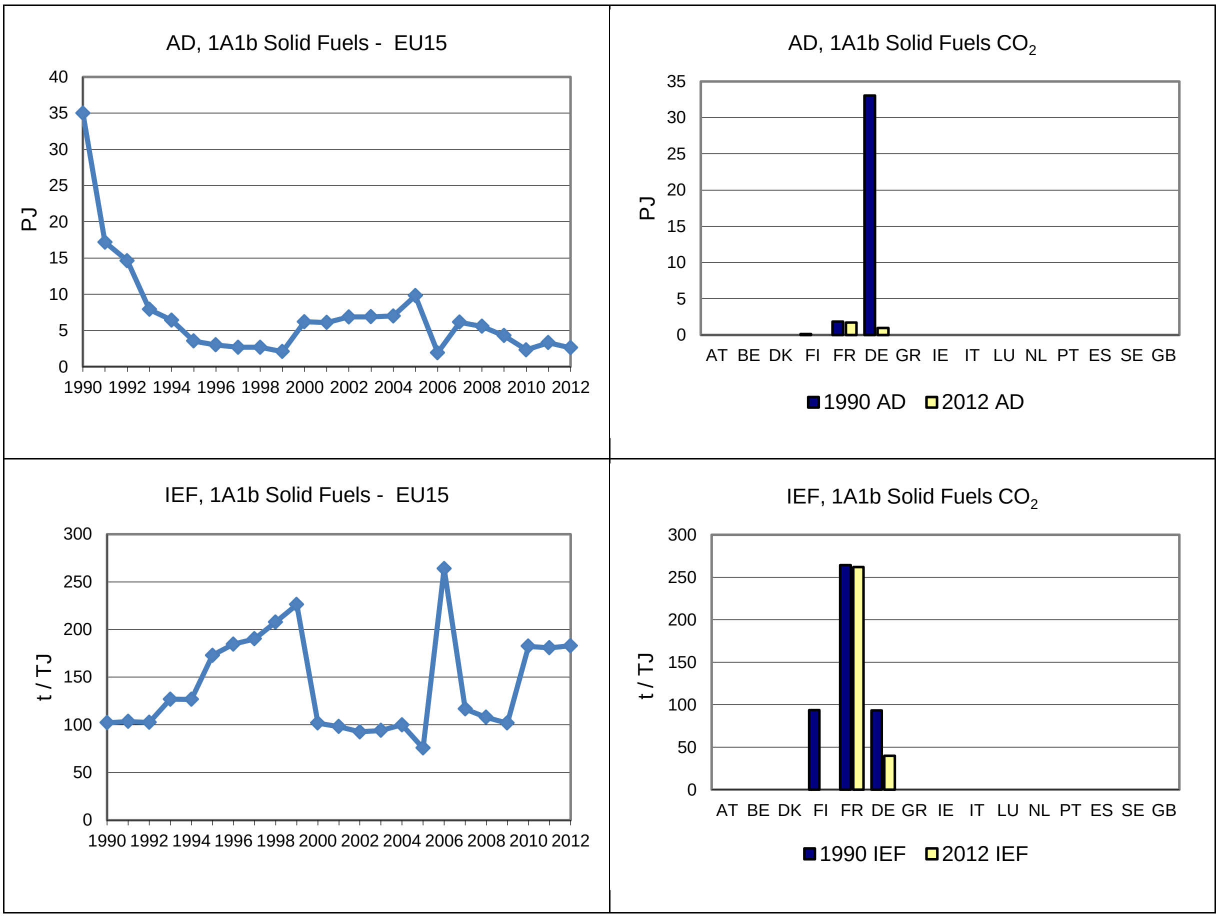
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	12	NO	NO	-	-	-	-12	-100%	NA	NA
France	486	551	440	92%	-111	-20%	-46	-9%	T2, T3	CS
Germany	3 076	49	37	8%	-12	-24%	-3 039	-99%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NO	NO	NO	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**3 574**	**600**	**477**	**100.0%**	**-122**	**-20%**	**-3 097**	**-87%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.19 shows the relevant activity data and implied emission factors. The use of solid fuels in petroleum refining has declined markedly since 1990. The EU-15 implied emission factor showed strong fluctuations, and amounts to 182.98 t/TJ in 2012. The variation in the EU-15 factor can be partly explained by the declining use of solid fuels in petroleum refining in Germany between 1990 and 1999. This explains the gradual increase of the EU-15 IEF up to 1999 through the growing weight of the much higher implied emission factor of France. The high emission factor in France is due to the use of blast furnace gas in the Dunkerque refinery. In Germany, there was a decline in the IEF in the early 1990s compared to a rather stable IEF since the mid-1990s. The reason is that the use of - mainly - lignite has constantly been reduced in favour of coke oven gas.

The increased EU-15 solid fuel combustion in 2000-2005 and 2007-2009 is due to an increase in fuel combustion in Germany in these years. The higher weight of the German IEF also explains the lower IEF at EU-15 level during these years. For 2006 Germany reports only negligible amounts of solid fuel use in petroleum refining. Therefore, the EU-15 IEF is almost entirely dominated by the French IEF in this year.

Figure 3.19 1A1b-Petroleum Refining, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A1b Petroleum Refining - Gaseous Fuels (CO_2)

In 2012, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 16 % of total greenhouse gas emissions from 1A1b. Emissions in the EU-15 increased by a factor of more than four between 1990 and 2012 (Table 3.14). None of the EU-15 Member States reduced their emissions.

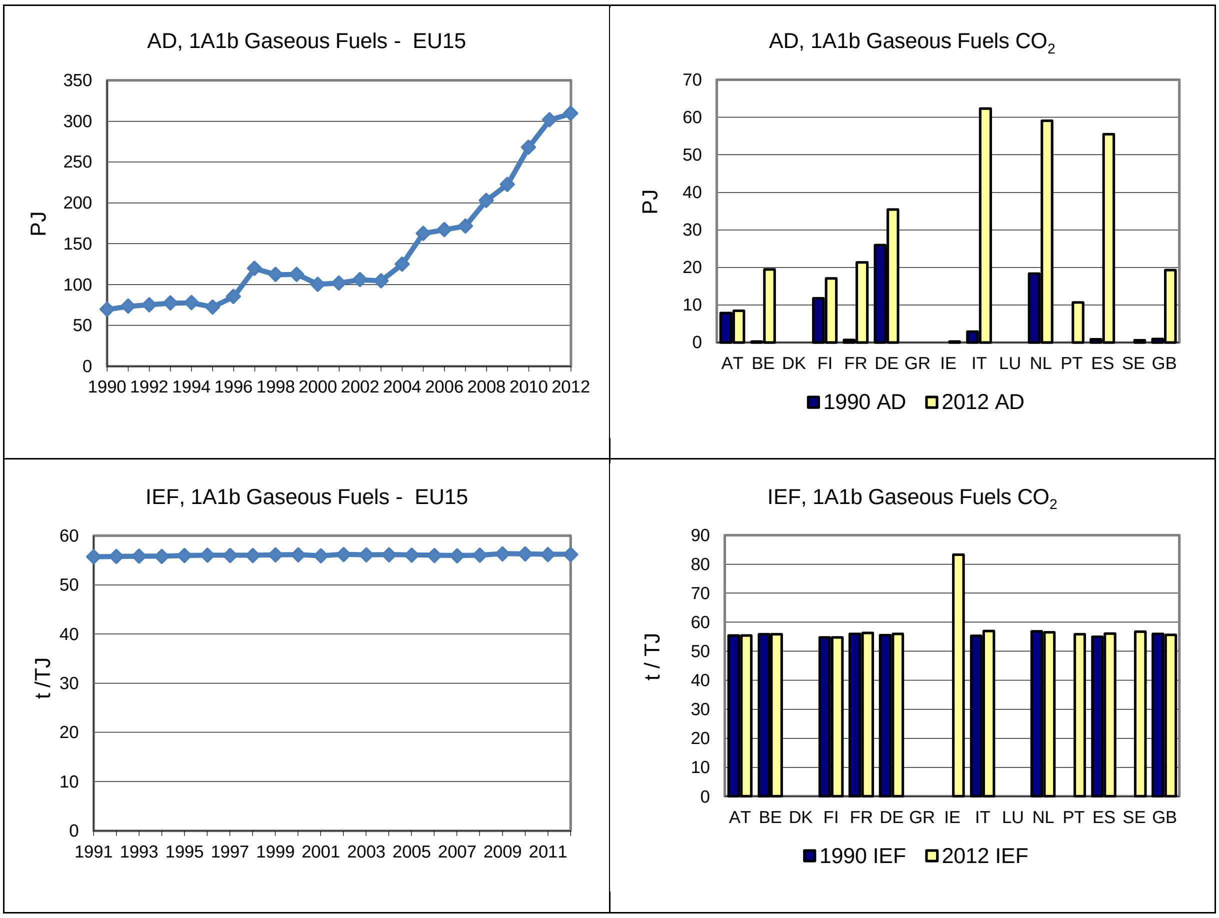
Table 3.14 1A1b Petroleum Refining, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	437	498	468	3%	-30	-6%	32	7%	T2	PS
Belgium	14	995	1 086	6%	91	9%	1 072	7757%	CS,T3	PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	644	944	936	5%	-8	-1%	292	45%	T3	CS
France	36	1 384	1 203	7%	-181	-13%	1 167	3224%	T2, T3	CS
Germany	1 441	1 912	1 983	11%	71	4%	542	38%	CS	CS
Greece	NO	IE	IE	-	-	-	-	-	NA	NA
Ireland	NO	15	16	0.1%	2	12%	16	-	T3	PS
Italy	159	3 278	3 547	20%	269	8%	3 388	2127%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 042	3 600	3 339	19%	-262	-7%	2 297	220%	T2	CS
Portugal	NO	533	595	3%	62	-	595	-	T2	D, CR, PS
Spain	45	2 607	3 113	18%	505	19%	3 068	6805%	T2	CS, PS
Sweden	NO	32	32	0.2%	-1	-3%	32	-	T2	CS
United Kingdom	49	1 152	1 073	6%	-80	-7%	1 023	2070%	T2	CS
EU-15	**3 868**	**16 953**	**17 390**	**100%**	**437**	**3%**	**13 522**	**350%**		

Abbreviations explained in the Chapter 'Units and abbreviations'

Figure 3.20 shows the activity data and implied emission factors for CO_2 emissions from gaseous fuels. The use of gaseous fuels increased by 350% between 1990 and 2012. The EU-15 implied emission factor has remained broadly stable and amounts to 56.22 t/TJ in 2012. Ireland reports a comparably high emission factor which is due to differences in the data published in the national energy balance and the reported emissions under the EU ETS. The national energy balance figure is lower than that reported under ETS, hence the IEF is higher. The largest emitter in 2012 was Italy with 20 % of all EU-15 emissions, followed by The Netherlands and Spain.

Figure 3.20 1A1b Petroleum Refining, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.1.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-15)

According to the IPCC, the manufacture of solid fuels and other energy industries includes combustion emissions from fuel use during the manufacture of secondary and tertiary products from solid fuels including production of charcoal. It comprises combustion emissions from the production of coke, brown coal briquettes and patent fuel. It can also cover the emissions from own-energy use in coal mining and gas extraction. Emissions from own on-site fuel use should be included. In addition, this category includes emissions from fuel combustion in oil and natural gas production.

CO_2 emissions from this category accounted for 2 % of total greenhouse gas emissions in 2012. Between 1990 and 2012, CO_2 emissions fell by 56% in the EU-15 (Table 3.15). Emissions from solid fuels fell markedly during the 1990s and then were stable for a few years. Since 2007 they began to decrease again. The strong drop in 2009 was due to the drop in iron and steel production triggered by the economic crisis.

Table 3.15 1A1c Manufacture of Solid Fuels and Other Energy Industries: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	510	522	506	1%	-16	-3%	-4	-1%
Belgium	2 023	243	225	0.5%	-18	-8%	-1 798	-89%
Denmark	545	1 417	1 437	3%	20	1%	892	164%
Finland	347	266	256	1%	-10	-4%	-91	-26%
France	4 718	3 210	2 978	7%	-232	-7%	-1 740	-37%
Germany	64 394	16 719	11 987	26%	-4 733	-28%	-52 407	-81%
Greece	102	46	45	0.1%	-1	-1%	-57	-56%
Ireland	100	93	104	0.2%	12	12%	4	4%
Italy	13 030	12 280	9 227	20%	-3 053	-25%	-3 803	-29%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1 528	1 989	2 069	5%	79	4%	541	35%
Portugal	75	NO	NO	0%	-	-	-75	-100%
Spain	2 117	1 990	1 889	4%	-102	-5%	-228	-11%
Sweden	301	348	361	1%	12	4%	59	20%
United Kingdom	13 762	15 781	14 712	32%	-1 069	-7%	951	7%
EU-15	**103 553**	**54 905**	**45 796**	**100%**	**-9 109**	**-17%**	**-57 757**	**-56%**

Figure 3.21 shows the trends in emissions from this source category by fuel in the EU-15 between 1990 and 2012. About 90 % of greenhouse gas emissions from the manufacture of solid fuels can be accounted for CO_2 emissions from solid (54 %) and gaseous (38 %) fuels.

Fuel used for manufacturing solid fuels fell by 51 % in the EU-15 between 1990 and 2012. In 2012, solid fuels represented 35 % of all fuel use, whereas gaseous fuels have a share of 54%.

Figure 3.21 1A1c-Manufacture of Solid Fuels and Other Energy Industries: Total and CO_2 emission and activity trends

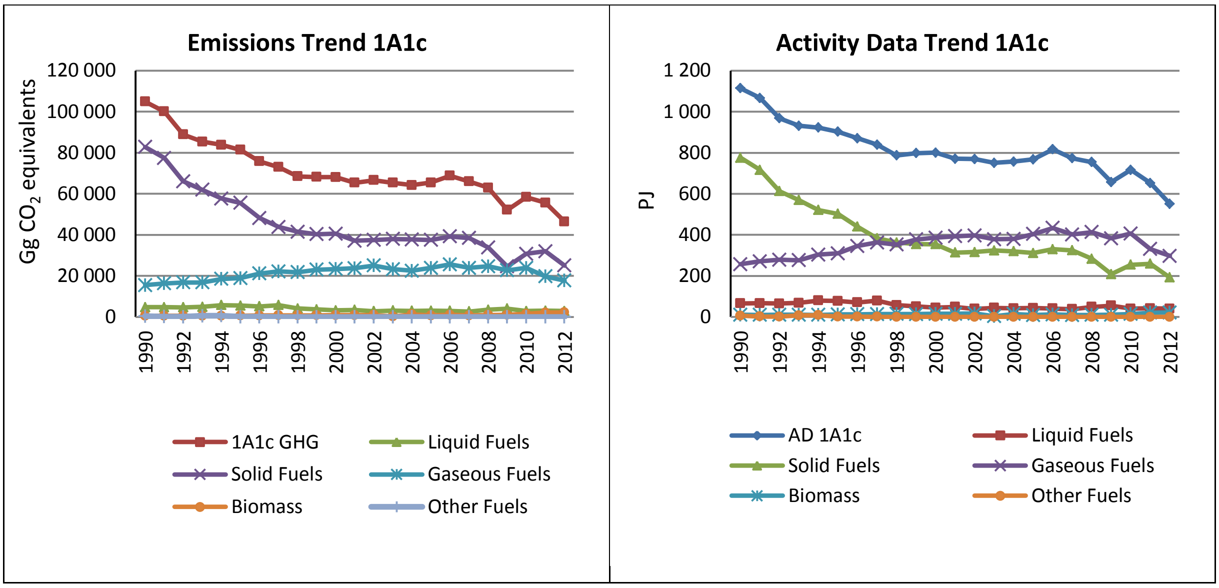


Figure 3.22 shows the relative importance of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State. The country shares range from the highest in Denmark to the lowest in Greece (Luxembourg and Portugal do not have emissions from this source category). Figure 3.23 shows the absolute contributions to EU-15 CO_2 emissions from the manufacture of solid fuels. Italy, Denmark and the UK are responsible for about 80 % of all EU-15 emissions.

Figure 3.22 Share of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State in 2012

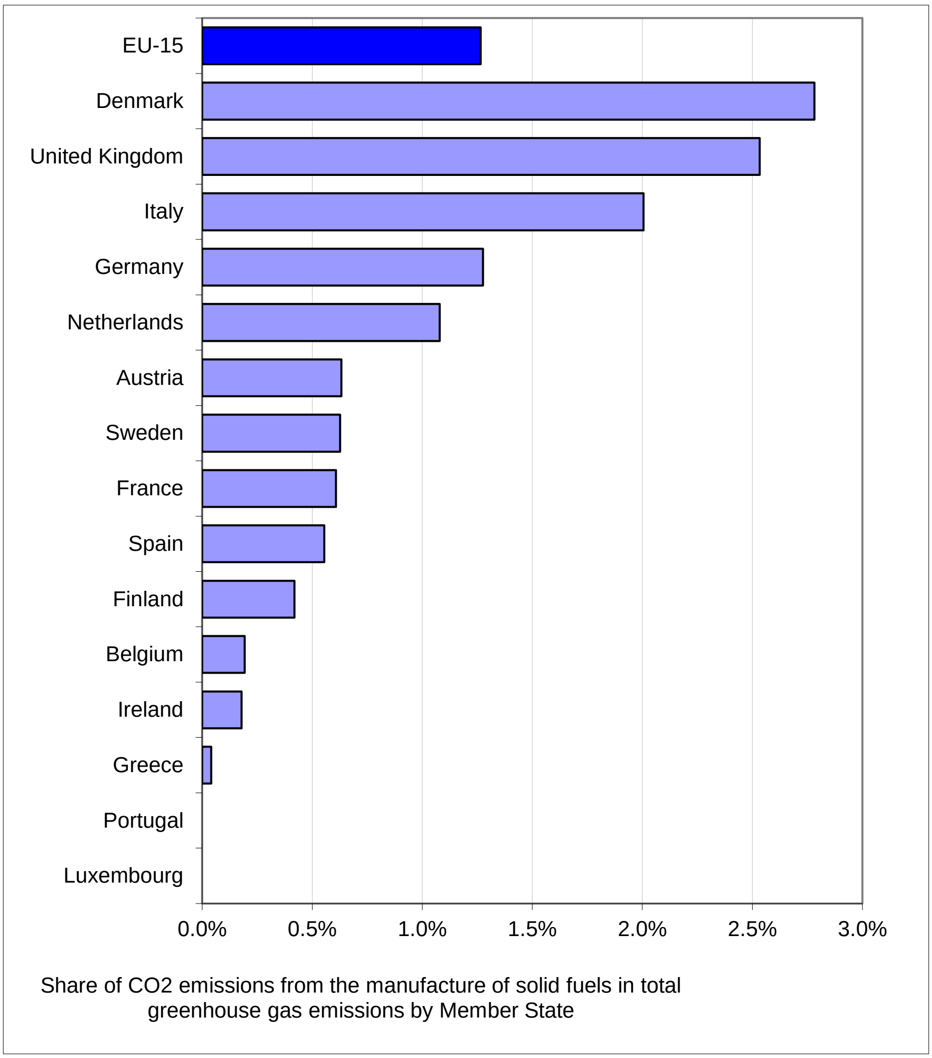
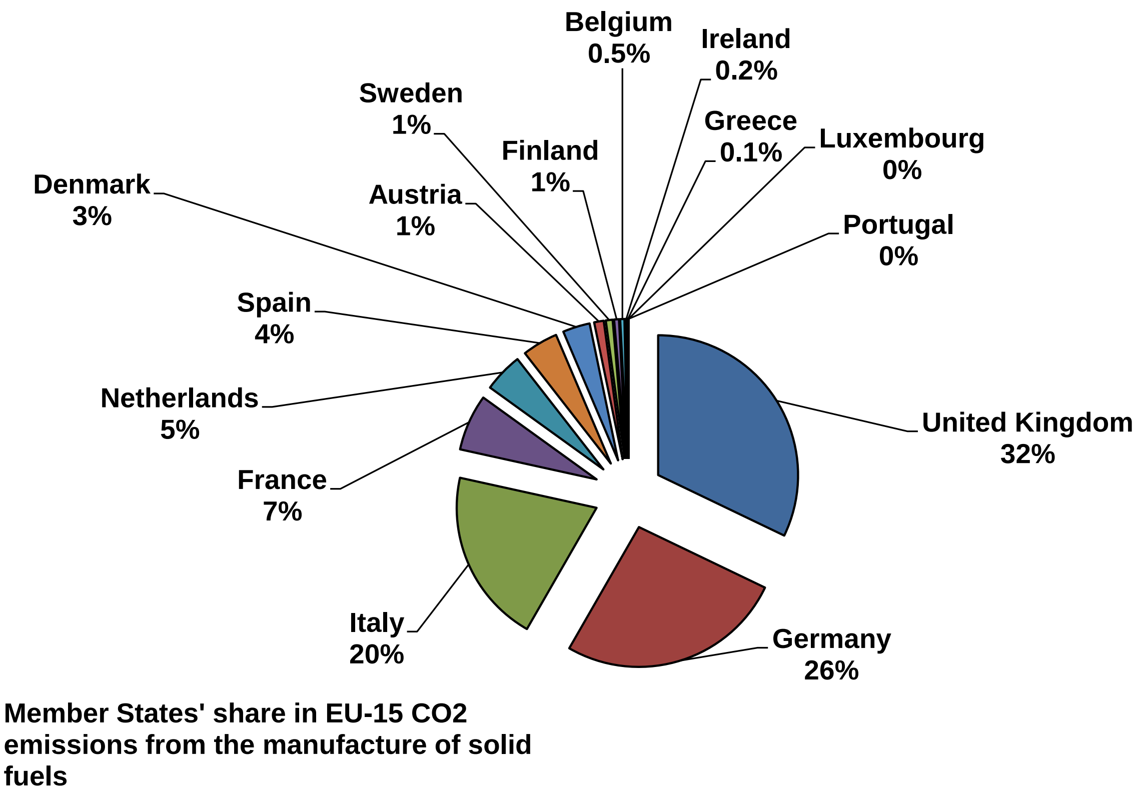


Figure 3.23   Member States' share of CO_2 emissions from the manufacture of solid fuels in EU-15



1.1.1.1.1 1A1c Manufacture of Solid Fuels and Other Energy Industries – Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels used in category 1A1c accounted for 38 % of total greenhouse gas emissions from this category in 2012. Emissions in the EU-15 increased by 15 % (Table 3.16) between 1990 and 2012. In the last few years there has been a significant reduction. More than 50 % of the gross increase in EU-15 emissions between 1990 and 2010 was due to the UK only. In general, oil and natural gas production are declining since 2000, therefore also natural gas used in oil and natural gas production is declining.

The decline in 2011 and 2012 was mainly driven by the UK and Italy. In the UK there have been reductions in gas use activity in the upstream use of gas in oil and gas production and in gas use of drive compressors in the downstream UK gas distribution network. Former reductions are driven by a strong decline in UK production of oil and gas whereas the reductions in the downstream gas distribution network are due to reduced demand for gas in the UK (2010 had very cold winters at the start and end of the year, so gas use was unusually high in that year).

In Italy the amount of gaseous fuel consumption for this category is the sum of the natural gas fuel consumption reported in the framework of the ETS by the six relevant plants. These are coke production plants and energy power production plants producing energy prevalently for the iron and steel national integrated plants. In particular the consumption of natural gas in one of these plants (the biggest one) drives the trend of the whole category. In the last years, natural gas consumption increased to produce energy to be sold to the energy market (and not only to serve the iron and steel plant). In 2012 the use of natural gas decreased as a consequence of a reduction in the energy demand.

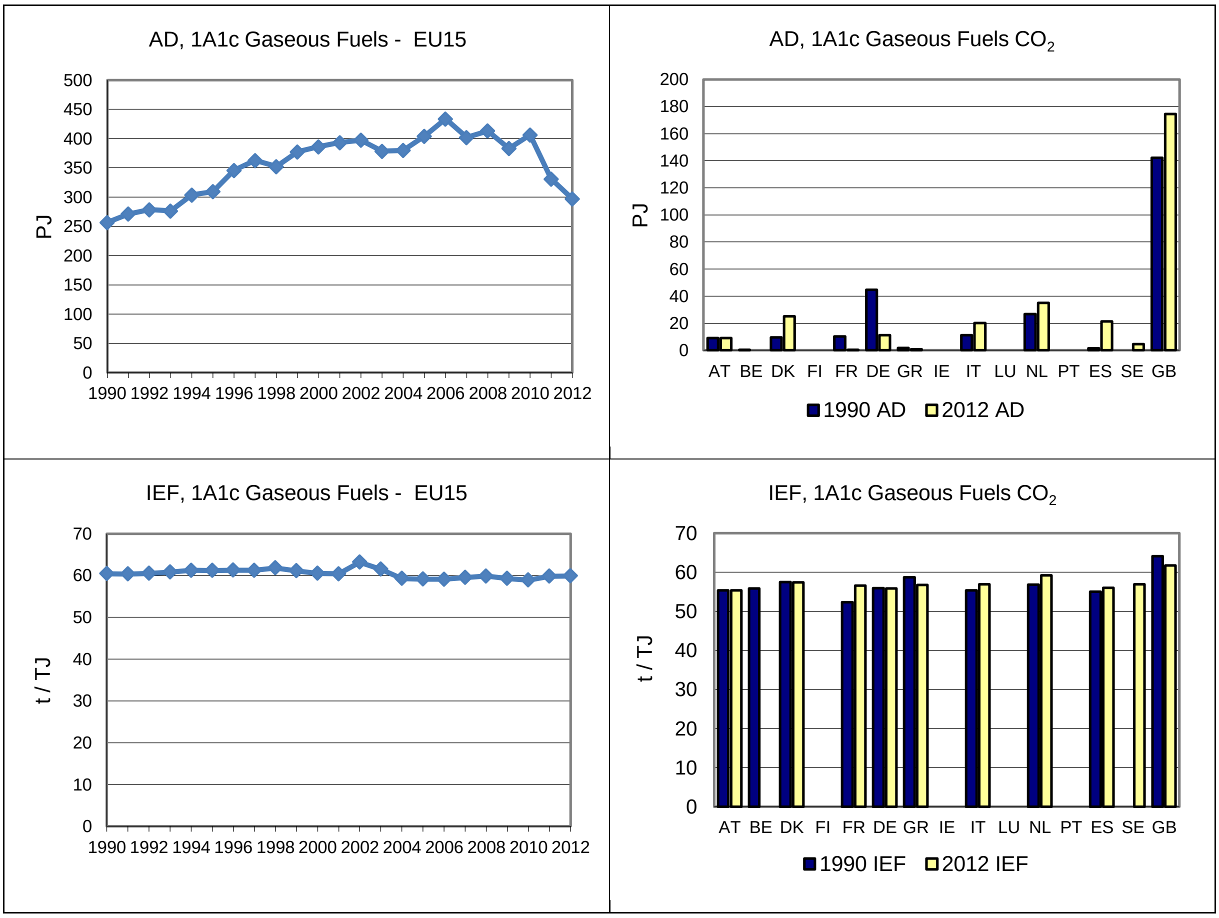
Table 3.16 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	506	522	506	3%	-16	-3%	-0.02	-0.004%	T2	CS
Belgium	3	NO	NO	-	0	-	-3	-100%	NA	NA
Denmark	545	1 417	1 437	8%	20	1%	892	164%	T3	PS,CS
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	531	17	16	0.1%	-1	-8%	-515	-97%	T2, T3	CS
Germany	2 501	377	624	4%	247	66%	-1 877	-75%	CS	CS
Greece	102	46	45	0.3%	-1	-1%	-57	-56%	T2	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	615	2 227	1 142	6%	-1 085	-49%	527	86%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 526	1 989	2 068	12%	79	4%	542	35%	T2	CS
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	82	1 259	1 196	7%	-63	-5%	1 114	1367%	T2	CS
Sweden	NO	NO	0	-	-	-	-	-	T2	CS
United Kingdom	9 114	11 969	10 773	60%	-1 196	-10%	1 659	18%	T2	CS
EU-15	**15 525**	**19 822**	**17 807**	**100%**	**-2 014**	**-10%**	**2 283**	**15%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.24 shows the activity data and implied emission factors for CO_2. The use of gaseous fuels increased by 15% between 1990 and 2012. The EU-15 implied emission factor is dominated by the UK IEF and amounts to around 59.91 t/TJ. The reason for the comparatively high IEF in the UK and the explanation for its decrease is as follows: In the UK emissions of gaseous fuels within this sector include colliery methane combustion and natural gas combustion, including offshore own gas use. The carbon emission factor for offshore own gas use is higher than the emission factor for other natural gas combustion, particularly at the start of the time series. This higher emission factor is to be expected, as the unrefined gaseous fuels used in the upstream oil and gas sector will contain heavier hydrocarbons (which are removed in gas treatment prior to injection into natural gas supply infrastructure at onshore terminals). This source is responsible for the majority of the emissions within this sector and is therefore the main driver in the trend in the implied emission factor. The emission factor for this source is based on data supplied by the offshore operators. It decreases across the time series, but remains higher than natural gas consumption in other sectors.

Figure 3.24 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1.1.1.1.2 1A1c Manufacture of Solid Fuels and Other Energy Industries – Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels used for the manufacture of solid fuels accounted for 54 % of total greenhouse gas emissions from 1A1c in 2012. Emissions in the EU-15 declined by 70%, mainly during the 1990s (Table 3.17). This was almost-entirely due to a strong decline in emissions in Germany.

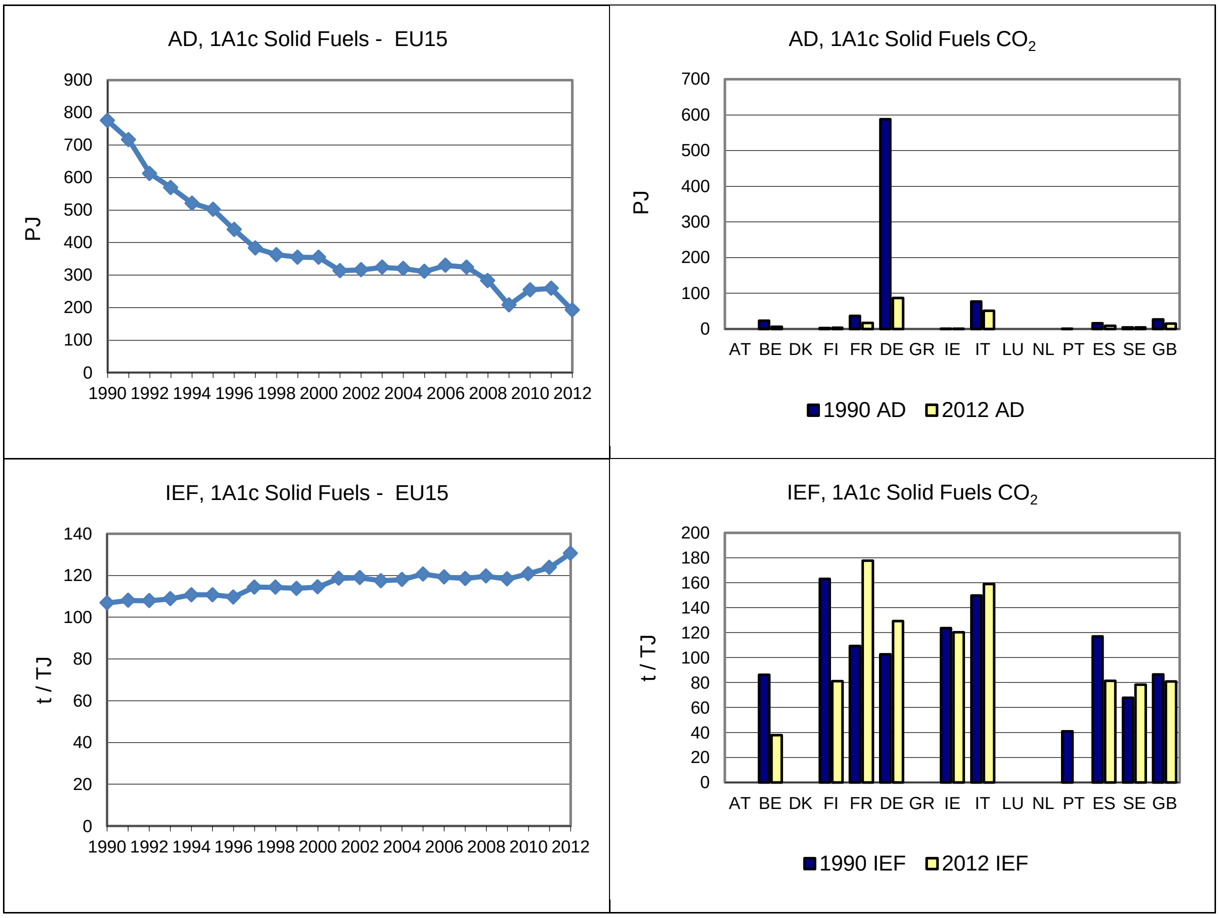
Table 3.17 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	2 016	243	225	1%	-18	-8%	-1 791	-89%	CS,T3	PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	347	266	256	1%	-10	-4%	-91	-26%	T3	CS
France	4 034	3 193	2 963	12%	-230	-7%	-1 071	-27%	T2, T3	CS
Germany	60 327	15 970	11 221	45%	-4 749	-30%	-49 106	-81%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	100	93	104	0.4%	12	12%	4	4%	T3	CS
Italy	11 473	10 042	8 085	32%	-1 957	-19%	-3 388	-30%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	IE	NO	NO	-	-	-	-	-	NA	NA
Portugal	26	NO	NO	-	0	-	-26	-100%	NA	NA
Spain	1 847	699	692	3%	-7	-1%	-1 155	-63%	T2	CS, PS
Sweden	300	345	358	1%	14	4%	58	19%	T2	CS
United Kingdom	2 337	1 193	1 208	5%	14	1%	-1 129	-48%	T2	CS
EU-15	**82 807**	**32 045**	**25 112**	**100%**	**-6 932**	**-22%**	**-57 695**	**-70%**		

Emissions of the year 1990 for the Netherlands are included in 1A2a
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.25 shows the relevant activity data and implied emission factors. Solid fuels have fallen steadily to less than half of the 1990-level. The EU-15 implied emission factor has increased to reach 130.63 t/TJ in 2012. This increase is mainly due to a decline in the German share in EU-15 emissions and a parallel increase in the share of Italy, which has a significantly higher implied emission factor. The decline in activity data in Germany is mainly due to a large decline in lignite production in the 1990s. Lignite use decreased strongly in the new German Länder from usage levels of the industry of the former GDR. From raw lignite, a range of refined products used to be produced for industry, households and small commercial operations. A comprehensive transition from lignite to other fuels then took place until the end of the 1990s. Italy includes in this category emissions from electricity generated in the iron and steel plant sites (using coal gases and other fuels). The high implied emission factor for solid fuels in Italy is due to the large use of derived steel gases and in particular blast furnace gas to produce electricity in the iron and steel plant plants. The largest emitters in 2012 were Italy and Germany, jointly responsible for 76 % of all EU-15 emissions.

Figure 3.25 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Activity Data and Implied Emission Factors for CO_2



3.2.2 Manufacturing industries and construction (CRF Source Category 1A2)

Category 1A2 includes emissions from combustion of fuels in manufacturing industries and construction including fuel use of non public electricity and heat generation (autoproducers). According to the guidelines, emissions from fuel combustion in coke ovens are reported under 1A1c except for Austria and the Netherlands, which report on site coke ovens of integrated iron and steel plants under category 1A2a. Some MS report emissions of blast furnace and coke oven gas combustion under categories 1A1a public electricity and heat production or 1A4 other sectors. Emissions from category 1A2 are specified by the sum of subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC, see listing below). Emissions from transport used by industry are reported under category 1A3 Transport. Most MS report emissions arising from off-road and other mobile machinery used in industry (e.g. construction machinery) under category 1A2f. Emissions from non energy fuel use (e.g. reducing agents used in blast furnaces or natural gas used for ammonia production) should be reported under category 2 Industrial Processes.

The following enumeration shows the correspondence of 1A2 sub categories and ISIC Rev 3.1 codes:

- 1 A 2 a Iron and Steel: ISIC Group 271 and Class 2731.
- 1 A 2 b Non-Ferrous Metals: ISIC Group 272 and Class 2732.
- 1 A 2 c Chemicals: ISIC Division 24.
- 1 A 2 d Pulp, Paper and Print: ISIC Divisions 21 and 22
- 1 A 2 e Food Processing, Beverages and Tobacco: ISIC Divisions 15 and 16.
- 1 A 2 f Other: Other manufacturing industries: ISIC Divisions 17 to 20, 25, 26, 28 to 37 and 45.

In 2012 category 1A2 contributed to 447 675 Gg CO_2 equivalents of which 99% CO_2, 1% N_2O and 0.3% CH_4.

Figure 3.26 shows the emission trends within source category 1A2, which is dominated by CO_2 from 1A2f Other contributing by 47 % and 1A2a Iron and steel by 22 %. Some Member States still have difficulties to allocate emissions to all sub-categories under 1A2, which is a main reason for 1A2f being the largest sub-category within 1A2 source category.

Figure 3.26 1A2 Manufacturing Industries and Construction: Total and CO_2 emission trends

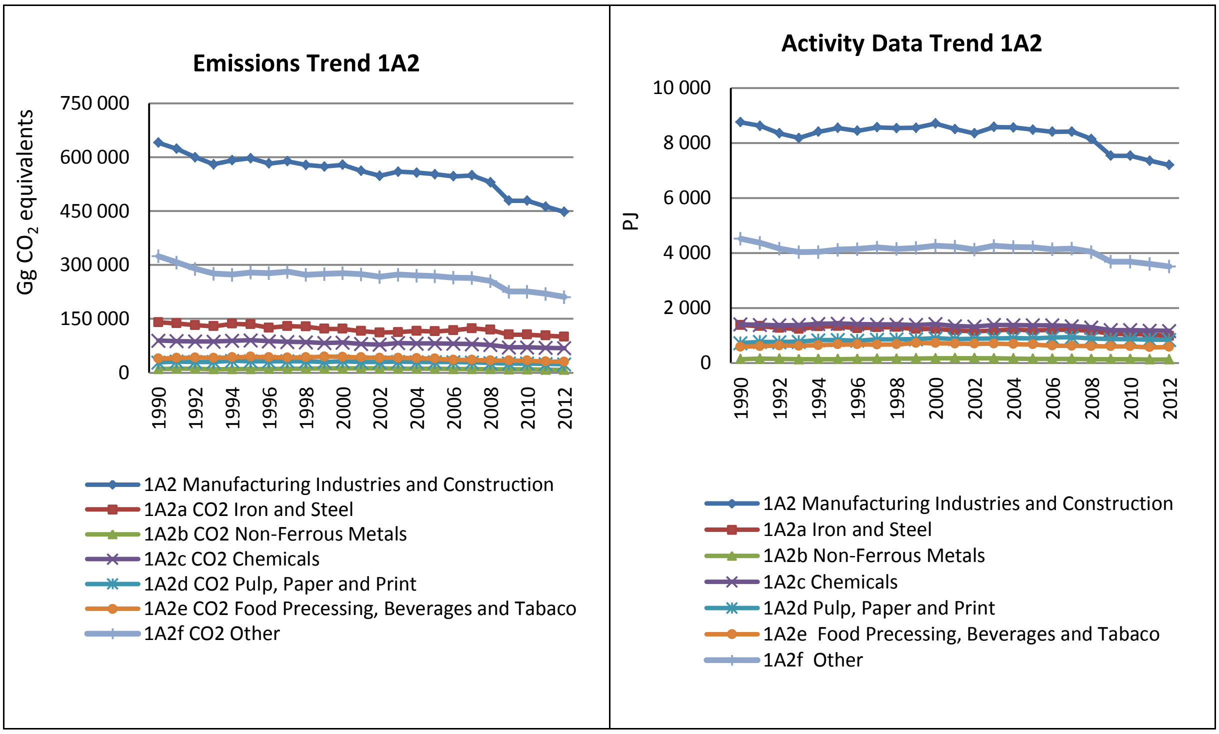


Table 3.18 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

Table 3.18 1A2 Manufacturing Industries and Construction: Member States' contributions to total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)
Austria	12 774	15 581	12 685	15 409
Belgium	32 848	20 973	32 605	20 712
Denmark	5 506	4 281	5 444	4 235
Finland	13 368	8 382	13 182	8 229
France	86 474	63 525	85 397	62 607
Germany	177 184	115 122	175 635	114 136
Greece	9 215	5 533	9 163	5 496
Ireland	3 961	4 276	3 943	4 255
Italy	86 948	54 922	85 276	53 656
Luxembourg	6 305	1 279	6 285	1 256
Netherlands	33 098	25 893	33 008	25 810
Portugal	9 716	7 512	9 621	7 414
Spain	44 672	46 406	44 157	45 493
Sweden	11 973	8 498	11 581	8 172
United Kingdom	106 349	65 505	104 630	64 471
EU-15	**640 390**	**447 687**	**632 611**	**441 352**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1A2 Manufacturing Industries and Construction is the fourth largest sector in the EU-15 accounting for 12 % of total GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from manufacturing industries declined by 30 % in the EU-15. The emissions from this key source are caused by fossil fuel consumption in manufacturing industries and construction, which was 18 % below 1990 levels in 2012. A shift from solid and liquid fuels to mainly natural gas took place and an increase of biomass and other fuels has been recorded.

Between 1990 and 2012, Germany shows by far the largest emission reductions in absolute terms. Also United Kingdom, France and Italy show emission reductions of more than ten million tonnes CO_2, whereas emission increases occurred in Austria, Ireland and Spain. The main reason for the large decline in Germany was the restructuring of the industry and efficiency improvements after German reunification. Between 2011 and 2012 GHG emissions decreased by 3 % with category 1A2f Other showing the strongest absolute decrease of – 8 906 Gg CO_2 from all sub categories.

Table 3.19 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A2 Manufacturing Industries for 1990 and 2011 and main explanations for the largest recalculations in absolute terms. The largest recalculations in 2011 were due to Spain, the United Kingdom, France and Germany. The recalculation of Spain in 2011 is dominated by a revision of - 11 076 Gg while the United Kingdom revised by - 3 164 Gg CO_2 as a consequence of reallocation and changes to the energy balance.

Table 3.19 1A2 Manufacturing Industries and Construction: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0.0	726	4.9	Revised energy balance.
Belgium	0	0.0	-475	-2.0	Recalculation of the 2011 inventory with final regional energy balances (Wallonia and Flanders). 1A2f liquid fuels: RBC: Reallocation of offroad AD (energy) (ERT recommendation). 1A2f biomass: Walloon region: between 2008 and 2011, the glue is now taken into account in the manufacture of wood panels and the biomass fraction of some wastes was corrected in the cement sector + Recalculation of the 2011 inventory with final regional energy balances.
Denmark	59	1.1	133	3.0	The recalculation is related to liquid fuels and is a result of correction of an error. The consumption of residual oil was underestimated in the former inventories. The CO2 emission from liquid fuels applied in manufacturing industries and construction for 2011 is 7% higher in the 2014 reporting than in the 2013 reporting.
Finland	11	0.1	-37	-0.4	Corrections in activity data.
France	-952	-1.1	-1 921	-3.0	Updated energy balance SOeS statistics for several years (decrease of the quantity of petroleum products) and revision of the fuel split of petroleum products (-> impact on the consumption of petroleum coke and LPG). - Correction of a double counting of the new fuel category ``GNR`` (for off road machineries), i.e. non-road diesel oil, for the first introduction year 2011 (impact for all sector in the CRf code 1A2)
Germany	0	0.0	2 241	2.0	Final data available from the National Energy Balance.
Greece	-404	-4.2	0	0.0	Emissions related to ammonia production were reallocated to IP sector.
Ireland	0	0.0	79	1.9	Revisions to sub-categories in 1.A.2 (a to f), were a result of revised fuel quantities in Energy Balance: natural gas (in 2004-2007 and 2011), petroleum coke (in 2003), fuel oil (in 2011) and coal (in 2009). Also new inclusion of peat in Energy Balance (2005 onwards, 1.A.2.e) and revised natural gas CO2 emission factors for 2004-2011 resulted in decrease of the 1.A.2 sector emissions by 1.5 per cent (CO2 eq.) on average in the period 2004-2010.
Italy	0	0.0	-2	0.0	Update of natural gas emission factor.
Luxembourg	0	0.0	12	0.9	Revised energy balance.
Netherlands	0	0.0	167	0.6	Improved activity data for mobile machinery in category 1A2a (2008-2011).
Portugal	-138	-1.4	-111	-1.3	1A1a: Correction of a compilation error due to a thorough revision of the sector. 1A1b to 1A1f:Revision of the 2011 energy balance data.
Spain	-2 314	-5.0	-11 076	-19.2	Activity included (fuel consumption) in the revision of the inventory fuel balance.
Sweden	70	0.6	-266	-3.0	1A2a: Revision of residual fuel oil AD for one of the major plants. 1A2f: Revision of activity data due to updated energy balances.
UK	1 216	1.2	-3 164	-4.7	National energy statistics revised for many sectors from 2008 onwards. 1A2c: New source: refinery gas combustion in chemical industry. National energy statistics revised for many sectors from 2008 onwards. 1A2f: Correction to EUETS data has caused a change to OPG CEF for all years. Correction to allocation of petcoke to lime sector. Reallocation of reinery gas to chemical sector.
EU-15	**-2 452**	**-0.4**	**-13 695**	**-2.9**	

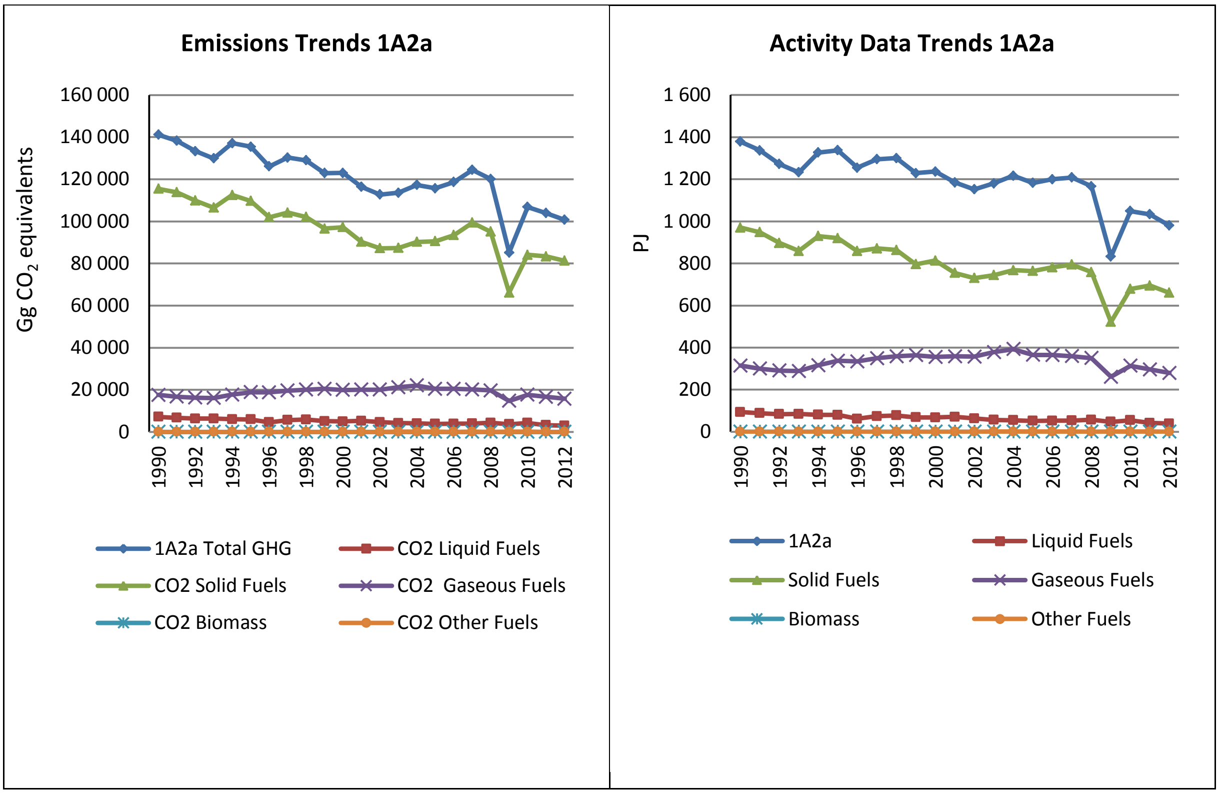
3.2.2.1 Iron and Steel (1A2a) (EU-15)

This chapter provides information about emission trends, Member States contribution, activity data and emission factors for category 1A2a on a fuel base. CO_2 emissions from 1A2a Iron and Steel accounted for 22 % of 1A2 source category and 2.8 % of total GHG emissions in 2012.

Figure 3.27 shows the emission trend within the category 1A2a, which is mainly dominated by CO_2 emissions from solid fuels. Between 1990 to 2012 total emissions decreased by 29 %, mainly due to improved efficiency of restructured iron and steel plants and the increased share of gaseous fuels. The strong increase of 25% between 2009 and 2010 correlates with crude steel production which was 25%

higher in 2010. Between 2011 and 2012 emissions decreased by 3% while crude steel production decreased by 5%. Between 1990 and 2012 emissions from solid fuels decreased by 30 %, emissions from liquid fuels by 58 % and emissions from gaseous fuels by 10%. Some Member States report emissions from blast furnace gas under categories 1A1a or other sub-categories of 1A2 where it is used as a fuel in the respective industrial branches. Emissions from coke ovens of integrated iron and steel plants are sometimes not reported in the respective category 1A1c but included in this category. Emissions from blast furnace and coke oven gas flaring without energy recovery are partly reported under category 1B1b. The methodology of splitting emissions from blast furnaces into energy related and process related emissions reported under category 2C1 does not follow a specific standard. E.g. Germany reports 68% of total CO_2 emissions from categories 1A2a and 2C1 under this category and Italy reports 92% in 2011. However, the main driver of category 1A2a CO_2 emissions is blast furnace iron (BFI) production which decreased from about 99 mio tonnes to 77 mio tonnes in 2012 (www.worldsteel.org statistics) whereas crude steel production slightly decreased since 1990 from about 148 mio tonnes to 144 mio tonnes in 2012 (www.worldsteel.org statistics).

Figure 3.27 1A2a Iron and Steel: Total, CO_2 and N_2O emission and activity trends



Between 1990 and 2012, CO_2 emissions from 1A2a Iron and Steel decreased by 29 % in the EU-15 (Table 3.20), mainly due to decreases in Belgium, UK, France, Spain and Italy. Between 2011 and 2012 emissions decreased by 3%.

Table 3.20 1A2a Iron and Steel: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	4 944	5 941	5 859	6%	-82	-1%	914	18%
Belgium	13 426	6 017	4 378	4%	-1 639	-27%	-9 048	-67%
Denmark	107	76	55	0.1%	-21	-28%	-52	-49%
Finland	2 497	2 949	2 252	2%	-697	-24%	-245	-10%
France	21 237	12 857	13 335	13%	478	4%	-7 902	-37%
Germany	34 742	34 275	33 054	33%	-1 221	-4%	-1 688	-5%
Greece	475	148	197	0.2%	49	33%	-278	-59%
Ireland	175	2	2	0.002%	-0.8%	-0.3%	-173	-99%
Italy	17 917	16 382	15 420	15%	-962	-6%	-2 497	-14%
Luxembourg	5 418	377	325	0.3%	-53	-14%	-5 093	-94%
Netherlands	4 011	4 280	4 312	4%	32	1%	301	8%
Portugal	1 228	125	140	0.1%	15	12%	-1 087	-89%
Spain	8 247	6 191	6 122	6%	-68	-1%	-2 124	-26%
Sweden	1 705	1 516	1 160	1%	-357	-24%	-546	-32%
United Kingdom	24 028	12 075	13 415	13%	1 339	11%	-10 613	-44%
EU-15	**140 156**	**103 212**	**100 026**	**100%**	**-3 186**	**-3%**	**-40 130**	**-29%**

1A2a Iron and Steel - Liquid Fuels (CO_2)

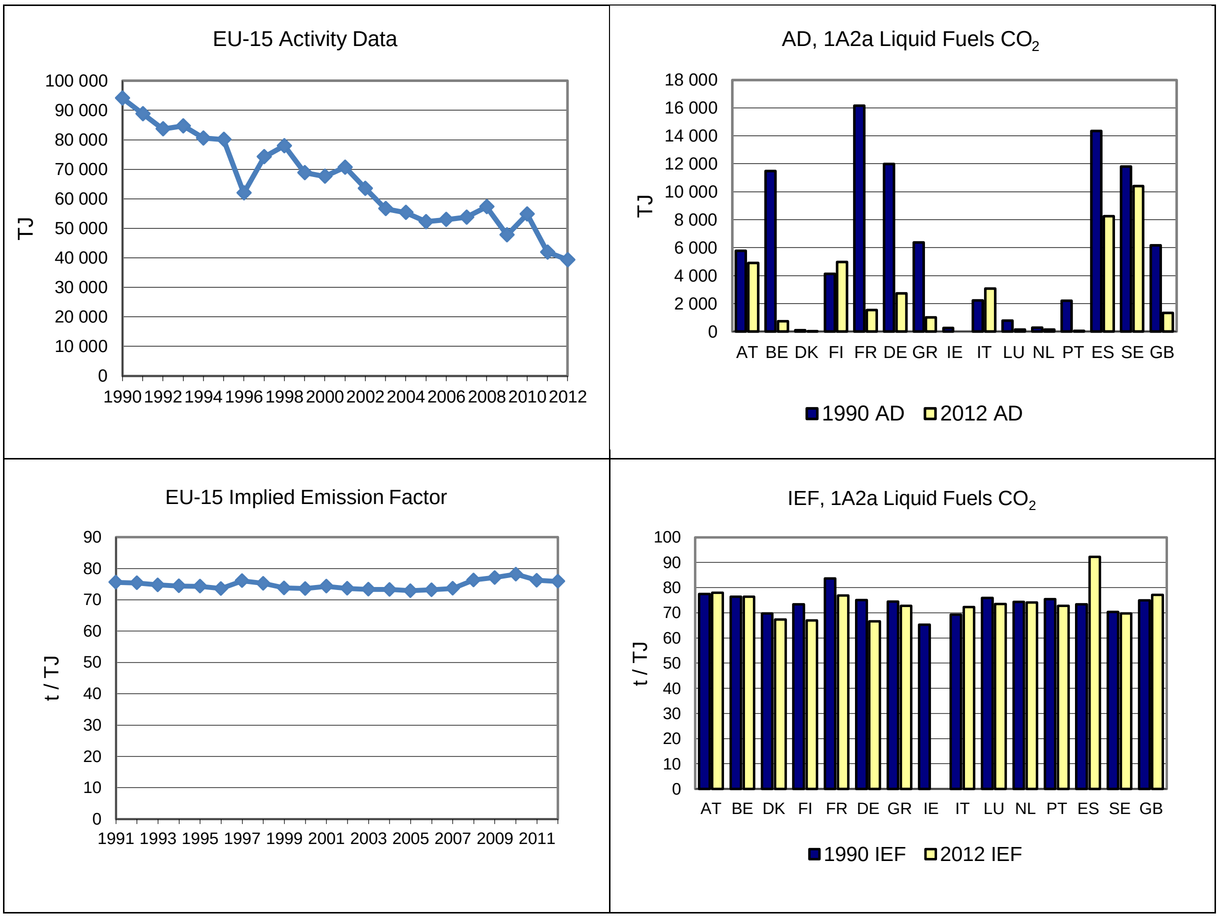
In 2012 CO_2 from liquid fuels had a share of 3 % within this category compared to 5 % in 1990. Between 1990 and 2012 emissions decreased by 58 % (Table 3.21). Significant absolute decreases have been achieved in Belgium, France, Germany and Greece. This activity mainly consists of residual fuel oil used for iron ore reduction in blast furnaces.

Table 3.21 1A2a Iron and Steel, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	448	444	383	13%	-61	-14%	-65	-15%	T2	CS,PS
Belgium	878	40	56	2%	16	41%	-822	-94%	T3	PS
Denmark	7	0	1	0.02%	0	22%	-6	-91%	T2,T1	CS,D
Finland	304	354	333	11%	-21	-6%	30	10%	T3	CS
France	1 352	143	118	4%	-25	-17%	-1 234	-91%	T2, T3	CS
Germany	900	190	182	6%	-8	-4%	-718	-80%	CS	CS
Greece	475	6	74	2%	67	1096%	-402	-85%	T2	PS
Ireland	16	NO	NO	-	-	-	-16	-100%	NA	NA
Italy	153	260	222	7%	-38	-14%	69	45%	T2	CS
Luxembourg	59	11	10	0.3%	0	-4%	-49	-83%	T1,T2	CS,D
Netherlands	21	11	11	0.4%	0	3%	-9	-45%	T2	CS,D
Portugal	167	3	4	0.1%	1	33%	-163	-98%	T2	D, CR, PS
Spain	1 052	836	760	25%	-76	-9%	-292	-28%	T2	CS, PS
Sweden	831	798	726	24%	-72	-9%	-105	-13%	T2, T3	CS, PS
United Kingdom	462	101	102	3%	2	2%	-359	-78%	T2	CS
EU-15	**7 125**	**3 196**	**2 983**	**100%**	**-213**	**-7%**	**-4 142**	**-58%**		

Figure 3.28 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Liquid fuel consumption in the EU-15 decreased by 58 % between 1990 and 2012. The CO_2 implied emission factor of EU-15 was 75.88 t/TJ in 2012. The comparatively high IEF of Spain is due to the use of petrol coke.

Figure 3.28 1A2a Iron and Steel, Liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2a Iron and Steel - Solid Fuels (CO_2)

In 2012, CO_2 from solid fuels had a share of 81 % within this category and 82 % in 1990. Between 1990 and 2012 the emissions decreased by 30 % (Table 3.22). Between 1990 and 2012 Belgium, France, Italy, Luxembourg, Spain and the United Kingdom showed major decreases. Between 2011 to 2012, all member states except Austria, Germany and the Netherlands show emission decreases.

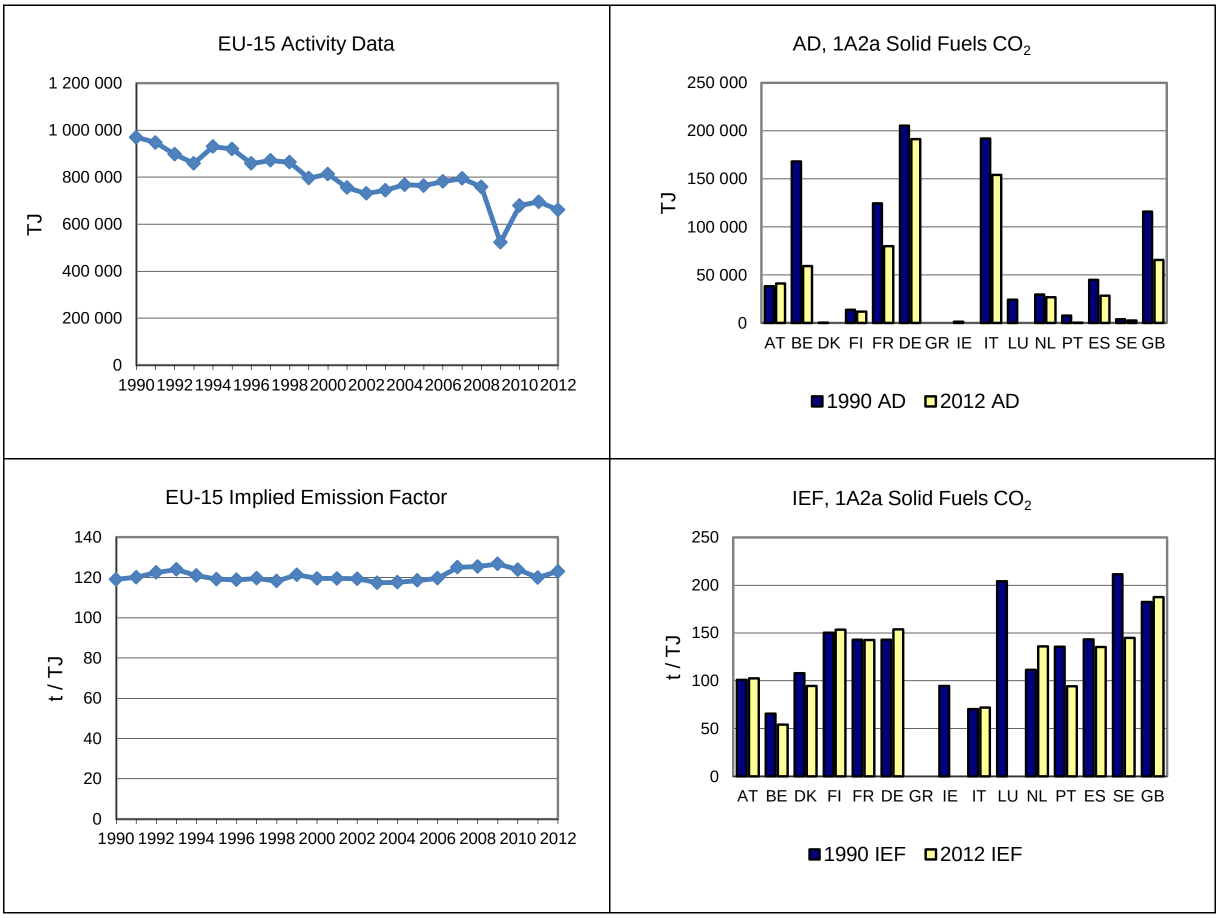
Table 3.22 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	3 846	4 236	4 196	5%	-41	-1%	350	9%	T2	CS,PS
Belgium	11 062	4 796	3 209	4%	-1 586	-33%	-7 853	-71%	T3	PS
Denmark	5	0.01	0.01	0.00001%	-0.004	-27%	-5	-100%		
Finland	2 084	2 476	1 808	2%	-669	-27%	-277	-13%	T3	CS,PS
France	17 784	10 931	11 387	14%	455	4%	-6 397	-36%	T2, T3	CS
Germany	29 396	30 308	29 417	36%	-891	-3%	21	0%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	115	NO	NO	-	-	-	-115	-100%	NA	NA
Italy	13 487	11 913	11 107	14%	-807	-7%	-2 381	-18%	T2	CS
Luxembourg	4 959	NO	NO	-	-	-	-4 959	-100%	NA	NA
Netherlands	3 323	3 591	3 628	4%	37	1%	305	9%	T2	CS
Portugal	1 058	17	21	0.03%	4	-	-1 036	-98%	T2	D, CR, PS
Spain	6 419	3 613	3 825	5%	211	6%	-2 594	-40%	T2	CS, PS
Sweden	849	664	378	0.5%	-286	-43%	-471	-56%	T2, T3	CS, PS
United Kingdom	21 103	10 796	12 299	15%	1 503	14%	-8 804	-42%	T2	CS
EU-15	**115 489**	**83 342**	**81 274**	**100%**	**-2 069**	**-2%**	**-34 216**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.29 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emitters are France, Germany, Italy and the UK; together they cause 79 % of the CO_2 emissions from solid fuels in 1A2a. Solid fuel combustion in the EU-15 decreased by 32 % between 1990 and 2012. The implied emission factor in 2012 of EU-15 was 123 t/TJ. Belgium and Italy report fuel consumption under this category which was not used for the calculation of the CO_2 emissions and thus results untypically low CO_2 emission factors.

Figure 3.29 1A2a Iron and Steel, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2012 CO_2 from gaseous fuels had a share of 16 % within source category 1A2a (compared to 12 % in 1990). Between 1990 and 2012 the emissions decreased by 10 % (Table 3.23).

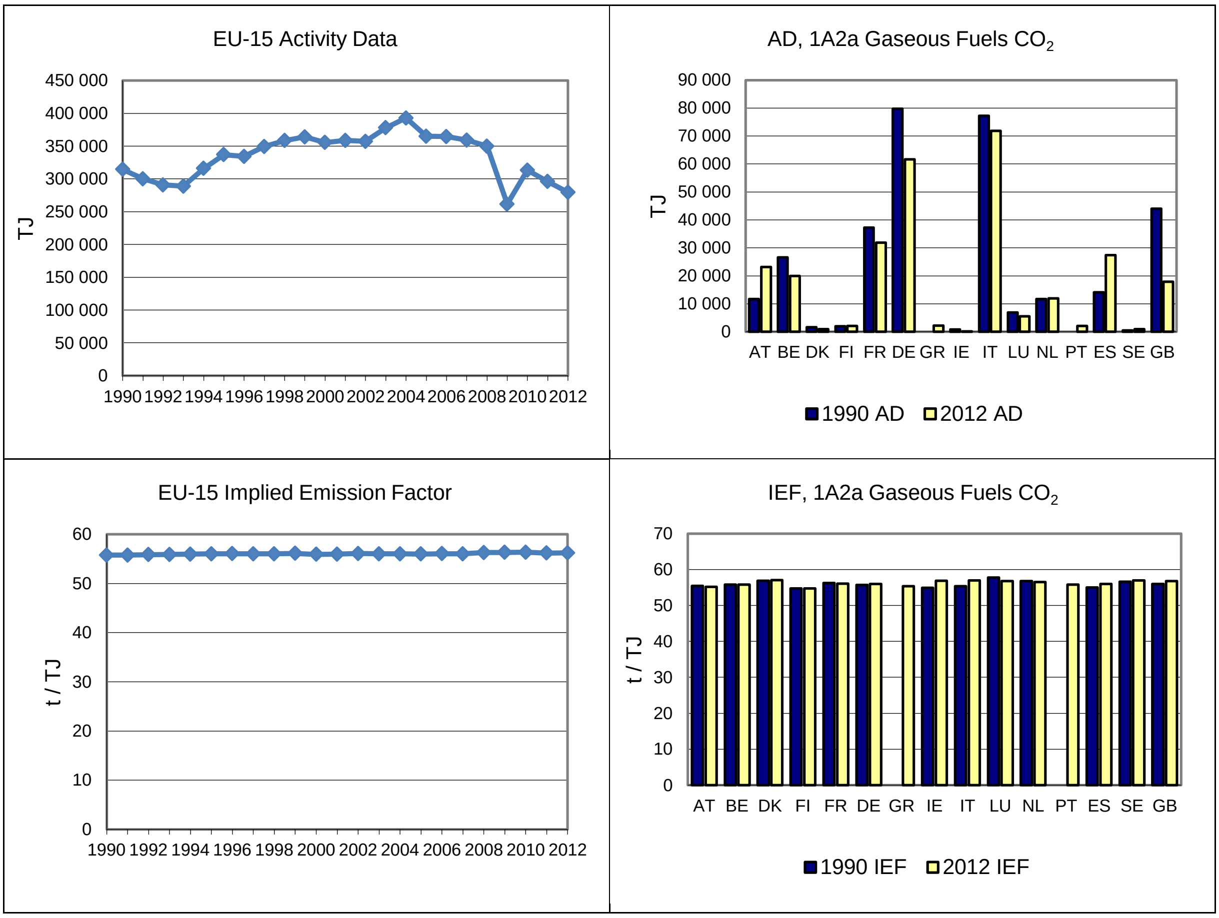
Table 3.23 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	650	1 260	1 279	8%	19	2%	630	97%	T2	CS,PS
Belgium	1 485	1 181	1 112	7%	-69	-6%	-373	-25%	T3	PS
Denmark	96	76	54	0.3%	-21	-28%	-41	-43%	T3	CS
Finland	109	119	111	1%	-7	-6%	2	2%	T3	CS
France	2 096	1 734	1 787	11%	53	3%	-308	-15%	T2, T3	CS
Germany	4 446	3 778	3 455	22%	-323	-9%	-992	-22%	CS	CS
Greece	NO	142	123	1%	-19	-13%	123	-	T2	CS
Ireland	44	2	2	0.02%	-0.01	-0.3%	-41	-95%	T1	CS
Italy	4 276	4 209	4 091	26%	-118	-3%	-185	-4%	T2	CS
Luxembourg	400	367	315	2%	-52	-14%	-86	-21%	T2	CS
Netherlands	667	678	673	4%	-5	-1%	6	1%	T2	CS
Portugal	NO	105	115	1%	10	9%	115	-	T2	D, CR, PS
Spain	776	1 741	1 537	10%	-204	-12%	762	98%	T2	CS
Sweden	25	55	56	0.4%	1	3%	31	123%	T2	CS
United Kingdom	2 463	1 179	1 014	6%	-165	-14%	-1 449	-59%	T2	CS
EU-15	**17 533**	**16 625**	**15 726**	**100%**	**-899**	**-5%**	**-1 807**	**-10%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.30 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain which contribute 69 % to CO_2 emissions from gaseous fuels in 1A2a. Gaseous fuel consumption in the EU-15 decreased by 11 % between 1990 and 2012. The implied emission factor of EU-15 was 56 t/TJ in 2012.

Figure 3.30 1A2a Iron and Steel, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

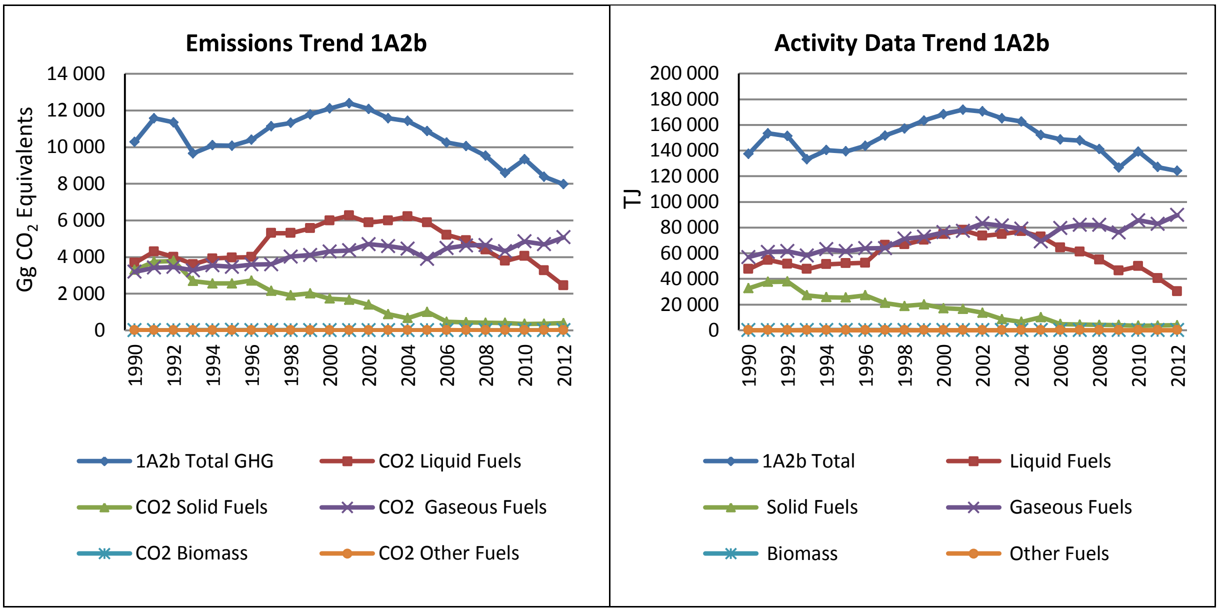


3.2.2.2 Non Ferrous Metals (1A2b) (EU-15)

In this chapter information is provided about emission trends, Member States contribution, activity data and emission factors for category 1A2b by fuels. CO_2 emissions from 1A2b Non-Ferrous Metals accounted for 2 % of 1A2 source category and 0.2 % of total GHG emissions in 2012.

Figure 3.31 shows the emission trend within the category 1A2b, which is in 2012 mainly dominated by CO_2 emissions from liquid and gaseous fuels. The share of solid fuels emissions decreased from 32 % in 1990 to 5 % in 2012. In 2012 total GHG emissions were 22 % below 1990 level. Increasing emissions were reported for CO_2 from gaseous fuels (+59 %) while emissions from other fuels decreased.

Figure 3.31 1A2b Non ferrous Metals: Total and CO_2 emission trends



EU-15 CO_2 emissions from 1A2b were 22 % below 1990 levels in 2012. In absolute terms, France and Germany reported the highest decreases, while Spain, Ireland and Italy reported substantial increases in this period (Table 3.24).

Table 3.24 1A2b Non ferrous Metals: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	132	257	245	3%	-12	-5%	113	86%
Belgium	624	427	431	5%	4	1%	-192	-31%
Denmark	11	4	4	0.05%	-0.3	-7%	-7	-65%
Finland	336	104	96	1%	-7	-7%	-240	-71%
France	2 638	939	939	12%	0.05	0.01%	-1 699	-64%
Germany	1 601	86	84	1%	-2	-2%	-1 517	-95%
Greece	608	462	529	7%	67	15%	-78	-13%
Ireland	809	1 482	1 485	19%	3	0%	676	84%
Italy	738	1 111	1 060	13%	-51	-5%	322	44%
Luxembourg	28	51	51	1%	1	1%	23	84%
Netherlands	216	186	153	2%	-33	-18%	-63	-29%
Portugal	IE,NO	IE	IE	-	-	-	-	-
Spain	1 179	2 551	2 115	27%	-436	-17%	936	79%
Sweden	128	83	84	1%	1	1%	-43	-34%
United Kingdom	1 143	580	647	8%	66	11%	-496	-43%
EU-15	**10 190**	**8 323**	**7 924**	**100%**	**-399**	**-5%**	**-2 266**	**-22%**

Portugal includes emissions under 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2b Non-Ferrous Metals - Solid Fuels (CO_2)

In 2012 CO_2 from solid fuels had a share of 5 % within source category 1A2b category (compared to 32 % in 1990). Between 1990 and 2012 the emissions decreased by 88 % (Table 3.25). Greece and Portugal reported emissions as 'Included elsewhere' and Ireland, the Netherlands, Luxembourg, Denmark and Sweden as 'Not occurring' or 'Not applicable'. Substantial decreases between 1990 and 2012 were reported by France and Germany.

Table 3.25 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions

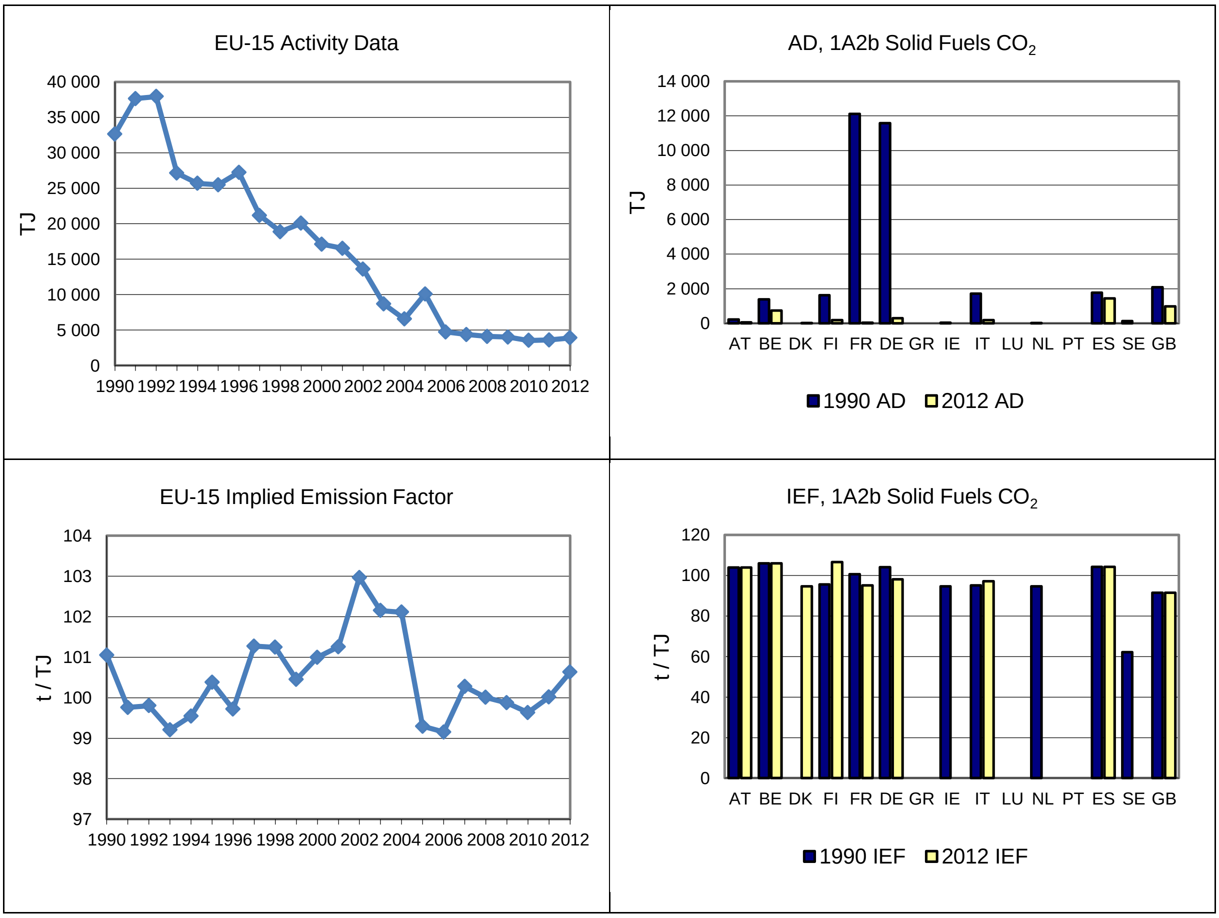
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	22	6	6	2%	-0.5	-7%	-16	-73%	T2	CS
Belgium	146	94	78	20%	-17	-18%	-68	-47%	T1	D
Denmark	NO	0.007	0.005	0.001%	-0.002	-27%	0.005	-		
Finland	155	21	20	5%	-1	-6%	-136	-87%	T3	CS
France	1 220	4	4	1%	0.2	6%	-1 216	-100%	T2, T3	CS
Germany	1 206	31	30	8%	-2	-5%	-1 177	-98%	CS	CS
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	4	NA	NA	-	-	-	-4	-100%	NA	NA
Italy	163	21	18	5%	-3	-15%	-145	-89%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	0.4	NO	NO	-	-	-	-0.4	-100%	NA	NA
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Spain	185	91	150	38%	59	64%	-35	-19%	T2	CS
Sweden	7	NO	NO	-	-	-	-7	-100%	NA	NA
United Kingdom	191	92	89	23%	-3	-4%	-102	-53%	T2	CS
EU-15	**3 300**	**361**	**393**	**100%**	**32**	**9%**	**-2 906**	**-88%**		

Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry is not available.
Greece includes emissions in the Industrial processes sector (as non-energy use of fuels).
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.32 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Belgium, Spain and the United

Kingdom; together they cause 80 % of the CO_2 emissions from solid fuels in 2012.Consumption of solid fuels in the EU-15 decreased by 88 % between 1990 and 2012. The implied emission factor of EU-15 was 101 t/TJ in 2012. The strong decline in 1993 AD is mainly due to a high decrease reported by France.

Figure 3.32 1A2b Non ferrous Metals, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2b Non-Ferrous Metals - Gaseous Fuels (CO_2)

In 2012 CO_2 from gaseous fuels had a share of 64 % within source category 1A2b (compared to 31 % in 1990). Between 1990 and 2012 the emissions increased by 59 % (Table 3.26). Between 1990 and 2012 the highest absolute increases occurred in Ireland, Greece and Italy.

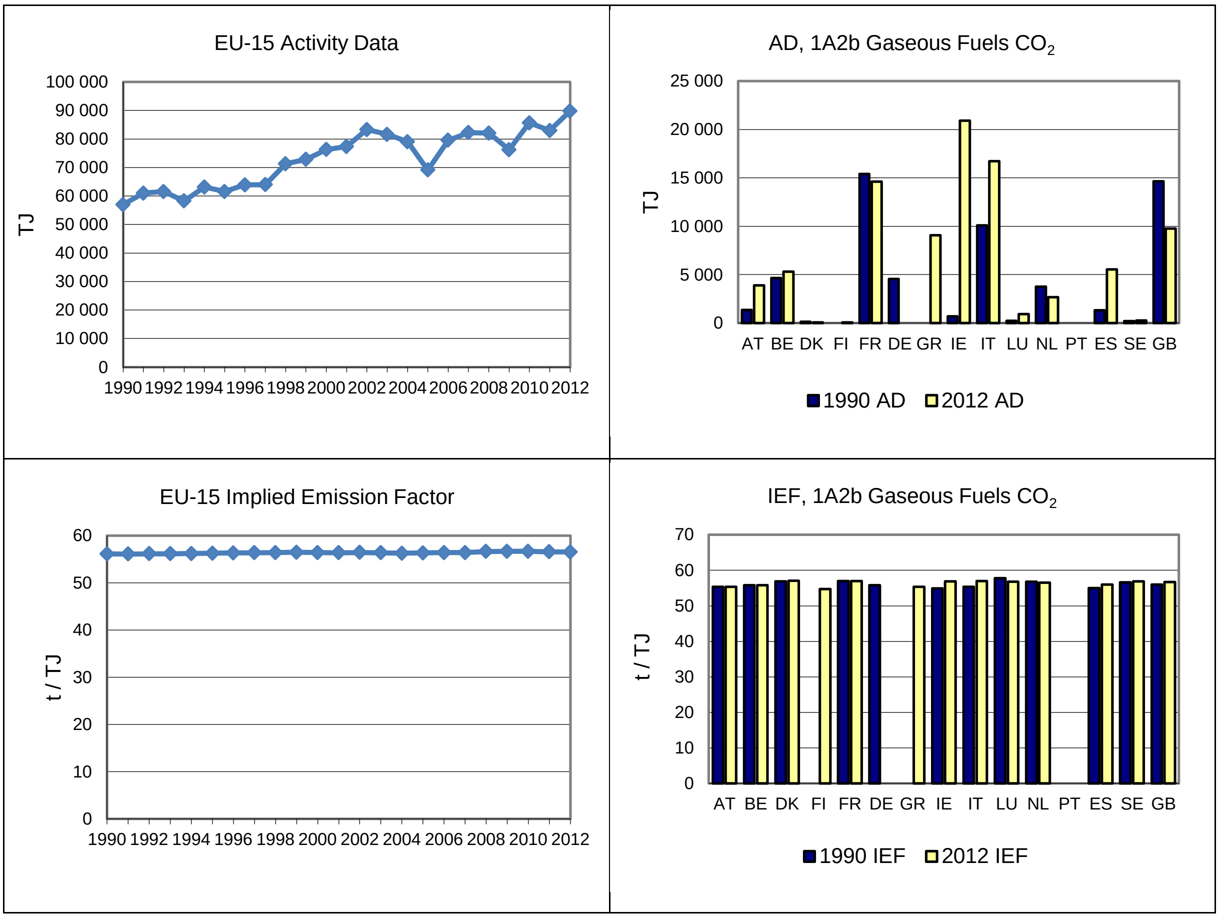
Table 3.26 1A2b Non ferrous Metals, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	75	228	216	4%	-11	-5%	141	189%
Belgium	260	286	296	6%	10	3%	37	14%
Denmark	7	3	3	0.1%	-0.2	-5%	-4	-55%
Finland	NO	3	3	0.1%	-0.3	-9%	3	-
France	878	811	832	16%	22	3%	-46	-5%
Germany	253	IE	IE	0%	-	-	-253	-100%
Greece	NO	149	502	10%	353	236%	502	-
Ireland	39	1 000	1 190	23%	190	-	1 151	2986%
Italy	558	982	952	19%	-30	-3%	394	71%
Luxembourg	13	51	51	1%	1	1%	38	-
Netherlands	213	185	152	3%	-34	-18%	-62	-29%
Portugal	NO	IE	IE	-	-	-	-	-
Spain	71	494	310	6%	-184	-37%	239	334%
Sweden	10	15	15	0.3%	-0.3	-2%	4	42%
United Kingdom	819	485	555	11%	70	14%	-265	-32%
EU-15	**3 197**	**4 694**	**5 078**	**100%**	**384**	**8%**	**1 881**	**59%**

Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available.
Germany reported emissions under 1A2f other (unspecified industrial power plants) because of confidential data.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.33 shows activity data and CO_2 implied emission factors for EU-15 and the Member States. The largest emissions are reported by France, Ireland, Italy, Greece and the United Kingdom; together they cause around 79 % of the CO_2 emissions in 2012 from gaseous fuels in 1A2b. Consumption of gaseous fuels in the EU-15 rose by 58 % between 1990 and 2012. The implied emission factor of EU-15 was 56.54 t/TJ in 2012. The jump in 2006 AD is mainly due to Ireland which reports a high increase in 2006 and Spain which reports a high decrease in 2007.

Figure 3.33 1A2b Non ferrous Metals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

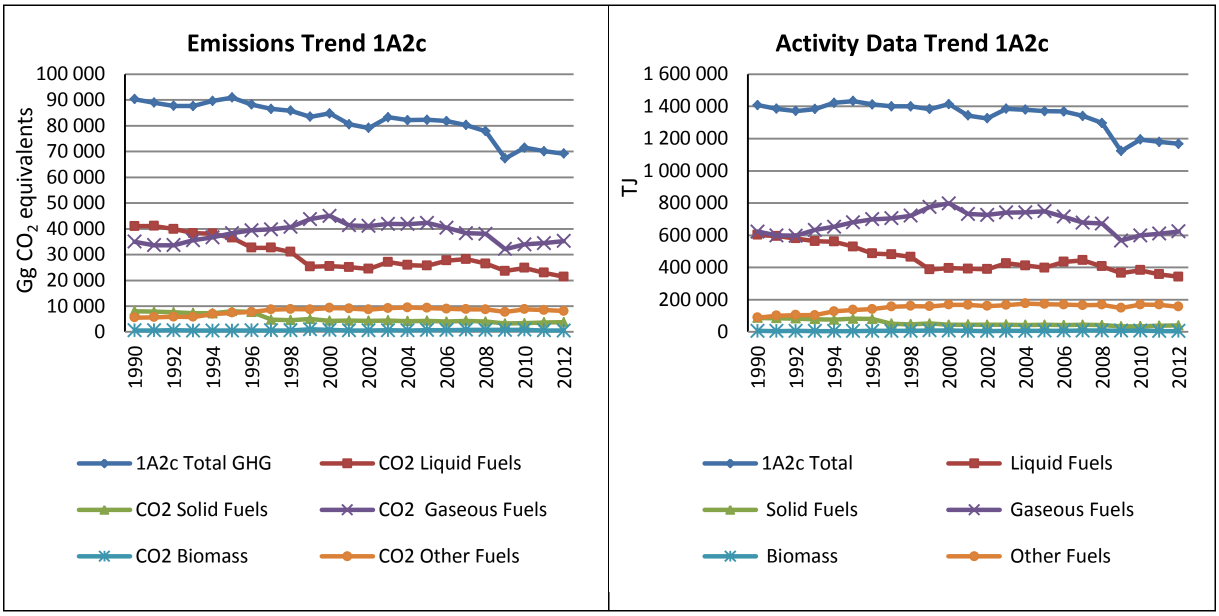


3.2.2.3 Chemicals (1A2c) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2c on a fuel base. CO_2 emissions from 1A2c Chemicals accounted for 15 % of 1A2 category and 2 % of total GHG emissions in 2012.

Figure 3.34 shows the emission trend within the category 1A2c, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 23 %, mainly due to decreases in emissions from liquid (-48 %) fuels. Increasing CO_2 emissions were reported for other fuels +46 %).

Figure 3.34 1A2c Chemicals: Total and CO_2 emission and activity trends



Between 1990 and 2012, CO_2 emissions from 1A2c Chemicals decreased by 24 % in the EU-15 (Table 3.27), mainly due to decreases in Italy, the Netherlands and the United Kingdom; Belgium and Spain reported substantial emission increases in this period. Between 2010 and 2012 emissions decreased substantially in Italy, the UK and the Netherlands.

Table 3.27 1A2c Chemicals: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	883	1 764	1 793	3%	29	2%	911	103%
Belgium	6 585	7 074	6 826	10%	-248	-4%	241	4%
Denmark	290	265	250	0.4%	-15	-6%	-40	-14%
Finland	1 286	805	645	1%	-160	-20%	-641	-50%
France	19 560	18 925	18 732	27%	-193	-1%	-828	-4%
Germany	IE	IE	IE	-	-	-	-	-
Greece	749	1 196	748	1%	-448	-37%	-1	0%
Ireland	410	279	265	0.4%	-14	-5%	-145	-35%
Italy	19 203	6 953	6 893	10%	-60	-1%	-12 310	-64%
Luxembourg	177	183	189	0.3%	7	4%	12	7%
Netherlands	17 133	12 401	12 337	18%	-64	-1%	-4 796	-28%
Portugal	1 476	1 216	921	1%	-295	-24%	-555	-38%
Spain	5 262	7 111	7 878	11%	767	11%	2 615	50%
Sweden	1 149	1 240	1 175	2%	-64	-5%	26	2%
United Kingdom	15 472	10 103	9 911	14%	-192	-2%	-5 561	-36%
EU-15	**89 637**	**69 515**	**68 565**	**100%**	**-950**	**-1%**	**-21 073**	**-24%**

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2c Chemicals - Liquid Fuels (CO_2)

In 2012, CO_2 from liquid fuels had a share of 31 % within source category 1A2c (compared to 45 % in 1990). Between 1990 and 2012, the emissions decreased by 48 % (Table 3.28). Several EU-15 Member States reported decreasing CO_2 emissions from this source category with Italy and the United Kingdom showing the highest reduction in absolute terms. Germany includes emissions under 1A2f.

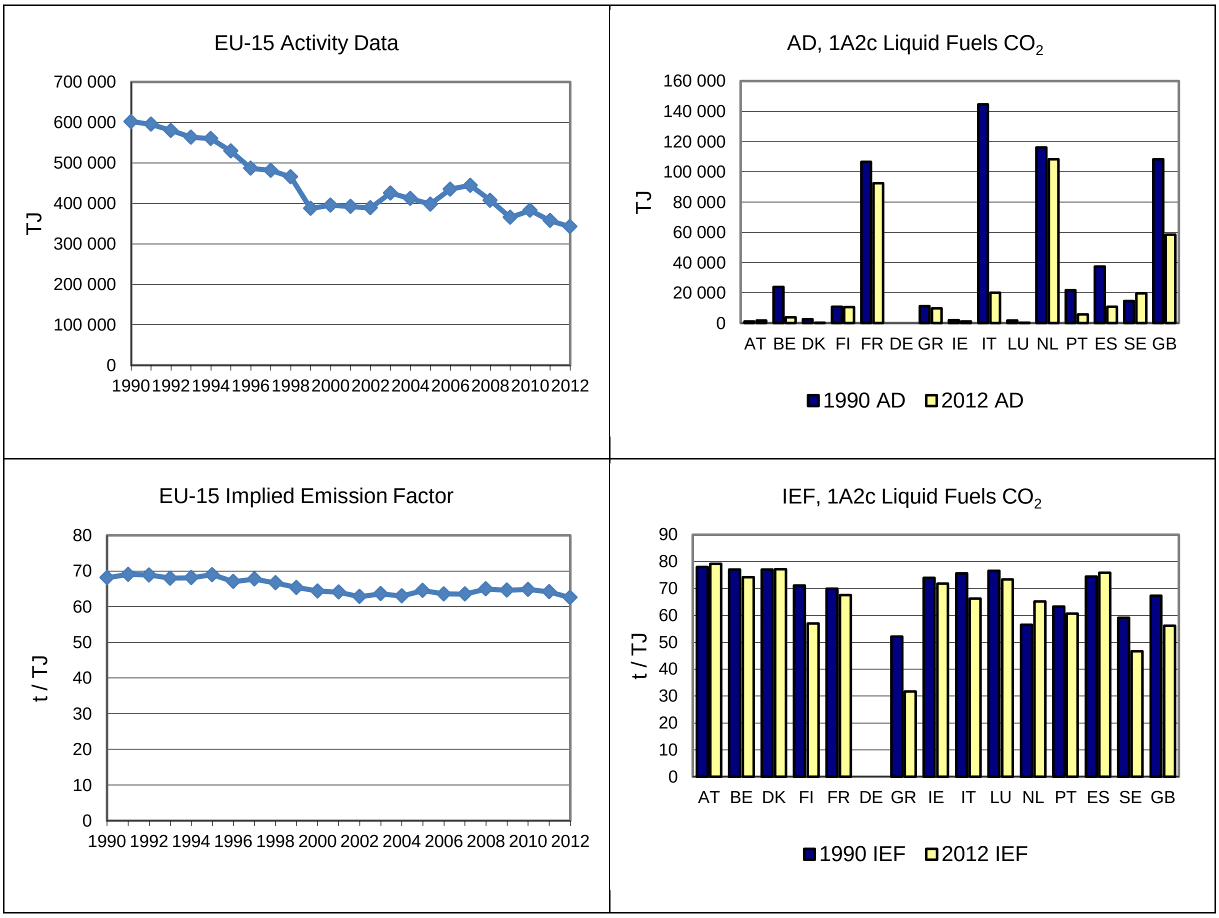
Table 3.28 1A2c Chemicals, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	82	131	132	1%	1	1%	50	60%	T2	CS,PS
Belgium	1 835	399	278	1%	-121	-30%	-1 558	-85%	T1	D
Denmark	188	16	16	0.1%	-0.2	-1%	-172	-92%	T2,T1	CS,D
Finland	772	716	602	3%	-114	-16%	-170	-22%	T3	CS
France	7 470	6 538	6 244	29%	-295	-5%	-1 227	-16%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	584	780	307	1%	-472	-61%	-276	-47%	T2	PS
Ireland	131	85	76	0.4%	-9	-11%	-55	-42%	T1	CS
Italy	10 956	1 178	1 329	6%	151	13%	-9 628	-88%	T2	CS
Luxembourg	120	9	13	0.1%	4	44%	-107	-89%	T1,T2	CS,D
Netherlands	6 570	7 186	7 055	33%	-132	-2%	484	7%	T2	CS,D
Portugal	1 373	615	347	2%	-268	-44%	-1 026	-75%	T2	D, CR
Spain	2 789	874	820	4%	-54	-6%	-1 969	-71%	T2	CS
Sweden	861	996	917	4%	-79	-8%	56	6%	T2	CS
United Kingdom	7 287	3 408	3 285	15%	-123	-4%	-4 002	-55%	T2	CS
EU-15	**41 019**	**22 930**	**21 419**	**100%**	**-1 511**	**-7%**	**-19 600**	**-48%**		

Emissions of Germany are included in 1A2f
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.35 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest contributions are reported by France and the Netherlands; together they cause around 62 % of the CO_2 emissions from liquid fuels in 1A2c. Liquid fuel combustion in the EU-15 decreased by 43 % between 1990 and 2012. The implied emission factor of EU-15 was 62.5 t/TJ in 2012. The low implied emission factor of Greece is because non-energy use is included in activity data. Sweden reports methane and methane based gas mixtures together with liquid fuels which implies a rather low IEF too. The decline in 1999 AD is due to the strong decrease reported by Italy.

Figure 3.35 1A2c Chemicals, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals - Solid Fuels (CO_2)

In 2012, solid fuels had a share of 5 % within source category 1A2c (compared to 9 % in 1990). Between 1990 and 2012 the emissions decreased by 53 % (Table 3.29). In absolute terms the Netherlands and the United Kingdom reported a significant decrease during this period. Germany includes emissions from this source category in source category 1A2f.

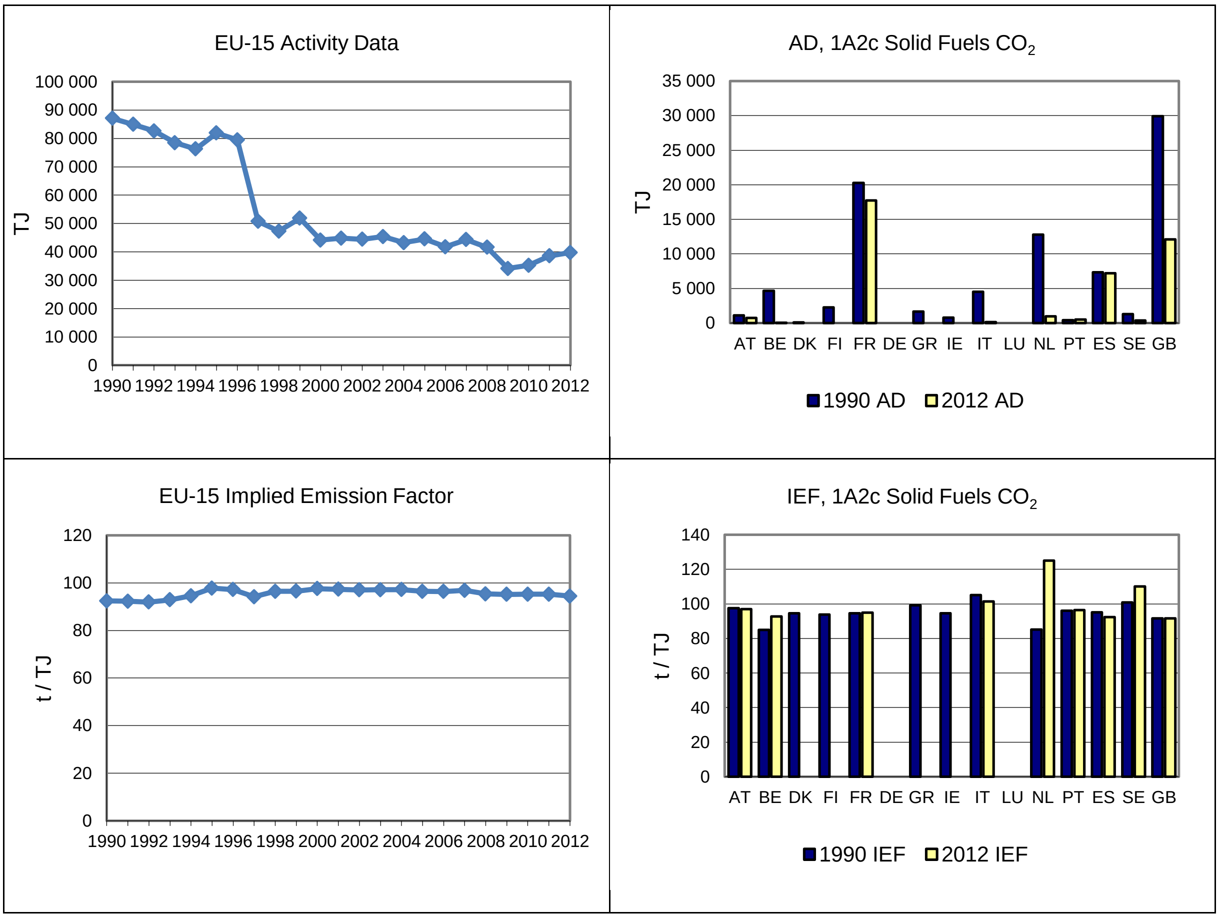
Table 3.29 1A2c Chemicals, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	107	68	71	2%	3	4%	-37	-34%	T2	CS,PS
Belgium	397	3	3	0.1%	0	-5%	-393	-99%	T1	D
Denmark	7	NA	NA	-	-	-	-7	-100%	NA	NA
Finland	214	NO	NO	-	0.0	-	-214	-100%	NA	NA
France	1 918	1 671	1 685	45%	13	1%	-233	-12%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	166	NO	NO	-	-	-	-166	-100%	NA	NA
Ireland	72	NA	NA	-	-	-	-72	-100%	NA	NA
Italy	478	15	15	0.4%	-0.3	-2%	-462	-97%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1 087	178	121	3%	-58	-32%	-967	-89%	T2	CS
Portugal	40	51	47	1%	-3	-7%	8	19%	T2	D, CR
Spain	697	602	665	18%	62	10%	-32	-5%	T2	CS, PS
Sweden	127	41	40	1%	-1	-3%	-87	-69%	T2	CS
United Kingdom	2 743	1 041	1 106	29%	65	6%	-1 636	-60%	T2	CS
EU-15	**8 052**	**3 672**	**3 753**	**100%**	**81**	**2%**	**-4 299**	**-53%**		

Emissions of Germany are inlcuded in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.36 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Spain and the United Kingdom; together they cause 92 % of the CO_2 emissions from solid fuels in 1A2c. Solid fuel combustion in the EU-15 decreased by -54 % between 1990 and 2012. The implied emission factor of EU-15 was 94.4 t/TJ in 2012. The Netherlands include chemical waste gas within this category which implies the change in their IEF.

Figure 3.36 1A2c Chemicals, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2012, CO_2 from gaseous fuels had a share of 51 % within source category 1A2c (compared to 39 % in 1990). Between 1990 and 2012, the emissions increased by 1 % (Table 3.30). Between 1990 and 2012 Italy and the Netherlands reported substantial decreases. The highest increases occurred in Spain and Austria. Germany includes emissions from this source category in source category 1A2f.

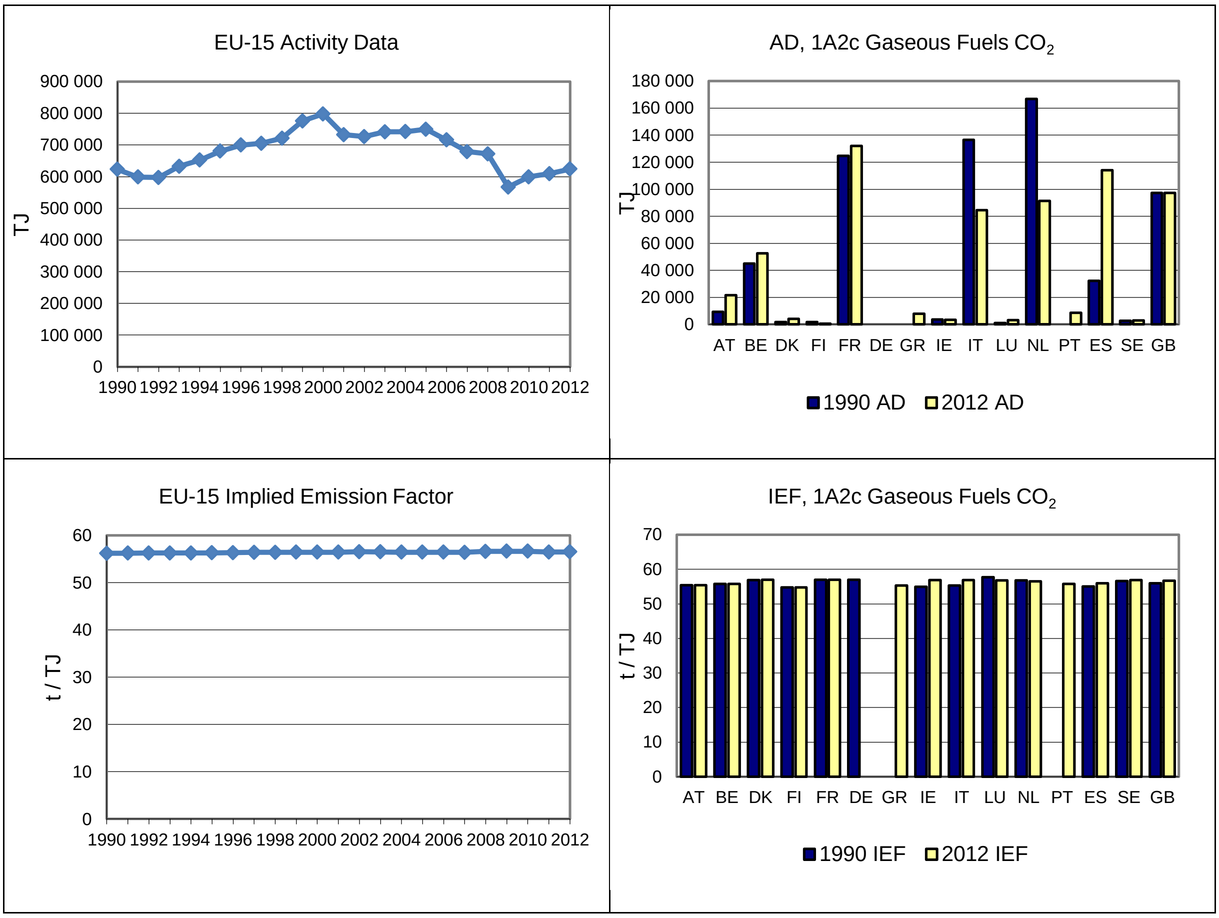
Table 3.30 1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	519	1 142	1 199	3%	57	5%	680	131%	T2	CS
Belgium	2 519	2 863	2 932	8%	69	2%	413	16%	T1	D
Denmark	96	249	234	1%	-15	-6%	138	145%	T3	CS
Finland	98	46	32	0.1%	-14	-31%	-67	-68%	T3	CS
France	7 111	7 408	7 532	21%	124	2%	421	6%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	416	441	1%	25	6%	441	-	T2	CS
Ireland	207	193	189	1%	-5	-2%	-19	-9%	T1	CS
Italy	7 561	4 978	4 813	14%	-165	-3%	-2 748	-36%	T2	CS
Luxembourg	57	174	177	1%	3	2%	119	208%	T2	CS
Netherlands	9 476	5 037	5 162	15%	125	2%	-4 313	-46%	T2	CS
Portugal	NO	475	477	1%	2	0%	477	-	T2	D, CR
Spain	1 777	5 635	6 393	18%	758	13%	4 616	260%	T2	CS
Sweden	155	154	167	0.5%	12	8%	12	8%	T2	CS
United Kingdom	5 443	5 654	5 520	16%	-134	-2%	77	1%	T2	CS
EU-15	**35 020**	**34 424**	**35 267**	**100%**	**843**	**2%**	**247**	**1%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.37 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands, Spain and the United Kingdom; together they cause 83 % of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-15 increased by 0.2 % between 1990 and 2012. The implied emission factor of EU-15 was 56.5 t/TJ in 2012.

Figure 3.37 1A2c Chemicals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals - Other Fuels (CO_2)

In 2012, CO_2 from other fuels had a share of 12 % within source category 1A2c (compared to 6 % in 1990). Between 1990 and 2012, the emissions increased by 46 % (Table 3.31). Several Member States reported emissions as ‘Not occurring’ or ‘Not applicable’, Germany and the United Kingdom included emissions in 1A2f. The major absolute increase was reported by Belgium between 1990 and 2012. Belgium reports recovered fuels from cracking units or other processes under this category; Italy reports gaseous fuels resulting from the petrochemical production processes.

Table 3.31 1A2c Chemicals, other fuels: Member States' contributions to CO_2

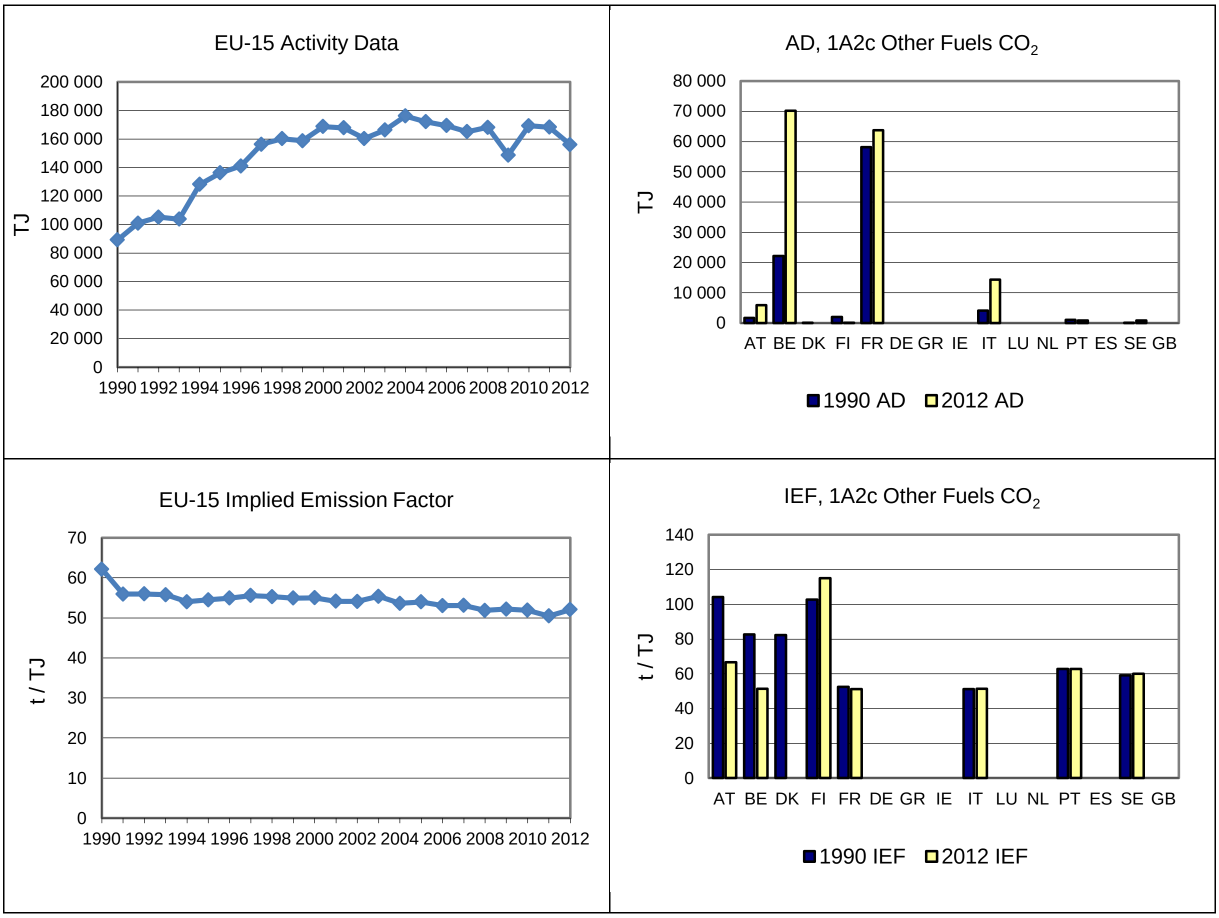
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	174	424	392	5%	-32	-8%	218	125%	T2	D,PS
Belgium	1 834	3 808	3 612	44%	-196	-5%	1 779	97%	T3	PS
Denmark	0.3	NA	NA	-	-	-	-0.3	-100%	NA	NA
Finland	202	44	12	0.2%	-31	-72%	-190	-94%	T3	CS
France	3 061	3 307	3 272	40%	-35	-1%	211	7%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	208	782	736	9%	-46	-6%	528	254%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	63	75	49	1%	-26	-34%	-13	-21%	T2	D, CR
Spain	NO	NO	NO	-	0	-	-	-	NA	NA
Sweden	6	48	52	1%	3	7%	46	829%	T2	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	NA	NA
EU-15	**5 547**	**8 489**	**8 126**	**100%**	**-363**	**-4%**	**2 579**	**46%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.38 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France and Italy; together they cause 94 % of the CO_2 emissions from other fuels in 1A2c. Other fuel consumption in the EU-15 increased by 75 % between 1990 and 2012. The implied emission factor of EU-15 was 52.1 t/TJ in 2012.

The high implied emission factor 1990 is due to new naphta cracking plants in Belgium which started operation in 1991 and which use recovered fuels with a high share of hydrogen gas. Therefore the IEF of Belgium is much lower for the years after 1990. Because Belgium contributes to 44.5 % of EU-15 emissions in 2012 it strongly affects the EU-15 IEF.

Figure 3.38 1A2c Chemicals, other fuels: Activity Data and Implied Emission Factors for CO_2

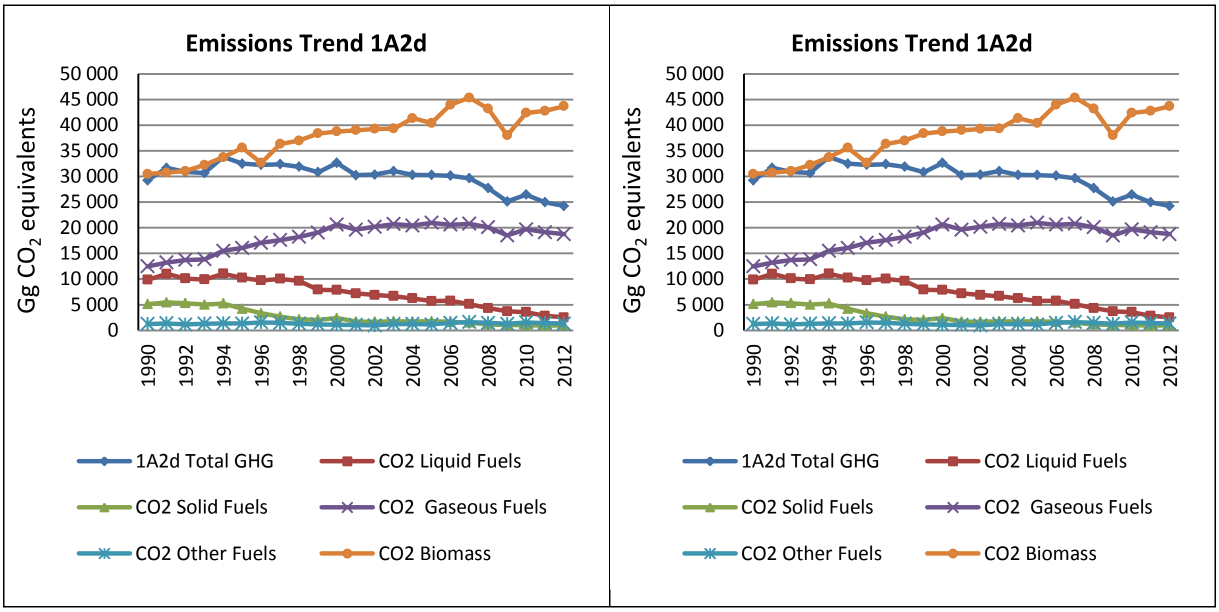


3.2.2.4 Pulp, Paper and Print (1A2d) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2d by fuels. CO_2 emissions from 1A2d Pulp, Paper and Print accounted for 5 % of 1A2 source category and 0.7 % of total GHG emissions in 2012.

Figure 3.39 shows the emission trend within the category 1A2d, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions decreased by 17 %. The share of gaseous fuels (and of biomass) is gradually increasing since 1990.

Figure 3.39 1A2d Pulp, Paper and Print: Total and CO_2 emission trends



Between 1990 and 2012, CO_2 emissions from 1A2d Pulp, Paper and Print decreased by 17 % in the EU-15 (Table 3.32), mainly due to decreases in Finland, France, Sweden and the UK. Between 2011 and 2012 emissions decreased by -3 %. Between 1990 and 1999 Luxembourg reported emissions as 'Not occurring' and "Included elsewhere".

Table 3.32 1A2d Pulp, Paper and Print: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	2 213	2 042	1 978	8%	-64	-3%	-235	-11%
Belgium	637	544	526	2%	-19	-3%	-112	-18%
Denmark	342	127	116	0.5%	-11	-9%	-226	-66%
Finland	5 336	3 327	2 964	13%	-364	-11%	-2 372	-44%
France	4 941	2 561	2 568	11%	7	0.3%	-2 374	-48%
Germany	4	15	16	0.1%	2	12%	13	344%
Greece	301	151	118	1%	-33	-22%	-183	-61%
Ireland	28	18	17	0.1%	-1	-6%	-12	-41%
Italy	3 076	4 425	4 292	18%	-133	-3%	1 215	40%
Luxembourg	IE,NO	15	24	0.1%	9	61%	24	-
Netherlands	1 743	1 109	1 101	5%	-8	-1%	-643	-37%
Portugal	746	1 034	1 003	4%	-31	-3%	257	34%
Spain	2 546	4 833	4 998	21%	165	3%	2 452	96%
Sweden	2 186	1 115	1 029	4%	-86	-8%	-1 157	-53%
United Kingdom	4 553	3 012	2 866	12%	-146	-5%	-1 687	-37%
EU-15	**28 655**	**24 328**	**23 616**	**100%**	**-712**	**-3%**	**-5 039**	**-18%**

Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2d Pulp, Paper and Print - Liquid (CO_2)

In 2012 CO_2 from liquid fuels had a share of 10 % within source category 1A2d (compared to 34 % in 1990). Between 1990 and 2012 the emissions decreased by 74 % (Table 3.33). Between 1990 and 2012 all Member States reported decreasing CO_2 emissions from this source category except Luxembourg (emissions were IE in 1990).

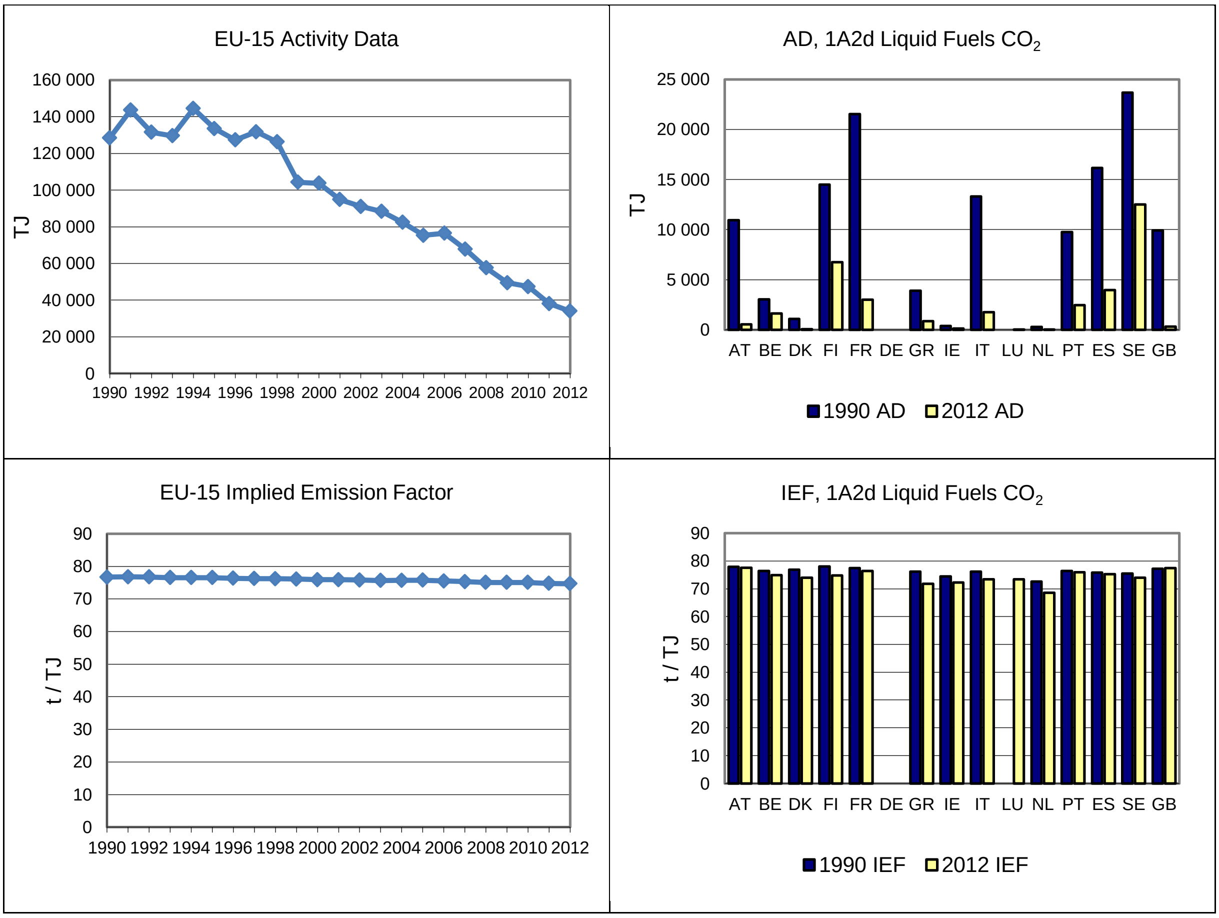
Table 3.33 1A2d Pulp, Paper and Print, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	853	54	41	2%	-13	-24%	-811	-95%	T2	CS,PS
Belgium	232	116	121	5%	5	4%	-111	-48%	T1	D
Denmark	83	3	3	0.1%	0.02	1%	-80	-96%	T2,T1	CS,D
Finland	1 132	516	504	20%	-13	-2%	-628	-55%	T3	CS
France	1 669	285	228	9%	-57	-20%	-1 441	-86%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	297	76	61	2%	-15	-20%	-236	-80%	T2	PS
Ireland	28	9	8	0.3%	-1	-9%	-20	-70%	T1	CS
Italy	1 015	144	129	5%	-16	-11%	-887	-87%	T2	CS
Luxembourg	IE	1	2	0.1%	1	177%	2	-	T2	CS
Netherlands	20	2	1	0.1%	-1	-36%	-19	-93%	T2	CS
Portugal	746	205	188	7%	-18	-9%	-558	-75%	T2	D, CR
Spain	1 225	383	298	12%	-85	-22%	-927	-76%	T2	CS, PS
Sweden	1 786	1 032	927	37%	-105	-10%	-859	-48%	T2	CS
United Kingdom	767	20	25	1%	5	26%	-742	-97%	T2	CS
EU-15	**9 852**	**2 847**	**2 536**	**100%**	**-311**	**-11%**	**-7 317**	**-74%**		

Emissions of Germany and the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.40 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Finland, France, Spain and Sweden; together they cause 77% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-15 decreased by 74 % between 1990 and 2012. The implied emission factor of EU-15 was 74.7 t/TJ in 2012.

Figure 3.40   1A2d Pulp, Paper and Print, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2d Pulp, Paper and Print - Solid Fuels (CO_2)

In 2012 CO_2 from solid fuels had a share of 4 % within source category 1A2d (compared to 17 % in 1990). Between 1990 and 2012 the emissions decreased by 81 % (Table 3.34). Only seven of the EU-15 Member States reported CO_2 emissions from this source category in 2012.

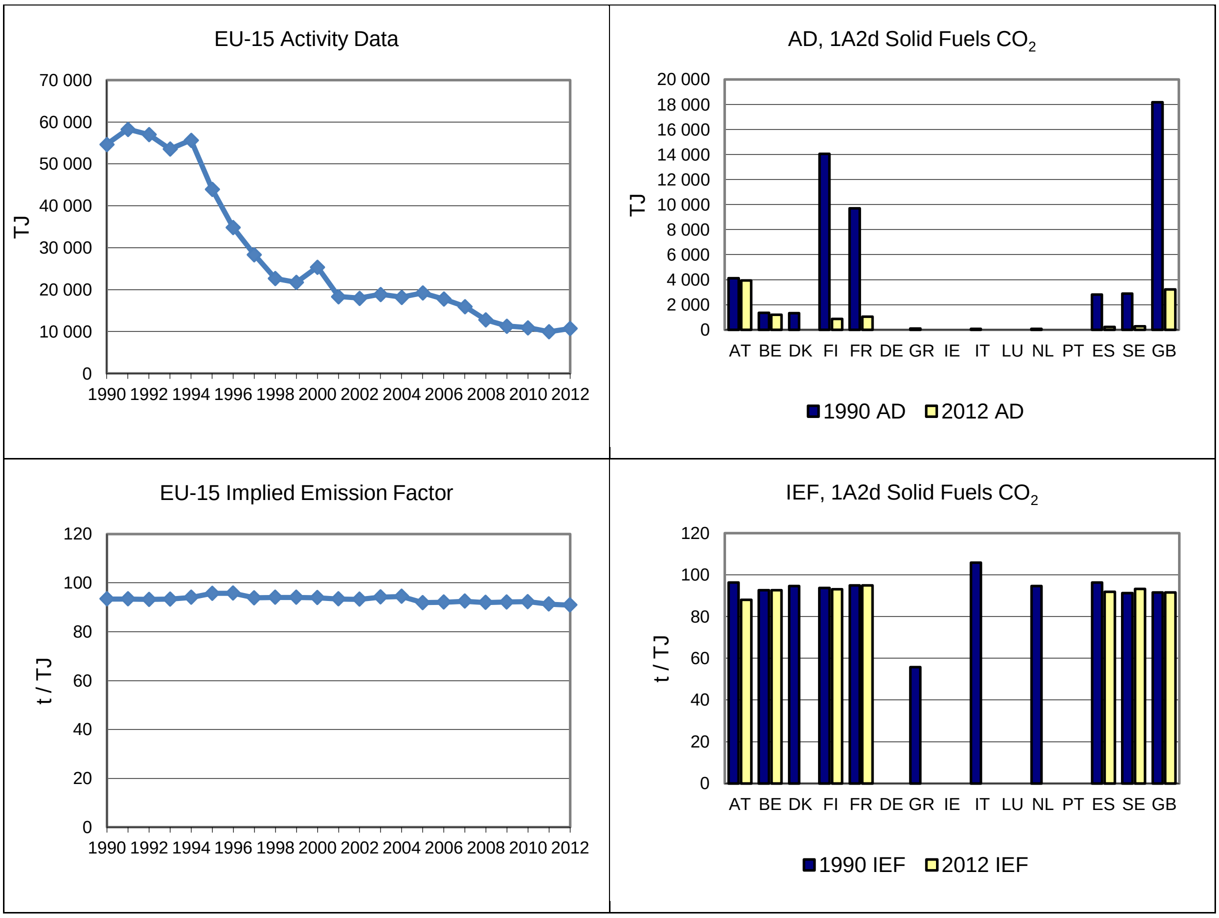
Table 3.34 1A2d Pulp, Paper and Print, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	397	353	348	36%	-5	-1%	-50	-13%	T2	CS,PS
Belgium	125	111	110	11%	-1	-1%	-15	-12%	T1	D
Denmark	125	NA	NA	-	-	-	-125	-100%	NA	NA
Finland	1 318	29	80	8%	51	173%	-1 238	-94%	T3	CS
France	922	94	99	10%	5	6%	-822	-89%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	5	NO	NO	-	-	-	-5	-100%	NA	NA
Ireland	NO	NO	NO	-	-	-	0	-	NA	NA
Italy	6	NO	NO	-	-	-	-6	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	8	NO	NO	-	-	-	-8	-100%	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	272	9	19	2%	10	114%	-252	-93%	T2	CS, PS
Sweden	263	14	26	3%	12	89%	-237	-90%	T2	CS
United Kingdom	1 664	302	295	30%	-7	-2%	-1 369	-82%	T2	CS
EU-15	**5 104**	**911**	**977**	**100%**	**66**	**7%**	**-4 127**	**-81%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.41 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Austria, Belgium, France and the United Kingdom; together they cause around 87 % of the CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption in the EU-15 decreased by 80% % between 1990 and 2012. The implied emission factor of EU-15 was 90.9 t/TJ in 2012. The low IEF of Spain is due to inclusion of gas works gas within this category.

Figure 3.41 1A2d Pulp, Paper and Print, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2d Pulp, Paper and Print - Gaseous Fuels (CO_2)

In 2012, CO_2 from gaseous fuels had a share of 77 % within source category 1A2d (compared to 43 % in 1990). Between 1990 and 2012, the emissions increased by 51 % (Table 3.35). Germany includes emissions in 1A2f.

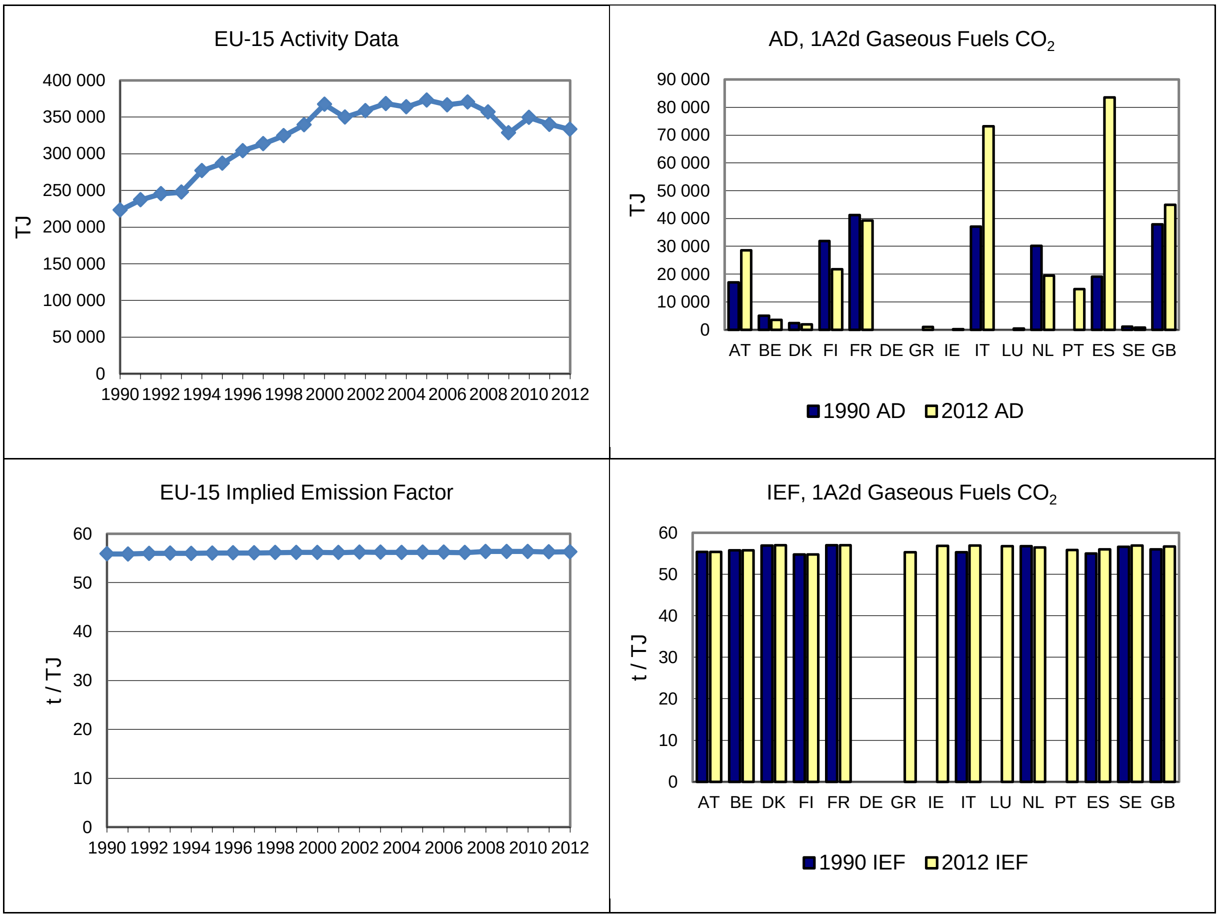
Table 3.35 1A2d Pulp, Paper and Print, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	943	1 627	1 582	8%	-45	-3%	639	68%	T2	CS
Belgium	280	197	199	1%	2	1%	-81	-29%	T1	D
Denmark	134	123	113	1%	-11	-9%	-21	-16%	T3	CS
Finland	1 748	1 517	1 190	6%	-326	-22%	-557	-32%	T3	CS
France	2 351	2 182	2 240	12%	58	3%	-111	-5%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	75	58	0.3%	-17	-23%	58	-	T2	CS
Ireland	NO	8	8	0.04%	-0.2	-2%	8	-	T1	CS
Italy	2 055	4 281	4 163	22%	-117	-3%	2 108	103%	T2	CS
Luxembourg	IE	15	23	0.1%	8	56%	23	-	T2	CS
Netherlands	1 715	1 106	1 099	6%	-7	-1%	-616	-36%	T2	CS
Portugal	NO	828	815	4%	-13	-2%	815	-	T2	D, CR
Spain	1 050	4 442	4 681	25%	239	5%	3 631	346%	T2	CS
Sweden	66	37	44	0.2%	6	17%	-22	-33%	T2	CS
United Kingdom	2 122	2 690	2 547	14%	-144	-5%	424	20%	T2	CS
EU-15	**12 464**	**19 129**	**18 762**	**100%**	**-366**	**-2%**	**6 298**	**51%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.42 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Austria, Finland, France, Italy, Spain and the United Kingdom; together they cause 87 % of the CO_2 emissions from gaseous fuels in 1A2d. Gaseous fuel consumption in the EU-15 rose by 49 % between 1990 and 2012. The implied emission factor of EU-15 was 56.3 t/TJ in 2012.

Figure 3.42 1A2d Pulp, Paper and Print, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

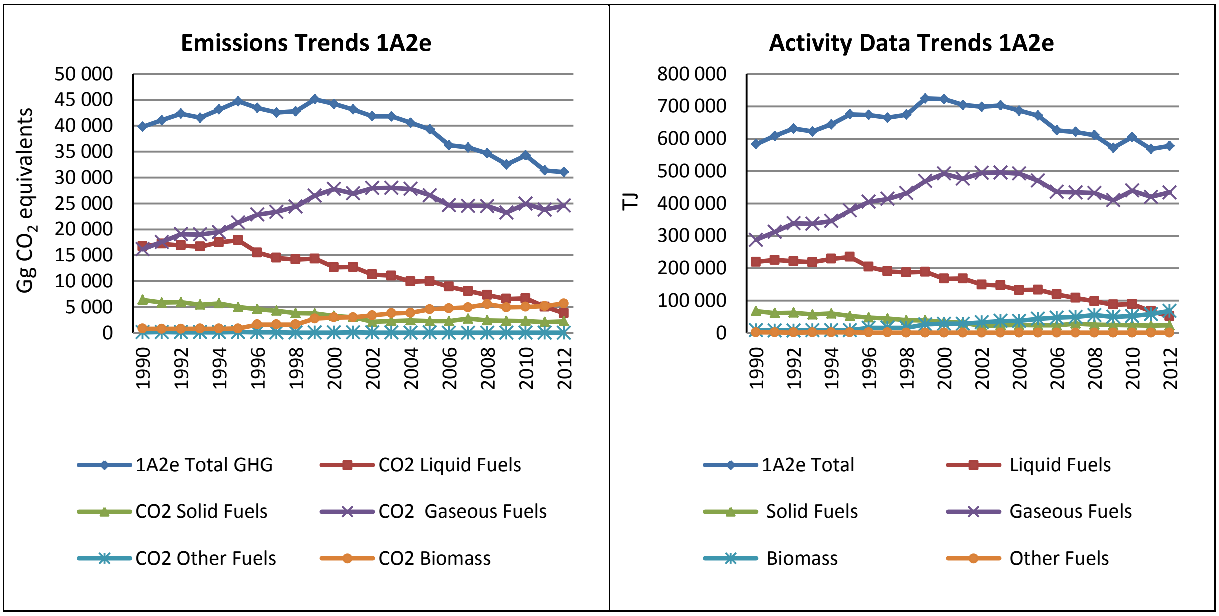


3.2.2.5 Food Processing, Beverages and Tobacco (1A2e) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2e by fuels. CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco accounted for 7 % of 1A2 source category and for 0.9 % of total GHG emissions in 2012.

Figure 3.43 shows the emission trend within the category 1A2e, which is dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions decreased by 22 % between 1990 and 2012. Emissions from gaseous fuels increased by 52 %, whereas emissions from all other fossil fuel types decreased.

Figure 3.43 1A2e Food Processing, Beverages and Tobacco: Total and CO_2 emission trends



Between 1990 and 2012, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco decreased by 22 % in the EU-15 (Table 3.36). Between 2011 and 2012 emissions decreased by 1 %.

Table 3.36 1A2e Food Processing, Beverages and Tobacco: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	870	958	981	3%	23	2%	112	13%
Belgium	2 990	2 048	2 103	7%	55	3%	-887	-30%
Denmark	1 466	1 317	1 208	4%	-109	-8%	-258	-18%
Finland	826	247	215	1%	-32	-13%	-611	-74%
France	9 197	8 738	8 756	29%	19	0.2%	-441	-5%
Germany	1 989	234	215	1%	-20	-8%	-1 774	-89%
Greece	902	401	506	2%	106	26%	-396	-44%
Ireland	1 017	850	837	3%	-13	-2%	-181	-18%
Italy	3 853	4 266	3 508	11%	-759	-18%	-345	-9%
Luxembourg	16	24	29	0.1%	5	22%	13	81%
Netherlands	4 079	3 383	3 421	11%	39	1%	-658	-16%
Portugal	822	938	874	3%	-65	-7%	51	6%
Spain	2 935	2 171	2 964	10%	793	37%	29	1%
Sweden	948	482	492	2%	10	2%	-456	-48%
United Kingdom	7 553	4 939	4 540	15%	-398	-8%	-3 012	-40%
EU-15	**39 464**	**30 996**	**30 650**	**100%**	**-346**	**-1%**	**-8 814**	**-22%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2e Food Processing, Beverages and Tobacco - Liquid (CO_2)

In 2012 CO_2 from liquid fuels decreased to a share of 12 % within source category 1A2e (compared to 42 % in 1990). Between 1990 and 2012, the emissions decreased by 77 % (Table 3.37). Between 1990 and 2012 all Member States showed a reduction of emissions.

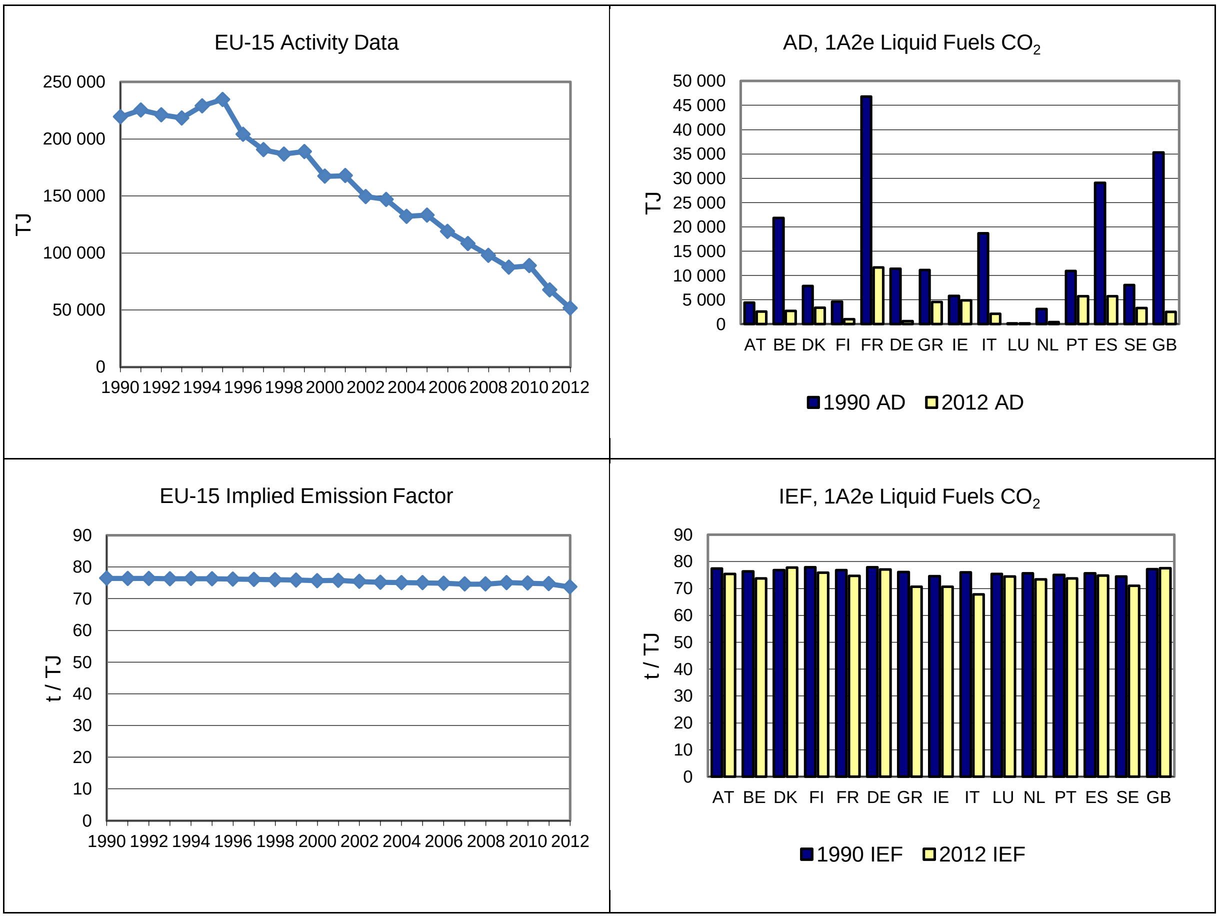
Table 3.37 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	345	198	198	5%	0.4	0.2%	-147	-43%	T2	CS,PS
Belgium	1 671	247	200	5%	-47	-19%	-1 471	-88%	T1	D
Denmark	601	300	265	7%	-35	-12%	-336	-56%	T3,T2,T1	PS,CS,D
Finland	363	91	79	2%	-13	-14%	-285	-78%	T3	CS
France	3 596	1 086	872	23%	-214	-20%	-2 724	-76%	T2, T3	CS
Germany	889	56	46	1%	-11	-19%	-843	-95%	CS	CS
Greece	847	236	323	8%	87	37%	-524	-62%	T2	PS
Ireland	433	387	347	9%	-39	-10%	-85	-20%	T1	CS
Italy	1 421	855	145	4%	-710	-83%	-1 276	-90%	T2	CS
Luxembourg	12	10	10	0.3%	1	8%	-2	-17%	T1,T2	CS,D
Netherlands	235	10	32	1%	21	209%	-203	-87%	T2	CS,D
Portugal	821	511	424	11%	-86	-17%	-397	-48%	T2	D, CR
Spain	2 198	319	429	11%	110	34%	-1 770	-80%	T2	CS
Sweden	596	235	233	6%	-2	-1%	-363	-61%	T2	CS
United Kingdom	2 727	502	198	5%	-305	-61%	-2 529	-93%	T2	CS
EU-15	**16 755**	**5 043**	**3 801**	**100%**	**-1 242**	**-25%**	**-12 955**	**-77%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.44 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Portugal and Spain; together they cause 45.5 % of the CO_2 emissions from liquid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 76 % between 1990 and 2012. The implied emission factor of EU-15 was 73.7 t/TJ in 2012.

Figure 3.44 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2e Food Processing Beverages and Tobacco - Solid (CO_2)

In 2012 solid fuels had a share of 7 % within source category 1A2e (compared to 16 % in 1990). Between 1990 and 2012 the emissions decreased by 65 % (Table 3.38) and all Member States reported decreasing CO_2 emissions from this source category.

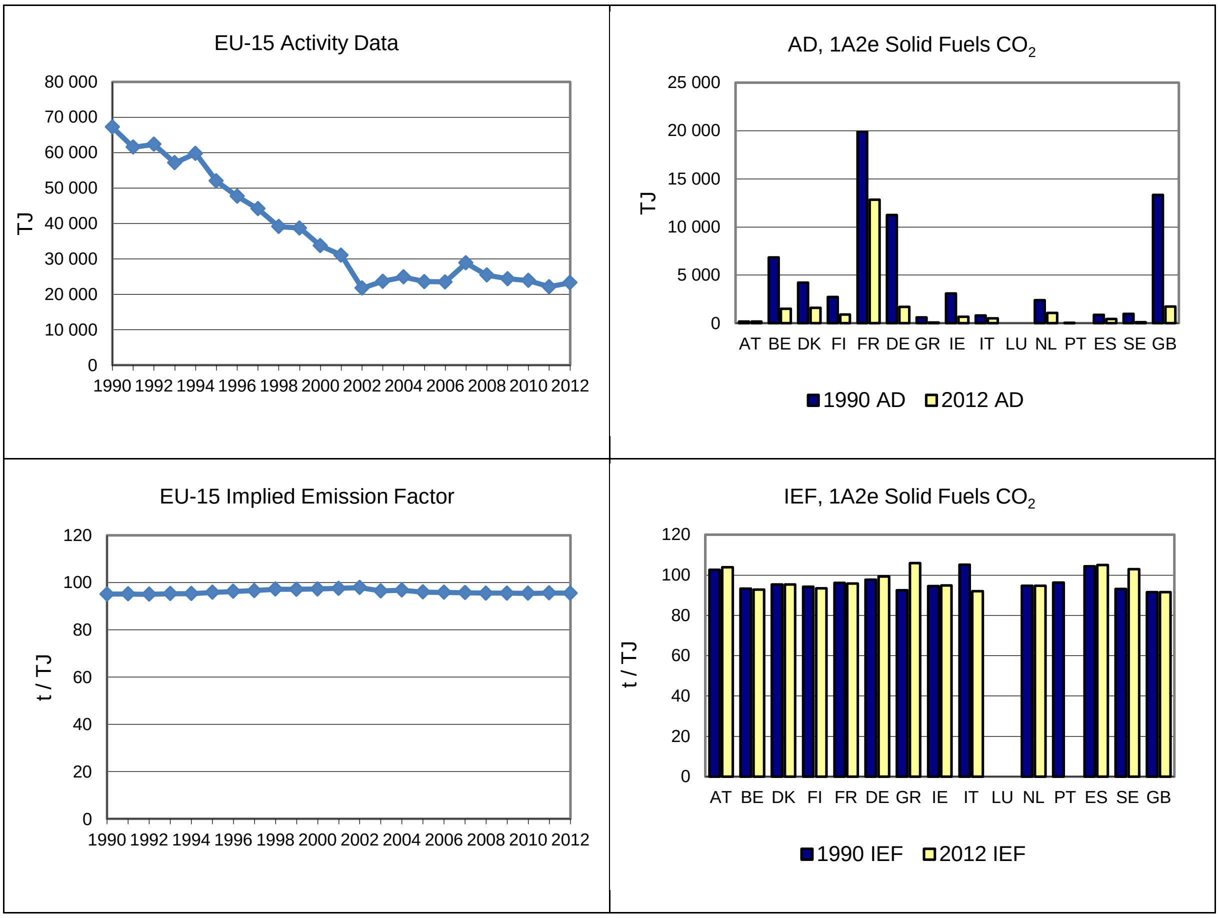
Table 3.38 1A2e Food Processing, Beverages and Tobacco, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	18	16	17	1%	1	6%	-1	-8%	T2	CS,PS
Belgium	638	127	139	6%	12	9%	-499	-78%	T1	D
Denmark	402	191	154	7%	-38	-20%	-248	-62%	T1	D
Finland	257	96	84	4%	-12	-13%	-173	-67%	T3	CS
France	1 913	1 171	1 230	55%	59	5%	-683	-36%	T2, T3	CS
Germany	1 100	178	169	8%	-9	-5%	-931	-85%	CS	CS
Greece	56	4	6	0.3%	2	52%	-49	-88%	T2	PS
Ireland	292	64	65	3%	1	2%	-227	-78%	T1	CS
Italy	86	NO	46	2%	46	-	-40	-46%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	227	63	100	4%	37	59%	-127	-56%	T2	CS
Portugal	1	NO	NO	-	-	-	-1	-100%	NA	NA
Spain	92	38	47	2%	9	24%	-45	-49%	T2	CS
Sweden	90	7	10	0.4%	3	35%	-80	-89%	T2	CS
United Kingdom	1 221	162	158	7%	-4	-2%	-1 063	-87%	T2	CS
EU-15	**6 393**	**2 118**	**2 225**	**100%**	**107**	**5%**	**-4 168**	**-65%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.45 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France which contributes 55.3 % of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 65 % between 1990 and 2012. The implied emission factor of EU-15 was 95.5 t/TJ in 2012.

Figure 3.45 1A2e Food Processing, Beverages and Tobacco, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2e Food Processing Beverages and Tobacco - Gaseous (CO_2)

In 2012 CO_2 from gaseous fuels had a share of 79 % within source category 1A2e (compared to 41 % in 1990). Between 1990 and 2012 the emissions increased by 52 % (Table 3.39). Between 1990 and 2012 most Member States reported increasing CO_2 emissions from this source category. Major absolute increases occurred in Belgium, France, and Spain. With the exception of the years 1995 to 2001 Germany reports emissions in 1A2f.

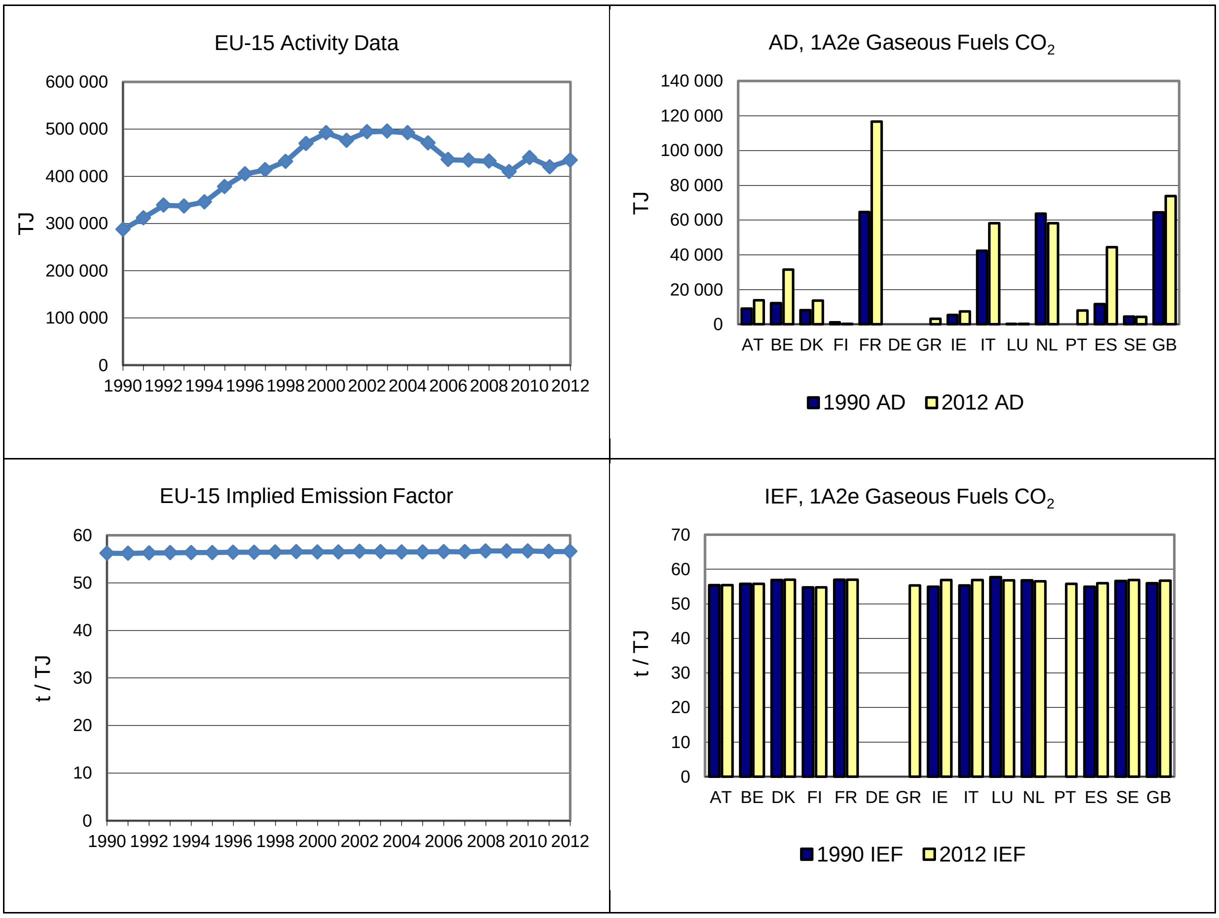
Table 3.39 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	507	745	767	3%	22	3%	260	51%	T2	CS
Belgium	681	1 674	1 764	7%	90	5%	1 083	159%	T1	D
Denmark	463	820	784	3%	-36	-4%	321	69%	T3	CS
Finland	67	16	15	0.1%	-1	-7%	-52	-78%	T3	CS
France	3 688	6 481	6 654	27%	173	3%	2 966	80%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	161	177	1%	17	10%	177	-	T2	CS
Ireland	293	399	424	2%	25	6%	131	45%	T1	CS
Italy	2 346	3 411	3 317	13%	-95	-3%	970	41%	T2	CS
Luxembourg	4	14	19	0.1%	4.5	31%	15	400%	T2	CS
Netherlands	3 617	3 310	3 290	13%	-20	-1%	-327	-9%	T2	CS
Portugal	NO	428	449	2%	22	5%	449	-	T2	D, CR
Spain	644	1 814	2 488	10%	674	37%	1 844	286%	T2	CS
Sweden	254	240	250	1%	10	4%	-4	-2%	T2	CS
United Kingdom	3 605	4 275	4 185	17%	-90	-2%	580	16%	T2	CS
EU-15	**16 168**	**23 787**	**24 582**	**100%**	**795**	**3%**	**8 413**	**52%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.46 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands, Spain and the United Kingdom; together they cause about 81 % of the CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption in the EU-15 rose by 51 % between 1990 and 2012. The implied emission factor of EU-15 was 56.6 t/TJ in 2012.

Figure 3.46 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

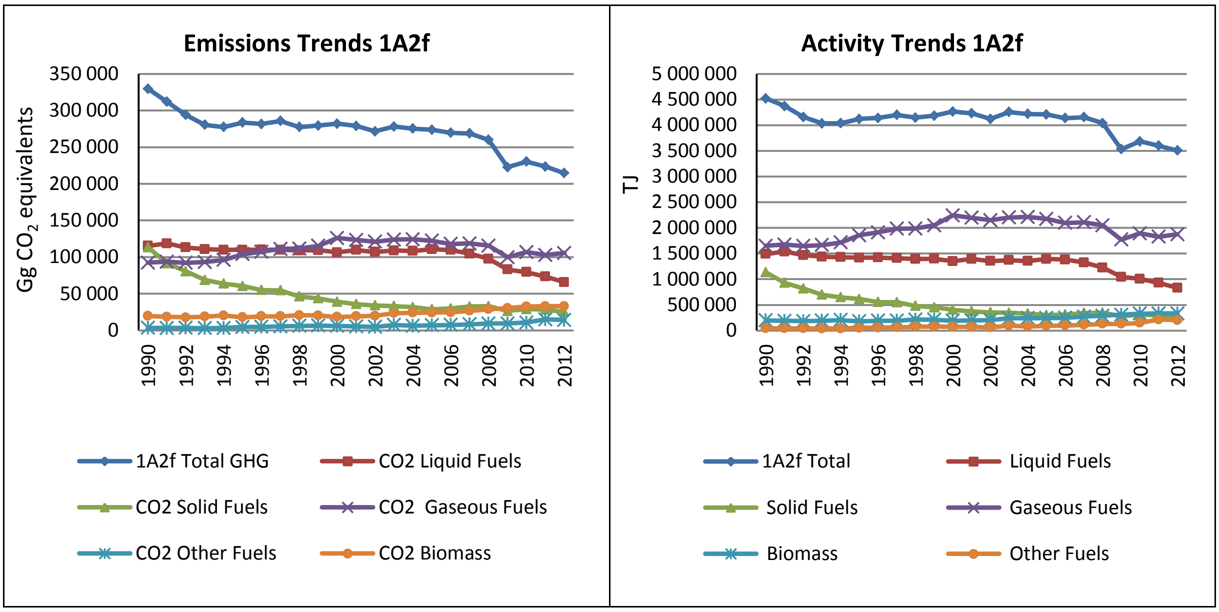


3.2.2.6 Other (1A2f) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2f by fuels. CO_2 emissions from 1A2f Other accounted for 47 % for 1A2 source category and for 6 % of total GHG emissions in 2012.

Figure 3.47 shows the emission trend within the category 1A2f, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels; the decrease in the early 1990s was mainly due to a decline of solid fuel consumption. Total GHG emissions decreased by 35 %, mainly due to decreases in emissions from solid (-78 %) and liquid (-43 %) fuels.

Figure 3.47 1A2f Other: Total and CO_2 emission trends



Between 1990 and 2012, CO_2 emissions from 1A2f Other decreased by 35 % in the EU-15 (Table 3.40), mainly due to decreases in France (-9.5 Mt) Germany (-57 Mt), Italy (-18 Mt) and the United Kingdom (-18.7 Mt).

Table 3.40 1A2f Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	3 644	4 593	4 553	2%	-40	-1%	909	25%
Belgium	8 343	6 760	6 449	3%	-312	-5%	-1 895	-23%
Denmark	3 227	2 705	2 603	1%	-102	-4%	-625	-19%
Finland	2 901	2 046	2 057	1%	11	1%	-844	-29%
France	27 823	18 508	18 277	9%	-231	-1%	-9 546	-34%
Germany	137 299	81 958	80 766	38%	-1 191	-1%	-56 533	-41%
Greece	6 126	2 913	3 397	2%	484	17%	-2 729	-45%
Ireland	1 503	1 624	1 649	1%	25	2%	147	10%
Italy	40 489	26 714	22 483	11%	-4 231	-16%	-18 006	-44%
Luxembourg	646	632	636	0.3%	4	1%	-9	-1%
Netherlands	5 826	4 553	4 485	2%	-67	-1%	-1 340	-23%
Portugal	5 350	5 052	4 476	2%	-576	-11%	-873	-16%
Spain	23 987	23 665	21 416	10%	-2 249	-10%	-2 572	-11%
Sweden	5 465	4 280	4 232	2%	-49	-1%	-1 233	-23%
United Kingdom	51 881	33 475	33 092	16%	-383	-1%	-18 789	-36%
EU-15	**324 509**	**219 477**	**210 571**	**100%**	**-8 906**	**-4%**	**-113 938**	**-35%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.41 gives an overview of sources that are reported under this source by each MS.

Table 3.41 1A2f Other: Overview of sources reported under this source category for 2012

Member State	1A2f (Other industries)	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	fuel combustion in cement clinker kilns	4553	0.3	0.3	4 666	2%
Belgium	non-metallic mineral products, (cement, lime, asphalt concrete, glass, mineral wool, bricks and tiles, fine ceramic materials), metal products, textile, leather and clothing and other industry (wood industry, rubber and synthetic material, manufacturing of furniture, recycling and construction included)	6449	1	0.4	6574	3%
Denmark	Cement production	787	0.1	0.01	792	0.4%
	Non-road machinery	1021	0.04	0.04	1036	0.5%
	Other non-specified	794	0.1	0.02	805	0.4%
Finland	Construction	1112	0.1	0.03	1123	1%
	Other non-specified	1091	0.4	0.04	1111	1%
	Transferred CO_2	-147	0	0	-147	-0.1%
France	cement production, lime production, plaster furnaces, asphalt concrete production, tiles and bricks production, fine ceramics production, glass production, enamel production, other furnaces	18277	1	0.8	18569	9%
Germany	Cement	6366	0.3	0.3	6453	3%
	Ceramics	61	0.003	0.0	62	0.03%
	Glass Wares	0	0	-	-	0%
	lime	2085	0.1	0.1	2109	1%
	Other (unspecified industrial power plants)	72254	7	2	72922	34%
Greece	internal combustion engines, cement production, lime production, ceramics production and glass production	3397	0.1	0.04	3410	2%
Ireland	cement production	1649	0.2	0.03	1663	1%
Italy	vehicles and machines manufacturing, construction materials, fabrication of bricks, fabrication of tiles, furniture and other various “made in Italy” products	22483	1	3	23424	11%

Member State	1A2f (Other industries)	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Luxembourg	Combustion plants < 50 MW, Gas Turbines, Cement (Clinker), Asphalt concrete plants, Flat glass, Fine ceramic materials, Other mobile sources and machinery in Industry, Other mobile equipment	636	0.1	0.1	657	0.3%
Netherlands	Machinery	1327	0.1	0.01	1332	1%
	Other industrial sectors	3158	1	0.1	3191	1%
Portugal	Iron and Steel, Metallurgic industry, Chemicals, Pulp and Paper, Food Processing, Beverages and Tobacco, Textile, Ceramic, Glass and glass products, Cement, Clothing, shoes and leather industry, Wood, Rubber, Metal Equipment and Machines, Extractive industry, Construction and Building and Other Transformation Industry.	4476	0.5	0.1	4518	2%
Spain	Crude oil, diesel fuel, LPG, bitumen, petrolieum coke, other derived petroleum, coking coal, hard coal, black lignite, coke, manufactured gas, natural gas, wood, res./wood, solid biomass, biogas, industrial waste	21416	8	1	21823	10%
Sweden	Machinery	1503	0.1	0.1	1525	1%
	Stationary	2729	1	0.4	2860	1%
UK	Other Industry (Combustion), Cement (Fuel Combustion), Cement (Non-decarbonising), Lime Production (Combustion), Autogenerators, Other industry (Mobile Combustion)	33092	4	3	33978	16%
EU-15 Total		**210 571**	**26**	**11**	**214453**	**100%**

1A2f Other - Liquid Fuels(CO_2)

In 2012 liquid fuels had a share of 31 % within source category 1A2f (compared to 35 % in 1990). Between 1990 and 2012 the emissions decreased by 43 % (Table 3.42). Between 1990 and 2012 the highest absolute decreases were achieved by France, Germany, Italy and the United Kingdom. The highest absolute increases were reported from Austria.

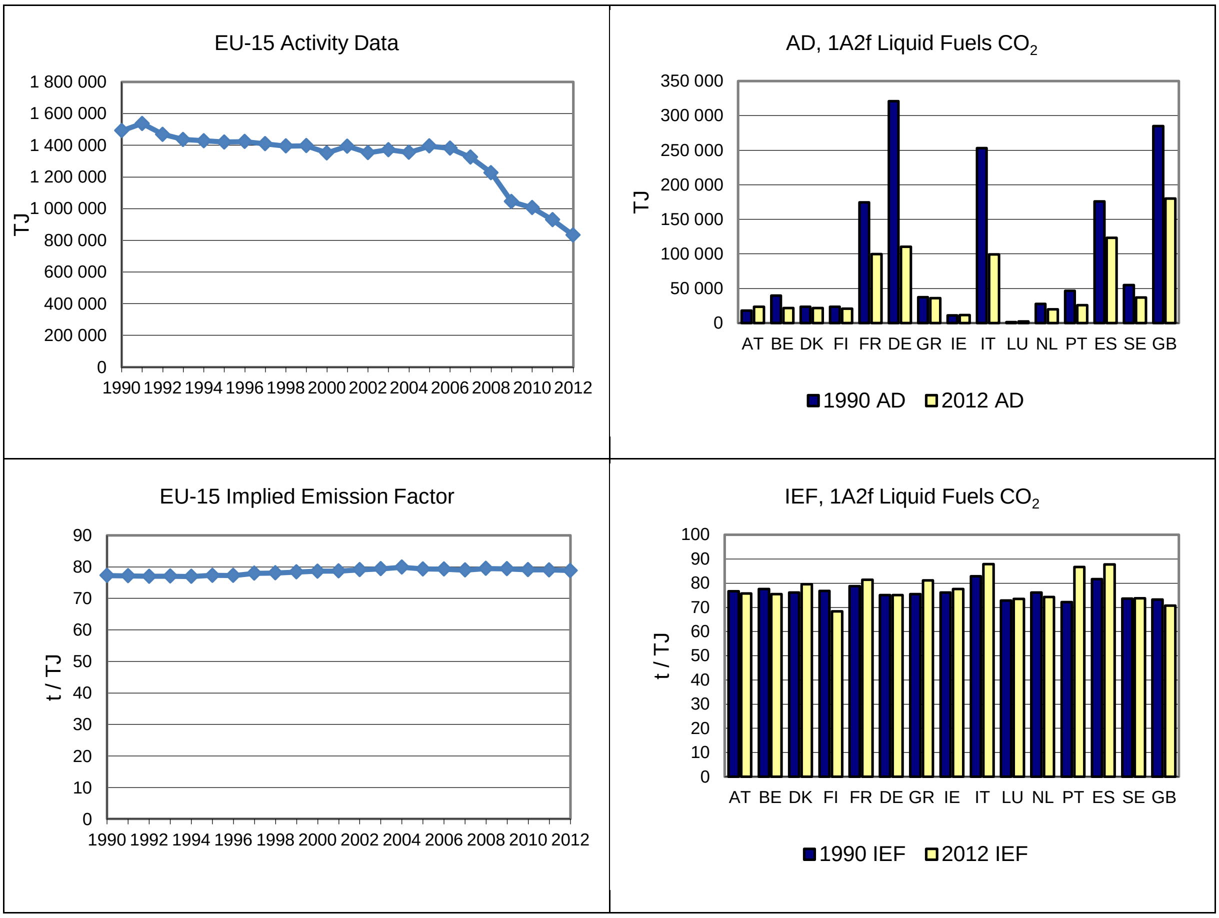
Table 3.42 1A2f Other, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	1 376	1 794	1 784	3%	-11	-1%	408	30%	T2	CS,PS
Belgium	3 064	1 873	1 642	3%	-230	-12%	-1 422	-46%	CS,T1	D,PS
Denmark	1 789	1 693	1 710	3%	17	1%	-79	-4%	R,T1,T2,T3	CS,D,PS
Finland	1 809	1 340	1 432	2%	92	7%	-377	-21%	CS,M,T3	CS
France	13 749	8 514	8 106	12%	-408	-5%	-5 642	-41%	T2,T3	CS
Germany	24 094	8 547	8 273	13%	-274	-3%	-15 821	-66%	CS	CS
Greece	2 828	2 400	2 925	4%	525	22%	97	3%	T2	PS
Ireland	824	839	893	1%	54	6%	69	8%	T1	CS
Italy	20 965	12 978	8 712	13%	-4 266	-33%	-12 253	-58%	T2	CS
Luxembourg	88	149	151	0.2%	2	1%	63	71%	T1,T2	CS,D
Netherlands	2 107	1 534	1 483	2%	-52	-3%	-625	-30%	T2	CS,D
Portugal	3 345	2 825	2 240	3%	-585	-21%	-1 105	-33%	T2	CR,D,PS
Spain	14 365	13 356	10 822	16%	-2 534	-19%	-3 543	-25%	T2,T3	CS,M
Sweden	4 057	2 732	2 723	4%	-8	0%	-1 334	-33%	T1,T2	CS
United Kingdom	20 866	12 865	12 728	19%	-137	-1%	-8 138	-39%	T2,T3	CS
EU-15	**115 326**	**73 440**	**65 624**	**100%**	**-7 816**	**-11%**	**-49 702**	**-43%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.48 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, Spain and the United Kingdom; together they cause 49 % of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 44 % between 1990 and 2012. The implied emission factor of EU-15 was 78.8 t/TJ in 2012.

Figure 3.48 1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other - Solid (CO_2)

In 2012 CO_2 from solid fuels had a share of 12 % within source category 1A2f (compared to 34 % in 1990). Between 1990 and 2012 the emissions decreased by 78 % (Table 3.43). Between 1990 and 2012 all Member States reported (partly significant) decreases of emissions; the highest absolute decreases were reported by Germany and the UK. Between 2011 and 2012 EU-15 emissions decreased by 10 %.

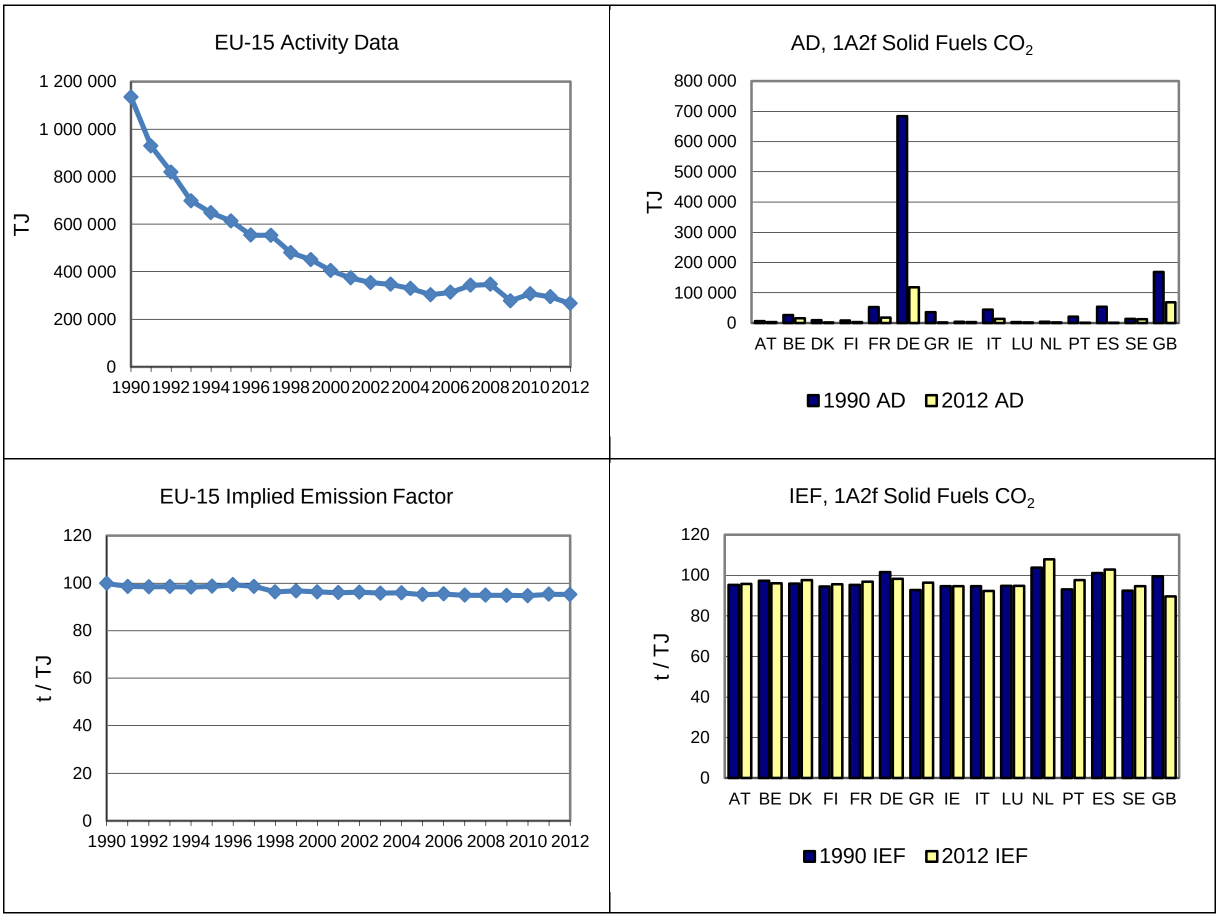
Table 3.43 1A2f Other, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	625	294	288	1%	-6	-2%	-337	-54%	T2	CS,PS
Belgium	2 537	1 624	1 544	6%	-80	-5%	-993	-39%	CS,T1	D,PS
Denmark	901	292	215	1%	-77	-26%	-686	-76%	CR,T1,T3	D,PS
Finland	815	336	247	1%	-89	-27%	-568	-70%	T3	CS
France	5 052	1 777	1 727	7%	-50	-3%	-3 324	-66%	T2,T3	CS
Germany	69 494	13 272	11 592	46%	-1 680	-13%	-57 901	-83%	CS	CS
Greece	3 298	306	238	1%	-68	-22%	-3 060	-93%	T2	PS
Ireland	389	316	274	1%	-42	-13%	-115	-30%	T1	CS
Italy	4 233	1 444	1 298	5%	-146	-10%	-2 935	-69%	T2	CS
Luxembourg	333	189	184	1%	-5	-3%	-149	-45%	T1	D
Netherlands	388	175	169	1%	-6	-3%	-218	-56%	T2	CS,D
Portugal	1 993	37	35	0.1%	-2	-5%	-1 957	-98%	T2	CR,D,PS
Spain	5 379	129	136	1%	7	5%	-5 242	-97%	T2	CS
Sweden	1 229	1 208	1 176	5%	-33	-3%	-54	-4%	T2	CS
United Kingdom	16 722	6 643	6 188	24%	-456	-7%	-10 535	-63%	T2	CS
EU-15	**113 386**	**28 042**	**25 310**	**100%**	**-2 732**	**-10%**	**-88 076**	**-78%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.49 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the United Kingdom; together they cause about 70 % of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 77 % between 1990 and 2012. The implied emission factor of EU-15 was 95.3 t/TJ in 2012.

Figure 3.49 1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other - Gaseous (CO_2)

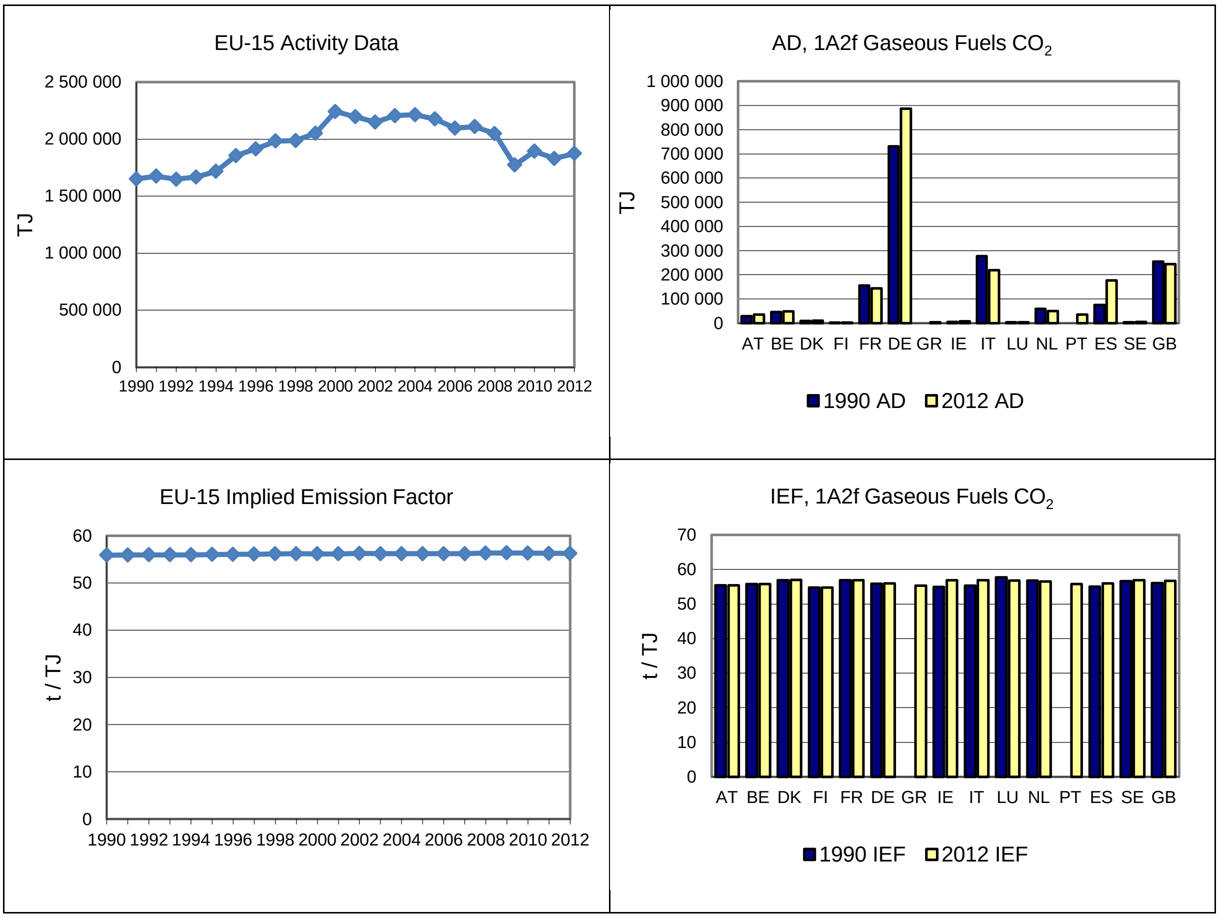
In 2012 CO_2 from gaseous fuels had a share of 49 % within source category 1A2f (compared to 28 % in 1990). Between 1990 and 2012, the emissions increased by 14 % (Table 3.44). Between 1990 and 2012 Spain, Germany and Portugal showed the highest absolute increases while Italy and France showed the highest absolute decreases.

Table 3.44 1A2f Other, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	1 573	2 025	1 955	2%	-71	-3%	382	24%	T2	CS
Belgium	2 556	2 631	2 708	3%	77	3%	152	6%	CS,T1	D
Denmark	538	644	608	1%	-37	-6%	70	13%	T3	CS
Finland	168	132	102	0.1%	-29	-22%	-66	-39%	T3	CS
France	8 884	7 959	8 169	8%	210	3%	-715	-8%	T2,T3	CS
Germany	40 841	48 387	49 690	47%	1 303	3%	8 849	22%	CS	CS
Greece	NO	191	219	0.2%	28	15%	219	-	T2	CS
Ireland	290	440	426	0.4%	-14	-3%	136	47%	T1	CS
Italy	15 290	12 291	12 472	12%	181	1%	-2 818	-18%	T2	CS
Luxembourg	225	244	250	0.2%	6	2%	25	11%	T2	CS
Netherlands	3 331	2 843	2 834	3%	-10	0%	-497	-15%	T2	CS
Portugal	NO	1 992	1 998	2%	6	0%	1 998	-	T2	CR,D,PS
Spain	4 124	9 286	9 927	9%	641	7%	5 803	141%	T2	CS
Sweden	178	266	263	0.2%	-4	-1%	84	47%	T1,T2	CS
United Kingdom	14 291	13 624	13 840	13%	216	2%	-452	-3%	T2	CS
EU-15	**92 289**	**102 955**	**105 459**	**100%**	**2 504**	**2%**	**13 171**	**14%**		

Figure 3.50 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Italy, Spain and the United Kingdom; together they cause 81 % of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion in the EU-15 rose by 14 % between 1990 and 2012. The implied emission factor of EU-15 was 56.3 t/TJ in 2012.

Figure 3.50 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other – Other fuels (CO_2)

This category became a new key source in 2014 because of the high contribution and increasing trend which is mainly due to the increased use of industrial waste in Germany.

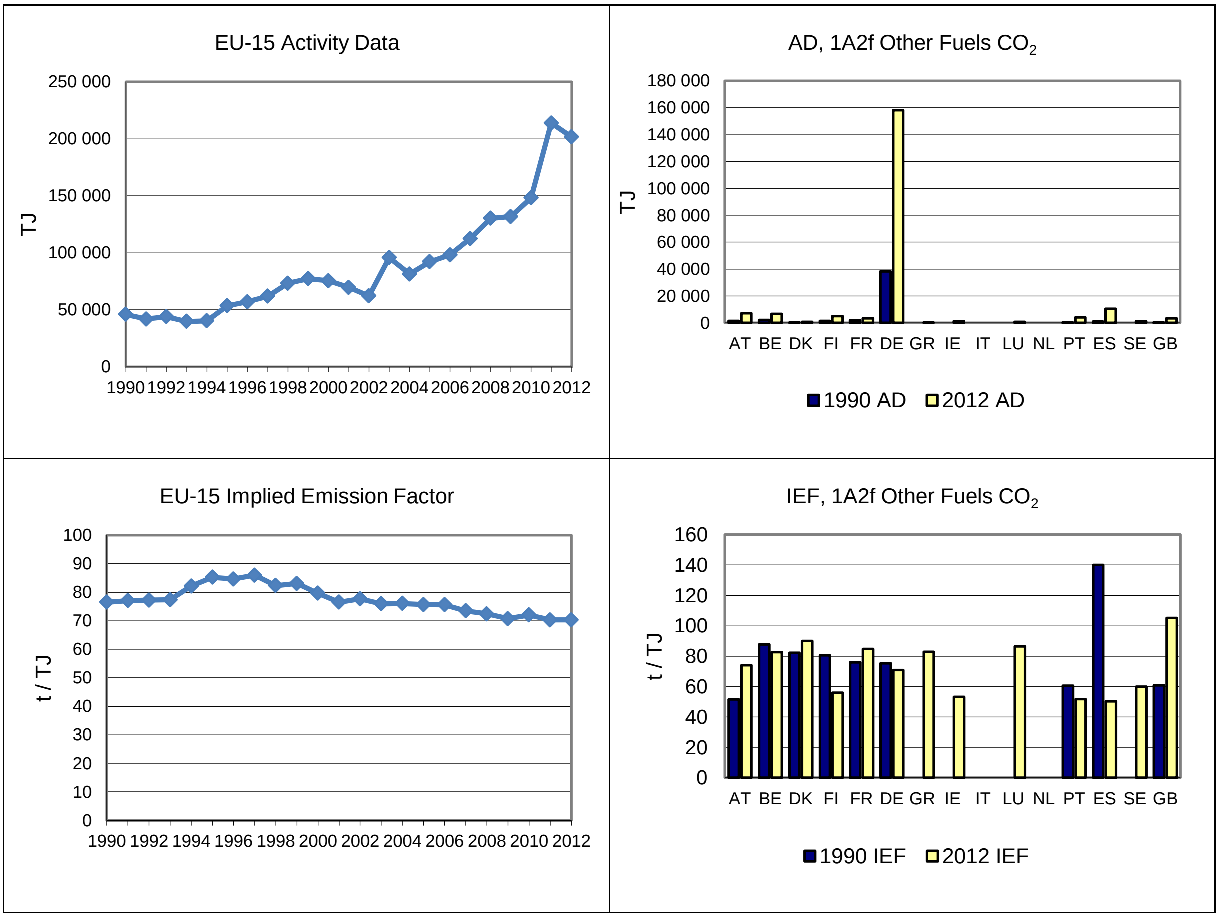
In 2012 CO_2 from other fuels had a share of 7 % within source category 1A2f (compared to 1 % in 1990). Between 1990 and 2012, the emissions increased by 304 % (Table 3.44). Between 1990 and 2012 Germany showed the highest absolute increases. Most member states report emissions from industrial waste (co-) incineration and particularly incineration of municipal waste (e.g. Spain) under this category, especially from cement kilns. Examples of industrial wastes are: waste tyres, waste oil/lubricants, solvents, plastics waste and paper waste. The rather high variation of the implied emission factors over time series represents the difference in fuel waste composition. In case that activity data includes the renewable (biomass) share of waste then the implied emission factors represent the fossil content of the fuels only.

Table 3.45 1A2f Other, other fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	70	479	527	4%	47	10%	457	651%	T2	D,PS
Belgium	186	633	555	4%	-78	-12%	368	197%	CS,T1	D
Denmark	0	76	71	0.5%	-6	-7%	70	30916%	CR,T3	CS,PS
Finland	109	238	276	2%	37	16%	166	152%	T3	CS
France	139	257	275	2%	18	7%	136	98%	T2,T3	CS
Germany	2 870	11 752	11 211	79%	-541	-5%	8 341	291%	CS	CS
Greece	NO	16	15	0%	-1	-7%	15	-	T2	PS
Ireland	NO	30	57	0%	27	-	57	-	T3	PS
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	50	51	0.4%	1	2%	51	-	T1	PS
Netherlands	NA,NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	12	198	204	1%	6	3%	192	1585%	T2	CR,D,PS
Spain	120	894	530	4%	-363	-41%	411	-	T2	CS,PS
Sweden	NO	74	70	0.5%	-4	-5%	70	-	T2	CS
United Kingdom	1	342	336	2%	-6	-2%	335	31168%	T2	CS
EU-15	**3 507**	**15 039**	**14 176**	**100%**	**-862**	**-6%**	**10 669**	**304%**		

Figure 3.50 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany; they cause 79 % of the CO_2 emissions from other fuels in 1A2f. The implied emission factor of EU-15 was 70.3 t/TJ in 2012.

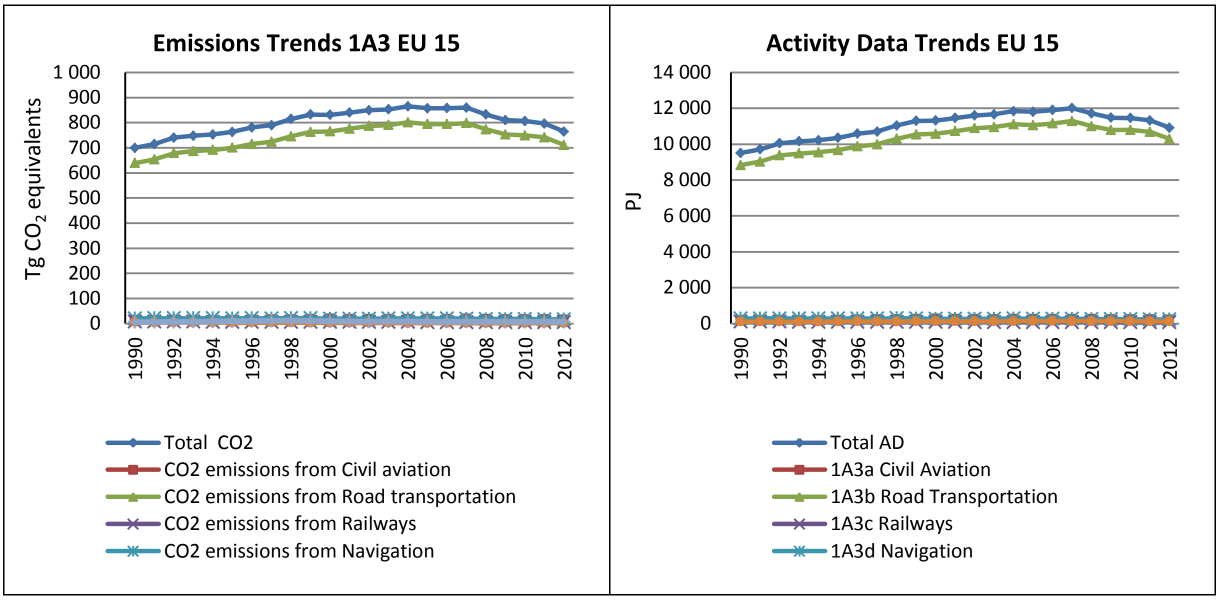
Figure 3.51 1A2f Other, other fuels: Activity Data and Implied Emission Factors for CO_2



3.2.3 Transport (CRF Source Category 1A3) (EU-15)

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.52. CO_2 emissions from this source category account for 21%, CH_4 for 0.03 %, N_2O for 0.2 % of total GHG emissions. Between 1990 and 2012, greenhouse gas emissions from transport increased by 9 % in the EU-15.

Figure 3.52 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Tg) and Activity Data in TJ



This source category includes ten key categories:

- 1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: LPG (CO_2)
- 1 A 3 c Railways: Liquid Fuels (CO_2)
- 1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
- 1 A 3 d Navigation: Residual Oil (CO_2)

Table 3.46 shows total GHG, CO_2, CH_4 and N_2O emissions from 1A3 Transport.

Table 3.46 1A3 Transport: Member States' contributions to CO_2 emissions and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)	CH4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N2O emissions in 2012 (Gg CO_2 equivalents)
Austria	14 029	21 636	13 771	21 418	64	13	193	205
Belgium	20 688	24 948	20 348	24 658	102	15	239	275
Denmark	10 778	12 245	10 619	12 103	48	12	111	130
Finland	12 757	12 678	12 483	12 471	99	34	174	173
France	121 239	132 546	119 382	130 858	849	169	1 008	1 519
Germany	164 727	155 486	162 368	153 861	1 123	149	1 236	1 477
Greece	14 493	16 098	14 082	15 838	104	60	307	199
Ireland	5 121	10 900	5 022	10 776	37	16	62	108
Italy	103 085	106 057	101 269	104 845	823	218	993	994
Luxembourg	2 721	6 518	2 673	6 432	19	6	30	79
Netherlands	26 255	33 985	25 994	33 659	159	47	103	279
Portugal	10 308	17 005	10 139	16 812	87	26	83	167
Spain	59 111	80 671	58 236	79 764	317	88	558	819
Sweden	19 272	19 106	18 890	18 913	187	51	195	141
United Kingdom	115 289	114 833	113 406	113 775	638	62	1 245	996
EU-15	**699 874**	**764 711**	**688 681**	**756 184**	**4 655**	**967**	**6 537**	**7 561**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.47 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A3 Transport for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 3.47 1A3 Transport: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-13	-0.1	Revised energy balance (CNG and LPG).
Belgium	-79	-0.4	-81	-0.3	New data on the biomass content of fuels and fossil fuels. Reference approach previously included "offroads" consumptions which are now removed as already accounted for in other sectors.
Denmark	0	0.0	-13	-0.1	Based on the updated version of COPERT IV launched in 2013, new vehicle sub categories have been introduced in the emission inventories for mopeds and passenger cars. For mopeds a division is now made between 2-stroke and 4-stroke engine technologies and for passenger cars small engine sizes below 0.8 l. for gasoline and below 1.4 l. for diesel have been included. Also NOx emission factors for euro 5 diesel passenger cars have been updated in the model based on the new COPERT IV version. Small errors in input gasoline fuel consumption for the years 2009-2011 and for input diesel fuel consumption in the years 2010-2011 have been corrected. Minor changes in ferry input data has been made for the years 2008-2011 causing minor emission changes for domestic navigation.
Finland	0	0.0	0	0.0	Correction in emission factors. Updates in bioshares of fuels.
France	5	0.0	1 845	1.4	1A3a, 1A3c + 1A3d: Updated data: improved accuracy. 1A3b: Recalculation is due to revision of biofuels dataset : present use of actual volumes incorporated into the fuels (new available statistics from customs vs previous estimated ratios as energy).
Germany	2	0.0	-168	-0.1	Revised into IPCC 2006 default EF. Revised NEB 2011. AD revised within NEB.
Greece	-41	-0.3	-487	-2.44	1.AA.3.A Civil Aviation \ Liquid Fuels \ Jet Kerosene: Update of average consumption per flight and update of total fuel onsumption. 1.AA.3.D Navigation \ Liquid Fuels \ Residual Oil: Update of AD
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-359	-0.3	Update of ship movements.
Luxembourg	0	0.0	-18	-0.3	Revised energy balance. 1.AA.3.D Navigation \ Liquid Fuels \ Gas/Diesel Oil: AD for one operator was revised based on operated engine power.
Netherlands	0	0.0	-5	0.0	Improved activity data.
Portugal	-1	0.0	10	0.1	1A3a: Update of the 2011 emissions values. 1A3c: Railways CO2 Emission Factor for diesel oil fuel was revised.
Spain	3 339	6.1	-648	-0.7	Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
Sweden	-6	0.0	375	1.9	1A3a: Jet kerosen used by military abroad has been taken into acoount as from submission 2014. The military has used jet kerosene for operations abroad as from 2002 and this amount is subtracted from civil aviation and affects the distribution of all aviation fuels and hence the emissions as from 2002. 1A3b: Revised activity data due to updates in the HBEFA model. 1A3c: As there is one year lag in the acitivity data for railways, the next last year (2011 in submission 2014) is always adjusted with the correct data. And the data for the last year (2012) is the same as for the previous year. 1A3d: The amount of diesel was slightly modified for all years in regard to the distribution of diesel to uncertain sectors, which affects all emssions. 1A3e: Revised activity data.
UK	65	0.1	25	0.0	National energy statistics revised for many sectors from 2008 onwards. 1A3a: Inclusion of local airport emission inventory cause small changes to activity data.
EU-15	**3 284**	**0.5**	**465**	**0.1**	

Table 3.48 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A3 Transport for 1990 and 2011.

Table 3.48 1A3 Transport: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	2	0.7	Update of HBEFA.
Belgium	-22	-8.4	27	10.4	New data on the biomass content of fuels and fossil fuels. Reference approach previously included "offroads" consumptions which are now removed as already accounted for in other sectors.
Denmark	0	0.0	0	0.0	Based on the updated version of COPERT IV launched in 2013, new vehicle sub categories have been introduced in the emission inventories for mopeds and passenger cars. For mopeds a division is now made between 2-stroke and 4-stroke engine technologies and for passenger cars small engine sizes below 0.8 l. for gasoline and below 1.4 l. for diesel have been included. Also NOx emission factors for euro 5 diesel passenger cars have been updated in the model based on the new COPERT IV version. Small errors in input gasoline fuel consumption for the years 2009-2011 and for input diesel fuel consumption in the years 2010-2011 have been corrected. Minor changes in ferry input data has been made for the years 2008-2011 causing minor emission changes for domestic navigation.
Finland	0	0.0	0	0.1	Correction in emission factors. Updates in bioshares of fuels.
France	14	1.4	39	2.8	1A3a, 1A3c + 1A3d: Updated data: improved accuracy. 1A3b: Adding GNV : improved completeness. Updated data: improved accuracy. Anticipation standards: improved accuracy.
Germany	0	0.0	12	0.9	Routine revision of TREMOD: technology specific Efs. Revised NEB 2011. AD revised within NEB.
Greece	-7	-2.3	-8	-3.1	1.AA.3.A Civil Aviation \ Liquid Fuels \ Jet Kerosene: Update of average consumption per flight and update of total fuel onsumption. 1.AA.3.D Navigation \ Liquid Fuels \ Residual Oil: Update of AD
Ireland	0	0.0	2	2.1	Revisions to road transport, 1.A.3 (b) sub-category are mainly due to methodological and emission factor change of implementing the most recent COPERT model (version 10.0), replacing version 9.1. Specifically, this has decreased emissions of N2O and CH4 from road transport by combined 0.7 per cent (CO2 eq.) on average between 1991 and 1998.
Italy	-21	-2.1	-25	-2.2	Update of ship movements.
Luxembourg	0	0.0	0	-0.3	Revised energy balance.
Netherlands	0	0.0	6.4	2.4	Improved activity data and EF.
Portugal	0	0.0	0	0.1	1A3a: Update of the 2011 emissions values. 1A3c: Railways CO2 Emission Factor for diesel oil fuel was revised.
Spain	30	5.6	-4	-0.4	Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
Sweden	-23	-10.4	-30	-18.2	1A3a: Jet kerosen used by military abroad has been taken into acoount as from submission 2014. The military has used jet kerosene for operations abroad as from 2002 and this amount is subtracted from civil aviation and affects the distribution of all aviation fuels and hence the emissions as from 2002. 1A3b: Revised activity data due to updates in the HBEFA model. 1A3c: As there is one year lag in the acitivity data for railways, the next last year (2011 in submission 2014) is always adjusted with the correct data. And the data for the last year (2012) is the same as for the previous year. 1A3d: The amount of diesel was slightly modified for all years in regard to the distribution of diesel to uncertain sectors, which affects all emssions. 1A3e: Revised activity data.
UK	9	0.7	15	1.6	National energy statistics revised for many sectors from 2008 onwards. 1A3a: Inclusion of local airport emission inventory cause small changes to activity and EF data. 1A3b: Change in methodology for estimating CH4 and N2O emissions from road transport based on fuel sold instead of kilometres travelled (ERT recommendation).
EU-15	**-20**	**-0.3**	**37**	**0.5**	

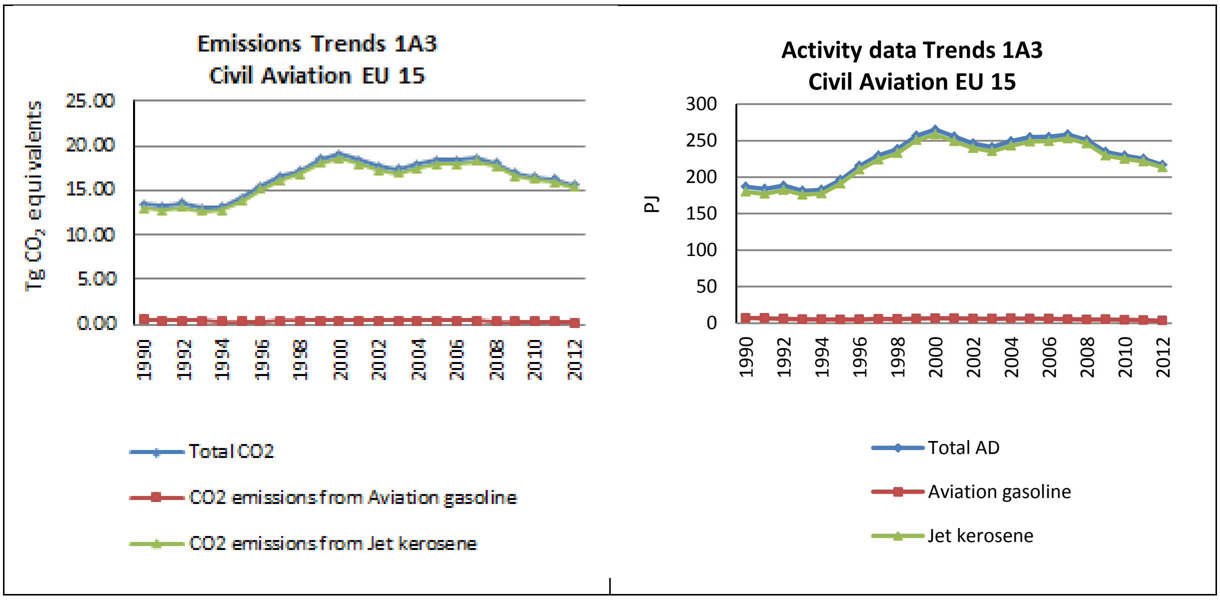
3.2.3.1 Civil Aviation (1A3a) (EU-15)

This source category includes emissions from civil domestic passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.), including take-offs and landings for these flight stages.

CO_2 emissions from 1A3a Civil Aviation account for 2 % of total transport-related GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from civil aviation increased by 16 % in the EU-15 (Table 3.49, Figure 3.53).

CO_2 emissions from Jet Kerosene account for 98 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2011 and 2012, CO_2 emissions from civil aviation decreased by 4 % in the EU-15 (Table 3.49, Figure 3.53).

Figure 3.53 1A3a Civil Aviation: CO_2 Emissions in CO_2 equivalents (Tg) and Activity data in TJ



The Member States France, Germany, Italy and Spain alone contributed 78 % to the emissions from this source. Most Member States increased emissions from civil aviation between 1990 and 2012 (Table 3.49).

Table 3.49 1A3a Civil Aviation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	32	62	55	0.4%	-7	-12%	23	71%
Belgium	13	37	27	0.2%	-10	-28%	14	109%
Denmark	243	146	133	1%	-13	-9%	-110	-45%
Finland	385	244	203	1%	-41	-17%	-182	-47%
France	4 241	4 906	5 047	32%	141	3%	806	19%
Germany	2 311	1 837	1 883	12%	46	3%	-428	-19%
Greece	319	495	490	3%	-5	-1%	171	54%
Ireland	51	19	11	0.1%	-8	-41%	-40	-78%
Italy	1 613	2 299	2 167	14%	-132	-6%	554	34%
Luxembourg	0.2	1	0.5	0.003%	-0.07	-13%	0.3	130%
Netherlands	28	22	21	0.1%	-1	-4%	-6	-23%
Portugal	228	365	368	2%	3	1%	140	61%
Spain	2 000	3 662	3 149	20%	-513	-14%	1 149	57%
Sweden	673	524	515	3%	-9	-2%	-158	-23%
United Kingdom	1 327	1 597	1 528	10%	-69	-4%	201	15%
EU-15	**13 464**	**16 215**	**15 599**	**100%**	**-617**	**-4%**	**2 134**	**16%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

In 2012 CO_2 emissions resulting from jet kerosene within the category 1A3a were responsible for 98 % of CO_2 emissions in 1A3a. Within the EU-15 the emissions increased between 1990 and 2012 by 18 % (Table 3.50). By far the largest absolute increase occurred in Spain. Between 2011 and 2012, the emissions decreased by 4 %.

Table 3.50 1A3a Civil Aviation, jet kerosene: Member States' contributions to CO_2 emissions and information on method applied and emission factor

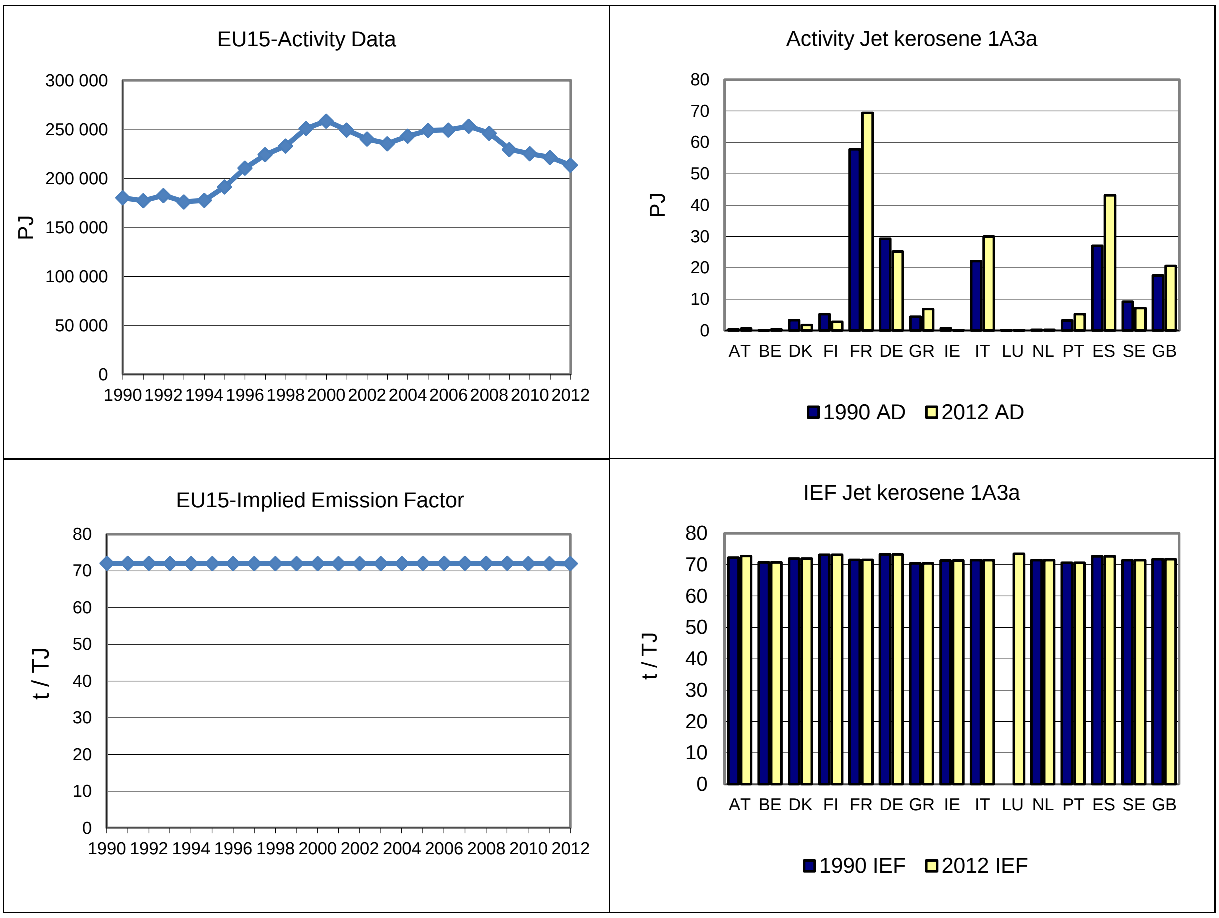
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	24	48	47	0.3%	-1	-3%	23	93%	T3	CS
Belgium	5	35	25	0.2%	-10	-28%	20	412%	T1	D
Denmark	234	142	128	1%	-13	-10%	-106	-45%	T2	CS
Finland	377	241	201	1%	-40	-17%	-176	-47%	T2	CS
France	4 135	4 822	4 973	32%	151	3%	838	20%	T2	CS
Germany	2 140	1 794	1 844	12%	50	3%	-296	-14%	T2,CS	CS
Greece	307	480	484	3%	3	1%	177	58%	T2	D
Ireland	48	17	9	0.1%	-7	-45%	-39	-81%	T3	CS
Italy	1 579	2 278	2 140	14%	-138	-6%	560	35%	T1,T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	16	16	16	0.1%	0	0%	0	0%	T2	D
Portugal	226	363	367	2%	4	1%	141	62%	T2	D
Spain	1 966	3 643	3 133	20%	-510	-14%	1 168	59%	T2	D
Sweden	658	516	509	3%	-7	-1%	-149	-23%	T1	D
United Kingdom	1 257	1 540	1 480	10%	-60	-4%	223	18%	T3	CS
EU-15	**12 975**	**15 935**	**15 356**	**100%**	**-579**	**-4%**	**2 381**	**18%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 88 % of CO_2 emissions and for 88 % of activity data from jet kerosene in 2012 (Figure 3.54). The IEF for the EU-15 is 71.96 t/TJ jet kerosene in 2012.

Table 3.50 shows that the majority of emissions from Civil Aviation jet kerosene were calculated using a higher tier method.

Figure 3.54 1A3a Civil Aviation, jet kerosene: Activity data and implied emission factors for CO_2



3.2.3.2 Road Transportation (1A3b) (EU-15)

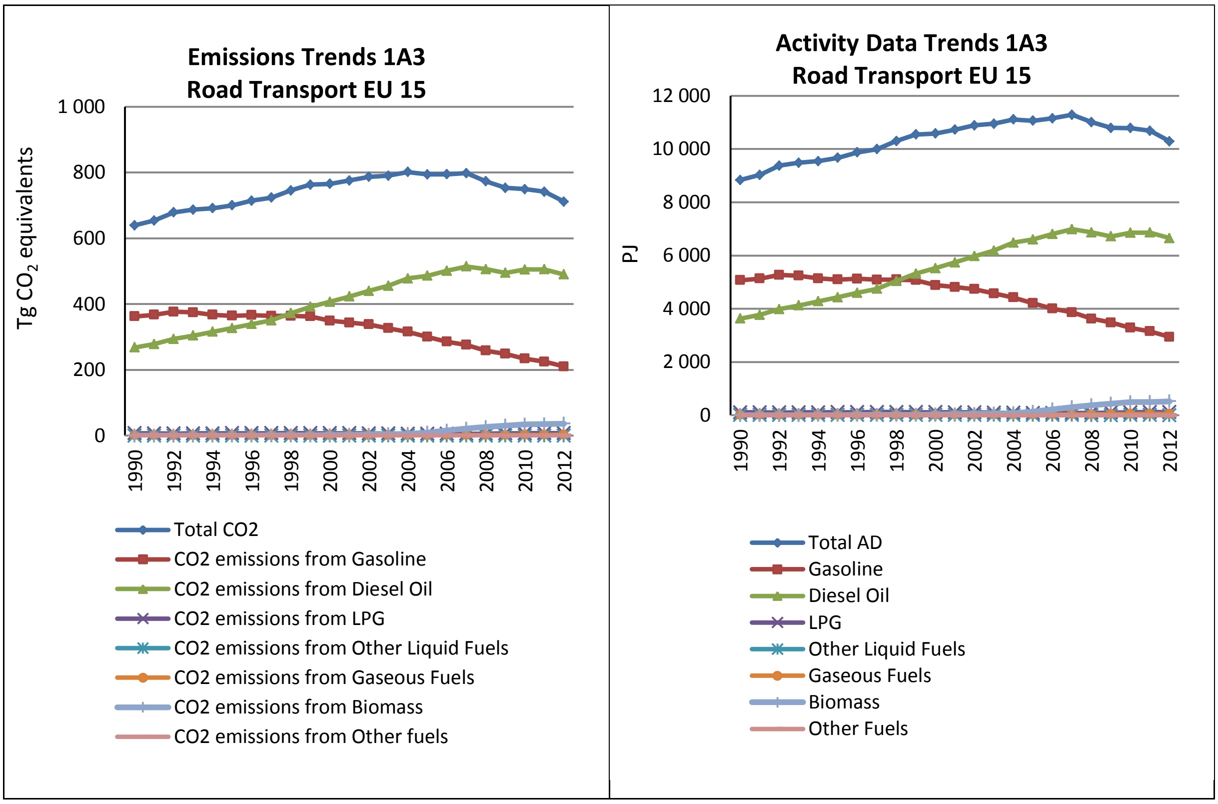
CO_2 emissions from 1A3b Road Transportation

The mobile source category Road Transportation includes all types of light-duty vehicles such as passenger cars and light commercial trucks, and heavy-duty vehicles such as tractors, trailers and buses, and two and three-wheelers (including mopeds, scooters, and motorcycles). These vehicles operate on many types of gaseous and liquid fuels.

CO_2 emissions from 1A3b Road Transportation is the second largest key source of all categories in the EU-15 accounting for 20 % of total GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from road transportation increased by 11 % in the EU-15 (Table 3.51). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 11% between 1990 and 2012.

Figure 3.55 gives an overview of the CO_2 trend caused by different fuels. The trend is mainly dominated by emissions resulting from the combustion of gasoline and diesel oil. The decline of gasoline and the strong increase of diesel show the gradual switch from gasoline to diesel passenger cars in several EU-15 Member States.

Figure 3.55 1A3b Road Transport: CO_2 Emission Trend and Activity Data



The Member States Germany, France, Italy, Spain and the United Kingdom contributed most to the CO_2 emissions from this source (77 %). All Member States, except for Germany (-3%) and the United Kingdom (-1%), show increased emissions from road transportation between 1990 and 2012. The Member States with the highest increases in absolute terms were Austria, France, the Netherlands and Spain. The countries with the lowest increase in relative terms were Finland and Sweden (Table 3.51).

Table 3.51 1A3b Road Transport: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	13 323	20 920	20 835	3%	-85	-0.4%	7 512	56%
Belgium	19 487	25 840	23 890	3%	-1 950	-8%	4 403	23%
Denmark	9 284	11 748	11 224	2%	-525	-4%	1 940	21%
Finland	10 806	11 488	11 052	2%	-436	-4%	246	2%
France	112 793	125 141	123 511	17%	-1 630	-1%	10 718	10%
Germany	150 358	147 479	145 826	21%	-1 653	-1%	-4 532	-3%
Greece	11 742	17 260	13 595	2%	-3 665	-21%	1 853	16%
Ireland	4 690	10 696	10 323	1%	-373	-3%	5 632	120%
Italy	93 387	108 095	97 038	14%	-11 058	-10%	3 650	4%
Luxembourg	2 647	6 729	6 420	1%	-309	-5%	3 774	143%
Netherlands	25 470	34 107	32 854	5%	-1 253	-4%	7 384	29%
Portugal	9 476	16 754	16 186	2%	-569	-3%	6 710	71%
Spain	50 614	79 017	73 428	10%	-5 589	-7%	22 814	45%
Sweden	17 301	18 795	17 741	2%	-1 055	-6%	440	3%
United Kingdom	108 127	107 658	107 409	15%	-249	-0.2%	-717	-1%
EU-15	**639 505**	**741 729**	**711 331**	**100%**	**-30 398**	**-4.1%**	**71 825**	**11%**

1A3b Road Transportation – Diesel Oil (CO_2)

CO_2 emissions from Diesel oil account for 69 % of CO_2 emissions from 1A3b Road Transport in 2012 (Figure 3.55). All Member States show increased emissions from Diesel oil between 1990 and 2012 (Table 3.52). Member States with the highest increase in per cent were Austria, Ireland, Luxembourg, Portugal and Spain. Some of these increases are due to fuel bought in the respective countries but consumed abroad (fuel tourism).

Table 3.52 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

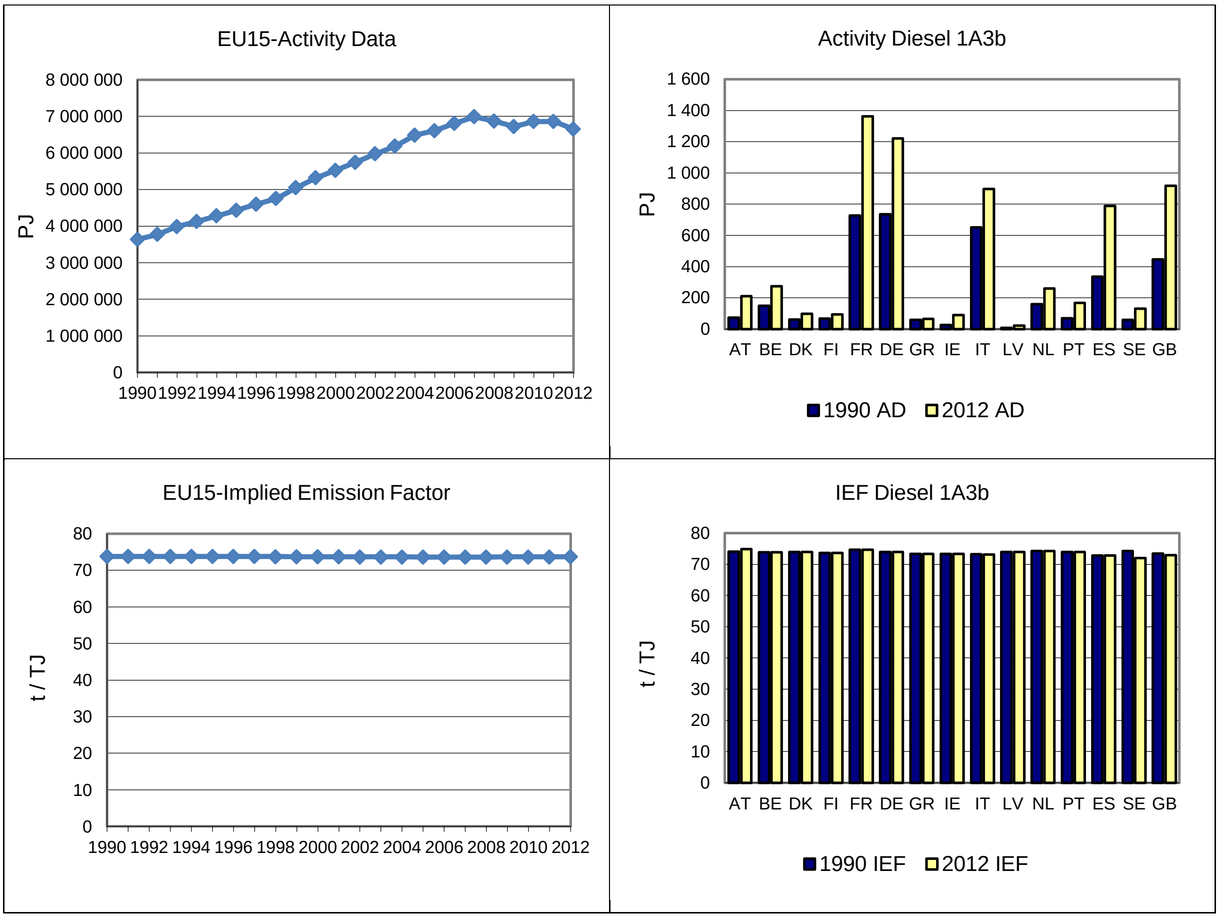
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	5 361	15 761	15 808	3%	47	0%	10 447	195%	T2	CS
Belgium	10 964	21 957	20 251	4%	-1 706	-8%	9 287	85%	T1	D
Denmark	4 436	7 523	7 227	1%	-296	-4%	2 791	63%	T2	CS
Finland	4 923	7 203	6 913	1%	-290	-4%	1 989	40%	T2	CS
France	54 308	101 784	101 753	21%	-32	0%	47 444	87%	T2	CS
Germany	54 458	88 597	90 339	18%	1 742	2%	35 881	66%	T2,CS	CS
Greece	4 326	6 582	4 823	1%	-1 759	-27%	497	11%	T1	D
Ireland	1 914	6 524	6 527	1%	4	0%	4 613	241%	T2	CS
Italy	47 776	73 501	65 629	13%	-7 872	-11%	17 853	37%	T2	CS
Luxembourg	1 343	5 605	5 322	1%	-283	-5%	3 979	296%	T2	CS
Netherlands	11 821	20 168	19 334	4%	-834	-4%	7 513	64%	T2	CS
Portugal	5 055	12 657	12 449	3%	-207	-2%	7 394	146%	T2	CS
Spain	24 504	62 941	57 436	12%	-5 505	-9%	32 932	134%	T2	M
Sweden	4 398	9 751	9 456	2%	-295	-3%	5 058	115%	T2	CS
United Kingdom	32 754	65 078	66 888	14%	1 809	3%	34 133	104%	T2	CS
EU-15	**268 342**	**505 632**	**490 155**	**100%**	**-15 477**	**-3.1%**	**221 812**	**83%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 78 % of CO_2 emissions and for 78 % of activity data from diesel oil in 2012 (Figure 3.56). The IEF for the EU-15 is 73.71 t/TJ diesel in 2012. The CO_2 IEF for diesel oil decreased by 0.1 per cent between 1990 (73.82 t/TJ) and 2012 (73.71 t/TJ). The main reason for the decline of the IEF is the changing in fuel specifications of some countries and their contribution to the weighted average. The contribution to diesel consumption of Germany, one of the largest contributing countries with higher IEFs than the average Member State, declined between 1990 and 2012 (from 20 per cent to 18 per cent); whereas for France the consumption increased in the same time period from 20 per cent to 20.5 per cent). On the other hand, the contribution to diesel consumption of Spain, which has a low IEF, increased from 9 per cent in 1990 to 12 per cent in 2012. In addition, a few member States (e.g. Italy, and the United Kingdom) show declining IEFs for the time-series 1990–2012.

Table 3.52 shows that the majority of CO_2 emissions from the combustion of diesel oil in road transportation were calculated using a higher tier method.

Figure 3.56 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for CO_2



1A3b Road Transportation – Gasoline (CO_2)

Between 1990 and 2012, CO_2 emissions from gasoline decreased by 42 % in the EU-15 (Table 3.53).

Table 3.53 1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions and information on method applied and emission factor

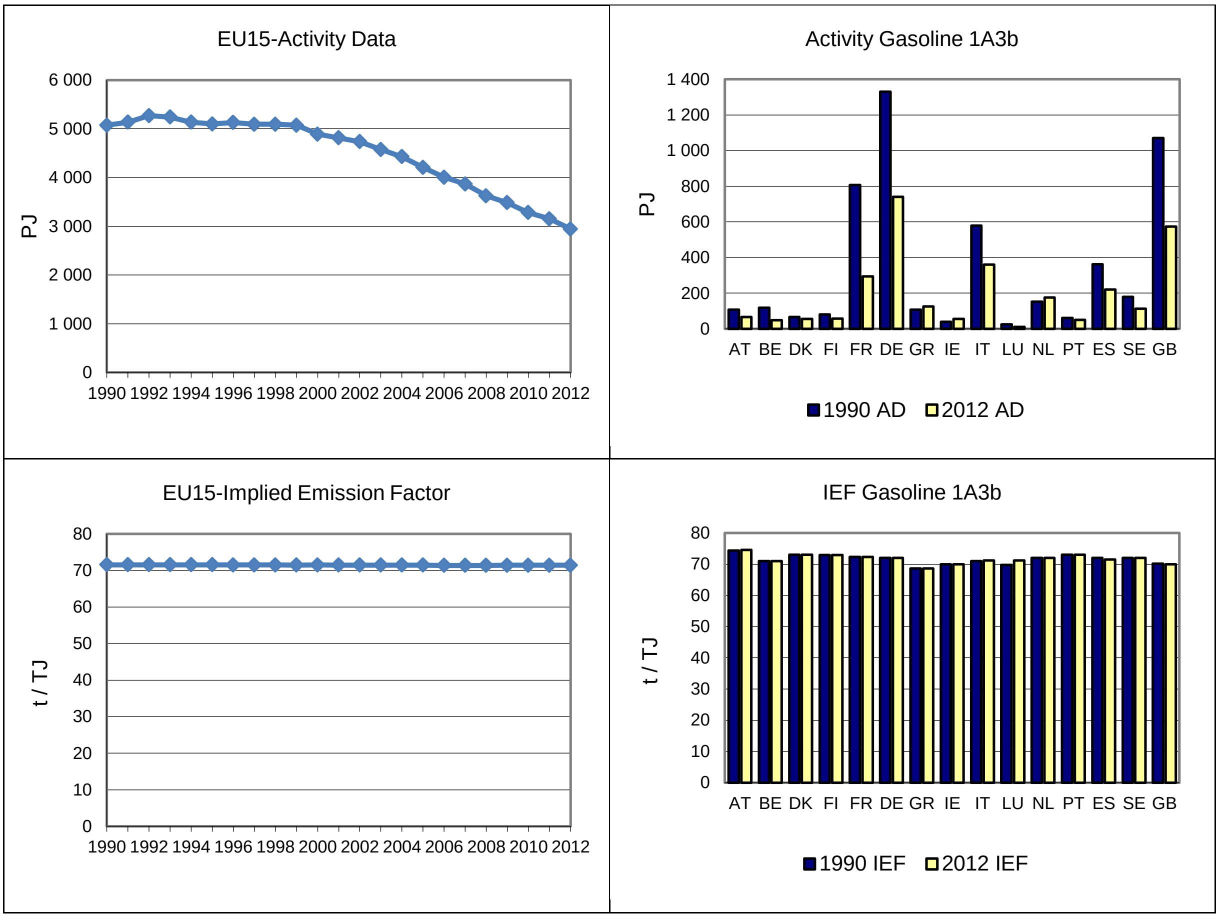
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	7 936	5 086	4 950	2%	-137	-3%	-2 986	-38%	T2	CS
Belgium	8 361	3 701	3 446	2%	-255	-7%	-4 914	-59%	T1	D
Denmark	4 838	4 226	3 997	2%	-229	-5%	-842	-17%	T2	CS
Finland	5 883	4 275	4 130	2%	-146	-3%	-1 753	-30%	T2	CS
France	58 335	22 760	21 197	10%	-1 563	-7%	-37 138	-64%	T2	CS
Germany	95 794	56 722	53 255	25%	-3 466	-6%	-42 539	-44%	T2,CS	CS
Greece	7 294	10 038	8 569	4%	-1 469	-15%	1 275	17%	T1	D
Ireland	2 758	4 171	3 793	2%	-378	-9%	1 035	38%	T2	CS
Italy	41 094	29 076	25 554	12%	-3 522	-12%	-15 540	-38%	T2	CS
Luxembourg	1 277	1 110	1 083	1%	-27	-2%	-195	-15%	T2	CS
Netherlands	10 908	13 057	12 641	6%	-416	-3%	1 733	16%	T2	CS
Portugal	4 420	3 985	3 617	2%	-368	-9%	-803	-18%	T2	CS
Spain	26 031	15 847	15 735	7%	-111	-1%	-10 296	-40%	T2	M
Sweden	12 900	8 942	8 158	4%	-784	-9%	-4 742	-37%	T2	CS
United Kingdom	75 110	42 172	40 149	19%	-2 024	-5%	-34 961	-47%	T2	CS
EU-15	**362 939**	**225 169**	**210 274**	**100%**	**-14 894**	**-7%**	**-152 665**	**-42%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 73 % for CO_2 emissions and for 74 % of activity data from gasoline in 2012 (Figure 3.57). The IEF for the EU-15 is 71.41 t/TJ gasoline in 2012. The CO_2 IEF for gasoline decreased by 0.2 per cent between 1990 (71.55 t/TJ) and 2012 (71.41 t/TJ). The main reason for the decline of the IEF is the changing specifications of gasoline in Germany and France, the two largest contributing countries with higher IEFs than the average Member State. The contribution to gasoline consumption in Germany and France declined between 1990 and 2012 (Germany from 26 per cent to 25 per cent; France from 16 per cent to 10 per cent). On the other hand, the contribution to gasoline consumption of Italy, which has a lower IEF than the average Member State, increased from 11 per cent in 1990 to 12 per cent in 2012. Also, the United Kingdom, which has a much lower IEF than the average Member State, can be seen here as an influencing factor as the contribution to gasoline consumption amounts to 19 per cent in 2012.

Table 3.53 shows that the majority of CO_2 emissions from gasoline combustion in road transportation were calculated using a higher tier method.

Figure 3.57   1A3b Road Transport, gasoline: Activity data and implied emission factors for CO_2



1A3b Road Transportation –LPG (CO_2)

Between 1990 and 2012, CO_2 emissions from LPG increased by 5 % in the EU-15. Two Member States report emissions as 'Not occurring'. Between 2011 and 2012 EU-15 emissions decreased by 1 % (Table 3.54).

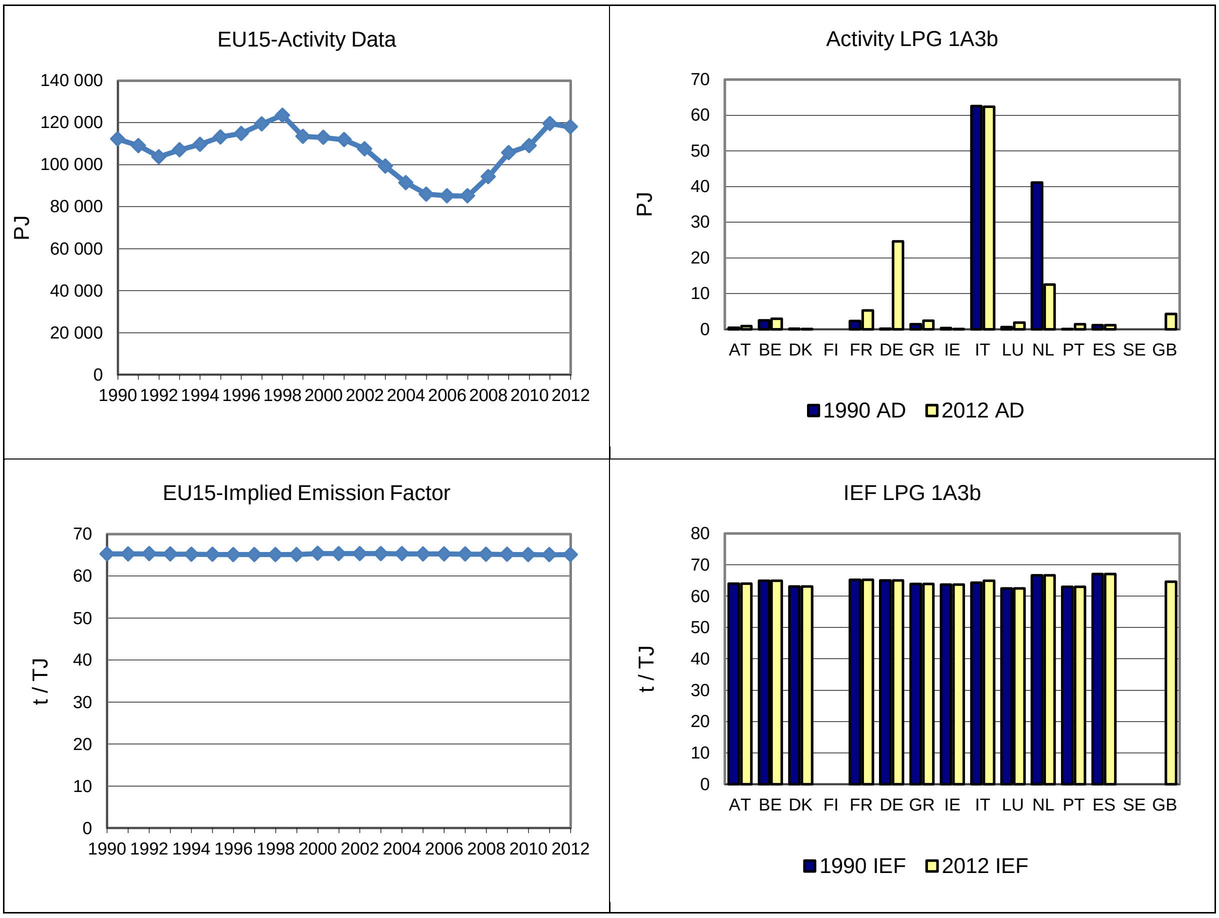
Table 3.54   1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	27	50	54	0.7%	3	7%	27	103%	T2	CS
Belgium	163	181	192	3%	11	6%	30	18%	T1	D
Denmark	9	0.13	0.12	0.001%	-0.01	-11%	-9	-99%	T1	D
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	150	380	346	5%	-34	-9%	196	131%	T2	CS
Germany	9	1 535	1 598	21%	64	4%	1 589	17720%	T2,CS	CS
Greece	91	541	151	2%	-390	-72%	60	67%	T1	D
Ireland	19	1	3	0.03%	1	82%	-16	-86%	T2	CS
Italy	4 026	3 803	4 051	53%	249	7%	25	1%	T2	CS
Luxembourg	11	2	5	0%	3	173%	-6	-55%	T2	CS
Netherlands	2 740	850	838	11%	-12	-1%	-1 903	-69%	T2	CS
Portugal	0	83	91	1%	8	9%	90	147158%	T2	CS
Spain	79	63	79	1%	15	24%	0	0%	T2	M
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	290	274	4%	-16	-5%	274	-	T2	CS
EU-15	**7 323**	**7 780**	**7 682**	**100%**	**-98**	**-1%**	**359**	**5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 84 % of CO_2 emission and for 83 % of activity data from LPG in 2012 (Figure 3.58). The IEF for the EU-15 is 65.11 t/TJ LPG in 2012. Table 3.54 shows that the majority of CO_2 emissions from LPG consumption in road transportation were calculated using a higher tier method.

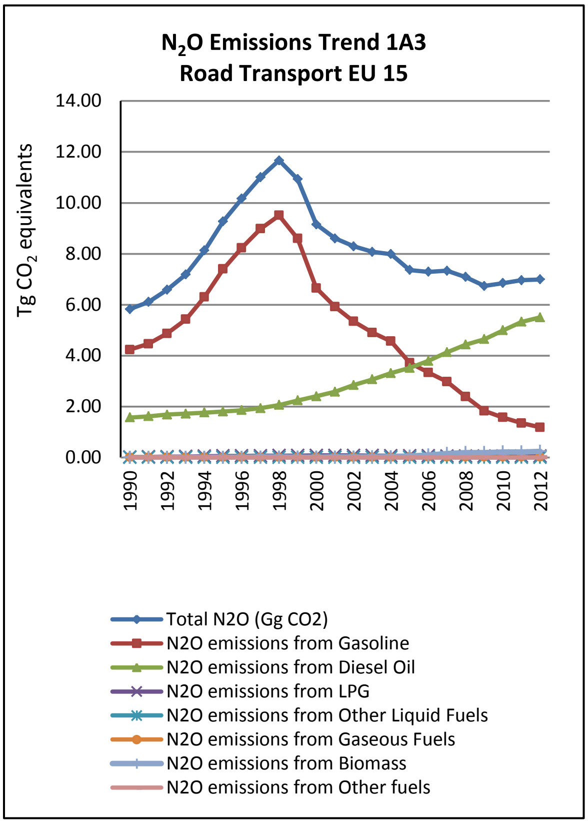
Figure 3.58 1A3b Road Transport, LPG: Activity data and implied emission factors for CO_2



N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.2 % of total EU-15 GHG emissions in 2012. Figure 3.59 gives an overview of the N_2O trend caused by different fuels. The trend is mainly dominated by emissions resulting from gasoline and diesel oil.

Figure 3.59 1A3b Road Transport: N_2O Emissions Trend



N_2O emissions increased between 1990 and 2012 by 20 % (Table 3.55). N_2O emissions increased in the 1990s due to the implementation of the catalytic converter in the early Euro vehicles (mainly Euro 1), but decreased thereafter (for post Euro 2 vehicles). The reason for the existing various trends in N_2O emission are different estimates of N_2O emission factors. In principle, two different models/emission factor sources are being used in EU-15 countries to estimate N_2O emissions: (1) HBEFA - Handbook of emissions factors, (2) COPERT. The Emission Factors Handbook (Austria, Germany, the Netherlands and Sweden) estimates that the N_2O emission factors decrease for every technology generation (Euro 1, Euro 2 etc.).

Table 3.55: N_2O Emission Factors in COPERT III/ AEIG Chapter rt070100 – August 2002

Vehicle category	Urban	Rural	Highway
Passenger Cars			
Gasoline Conventional	5	5	5
Gasoline Euro I and on	53	16	35
Diesel CC < 2.0 l	27	27	27
Diesel CC > 2.0 l	27	27	27
LPG	15	15	15
2 - stroke	5	5	5
Light Duty Vehicles			
Gasoline Conventional	6	6	6
Gasoline Euro I and on	53	16	35
Diesel	17	17	17
Heavy Duty Vehicles			
Gasoline > 3.5 t	6	6	6
Diesel < 7.5 t	30	30	30
Diesel 7.5 t < W < 16 t	30	30	30
Diesel 16 t < W < 32 t	30	30	30
Diesel W > 32 t	30	30	30
Urban Buses	30	-	-
Coaches	30	30	30
Motorcycles			
< 50 cm³	1	1	1
> 50 cm³ 2 stroke	2	2	2
> 50 cm³ 4 stroke	2	2	2

These emission factors were fully updated for passenger cars and light commercial vehicles with the launch of the first official COPERT 4 version 3.0 (November 2006) and were introduced in the rt070100 chapter of AEIG dated September 2006. These emission factors introduced reductions in N_2O as the emission technology improved. In particular for gasoline vehicles, these emission factors also introduced an increase in the emission level as the vehicle grows older and a decrease as the fuel sulfur decreased. All emission factors were based on an extensive literature review and synthesis of the findings that was conducted in 2005. Use of the new emission factors over COPERT III should in general lead to reductions of the national N_2O levels.

In 2007, the HDV N_2O emission factors were updated based on a relevant report that was published by the Dutch Institute TNO (Report TNO 03.OR.VM.006.1/IJR). These emission factors were sensitive to vehicle size and driving conditions (urban, rural, highway). Depending on the national stock details, use of the emission factors could lead to both slight increases or slight decreases compared to the previous set. The new emission factors were introduced in COPERT 4 v5.0 (December 2007) but were then introduced in the AEIG with the original GB2009 revision (Technical report 9/2009 – June 2009).

Since June 2009 this basic methodology of N_2O calculation has remained without changes.

The COPERT 4 implementation of the methodology introduced some calculation errors that were fixed in the subsequent software versions. Also a number of slight updates (extension of the methodology to other categories) have been incorporated. A summary of these updates and software fixes is provided in Table 3.56.

Table 3.56: N_2O and CH_4 relevant changes in the COPERT 4 methodology

Version: 3.0	Date: November 2006
METHODOLOGY: Update of the gasoline and diesel passenger car and light duty vehicle N_2O emission factors. Introduction of impact of vehicle technology, vehicle age and fuel sulfur.	
Reference: http://www.emisia.com/versions.html	

Version: 5.0	Date: December2007
METHODOLOGY: Update of the diesel HDV emission factors based on Dutch study	
Reference: http://www.emisia.com/versions.html	
Version: 5.1	Date: February 2008
SOFTWARE CORRECTION: Use of the cumulative mileage instead of annual mileage to calculate N_2O degradation. The correction should lead to an increase in emissions	
Reference: http://www.emisia.com/versions.html	
Version: 6.1	Date: February 2009
METHODOLOGY: The Euro 5 and 6 passenger car and light duty trucks emission factors of CH_4, N_2O, NH_3 have been inherited by default from Euro 4. They were zero in the previous version. The revision will slightly increase total N_2O emissions.	
Reference: http://www.emisia.com/versions.html	
Version: 7.0	Date: December 2009
SOFTWARE CORRECTION: There was a software bug during the calculation of N_2O, NH_3 and CH_4 hot and cold emissions. Because of this bug there was a misallocation between the hot and cold emissions of these pollutants. Furthermore the N_2O cold emissions were stored in place of NH_3 cold emissions and vice versa. This is now corrected. The corrections is expected to lead to MS specific changes	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v7_0.pdf	
Version: 8.1	Date: May 2011
METHODOLOGY: N_2O hot and cold emission factors parameters for Euro 5 and Euro 6 LPG passenger cars are set equal to Euro 5 and Euro 6 gasoline ones. This is estimated to slightly increase N_2O in some MS were LPG vehicles are widespread.	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v8_1.pdf	
Version: 9.0	Date: October 2011
METHODOLOGY: Bioethanol was introduced as a fuel. N_2O emissions are now split to a fossil and a non-fossil (biomass) part (for exporting to CRF).	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v9_0.pdf	
Version: 10.0	Date: November 2012
METHODOLOGY: CH_4 emission factors for Euro 4, 5 and 6 gasoline passenger cars have been updated. This is estimated to slightly increase total CH_4 emissions.	
Reference: http://www.emisia.com/files/COPERT4_v10_0.pdf	

Table 3.57 shows that all Member States use recent N_2O emission factors in 2012. Four MS use different or country specific models or emission factors, as can be seen in Table 3.58.

Table 3.57 1A3b Road Transport: Member States' contributions to N_2O emissions

Member State	N2O emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	173	197	187	3%	-10	-5%	14	8%
Belgium	204	256	250	4%	-6	-2%	47	23%
Denmark	91	121	116	2%	-5	-4%	26	28%
Finland	160	163	161	2%	-2	-1%	1	1%
France	945	1 365	1 446	21%	81	6%	501	53%
Germany	1 158	1 349	1 423	20%	74	5%	264	23%
Greece	145	134	104	1%	-30	-23%	-42	-29%
Ireland	44	94	91	1%	-4	-4%	46	104%
Italy	879	1 019	921	13%	-98	-10%	42	5%
Luxembourg	27	80	78	1%	-3	-3%	51	191%
Netherlands	101	277	277	4%	-0.02	-0.01%	175	172%
Portugal	67	162	159	2%	-3	-2%	92	138%
Spain	493	780	762	11%	-18	-2%	269	55%
Sweden	157	107	118	2%	11	10%	-39	-25%
United Kingdom	1 182	860	901	13%	42	5%	-281	-24%
EU-15	**5 827**	**6 965**	**6 994**	**100%**	**29**	**0%**	**1 168**	**20%**

Table 3.58 Methods/models used for road transport by EU-15 MS

1A3b	**Method/Emission factors**	**Remark**
Austria	CS /HBEFA	GLOBEMI model is used for the calculation of emissions from road transport
Belgium	CS / COPERT 4	Emissions of CH_4 and N_2O are since the 29th October 2012 submission also based on the amounts of fuel sold of the federal petroleum balance in combination with COPERT 4 emission factors. The compiled emissions of each region based on COPERT 4 v10.0 modeling are hereby corrected/increased according the ratio between the fuel used (consumptions compiled by regional models) and the fuel sold (provided by federal statistics) to get consistency with the methodology used to calculate the emissions of CO_2.
Denmark	CS / COPERT 4	An internal DCE model with a structure similar to the European COPERT IV emission model is used to calculate the Danish annual emissions for road traffic.
Finland	CS / COPERT 4	According to the recommendations in the review the N_2O emission factors have been updated in the LIISA model. Emission factors used in the COPERT IV program have been used as the reference values.
France	COPERT 4	
Germany	CS / HBEFA	
Greece	COPERT 4	
Ireland	COPERT 4	

1A3b	Method/Emission factors	Remark
Italy	COPERT 4	
Luxembourg	COPERT 4	
Netherlands	CS / VERSIT+	
Portugal	COPERT 4	
Spain	COPERT 4	
Sweden	CS / HBEFA	
United Kingdom	COPERT 4	

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 79 % of N_2O emissions from 1A3b "Road Transportation" in 2012. Between 1990 and 2012 N_2O emissions from Diesel oil increased in all Member States, except for Greece which decreased their emissions by 43 %; within the EU-15 the emission increased by 250 %. The smallest increase in absolute terms was reported by Denmark, Finland, Ireland and Luxembourg. Between 2011 and 2012, EU-15 emissions rose by 3 % (Table 3.59).

Table 3.59 1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions and information on method applied and emission factor

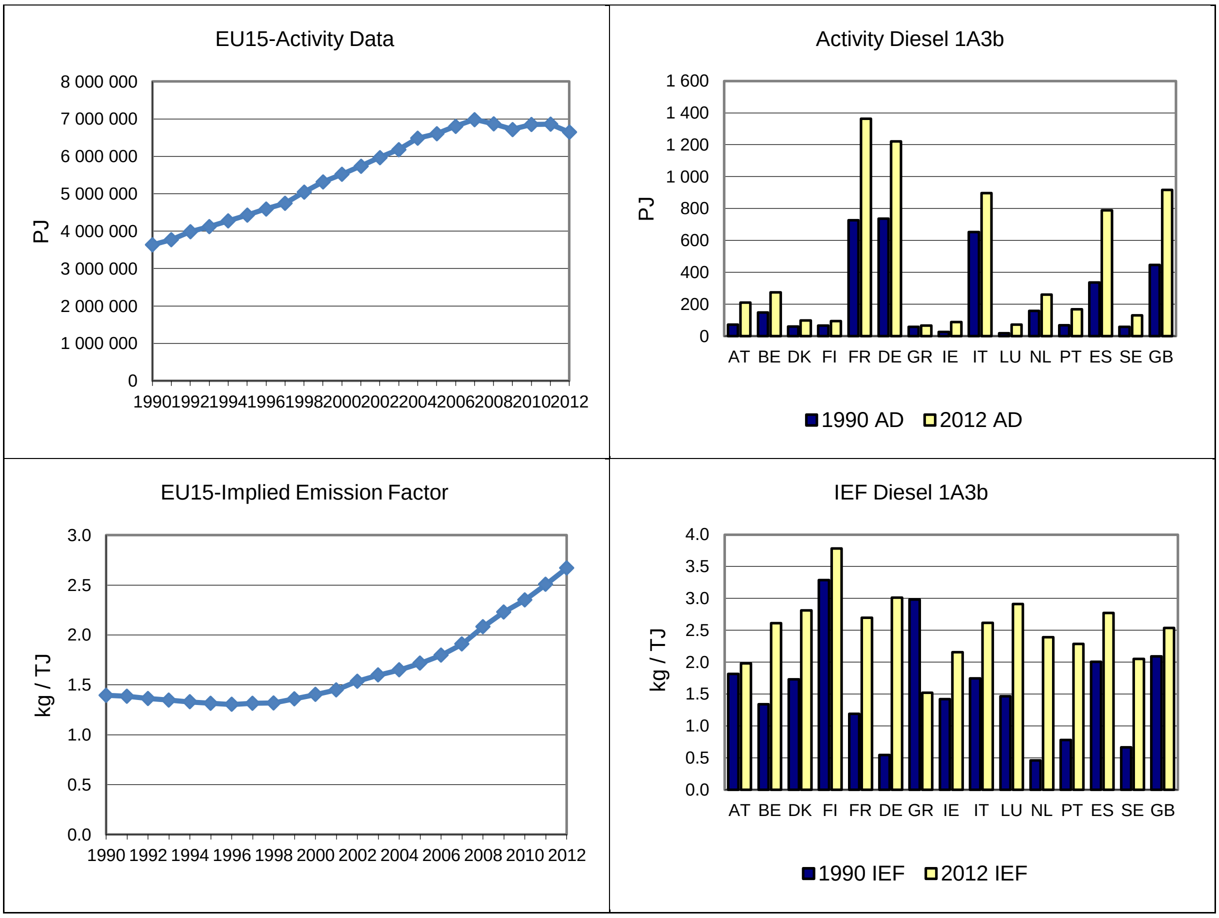
Member State	N2O emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	41	130	129	2%	-1	-1%	89	218%	T3	CS
Belgium	62	226	222	4%	-4	-2%	161	260%	M,T2	CR,CS
Denmark	32	88	85	2%	-3	-3%	53	165%	T3	OTH
Finland	68	110	110	2%	-0.04	-0.04%	42	62%	T3	CS
France	268	1 040	1 139	21%	99	10%	871	325%	T3	CS
Germany	124	1 040	1 140	21%	100	10%	1 016	818%	T3,CS	CS,M
Greece	55	49	31	1%	-18	-37%	-23	-43%	T3	M
Ireland	12	58	60	1%	2	3%	48	418%	T3	M
Italy	353	805	728	13%	-77	-10%	375	106%	T3	CS
Luxembourg	8	67	65	1%	-2	-2%	57	688%	T3	D
Netherlands	23	182	193	4%	11	6%	170	753%	T2	CS
Portugal	17	117	119	2%	2	2%	103	620%	T3	CR
Spain	209	689	677	12%	-12	-2%	468	223%	T3	M
Sweden	12	75	83	2%	9	12%	71	583%	T3	M
United Kingdom	289	654	722	13%	67	10%	433	150%	T3	CS
EU-15	**1 572**	**5 330**	**5 504**	**100%**	**175**	**3%**	**3 933**	**250%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 80 % of N_2O emissions and for 78 % of activity data from diesel oil in 2012 (Figure 3.60). The IEF for the EU-15 is 2.67 kg/TJ Diesel in 2012.

Table 3.59 shows that all N_2O emissions from combustion of diesel oil in road transportation were calculated using a higher tier method.

Figure 3.60 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for N_2O emission



1A3b Road Transportation – Gasoline (N_2O)

N_2O emissions from Gasoline account for 17 % of N_2O emissions from 1A3b Road Transportation in 2012. Between 1990 and 2012, N_2O emissions from gasoline decreased by 72 % in the EU-15. Between 2011 and 2012, all Member States, except for Sweden, showed a decreasing trend. The EU-15 total N_2O emissions dropped by 12 % (Table 3.60).

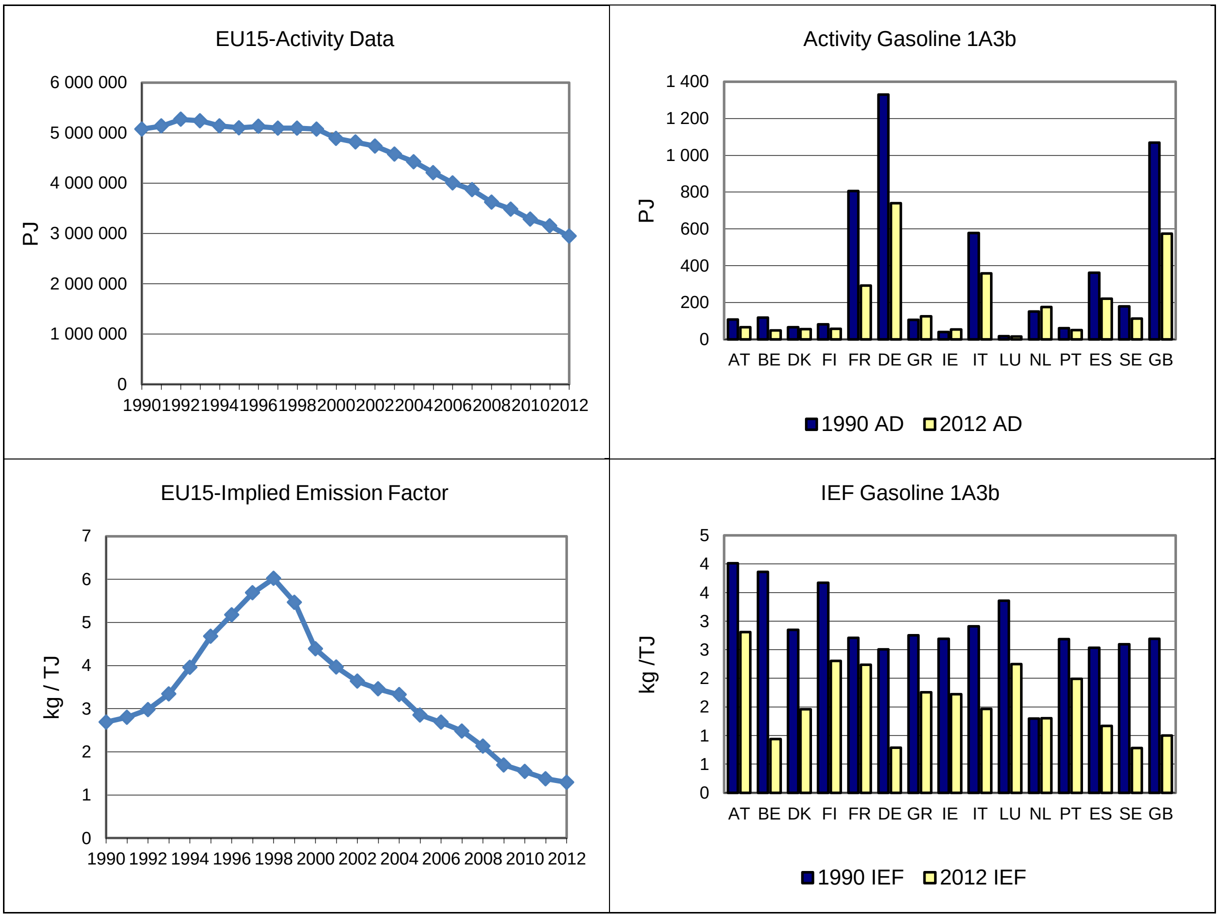
Table 3.60 1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions and information on method applied and emission factor

Member State	N2O emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	133	67	58	5%	-9	-14%	-75	-57%	T3	CS
Belgium	141	17	14	1%	-3	-15%	-127	-90%	M,T2	CR,CS
Denmark	59	29	25	2%	-5	-16%	-34	-58%	T3	OTH
Finland	92	45	40	3%	-5	-11%	-51	-56%	T3	CS
France	677	230	203	17%	-27	-12%	-474	-70%	T3	CS
Germany	1 034	214	181	15%	-33	-16%	-853	-82%	T3,CS	CS,M
Greece	91	80	68	6%	-12	-15%	-23	-25%	T3	M
Ireland	33	34	29	2%	-5	-14%	-4	-12%	T3	M
Italy	522	182	163	14%	-19	-10%	-359	-69%	T3	CS
Luxembourg	18	12	10	1%	-1	-9%	-8	-43%	T3	D
Netherlands	61	83	71	6%	-12	-14%	10	17%	T2	CS
Portugal	50	36	31	3%	-5	-14%	-20	-39%	T3	CR
Spain	284	86	80	7%	-7	-8%	-204	-72%	T3	M
Sweden	144	26	27	2%	1	5%	-117	-81%	T3	M
United Kingdom	893	203	178	15%	-25	-12%	-715	-80%	T3	CR
EU-15	**4 232**	**1 345**	**1 179**	**100%**	**-167**	**-12%**	**-3 053**	**-72%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom accounted for 68 % of N_2O emissions and for 74 % of activity data from gasoline in 2012 (Figure 3.61). The IEF for the EU-15 is 1.29 kg/TJ Gasoline in 2012.

Figure 3.61 1A3b Road Transport, gasoline: Activity data and implied emission factors for N_2O

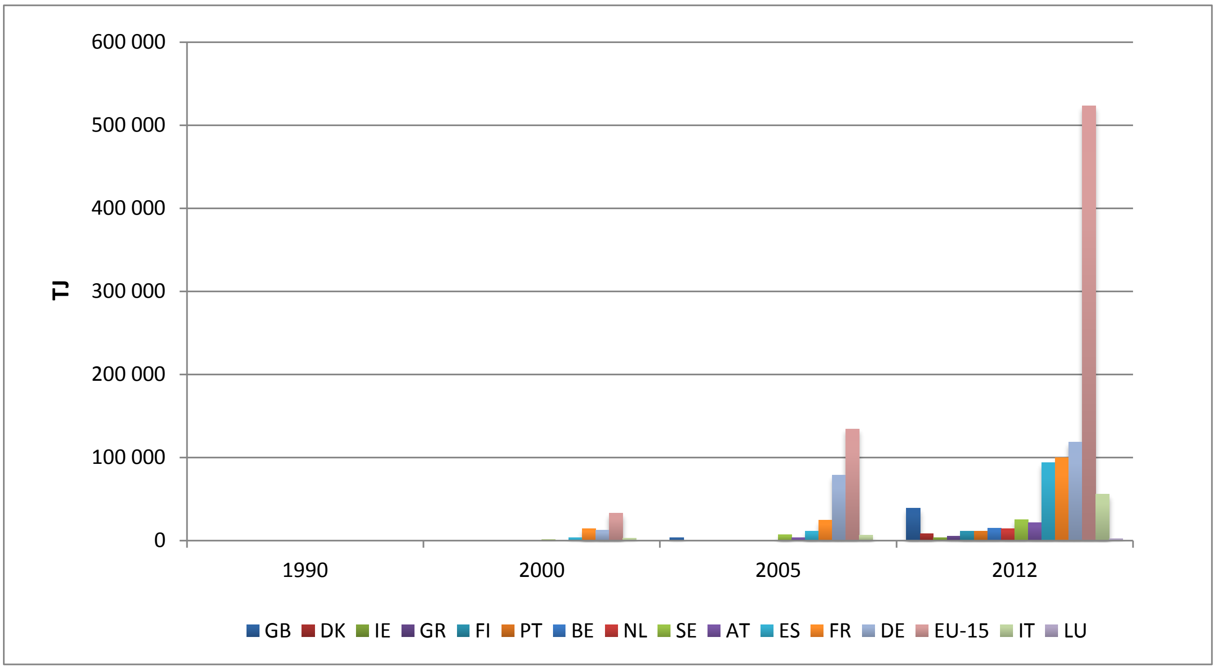


1A3b Road Transportation – Activity Data Biofuels

According to the European Directive on the promotion of the use of biofuels or other renewable fuels for transport (2003/30/EG), Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets, to reduce greenhouse gas emissions. Member States brought into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 December 2004. A reference value for these targets shall be 2 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2005. A reference value for these targets shall be 5.8 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010. Due to the possibility of different national implementation the MS need to approach partly different targets.

Between 1990 and 2012, activity data of biofuels increased from 41.12 TJ to 523.8 TJ in the EU-15 (Figure 3.62). Germany still reports most of total amount of biofuels (22.6 % of total EU-15 activity in 2012 vs. 23 % in 2011) over the last years, followed by France (19 %). All Member States report biofuels activity data under 1A3b for 2012.

Figure 3.62 1A3b Road Transport, biofuels: Trend of Activity data of biofuels

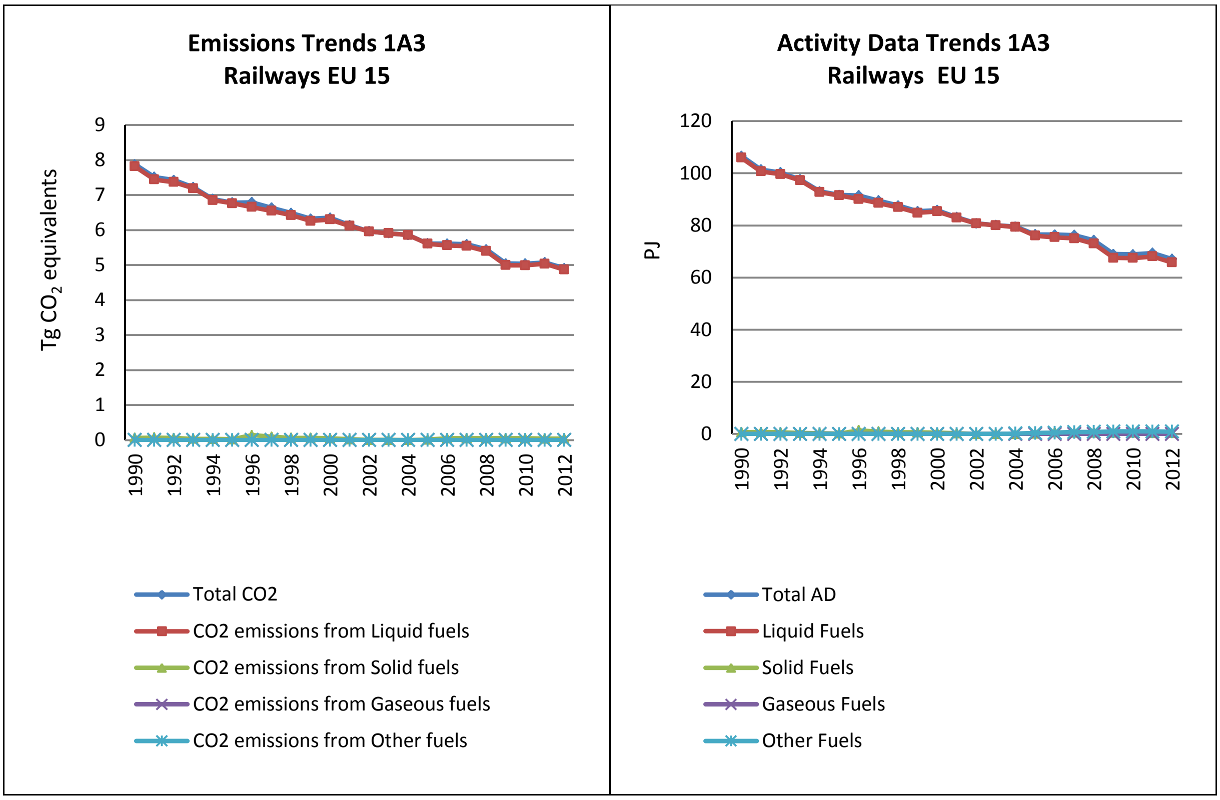


3.2.3.3 Railways (1A3c) (EU-15)

Railway locomotives generally are one of these types: diesel, coal, electric, or steam. Diesel locomotives generally use diesel engines in combination with an alternator or generator to produce the electricity required to power their traction motors. Emissions from Railways arise from the combustion of liquid and solid fuels.

CO_2 emissions from 1A3c Railways account for 0.1 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from rail transportation decreased by 38 % in the EU-15. The total trend is dominated by CO_2 emissions from liquid fuels (Figure 3.63). The emissions from this key category are due to fossil fuel consumption in rail transport, which decreased by 38 % between 1990 and 2012.

Figure 3.63 1A3c Railways: CO_2 Emission Trend and Activity Data



The Member States France, Germany and the United Kingdom contributed most to the emissions from this source (75 %). Between 1990 and 2012, Germany had by far the highest decreases in absolute terms (Table 3.61).

Table 3.61 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	178	120	124	3%	4	3%	-54	-30%
Belgium	224	102	93	2%	-9	-9%	-131	-59%
Denmark	297	249	249	5%	-0.1	-0.02%	-47	-16%
Finland	191	98	99	2%	0.5	0.5%	-92	-48%
France	1 070	545	523	11%	-22	-4%	-547	-51%
Germany	2 881	1 091	1 045	21%	-45	-4%	-1 836	-64%
Greece	203	47	79	2%	31	67%	-124	-61%
Ireland	133	122	118	2%	-4	-3%	-15	-11%
Italy	441	140	44	1%	-97	-69%	-397	-90%
Luxembourg	25	11	10	0.2%	-1	-9%	-14	-59%
Netherlands	91	102	85	2%	-18	-17%	-6	-7%
Portugal	175	41	33	1%	-8	-19%	-142	-81%
Spain	414	273	254	5%	-19	-7%	-161	-39%
Sweden	101	59	59	1%	0	0%	-42	-42%
United Kingdom	1 455	2 077	2 095	43%	18	1%	640	44%
EU-15	**7 879**	**5 078**	**4 909**	**100%**	**-169**	**-3%**	**-2 970**	**-38%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2012, CO_2 emissions from liquid fuels decreased by 38 % in the EU-15. Between 2011 and 2012, EU-15 emissions decreased by 3 % (Table 3.62).

Table 3.62 1A3c Railways, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

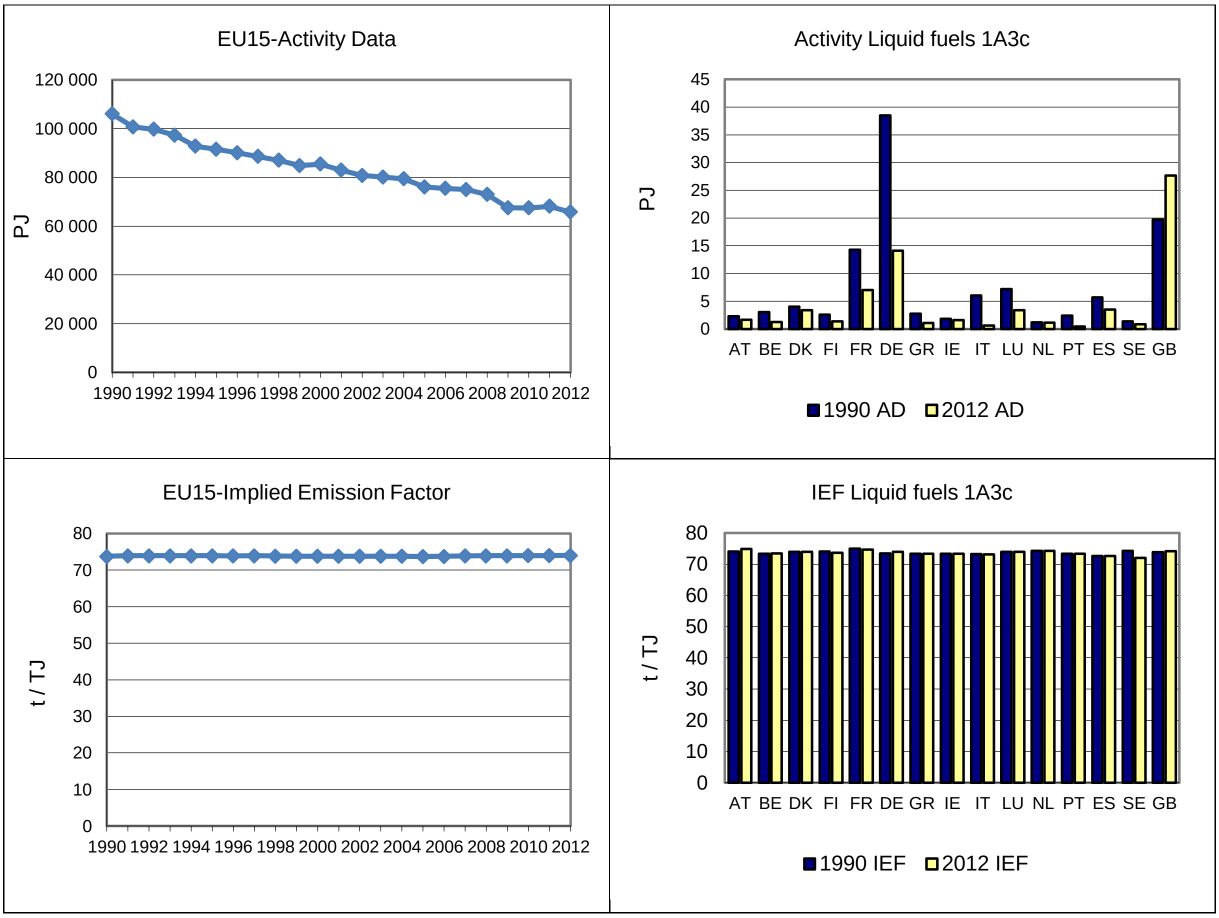
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	171	120	123	3%	4	3%	-48	-28%	T2	CS
Belgium	224	102	93	2%	-9	-9%	-131	-59%	T2	CS,D
Denmark	297	249	249	5%	-0.1	0%	-47	-16%	T2	CS
Finland	191	98	99	2%	0.5	0%	-92	-48%	T2	CS
France	1 070	545	523	11%	-22	-4%	-547	-51%	T2	CS
Germany	2 827	1 091	1 045	21%	-45	-4%	-1 782	-63%	T2	CS,D
Greece	200	47	79	2%	31	67%	-121	-61%	T1	D
Ireland	133	122	118	2%	-4	-3%	-15	-11%	T2	CS
Italy	441	140	44	1%	-97	-69%	-397	-90%	T1	CS
Luxembourg	25	11	10	0.2%	-1	-9%	-14	-59%	T2	CS
Netherlands	91	102	85	2%	-18	-17%	-6	-7%	T2	CS
Portugal	175	41	33	1%	-8	-19%	-142	-81%	T1	OTH
Spain	414	273	254	5%	-19	-7%	-161	-39%	T2	M
Sweden	101	59	59	1%	0	0%	-42	-42%	T2	CS
United Kingdom	1 455	2 036	2 052	42%	16	1%	597	41%	T2	CS
EU-15	**7 816**	**5 037**	**4 866**	**100%**	**-171**	**-3%**	**-2 950**	**-38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 80 % of CO_2 emissions and for 80 % of activity data from liquid fuels in 2012 (Figure 3.64). The IEF for the EU-15 is 74.01 t/TJ Liquid fuels in 2012.

Table 3.62 shows that the majority of CO_2 emissions from the combustion of liquid fuels in railways were calculated using a higher tier method.

Figure 3.64 1A3c Railways, liquid fuels: Activity data and implied emission factors for CO_2

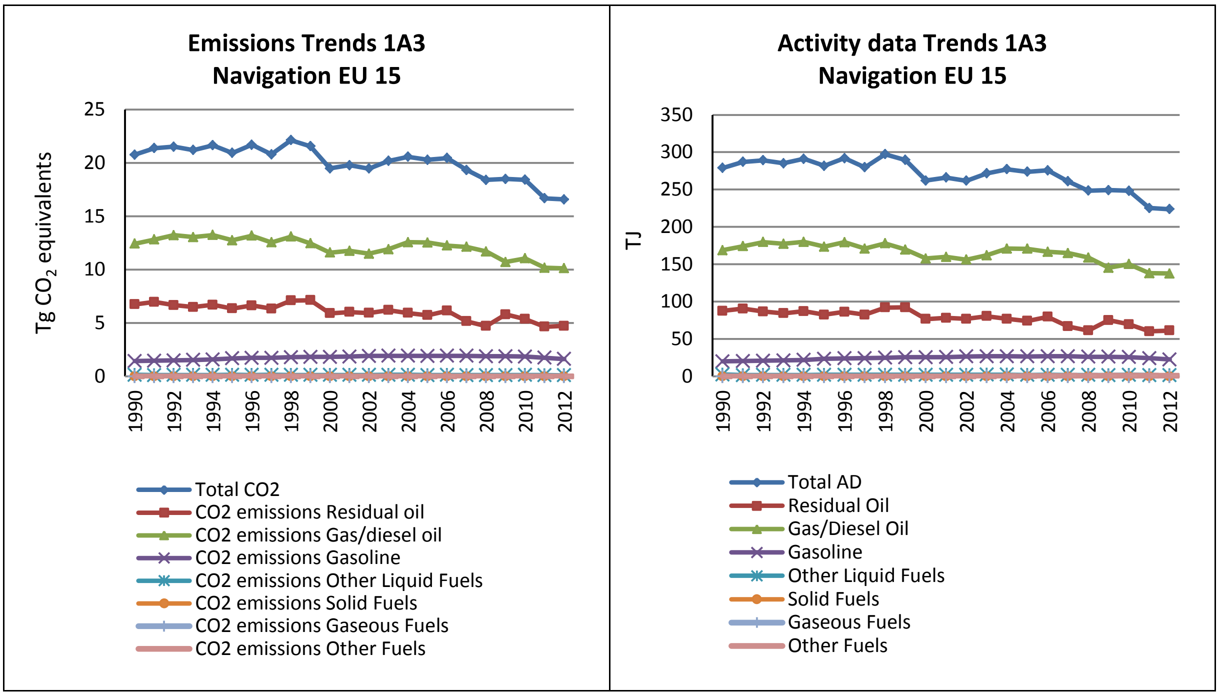


3.2.3.4 Navigation (1A3d) (EU-15)

This source category covers all water-borne transport from recreational craft to large ocean-going cargo ships that are driven primarily by large, slow and medium speed diesel engines and occasionally by steam or gas turbines. Emissions arise from gas/diesel oil, residual oil or other.

CO_2 emissions from 1A3d Navigation account for 0.5 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from navigation decreased by 20 % in the EU-15 (Table 3.63). The emissions from this key source are due to fossil fuel consumption in navigation. The total CO_2 emission trend is dominated by emissions from gas/diesel oil and residual oil (Figure 3.65).

Figure 3.65 1A3d Navigation: CO_2 Emission Trend and Activity Data



Five Member States (France, Greece, Italy, Spain and the United Kingdom) contributed the most to the emissions from this source (76 %). Most Member States had decreasing emissions from navigation between 1990 and 2012. The Member States with the highest decreases in absolute terms were Germany, Italy and Spain (Table 3.63).

Table 3.63 1A3d Navigation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	14	11	12	0.1%	0.2	1%	-3	-18%
Belgium	398	474	463	3%	-11	-2%	65	16%
Denmark	796	559	498	3%	-61	-11%	-298	-37%
Finland	441	537	484	3%	-53	-10%	43	10%
France	1 065	1 210	1 242	7%	32	3%	177	17%
Germany	2 066	892	971	6%	79	9%	-1 094	-53%
Greece	1 818	1 661	1 664	10%	3	0.2%	-154	-8%
Ireland	85	172	182	1%	10	6%	97	114%
Italy	5 420	4 844	4 890	29%	46	1%	-530	-10%
Luxembourg	1	1	1	0.01%	0.02	2%	0.01	1%
Netherlands	405	664	699	4%	35	5%	294	73%
Portugal	260	202	225	1%	24	12%	-35	-13%
Spain	5 187	2 556	2 649	16%	93	4%	-2 538	-49%
Sweden	543	488	302	2%	-186	-38%	-241	-44%
United Kingdom	2 273	2 417	2 299	14%	-118	-5%	27	1%
EU-15	**20 772**	**16 689**	**16 581**	**100%**	**-108**	**-1%**	**-4 191**	**-20%**

1A3d Navigation – Residual Oil (CO_2)

CO_2 emissions from residual oil account for 28 % of CO_2 emissions from 1A3d Navigation in 2012. Between 1990 and 2012, CO_2 emissions from residual oil decreased by 30 % in the EU-15. The countries with the highest decrease in absolute terms were Spain and United Kingdom. Austria, Germany, Ireland, Luxembourg and the Netherlands reported emissions as 'Not Occurring' (Table 3.64) for 2012, whereas Belgium reported emissions as 'Included Elsewhere' and specifically, the aforementioned emissions are included in gas/diesel oil, since the amounts of residual oil are very small.

Table 3.64 1A3d Navigation, residual oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

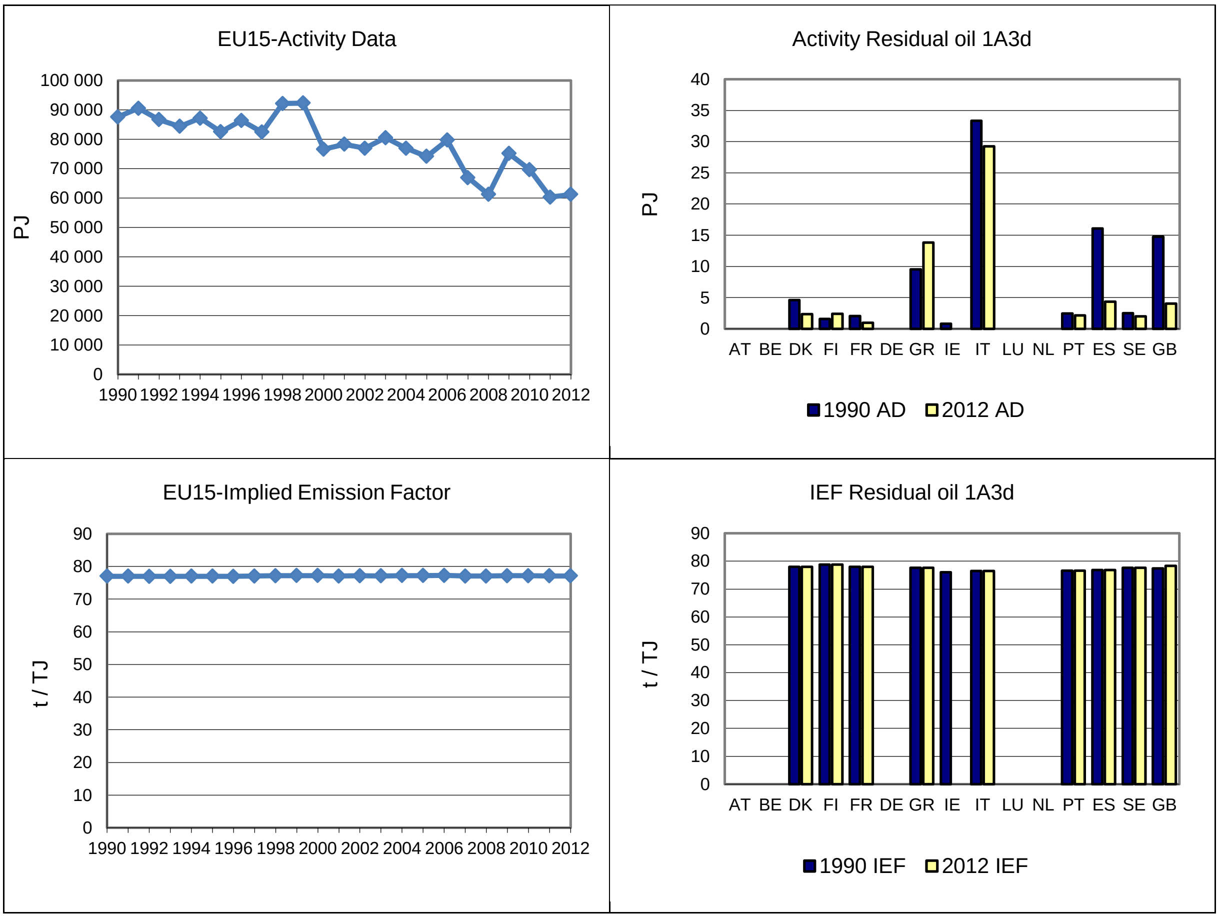
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	IE	IE	IE	-	-	-	-	-	NA	NA
Denmark	357	185	184	4%	-2	-1%	-173	-49%	T2	CS
Finland	123	200	189	4%	-11	-5%	66	53%	T2	CS
France	157	76	76	2%	-0.2	-0.3%	-81	-52%	T2	CS
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	738	846	1 071	23%	225	27%	332	45%	T1	D
Ireland	63	NO	NO	-	-	-	-63	-100%	NA	NA
Italy	2 553	2 143	2 239	47%	96	4%	-314	-12%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	188	145	163	3%	17	12%	-25	-13%	T2, CR	CR
Spain	1 234	453	333	7%	-120	-27%	-901	-73%	T2	M, CS
Sweden	194	250	153	3%	-97	-39%	-41	-21%	T2	CS
United Kingdom	1 140	350	316	7%	-34	-10%	-824	-72%	T2	CS
EU-15	**6 747**	**4 650**	**4 724**	**100%**	**74**	**2%**	**-2 024**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Greece, Italy and Spain account for 77 % of CO_2 emissions and for 77 % of activity data from residual oil in 2012 (Figure 3.66). The IEF for the EU-15 is 77.11 t/TJ Residual oil in 2012.

Table 3.64 shows, that the majority of CO_2 emissions from the combustion of residual oil in navigation were calculated using a higher tier method.

Figure 3.66 1A3d Navigation, residual oil: Activity data and implied emission factors for CO_2



1A3d Navigation – Gas/Diesel Oil (CO_2)

CO_2 emissions from Gas/Diesel oil account for 61 % of CO_2 emissions from 1A3d Navigation in 2012 (Table 3.65). The CO_2 emissions from Gas/Diesel oil decreased by 19 % between 1990 and 2012.

Table 3.65 1A3d Navigation, gas/diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

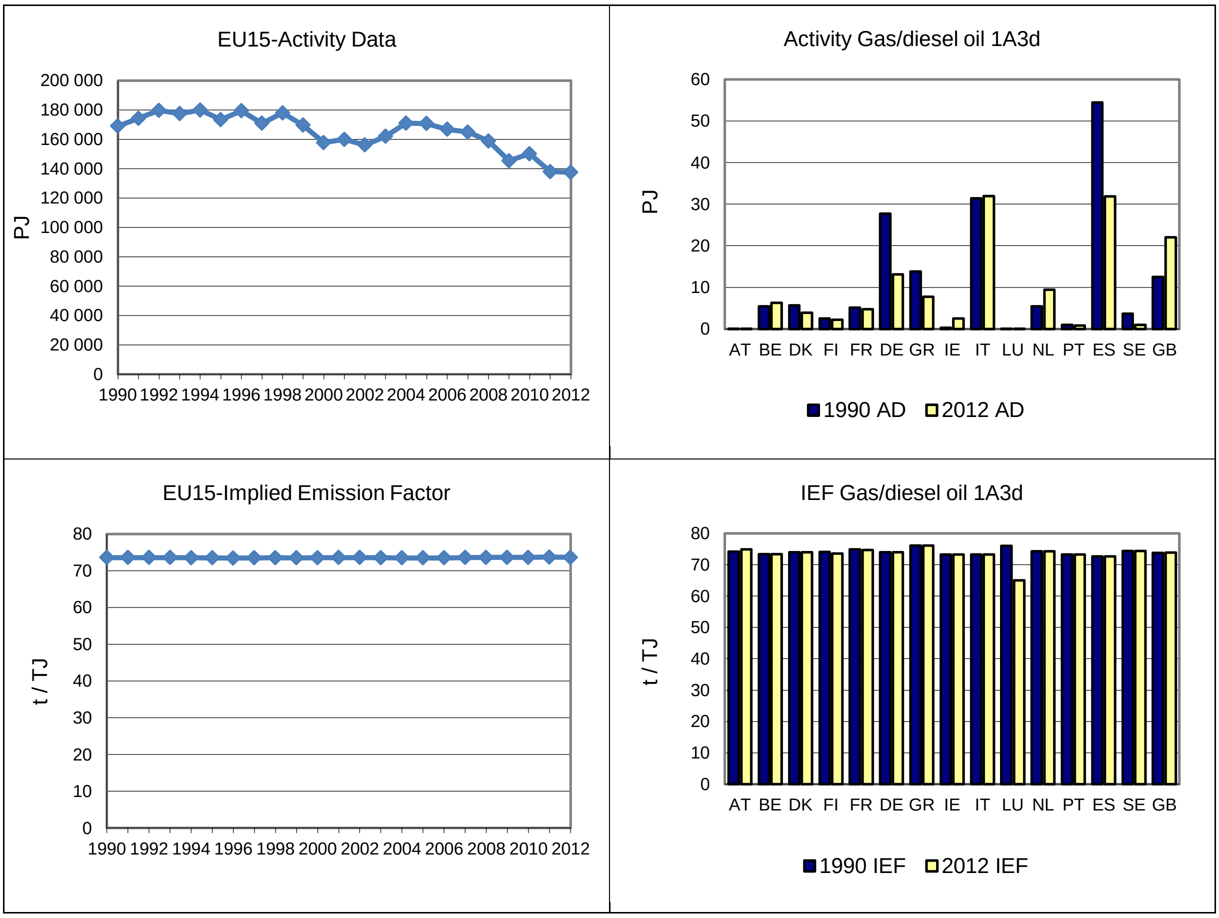
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	4	3	3	0.03%	0.3	9%	-1	-21%	T2	CS
Belgium	398	474	463	5%	-11	-2%	65	16%	T2	CS,D
Denmark	417	349	289	3%	-60	-17%	-127	-31%	T2	CS
Finland	186	185	162	2%	-22	-12%	-24	-13%	M,T3	CS
France	382	371	353	3%	-18	-5%	-29	-8%	T2	CS
Germany	2 050	892	971	10%	79	9%	-1 079	-53%	T2	CS
Greece	1 052	805	589	6%	-216	-27%	-463	-44%	T1	D
Ireland	22	172	182	2%	10	6%	159	718%	T2	CS
Italy	2 299	2 235	2 342	23%	107	5%	43	2%	T2	CS
Luxembourg	1	1	1	0.01%	-0.001	-0.1%	0.2	20%	T2	CS
Netherlands	405	664	699	7%	35	5%	294	73%	T2	CS
Portugal	72	56	63	1%	7	12%	-10	-13%	T2, CR	CR
Spain	3 953	2 102	2 316	23%	214	10%	-1 638	-41%	T2	M, CS
Sweden	272	161	72	1%	-89	-55%	-200	-73%	T2	CS
United Kingdom	921	1 706	1 626	16%	-80	-5%	706	77%	T2	CS
EU-15	**12 434**	**10 175**	**10 131**	**100%**	**-45**	**-0.4%**	**-2 303**	**-19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Greece, Italy, Spain and the United Kingdom account for 78 % of the CO_2 emissions and for 78 % of activity data from gas/diesel oil in 2012 (Figure 3.67). The IEF for the EU-15 is 73.62 t/TJ residual oil in 2012.

Table 3.65 shows that the majority of CO_2 emissions from the combustion of gas/diesel oil in navigation were calculated using a higher tier method.

Figure 3.67 1A3d Navigation, gas/diesel oil: Activity data and implied emission factors for CO_2



3.2.3.5 Other (1A3e) (EU-15)

CO_2 emissions from 1A3e Other account for 0.2 % of total EU-15 GHG emissions in 2012. This source includes mainly pipeline transport and ground activities in airports and harbours. The emissions from this key source are due to fossil fuel consumption in other transportation, which increased by 10 % between 1990 and 2012. A fuel shift occurred from oil to gas.

Germany contributed 53 % to the EU-15 emissions from this source in 2012 (Table 3.66). Between 1990 and 2012 the EU-15 emissions increased by 10 %. Denmark, Luxembourg and the Netherlands report emissions as ‘Not occurring’ or ‘Not applicable’. Portugal includes off-road vehicles and machines from manufacturing industries, residential and commercial/institutional with the other combustion equipment of these source categories; emissions from the consumption of jet fuel from military operation in 1 A 5 b (Other Mobile); and emissions from off-road vehicles and machines from agriculture/forestry sector in 1 A 4 c Agriculture/Forestry/Fisheries (see country NIR Portugal, p.154-155).

Table 3.66 1A3e Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	224	397	394	5%	-4	-1%	169	75%
Belgium	225	239	185	2%	-54	-22%	-40	-18%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	660	648	633	8%	-15	-2%	-27	-4%
France	213	500	536	7%	35	7%	322	151%
Germany	4 752	4 168	4 134	53%	-34	-1%	-618	-13%
Greece	NO	11	11	0.1%	-0.2	-1%	11	-
Ireland	62	153	142	2%	-11	-7%	80	129%
Italy	407	690	706	9%	16	2%	299	73%
Luxembourg	NA	NA	NA	-	-	-	-	-
Netherlands	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	IE	IE	IE	-	-	-	-	-
Spain	20	295	284	4%	-11	-4%	264	1302%
Sweden	272	295	296	4%	1	0.3%	24	9%
United Kingdom	225	441	444	6%	3	1%	219	97%
EU-15	**7 061**	**7 838**	**7 764**	**100%**	**-73**	**-1%**	**704**	**10%**

Abbreviations explained in the Chapter 'Units and abbreviation

3.2.4 Other Sectors (CRF Source Category 1A4) (EU-15)

Category 1A4 mainly includes emissions from 'small scale fuel combustion' used for space heating and hot water production in commercial and institutional buildings, households, agriculture and forestry. It includes also emissions from mobile machinery used within these categories (e.g mowers, harvesters, tractors, chain saws, motor pumps) as well as fuel used for grain drying, horticultural greenhouse heating or CO_2 fertilisation and stall heating. Category 1A4c includes emissions from domestic inland, coastal, deep sea and international fishing. Emissions from transportation of agricultural goods are reported under category 1A3 Transport.

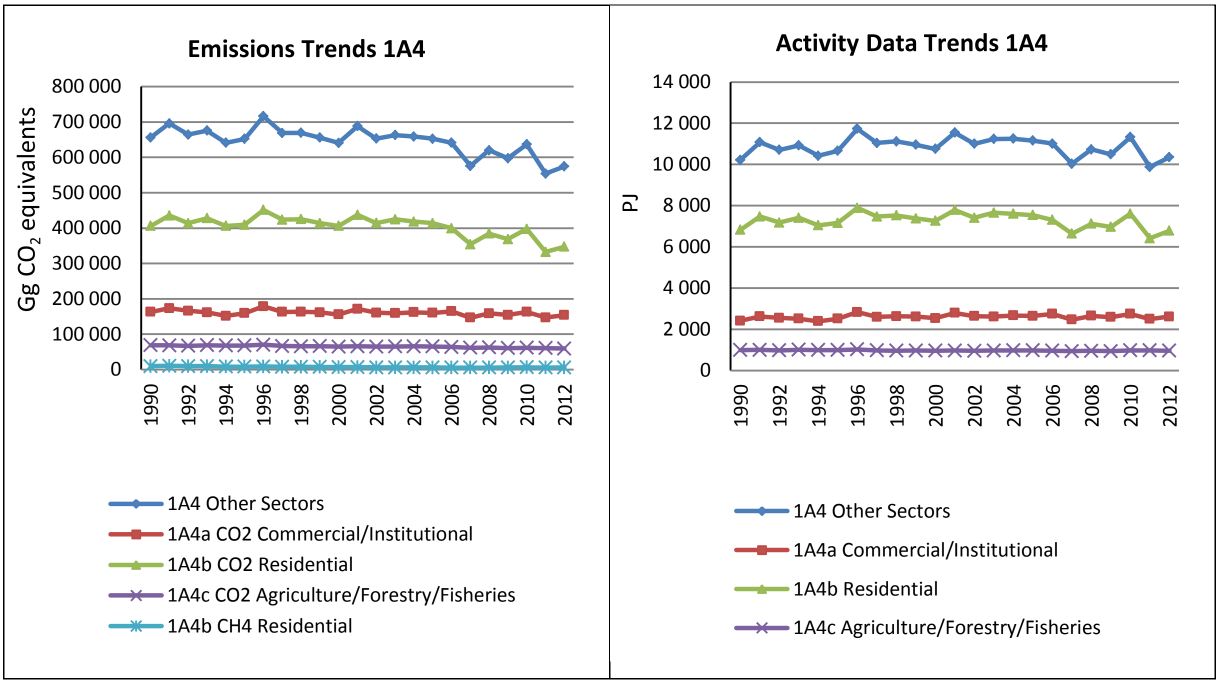
The following enumeration shows the correspondence of 1A4 sub categories and ISIC 3.1 rev codes:

- 1 A 4 a Commercial/Institutional: ISIC categories 4103, 42, 6, 719, 72, 8, and 91-96
- 1 A 4 b Residential: All emissions from fuel combustion in households
- 1 A 4 b Agriculture/Forestry/Fishing: ISIC categories 05, 11, 12, 1302

In 2012 category 1A4 contributed to 574 162 Gg CO_2 equivalents of which 97.6 % CO_2, 1.4 % CH_4 and 1.1 % N_2O.

Figure 3.68 shows the trend of total GHG emissions within source category 1A4 and the dominating sources: CO_2 emissions from 1A4b Residential and from 1A4a Commercial/Residential. The emission trends of the large key sources show larger fluctuations between 1990 and 2012. Between 1990 and 2012 emissions from 1A4 decreased by 12 %. Between 2011 to 2012 emissions significantly increased by 4% (20 Mt CO_2 equivalents) which is mainly due to an increase of category 1A4b which increased by 4.5% (15 Mt CO_2 equivalents).

Figure 3.68 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends



In 2012 GHG emissions from source category 1A4 accounted for 16 % of total GHG emissions. This source category includes ten key sources which contributed to 98% of total 1A4 GHG emissions. The following list shows the key sources and their contribution to total 1A4 GHG emissions for the year 2012:

- 1 A 4 a Commercial/Institutional: Gaseous Fuels - CO_2 (18 %)
- 1 A 4 a Commercial/Institutional: Liquid Fuels - CO_2 (7 %)
- 1 A 4 a Commercial/Institutional: Solid Fuels - CO_2 (0.4 %)
- 1 A 4 a Commercial/Institutional: Other Fuels – CO_2 (0.7 %)
- 1 A 4 b Residential: Gaseous Fuels - CO_2 (40 %)
- 1 A 4 b Residential: Liquid Fuels - CO_2 (18 %)
- 1 A 4 b Residential: Solid Fuels - CO_2 (2 %)
- 1 A 4 b Residential: Biomass - CH_4 (0.8 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels - CO_2 (2 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels - CO_2 (8 %)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels - CO_2 (0.1 %)

Table 3.67 shows total GHG, CO_2 and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2012 CO_2 emissions from 1A4 Other Sectors decreased by 12 %, CH_4 decreased by 32 % and N_2O emissions decreased by 7 %.

Table 3.67 1A4 Other Sectors: Member States' contributions to total GHG, CO_2 and CH_4 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)
Austria	14 407	9 498	13 786	9 097	387	202
Belgium	27 656	25 077	27 287	24 717	266	256
Denmark	9 159	5 282	8 976	5 038	113	157
Finland	7 176	4 288	6 907	3 957	183	256
France	100 631	98 048	95 598	95 393	3 736	1 252
Germany	208 066	139 050	204 483	137 532	2 595	929
Greece	8 592	9 383	8 126	9 161	84	86
Ireland	10 518	9 068	10 031	8 830	379	148
Italy	78 569	84 991	76 634	81 812	446	1 179
Luxembourg	1 323	1 624	1 310	1 606	9	8
Netherlands	38 291	39 588	37 791	38 217	455	1 328
Portugal	4 658	4 510	4 070	4 150	348	198
Spain	26 172	42 164	25 093	40 781	761	956
Sweden	10 809	3 155	10 389	2 754	243	284
United Kingdom	110 033	98 440	107 538	97 239	1 525	570
EU-15	**656 059**	**574 167**	**638 019**	**560 284**	**11 531**	**7 811**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.68 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A4 Other sectors for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 3.68 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-556	-5.4	Revised energy balance.
Belgium	-33	-0.1	-1 029	-4.2	Energy balance update (final values 2011) 1A4a liquid fuels: reallocation of off-road activities in harbours, airports and transhipment companies in 1A3e and 1A5b (defence) instead of 1A4a before 1A4b liquid fuels: Flanders: for fuel oil, the data from 2002 were based on an estimate of the number of households from the latest census of 2001 using heating oil as main energy source, corrected with newly built homes (+) and demolished houses (-). The switch in existing houses from fuel oil to natural gas was so far not taken into account, leading to an accumulated overestimation of households using fuel oil as main energy source. This correction was made during the 2014 submission for the years 2002-2012. 1A4b biomass: Flanders en Wallonia: new methodology to estimate the woodconsumption for households.The methology uses the urbanisation degree and unweighted average uses of biomass as main heating source or as secondary heating source from the Eurostat survey to calculate the total biomass used for the period 1990 -2011. 1A4c liquid fuels: RBC : Offroad AD revision (energy)
Denmark	2	0.0	18	0.3	The number and engine size of machine pool tractors has been updated for the years 2007-2011. The number of ATV's has been changed for the years 2009-2011. Errors in the fuel consumption for fisheries in 2000, 2010 and 2011 have been corrected.
Finland	0	0.0	-56	-1.5	Corrections in activity data. Updates in space heating model.
France	-1	0.0	1 512	1.7	Recalculations performed are due to changes in activity data : - update of energy balance statistics, - update of fuel type split for petroleum products (data from CPDP statistics).
Germany	0	0.0	9 831	8.1	Final data available from the National Energy Balance.
Greece	0	0.0	0	0.00	
Ireland	0	0.0	-10	-0.1	Revised charcoal use quantity.
Italy	0	0.0	-336	-0.4	Update of waste fuel consumption with energy recovery. Update of residual oil and natural gas emission factor. Update of AD waste and industrial waste.
Luxembourg	0	0.0	12	0.8	Revised energy balance.
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-7	-0.2	Recalculations in this source category results from the revision of the 2003, 2008, 2009 and 2011 energy balance data.
Spain	-227	-0.9	7 792	22.7	Light differences due to a revision of the significant digits of the emission factor for diesel/gas-oil. Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
Sweden	4	0.0	-78	-2.5	Revision of activity data due to updated energy balances.
UK	39	0.0	3 189	3.8	National energy statistics revised for many sectors from 2008 onwards. 1A4b: Revision to carbon balance apprach to use AD and EFS from ISSB/Tata in preference to DUKES stats and historic EF defaults.
EU-15	**-216**	**0.0**	**20 284**	**3.9**	

Table 3.69 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1A4 Other sectors for 1990 and 2011.

Table 3.69 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

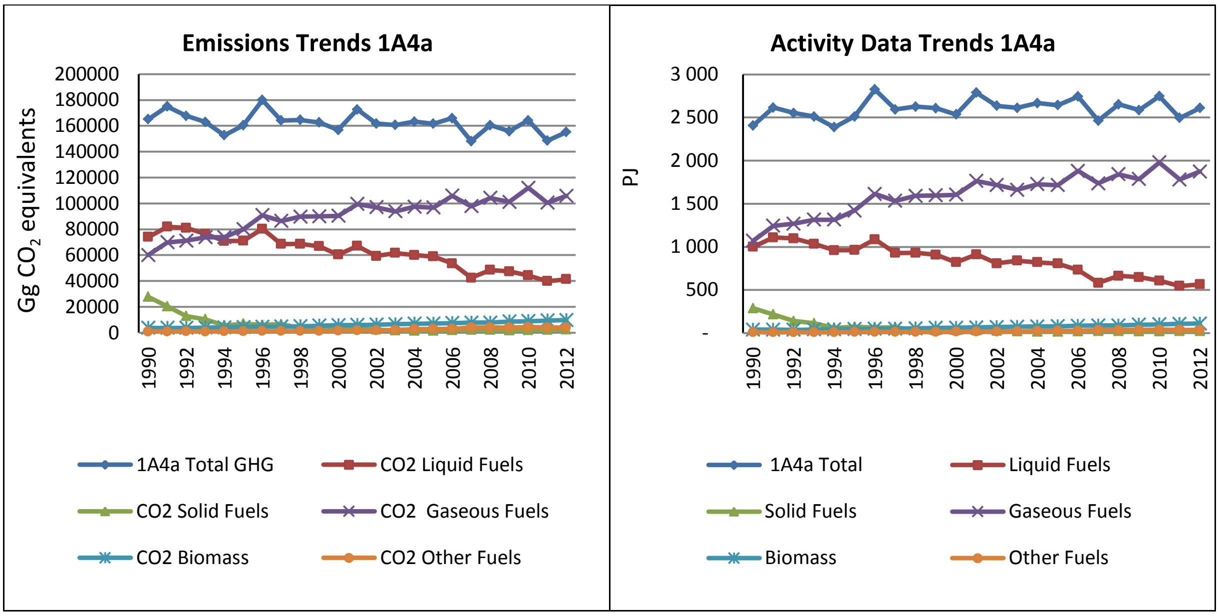
	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	1	0.2	1	0.3	Revised energy balance.
Belgium	17	7.0	59	38.8	Energy balance update (final values 2011) 1A4a liquid fuels: reallocation of off-road activities in harbours, airports and transhipment companies in 1A3e and 1A5b (defence) instead of 1A4a before 1A4b liquid fuels: Flanders: for fuel oil, the data from 2002 were based on an estimate of the number of households from the latest census of 2001 using heating oil as main energy source, corrected with newly built homes (+) and demolished houses (-). The switch in existing houses from fuel oil to natural gas was so far not taken into account, leading to an accumulated overestimation of households using fuel oil as main energy source. This correction was made during the 2014 submission for the years 2002-2012. 1A4b biomass: Flanders en Wallonia: new methodology to estimate the woodconsumption for households.The methology uses the urbanisation degree and unweighted average uses of biomass as main heating source or as secondary heating source from the Eurostat survey to calculate the total biomass used for the period 1990 -2011. 1A4c liquid fuels: RBC : Offroad AD revision (energy)
Denmark	5	4.5	15	10.2	The CH4 emission from residential wood combustion has been recalculated based on improved emission factors for stoves. This has caused a 16 % increase of the CH4 emission reported for biomass fuels in residential plants for 2011.
Finland	0	0.0	0	0.2	Corrections in activity data. Updates in space heating model.
France	0	0.0	3	0.3	Filtering method: improved accuracy.
Germany	0	0.0	42	4.9	Final data available from the National Energy Balance.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	-1	-0.7	Revised bituminous coal quantity in Energy Balance. Revised charcoal use quantity.
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.5	Revised energy balance.
Netherlands	0	0.0	0	0.0	
Portugal	-1	-0.2	3	1.7	Revision of the 2011 energy balance data.
Spain	-56	-6.8	219	30.5	Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
Sweden	0	0.0	-17	-5.5	Revision of activity data due to updated energy balances.
UK	0	0.0	5	0.9	National energy statistics revised for many sectors from 2008 onwards. Reallocation within biomass to anaerobic digestion (now reported within 1A2f).
EU-15	**-33**	**-0.3**	**330**	**4.5**	

3.2.4.1 Commercial/Institutional (1A4a) (EU-15)

In this chapter information about emission trends, Member states' contribution, activity data, and emission factors is provided for category 1A4a by fuels. CO_2 emissions from 1A4a Commercial/Institutional accounted for 4.3 % of total GHG emissions in 2012.

Figure 3.69 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Between 1990 and 2012 GHG emissions decreased by 6 %, mainly due to decreases in CO_2 emissions from solid (-91 %) and liquid (-44 %) fuels while CO_2 emissions from gaseous fuels showed an continuous uptrend for the whole time series until 2012. Between 2011 and 2012 the CO_2 emissions increased by 4 %, mainly driven by a increase in gaseous and liquid fuel consumption.

Figure 3.69 1A4a Commercial/Institutional: Total and CO_2 emission and activity trends



Between 1990 and 2012, CO_2 emissions from 1A4a decreased by 6 % in the EU-15 (Table 3.70). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of offices, (3) building codes, (4) thermal properties of building stock, (5) fuel split for heating and warm water, (6) use of renewable energy sources, e.g. biomass or solar panels, and (7) use of district heating. Fossil fuel consumption in Commercial/Institutional increased by 9 % between 1990 and 2012.

France, Germany, Italy and the United Kingdom contributed the most to the emissions from this source (75 %). The Member States with the highest increases in absolute terms were Spain, Italy and the Netherlands. The Member States with the highest reduction in absolute terms were Germany, the United Kingdom and Sweden.

Table 3.70 1A4a Commercial/Institutional: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	2 568	1 951	1 423	1%	-528	-27%	-1 145	-45%
Belgium	4 253	5 187	5 911	4%	725	14%	1 658	39%
Denmark	1 486	910	824	1%	-86	-9%	-662	-45%
Finland	1 940	926	1 014	1%	88	9%	-925	-48%
France	28 763	26 482	28 718	19%	2 236	8%	-45	-0.2%
Germany	63 950	35 462	38 016	25%	2 554	7%	-25 934	-41%
Greece	527	1 076	1 341	1%	265	25%	814	154%
Ireland	2 319	2 090	2 101	1%	11	1%	-217	-9%
Italy	16 144	27 799	27 729	18%	-70	-0.3%	11 585	72%
Luxembourg	634	412	635	0.4%	223	54%	1	0.2%
Netherlands	8 379	9 971	11 075	7%	1 104	11%	2 696	32%
Portugal	749	1 091	1 102	1%	11	1%	353	47%
Spain	3 804	13 920	13 241	9%	-680	-5%	9 437	248%
Sweden	2 533	681	495	0.3%	-186	-27%	-2 038	-80%
United Kingdom	24 817	19 043	20 070	13%	1 026	5%	-4 748	-19%
EU-15	**162 865**	**147 002**	**153 696**	**100%**	**6 694**	**5%**	**-9 170**	**-6%**

1A4 a Commercial/Institutional – Liquid Fuels (CO_2)

In 2012 CO_2 emissions from liquid fuels had a share of 27 % within source category 1A4a (compared to 45 % in 1990). Between 1990 and 2012, the emissions decreased by 44 % (Table 3.71). Only two Member States had increases in this period, with the highest absolute increase in Greece and Spain. The highest absolute decrease was achieved in Germany. Between 2011 and 2012 EU-15 total emissions increased by 4 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oil tanks in 2007 because of high ou tdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

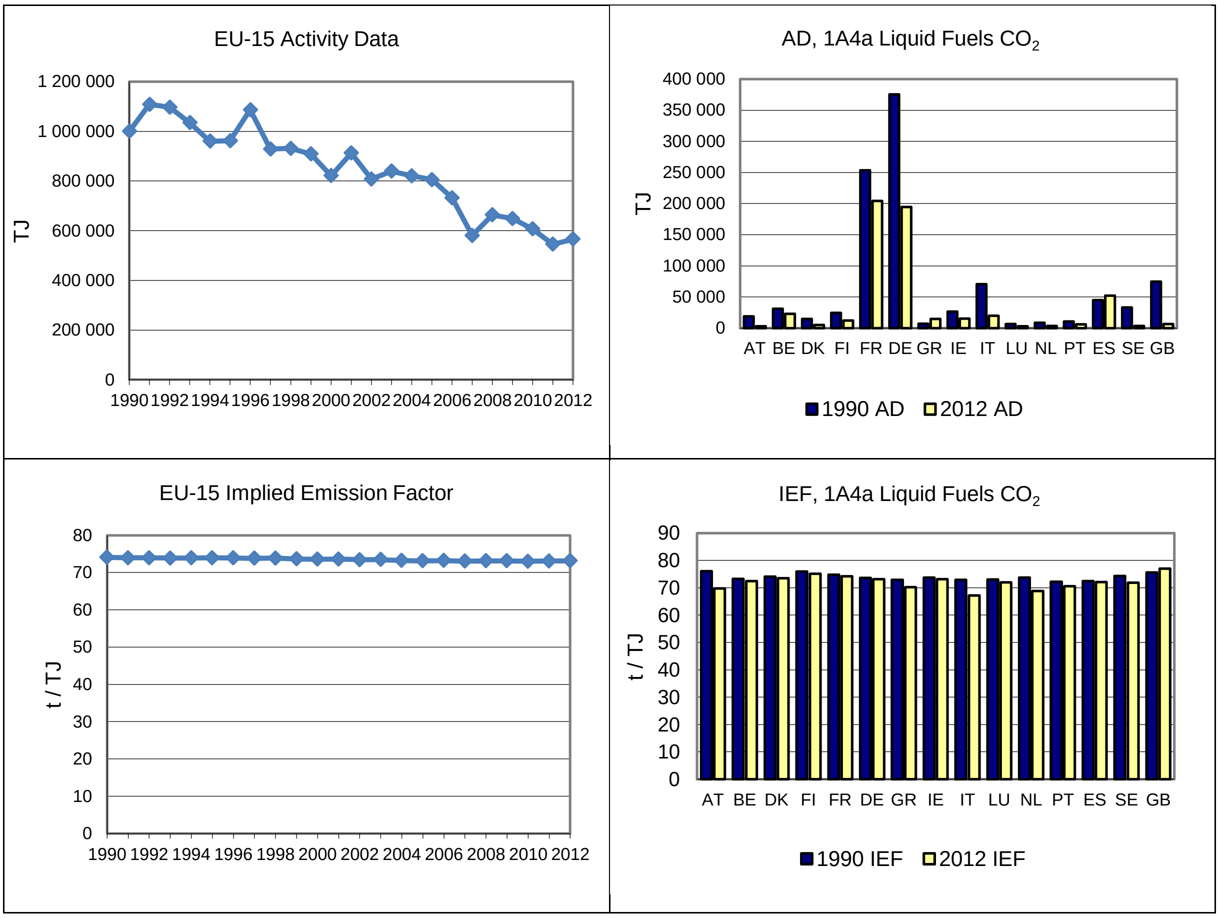
Table 3.71 1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	1 421	422	189	0.5%	-233	-55%	-1 232	-87%	T2	CS
Belgium	2 290	1 452	1 642	4%	190	13%	-648	-28%	T1	D
Denmark	1 081	333	366	1%	33	10%	-715	-66%	T2,T1	CS,D
Finland	1 873	805	899	2%	95	12%	-974	-52%	T1	CS
France	18 956	14 423	15 182	37%	759	5%	-3 773	-20%	T2	CS
Germany	27 633	13 171	14 244	34%	1 073	8%	-13 389	-48%	CS	CS
Greece	505	694	1 021	2%	327	47%	516	102%	T2	D
Ireland	1 957	1 183	1 102	3%	-81	-7%	-855	-44%	T1	CS
Italy	5 157	1 562	1 319	3%	-242	-16%	-3 838	-74%	T2	CS
Luxembourg	464	137	216	1%	79	58%	-249	-54%	T2	CS
Netherlands	619	232	247	1%	15	6%	-372	-60%	T2	CS,D
Portugal	749	470	435	1%	-35	-7%	-314	-42%	T2	D, CR
Spain	3 254	4 047	3 753	9%	-294	-7%	499	15%	T2	M, CS
Sweden	2 447	406	262	1%	-144	-35%	-2 185	-89%	T1	CS
United Kingdom	5 642	535	492	1%	-43	-8%	-5 150	-91%	T2	CS
EU-15	**74 049**	**39 872**	**41 371**	**100%**	**1 499**	**4%**	**-32 678**	**-44%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.70 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany and Spain; together they cause 80 % of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 43 % between 1990 and 2012. The implied emission factor of EU-15 was 73.1 t/TJ in 2012. The dip in activity data 2007 is mainly due to Germany due to reasons explained earlier in this chapter.

Figure 3.70 1A4a Commercial/Institutional, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2012, CO_2 from solid fuels had a share of 2 % within source category 1A4a (compared to 17 % in 1990). Between 1990 and 2012 the emissions decreased by 91 % (Table 3.72). Eight Member States report emissions as ‘Not occurring’ in 2012; all other Member States reduced emissions between 1990 and 2012 except Spain. Between 2011 and 2012 EU-15 emissions increased by 3 %.

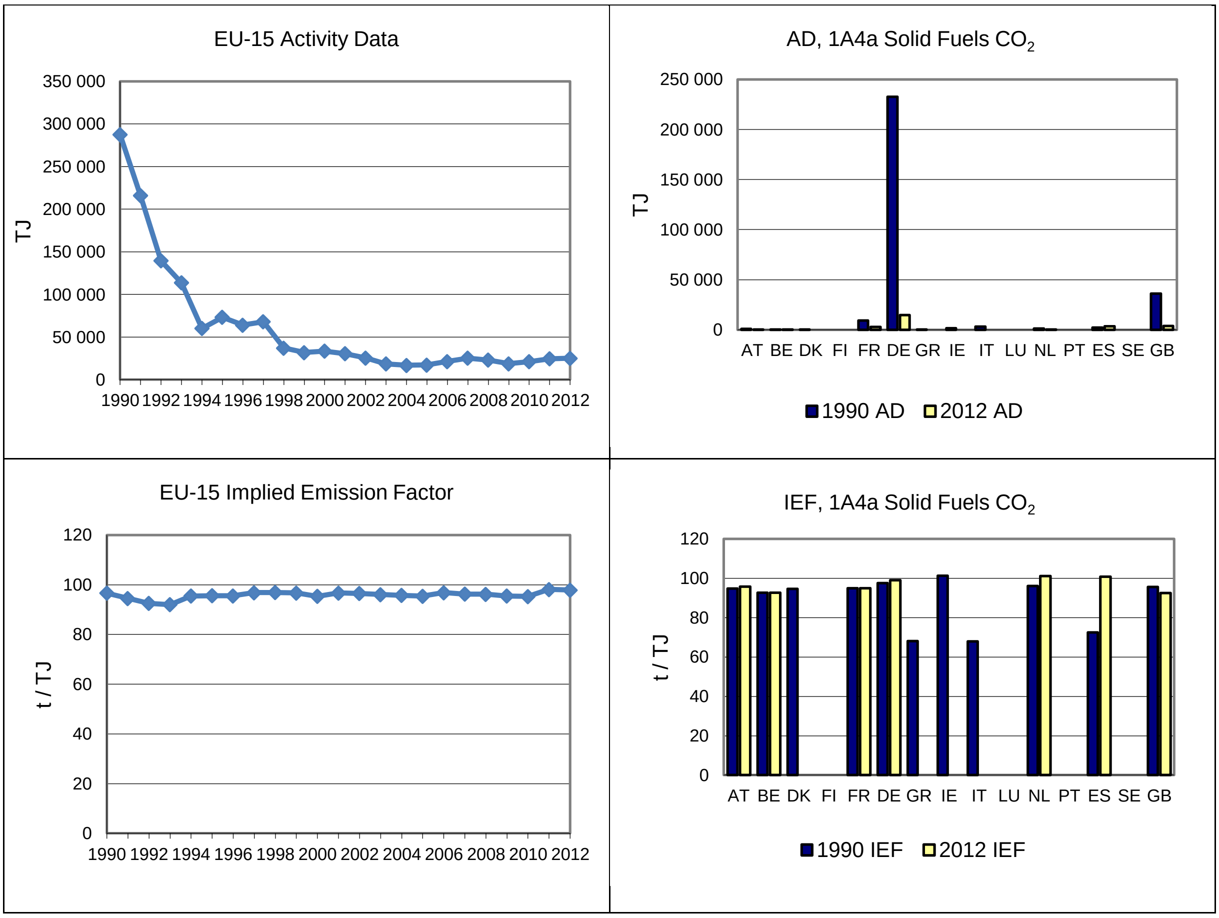
Table 3.72 1A4a Commercial/Institutional, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	90	17	15	1%	-2	-12%	-75	-83%	T2	CS
Belgium	9	0	1	0.05%	1	475%	-8	-87%	T1	D
Denmark	8	NO	NO	-	-	-	-8	-100%	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	868	161	274	11%	113	70%	-594	-68%	T2	CS
Germany	22 712	1 434	1 459	59%	25	2%	-21 253	-94%	CS	CS
Greece	22	NO	NO	-	-	-	-22	-100%	NA	NA
Ireland	138	NO	NO	-	-	-	-138	-100%	NA	NA
Italy	218	NO	NO	-	-	-	-218	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	128	27	5	0.2%	-22	-83%	-123	-96%	T2	CS,D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	154	370	353	14%	-17	-5%	199	129%	T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	3 454	395	359	15%	-36	-9%	-3 094	-90%	T2	CS
EU-15	**27 802**	**2 406**	**2 467**	**100%**	**62**	**3%**	**-25 335**	**-91%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.71 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany, Spain and the United Kingdom in 2012; together they cause 88 % of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 91 % between 1990 and 2012. The implied emission factor of EU-15 was 97.8 t/TJ in 2012. The implied emission factors of Italy and Spain are comparatively low because of a high share of gas works gas is included.

Figure 3.71 1A4a Commercial/Institutional, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2012 CO_2 from gaseous fuels had a share of 68 % within source category 1A4a (compared to 36 % in 1990). Between 1990 and 2012, the emissions increased by 76 % (Table 3.73). All Member States reported increasing emissions. The highest absolute increases occurred in Germany, France; Italy and Spain. Between 2011 and 2012 EU-15 emissions increased by 5 %.

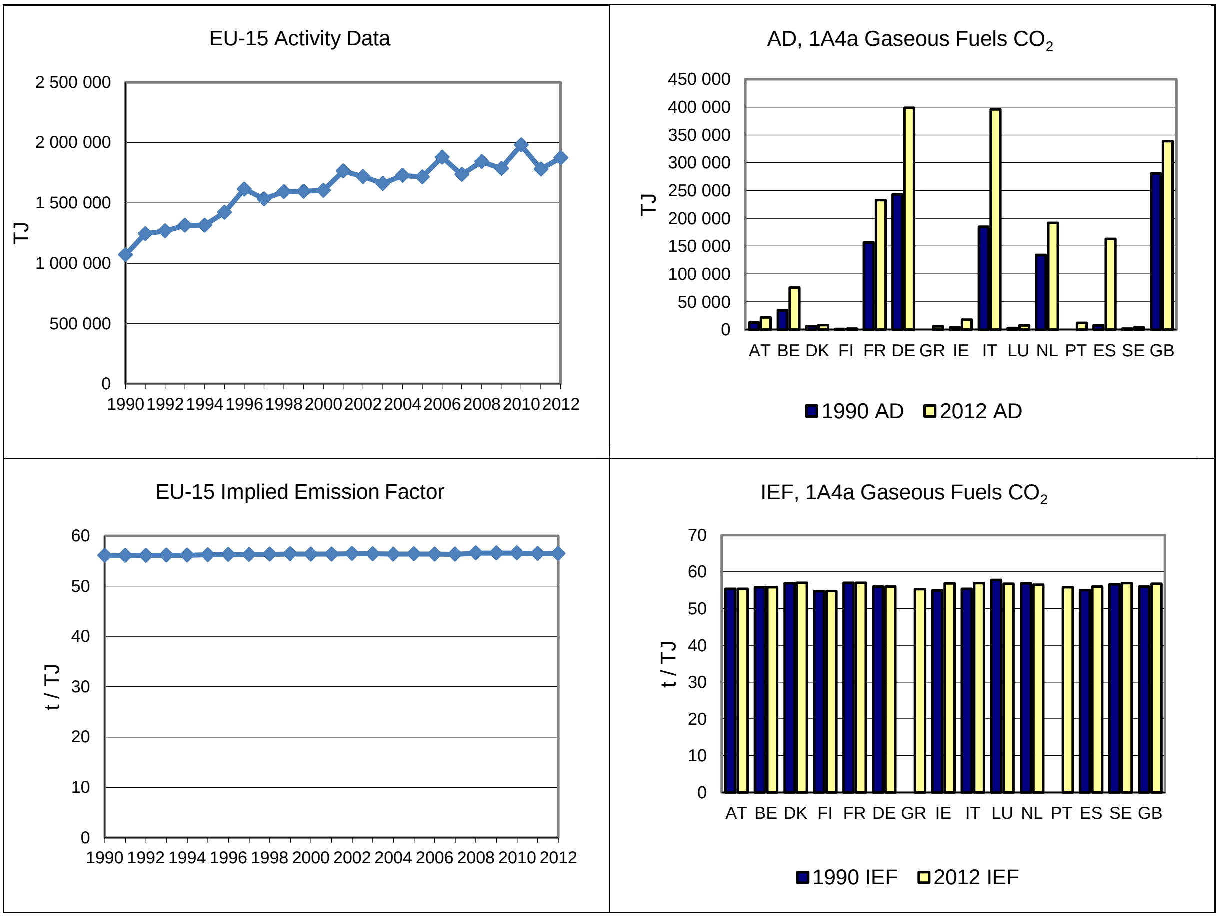
Table 3.73 1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	707	1 510	1 217	1%	-293	-19%	510	72%	T2	CS
Belgium	1 924	3 660	4 194	4%	534	15%	2 270	118%	T1	D
Denmark	363	570	449	0.4%	-121	-21%	86	24%	T3	CS
Finland	50	108	100	0.1%	-8	-7%	50	98%	T1	CS
France	8 939	11 897	13 261	13%	1 364	11%	4 322	48%	T2	CS
Germany	13 605	20 857	22 313	21%	1 456	7%	8 708	64%	CS	CS
Greece	NO	381	320	0.3%	-61	-16%	320	-	T2	CS
Ireland	223	907	999	1%	93	10%	776	347%	T1	CS
Italy	10 243	22 164	22 522	21%	357	2%	12 279	120%	T2	CS
Luxembourg	170	276	420	0.4%	144	52%	250	147%	T2	CS
Netherlands	7 632	9 712	10 823	10%	1 111	11%	3 191	42%	T2	CS
Portugal	NO	621	667	1%	45	7%	667	-	T2	D, CR
Spain	395	9 503	9 134	9%	-369	-4%	8 739	2211%	T2	CS
Sweden	86	275	233	0.2%	-42	-15%	147	171%	T1	CS
United Kingdom	15 721	18 114	19 219	18%	1 105	6%	3 497	22%	T2	CS
EU-15	**60 058**	**100 554**	**105 869**	**100%**	**5 314**	**5%**	**45 810**	**76%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.72 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, the Netherlands and the UK; together they cause 83 % of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion in the EU-15 rose by 75 % between 1990 and 2012. The implied emission factor of EU-15 was 56.5 t/TJ in 2012.

Figure 3.72 1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A4a Commercial/Institutional – Other Fuels (CO_2)

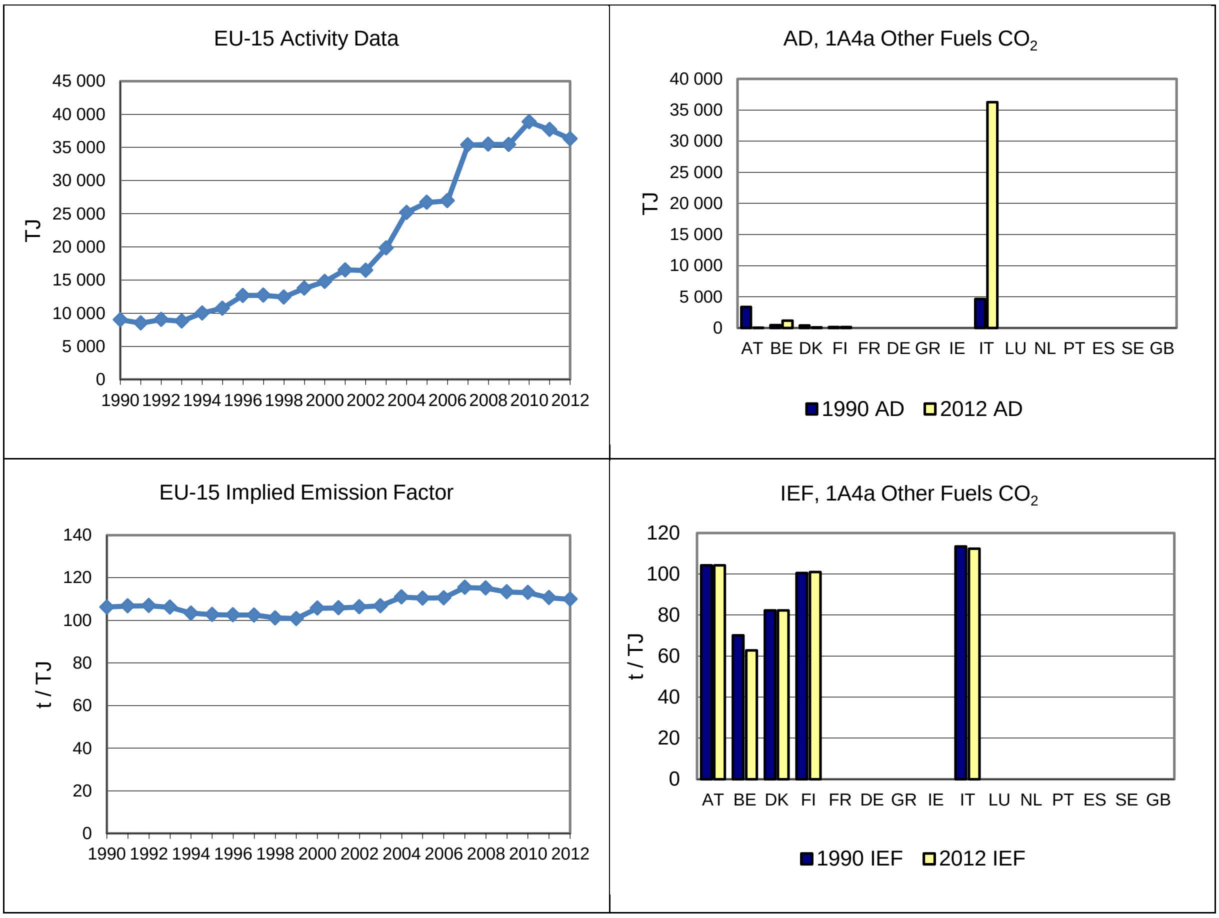
In 2012, CO_2 from other fuels had a share of 3 %. Between 1990 and 2012 the emissions increased by 317 % (Table 3.74). Ten Member States report emissions as 'Not occurring' in 2012; all other Member States reduced emissions between 1990 and 2012 except Italy and Belgium. Between 2011 and 2012 EU-15 emissions decreased by 4 %.

Table 3.74: 1A4a Commercial/Institutional, other fuels: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	350	2	2	0.1%	0.1	6%	-347	-99%	T2	D
Belgium	31	74	74	2%	-0.1	-0.2%	43	140%	T1	D
Denmark	34	7	10	0.2%	3	42%	-24	-72%	T3	CS
Finland	16	13	15	0.4%	1	11%	-1	-6%	T1	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	526	4 074	3 888	97%	-185	-5%	3 362	639%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NO	NO	NO	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**956**	**4 170**	**3 989**	**100%**	**-181**	**-4%**	**3 033**	**317%**		

Figure 3.73 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Italy; it causes 97.5 % of the CO_2 emissions from other fuels in 1A4a. The implied emission factor of EU-15 was 109.9 t/TJ in 2012.

Figure 3.73 1A4a Commercial/Institutional, other fuels: Activity Data and Implied Emission Factors for CO_2

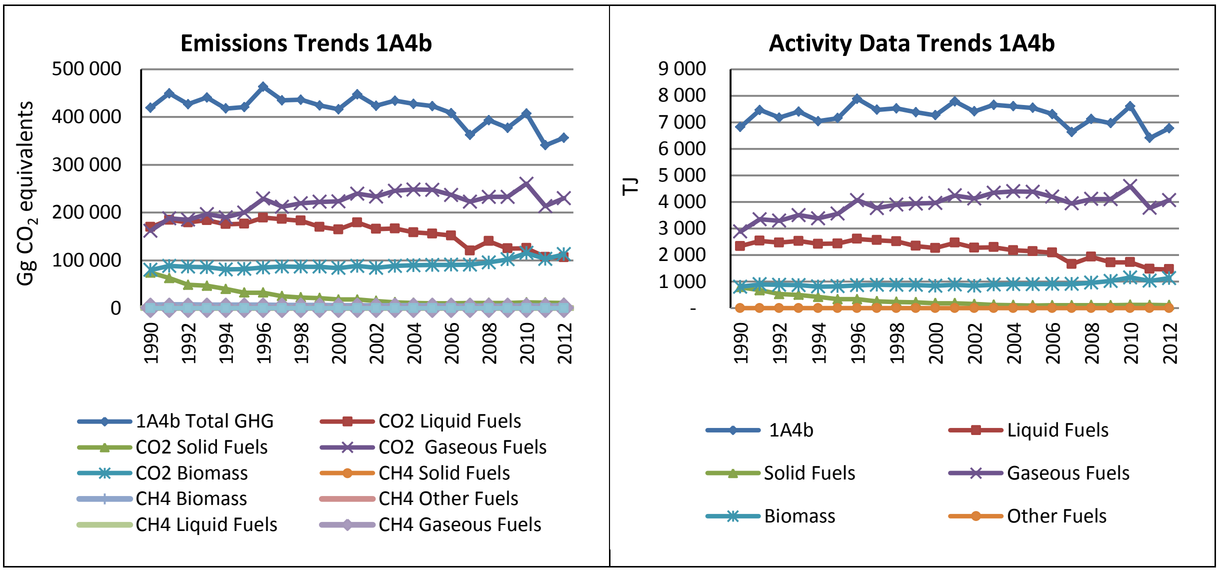


3.2.4.2 Residential (1A4b) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4b by fuels. CO_2 emissions from 1A4b Residential are the sixth largest key category of GHG emissions in the EU-15 and account for 9.8 % of total GHG emissions in 2012.

Figure 3.74 shows the emission trend within the category 1A4b, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total GHG emissions decreased by 15% since 1990, although CO_2 emissions from gaseous fuels increased strongly (+42 %) which was counterbalanced by decreasing emissions from other fossil fuels.

Figure 3.74 1A4b Residential: Total, CO_2 and CH_4 emission and activity trends



CO_2 emissions from 1A4b Residential

Between 1990 and 2012, CO_2 emissions from households decreased by 14 % in the EU-15 (Table 3.75). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of dwellings, (3) building codes, (4 thermal properties of of building stock, (5) fuel split for heating and warm water, (6) use of renewable energy sources, e.g. biomass or solar panels, and (7) use of district heating. Fossil fuel consumption of households decreased by 6 % between 1990 and 2012, with a fuel shift from coal and oil to gas.

Between 1990 and 2012, the largest reduction in absolute terms was reported by Germany reducing emissions by 36.2 million tonnes. Only four Member States show increases in their emissions. One reason for the performance of the Nordic countries and Austria is increased use of district heating. As district heating replaces heating boilers in households, an increase in the share of district heating reduces CO_2 emissions from households (but increases emissions from energy industries if fossil fuels are used). In Germany, efficiency improvements and the fuel switch in eastern German households are two reasons for the emission reductions. Between 2011 and 2012 nine member States show a decrease in emissions while the three large contributors France, Germany and the United Kingdom show increases up to 13%.

Table 3.75 1A4b Residential: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	9 965	6 973	6 880	2%	-93	-1%	-3 085	-31%
Belgium	20 269	16 072	16 687	5%	616	4%	-3 581	-18%
Denmark	5 004	2 428	2 124	1%	-303	-12%	-2 879	-58%
Finland	3 108	1 319	1 429	0%	110	8%	-1 679	-54%
France	56 010	51 269	55 357	16%	4 088	8%	-653	-1%
Germany	129 474	89 578	93 321	27%	3 743	4%	-36 153	-28%
Greece	4 671	7 903	6 947	2%	-956	-12%	2 276	49%
Ireland	7 052	6 421	6 038	2%	-383	-6%	-1 014	-14%
Italy	52 118	47 838	47 268	14%	-569	-1%	-4 850	-9%
Luxembourg	660	1 046	920	0.3%	-125	-12%	260	39%
Netherlands	19 495	16 868	17 942	5%	1 074	6%	-1 553	-8%
Portugal	1 660	2 186	2 031	1%	-155	-7%	371	22%
Spain	12 979	17 000	16 658	5%	-342	-2%	3 679	28%
Sweden	6 256	825	772	0.2%	-53	-6%	-5 484	-88%
United Kingdom	77 498	64 573	72 976	21%	8 403	13%	-4 522	-6%
EU-15	**406 218**	**332 299**	**347 352**	**100%**	**15 053**	**5%**	**-58 867**	**-14%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2012 CO_2 from liquid fuels had a share of 30 % within source category 1A4b (compared to 40 % in 1990). Between 1990 and 2012 emissions decreased by 38 % (Table 3.76). The highest absolute increases showed Greece, Ireland and the United Kingdom. The highest absolute decreases were reported by Germany, France, Italy and Sweden. Between 2011 and 2012 EU-15 emissions decreased by 1 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oil tanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

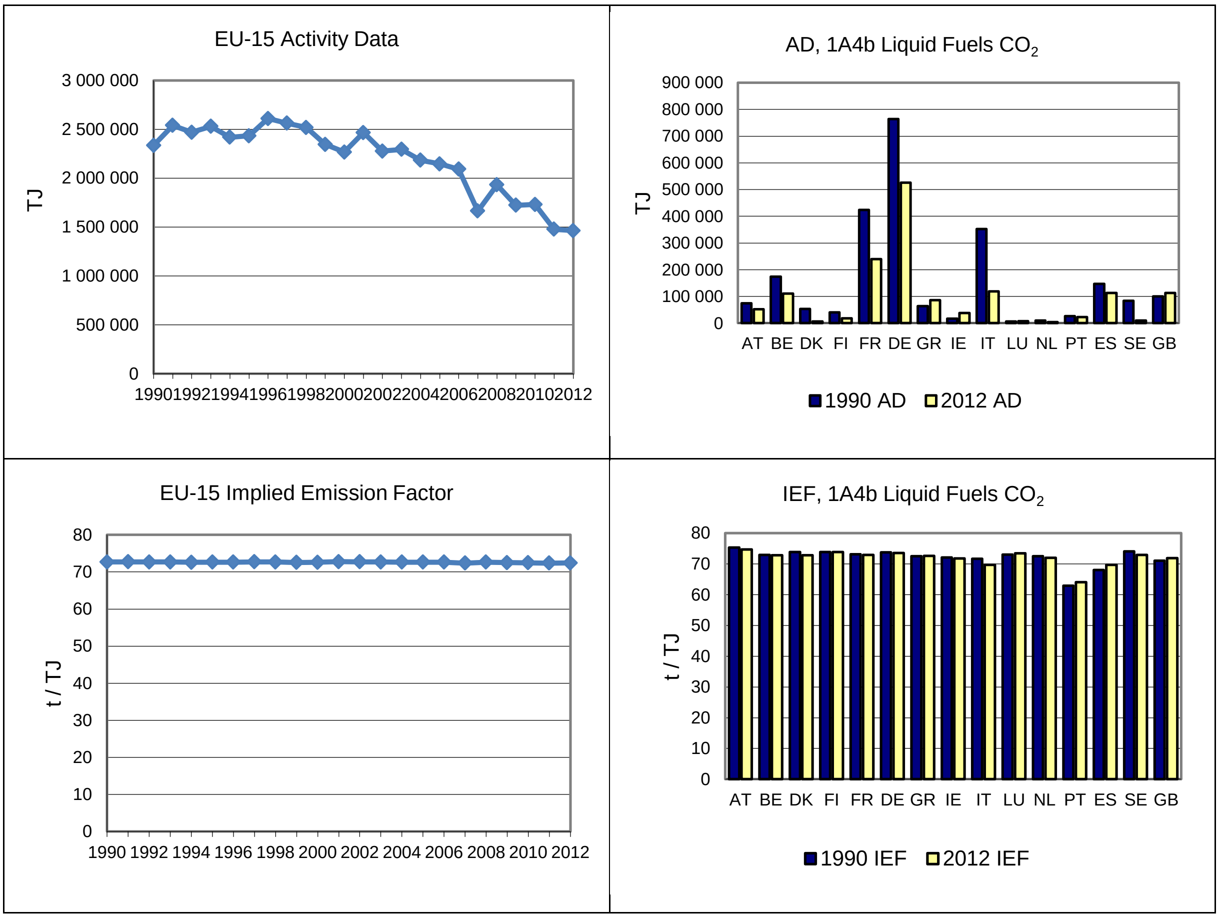
Table 3.76 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	5 605	3 964	3 880	4%	-84	-2%	-1 726	-31%	T2	CS
Belgium	12 665	8 422	8 091	8%	-331	-4%	-4 574	-36%	T1	D
Denmark	3 944	822	493	0.5%	-329	-40%	-3 451	-88%	T2,T1	CS,D
Finland	2 987	1 230	1 333	1%	103	8%	-1 655	-55%	T1	CS
France	31 011	17 376	17 434	16%	58	0%	-13 577	-44%	T2	CS
Germany	56 344	36 551	38 693	37%	2 142	6%	-17 651	-31%	CS	CS
Greece	4 585	7 080	6 227	6%	-853	-12%	1 642	36%	T2	D
Ireland	1 175	3 106	2 734	3%	-372	-12%	1 559	133%	T1	CS
Italy	25 292	9 154	8 241	8%	-913	-10%	-17 051	-67%	T2	CS
Luxembourg	464	529	521	0.5%	-8	-2%	56	12%	T2	CS
Netherlands	737	222	265	0.2%	43	19%	-473	-64%	T2	CS,D
Portugal	1 660	1 581	1 426	1%	-155	-10%	-234	-14%	T2	D, CR
Spain	9 971	8 329	7 863	7%	-466	-6%	-2 107	-21%	T2	M, CS
Sweden	6 170	700	682	1%	-18	-3%	-5 488	-89%	T1, T2	CS
United Kingdom	7 092	7 936	8 082	8%	146	2%	990	14%	T2	CS
EU-15	**169 703**	**107 001**	**105 964**	**100%**	**-1 037**	**-1%**	**-63 739**	**-38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.75 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France, Germany, Italy, Spain and the United Kingdom; together they cause 83 % of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 37 % between 1990 and 2012. The implied emission factor of EU-15 was 72.4 t/TJ in 2012. The implied emission factor of Portugal is lower than for other countries because a high share of city gas and LPG is used by the domestic sector.

Figure 3.75 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4b Residential –Solid Fuels (CO_2)

In 2012 CO_2 from solid fuels had a share of 3 % within source category 1A4b (compared to 18 % in 1990). Between 1990 and 2012 the emissions decreased by 85 % (Table 3.77). All Member States reported decreasing emissions with the highest reductions in absolute terms in Germany, the United Kingdom, Ireland and France. Between 2011 and 2012 EU-15 emissions decreased by 5 %. Sweden and Portugal report emissions as ‘Not occuring’.

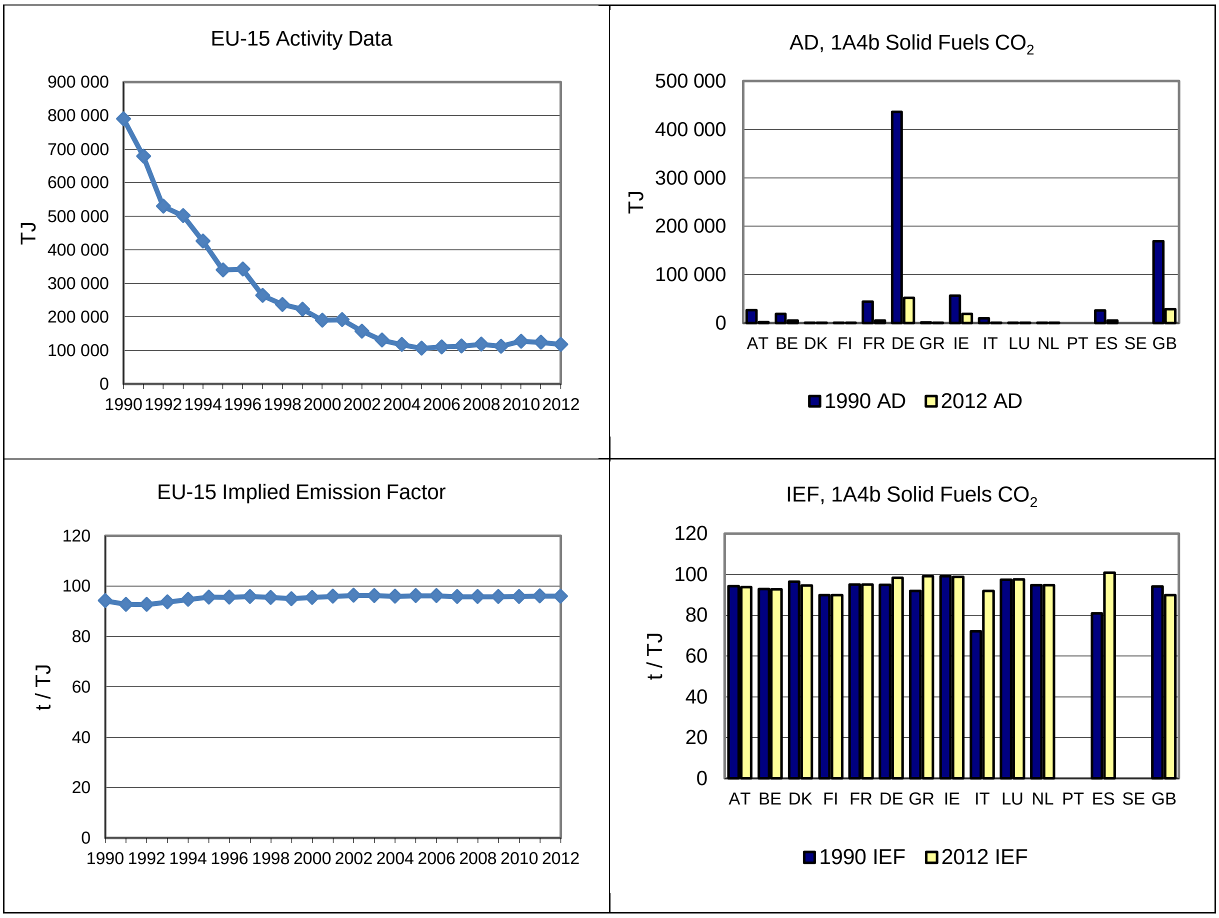
Table 3.77 1A4b Residential, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	2 512	191	149	1%	-42	-22%	-2 363	-94%	T2	CS
Belgium	1 759	369	492	4%	124	34%	-1 267	-72%	T1	D
Denmark	72	3	2	0.02%	-0.5	-18%	-70	-97%	T1	D
Finland	33	1	1	0.01%	0.1	9%	-32	-96%	T1	D
France	4 168	279	474	4%	195	70%	-3 694	-89%	T2	CS
Germany	41 415	5 688	5 145	46%	-543	-10%	-36 270	-88%	CS	CS
Greece	87	19	2	0.01%	-17	-91%	-85	-98%	T2	D
Ireland	5 607	1 955	1 874	17%	-81	-4%	-3 733	-67%	T1	CS
Italy	702	17	12	0.1%	-5	-32%	-691	-98%	T2	CS
Luxembourg	26	2	2	0.02%	-0.4	-18%	-24	-93%	T1	D
Netherlands	61	15	18	0.2%	3	20%	-43	-70%	T2	CS,D
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	2 091	613	537	5%	-77	-13%	-1 554	-74%	T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	15 929	2 739	2 569	23%	-170	-6%	-13 360	-84%	T2	CS
EU-15	**74 463**	**11 891**	**11 277**	**100%**	**-614**	**-5%**	**-63 185**	**-85%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.76 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Ireland and the United Kingdom; together they cause 85 % of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 85 % between 1990 and 2011. The implied emission factor of EU-15 was 96 t/TJ in 2012. The 1990 implied emission factors of Italy and Spain are comparatively low because of a high share of gas works gas is included.

Figure 3.76 1A4b Residential, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4b Residential – Gaseous Fuels (CO_2)

In 2012, CO_2 from gaseous fuels had a share of 65 % within source category 1A4b (compared to 39 % in 1990). Between 1990 and 2012, the emissions increased by 42 % (Table 3.78). All Member States except the Netherlands reported increasing emissions. The highest absolute increase occurred in Germany, France, the United Kingdom, Spain and Italy. Between 2011 and 2012, EU-15 emissions increased by 8 %.

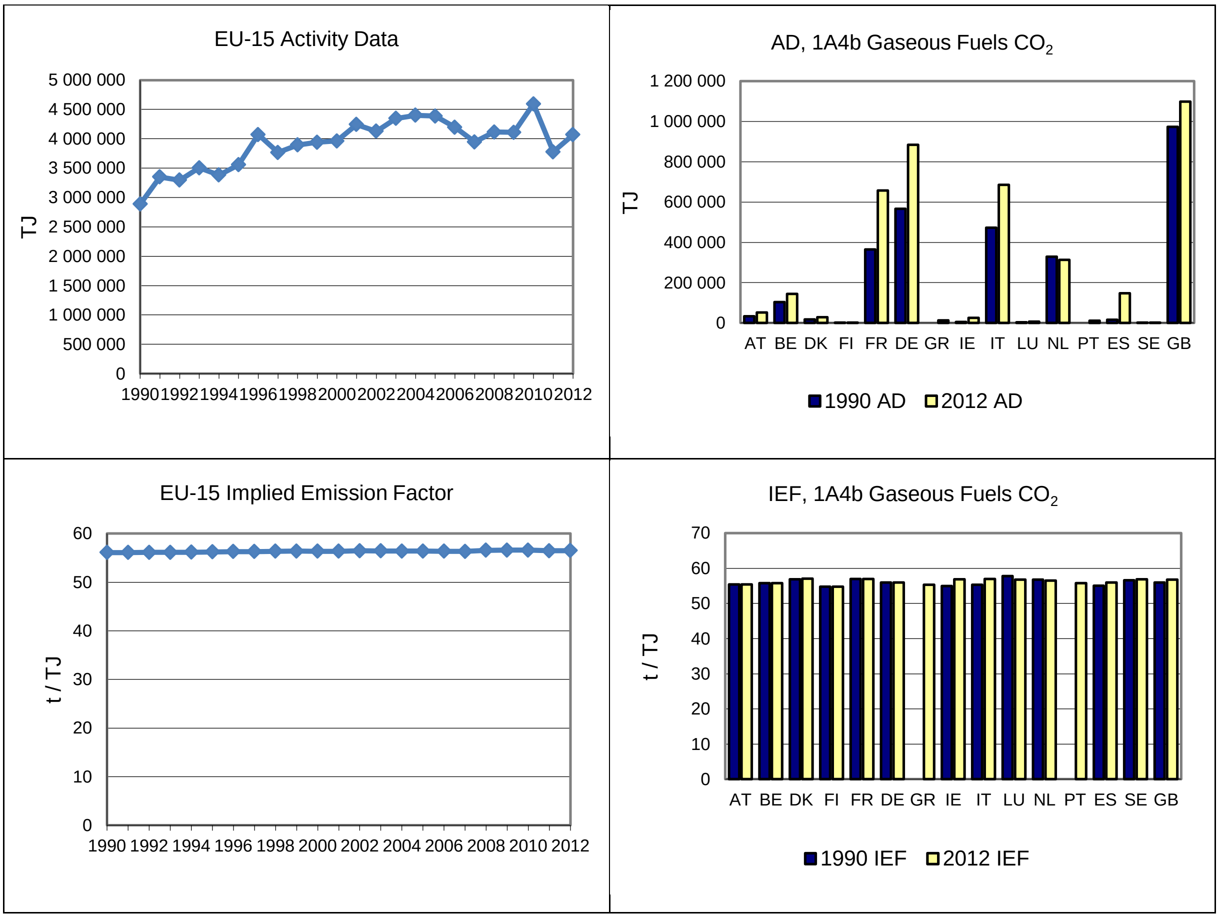
Table 3.78 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	1 847	2 818	2 851	1%	33	1%	1 004	54%	T2	CS
Belgium	5 824	7 276	8 099	4%	823	11%	2 274	39%	T1	D
Denmark	988	1 603	1 630	1%	27	2%	642	65%	T3	CS
Finland	22	68	74	0.03%	6	10%	52	238%	T1	CS
France	20 831	33 614	37 449	16%	3 835	11%	16 618	80%	T2	CS
Germany	31 714	47 339	49 483	22%	2 144	5%	17 769	56%	CS	CS
Greece	NO	805	719	0.3%	-86	-11%	719	-	T2	CS
Ireland	270	1 360	1 430	1%	70	5%	1 160	430%	T1	CS
Italy	26 123	38 667	39 015	17%	349	1%	12 892	49%	T2	CS
Luxembourg	170	515	398	0.2%	-117	-23%	228	134%	T2	CS
Netherlands	18 696	16 630	17 659	8%	1 028	6%	-1 038	-6%	T2	CS
Portugal	NO	606	605	0.3%	-0.5	-0.1%	605	-	T2	D, CR
Spain	918	8 058	8 258	4%	200	2%	7 340	800%	T2	CS
Sweden	86	125	90	0.04%	-35	-28%	4	4%	T1	CS
United Kingdom	54 478	53 899	62 326	27%	8 427	16%	7 848	14%	T2	CS
EU-15	**161 967**	**213 381**	**230 084**	**100%**	**16 703**	**8%**	**68 117**	**42%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.77 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and the United Kingdom; together they cause 82 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-15 rose 41 % between 1990 and 2012. The implied emission factor of EU-15 was 56.6 t/TJ in 2012.

Figure 3.77 1A4b Residential, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



CH_4 emissions from 1A4b Residential

CH_4 emissions from 1A4b Residential accounted for 0.2 % of total GHG emissions in 2012. Between 1990 and 2012, CH_4 emissions from households decreased by 38 % in the EU-15 (Table 3.79). In 2012 France was responsible for 22 % of EU-15 CH_4 emissions even though emissions were reduced by 68 % between 1990 and 2012. Italy reported the highest increase in emissions. Between 2011 and 2012 EU-15 emissions increased by 5 %.

Table 3.79 1A4b Residential: Member States' contributions to CH_4 emissions

Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	378	170	184	3%	14	8%	-194	-51%
Belgium	227	181	220	4%	39	21%	-7	-3%
Denmark	83	121	118	2%	-3	-2%	35	43%
Finland	164	218	238	4%	20	9%	74	45%
France	3 649	1 073	1 169	20%	96	9%	-2 480	-68%
Germany	1 200	723	734	12%	12	2%	-466	-39%
Greece	80	73	74	1%	1	1%	-6	-8%
Ireland	372	142	137	2%	-4	-3%	-234	-63%
Italy	396	939	1 062	18%	123	13%	666	168%
Luxembourg	7	6	7	0.1%	1	12%	-0.4	-5%
Netherlands	361	332	348	6%	17	5%	-13	-4%
Portugal	344	202	195	3%	-7	-4%	-149	-43%
Spain	738	771	767	13%	-4	-1%	29	4%
Sweden	234	235	227	4%	-8	-3%	-8	-3%
United Kingdom	1 450	463	478	8%	14	3%	-973	-67%
EU-15	**9 685**	**5 649**	**5 959**	**100%**	**310**	**5%**	**-3 726**	**-38%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2012 CH_4 from biomass had a share of 1.3 % within source category 1A4b (compared to 1.4 % in 1990). Between 1990 and 2012 the emissions decreased by 22 % (Table 3.80). France reported the highest absolute decrease, while Germany's (+137 %) and Italy's (+218 %) CH_4 emissions increased significantly. Between 2011 and 2012, EU-15 emissions increased by 7%.

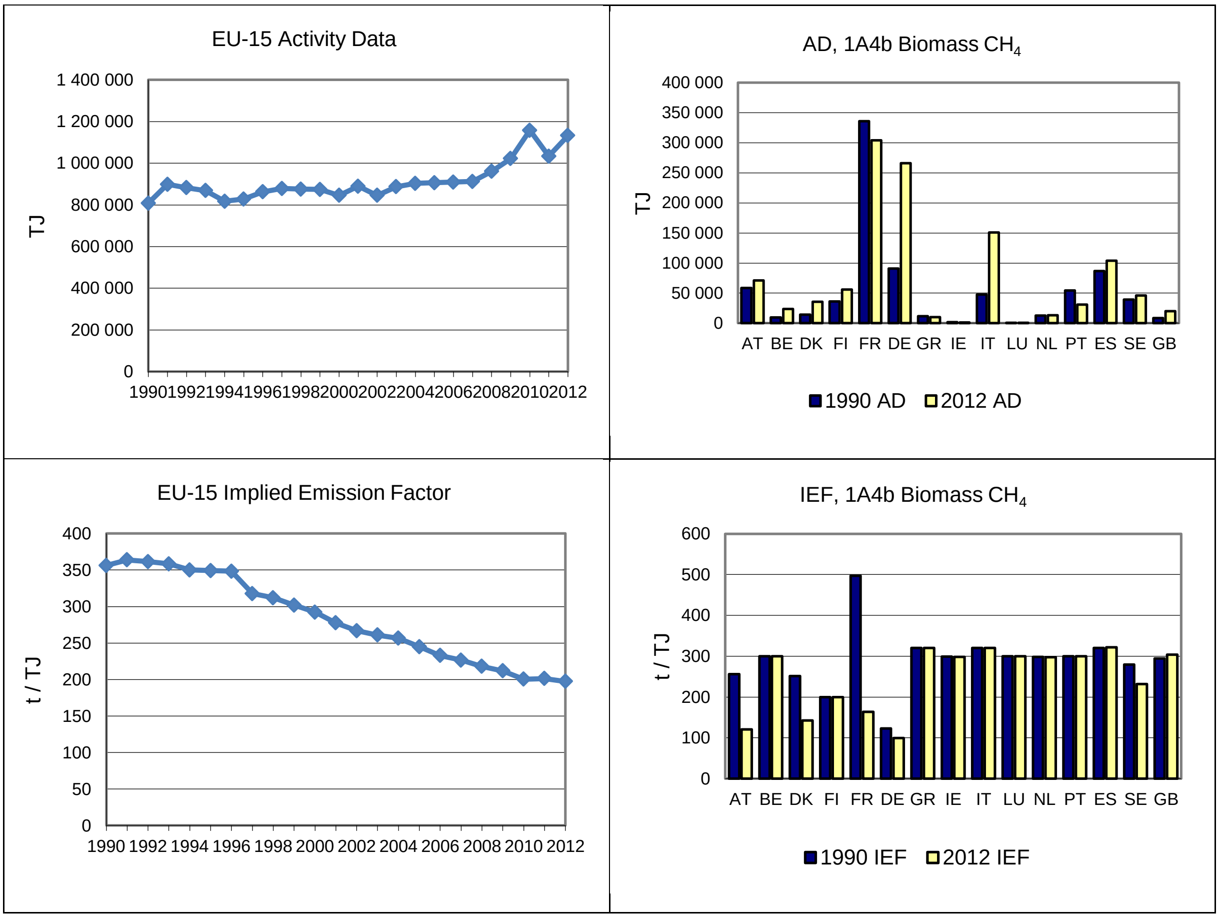
Table 3.80 1A4b Residential, biomass: Member States' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	314	164	179	4%	15	9%	-135	-43%	T2	CS
Belgium	60	118	148	3%	30	25%	88	147%	T1	D
Denmark	74	108	107	2%	-1	-1%	33	44%	CR	CS
Finland	152	214	234	5%	20	9%	81	53%	T1	D
France	3 511	957	1 045	22%	88	9%	-2 466	-70%	T2	CS
Germany	235	509	557	12%	48	9%	322	137%	T2	CS
Greece	77	67	69	1%	2	3%	-8	-10%	T2	D
Ireland	12	6	7	0.2%	1	22%	-4	-38%	T1	D
Italy	319	890	1 015	22%	124	14%	695	218%	T2	CR
Luxembourg	4	4	5	0.1%	1	27%	1	14%	T1	D
Netherlands	79	80	81	2%	1	1%	2	2%	T1	D
Portugal	343	201	194	4%	-7	-4%	-150	-44%	T2	D, CR
Spain	583	699	702	15%	4	1%	119	20%	T2	CR
Sweden	229	231	223	5%	-8	-3%	-6	-2%	T1	CS
United Kingdom	53	120	129	3%	8	7%	76	145%	T1	D
EU-15	**6 046**	**4 368**	**4 694**	**100%**	**326**	**7%**	**-1 351**	**-22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.78 shows activity data and implied emission factors for CH_4 from biomass for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain; together they cause 71 % of the CH_4 emissions from biomass fuels in 1A4b. Biomass fuel consumption in the EU-15 rose by 40 % between 1990 and 2012. The implied emission factor of EU-15 was 197.32 kg/TJ in 2012. The decrease of the IEF is because of improved combustion in new (automated) heating devices and less use of small stoves having higher CH_4 emissions.

Figure 3.78 1A4b Residential, biomass: Activity Data and Implied Emission Factors for CH_4

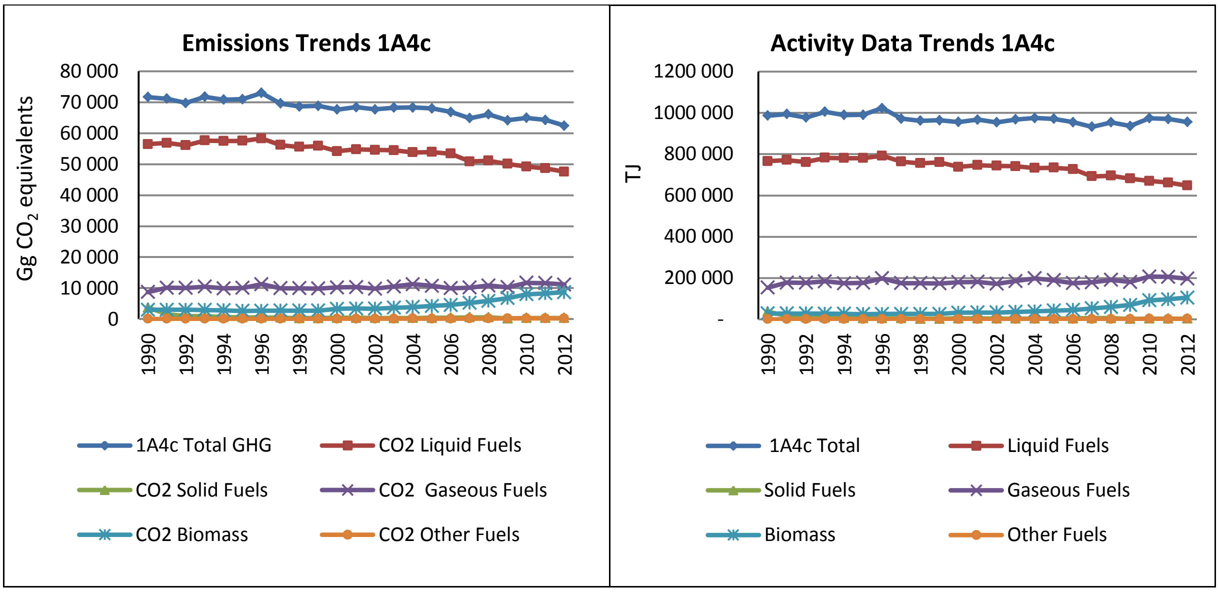


3.2.4.3 Agriculture/Forestry/Fisheries (1A4c) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4c by fuels. CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries accounted for 2 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 14 % in the EU-15 (Table 3.81).

Figure 3.79 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 13 %, mainly due to decreases in CO_2 emissions from liquid fuels (-16 %).

Figure 3.79 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



Only five Member States, France, Germany, Italy, the Netherlands and Spain together contributed 75 % to the emissions from this source. Spain was the Member State with the highest increase in absolute terms between 1990 and 2012, while the highest decreases were achieved in Germany, Greece, Italy and the United Kingdom.

Table 3.81 1A4c Agriculture/Forestry/Fisheries: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	1 253	858	794	1%	-64	-7%	-459	-37%
Belgium	2 765	1 952	2 119	4%	167	9%	-646	-23%
Denmark	2 485	2 126	2 089	4%	-38	-2%	-396	-16%
Finland	1 859	1 442	1 514	3%	72	5%	-345	-19%
France	10 825	11 270	11 318	19%	47	0%	493	5%
Germany	11 060	6 112	6 195	10%	83	1%	-4 865	-44%
Greece	2 927	1 763	872	1%	-891	-51%	-2 055	-70%
Ireland	660	714	690	1%	-24	-3%	30	5%
Italy	8 372	7 120	6 814	12%	-306	-4%	-1 558	-19%
Luxembourg	16	51	51	0.1%	-0.04	-0.1%	35	226%
Netherlands	9 917	9 415	9 200	16%	-214	-2%	-717	-7%
Portugal	1 661	1 049	1 017	2%	-32	-3%	-644	-39%
Spain	8 310	11 185	10 882	18%	-303	-3%	2 572	31%
Sweden	1 599	1 493	1 487	3%	-6	0%	-112	-7%
United Kingdom	5 223	4 235	4 194	7%	-41	-1%	-1 029	-20%
EU-15	**68 935**	**60 785**	**59 236**	**100%**	**-1 549**	**-3%**	**-9 699**	**-14%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4c Agriculture/Forestry/Fisheries – Liquid Fuels (CO_2)

In 2012 CO_2 from liquid fuels had a share of 76 % within source category 1A4c (compared to 79 % in 1990). Between 1990 and 2012 the emissions decreased by 16 % (Table 3.82). Only France, Ireland, Luxembourg and Sweden reported increasing emissions with the highest increases in absolute terms in Spain. Between 2011 and 2012 EU-15 emissions decreased by 2 %.

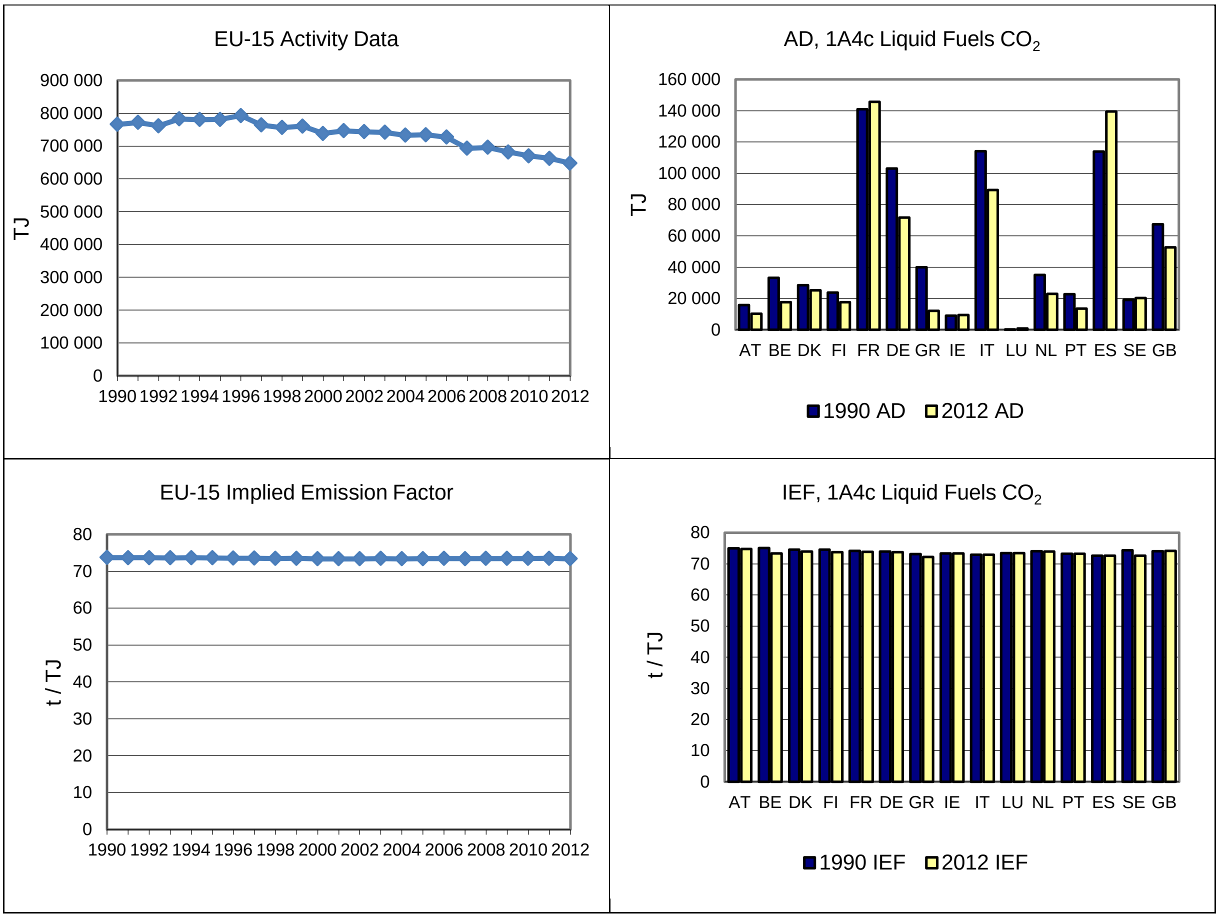
Table 3.82 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	1 181	822	759	2%	-63	-8%	-423	-36%	T2	CS
Belgium	2 490	1 200	1 290	3%	90	7%	-1 200	-48%	T1	D
Denmark	2 121	1 873	1 859	4%	-14	-1%	-262	-12%	T2,T1	CS,D
Finland	1 774	1 245	1 292	3%	46	4%	-483	-27%	M,T1	CS
France	10 442	10 717	10 761	23%	45	0.4%	319	3%	T2	CS
Germany	7 627	5 260	5 285	11%	25	0.5%	-2 342	-31%	CS	CS
Greece	2 917	1 763	872	2%	-891	-51%	-2 044	-70%	T2	D
Ireland	660	714	690	1%	-24	-3%	30	5%	T1	CS
Italy	8 321	6 811	6 508	14%	-303	-4%	-1 813	-22%	T2	CS
Luxembourg	16	51	51	0.1%	-0.04	-0.1%	35	226%	T2	CS
Netherlands	2 587	1 731	1 692	4%	-40	-2%	-896	-35%	T2	CS,D
Portugal	1 661	1 021	988	2%	-33	-3%	-673	-41%	T2	D, CR
Spain	8 267	10 077	10 130	21%	53	1%	1 863	23%	T2, T3	M, CS
Sweden	1 410	1 476	1 470	3%	-6	-0.4%	60	4%	T1, T2	CS
United Kingdom	4 993	3 904	3 908	8%	3	0.1%	-1 085	-22%	T2	CS
EU-15	**56 467**	**48 666**	**47 554**	**100%**	**-1 112**	**-2%**	**-8 913**	**-16%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.80 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain; together they cause 69 % of the CO_2 emissions from liquid fuels in 1A4c. Fuel consumption in the EU-15 decreased by 15 % between 1990 and 2012. The implied emission factor of EU-15 was 73.4 t/TJ in 2012.

Figure 3.80 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries – Solid Fuels (CO_2)

In 2012 CO_2 from solid fuels had a share of 0.6 % within source category 1A4c (compared to 5 % in 1990). Between 1990 and 2012 the emissions decreased by 90 % (Table 3.83). Nine member states reported CO_2 emissions from this source category as 'Not occurring' or "Not applicable" in 2012. All other Member States reported decreasing emissions between 1990 and 2012. Between 2011 and 2012 EU-15 emissions increased by 2 %, mainly due to increases reported by Germany. The strong decrease in 1990 to 1992 emissions is due to the reporting of Germany.

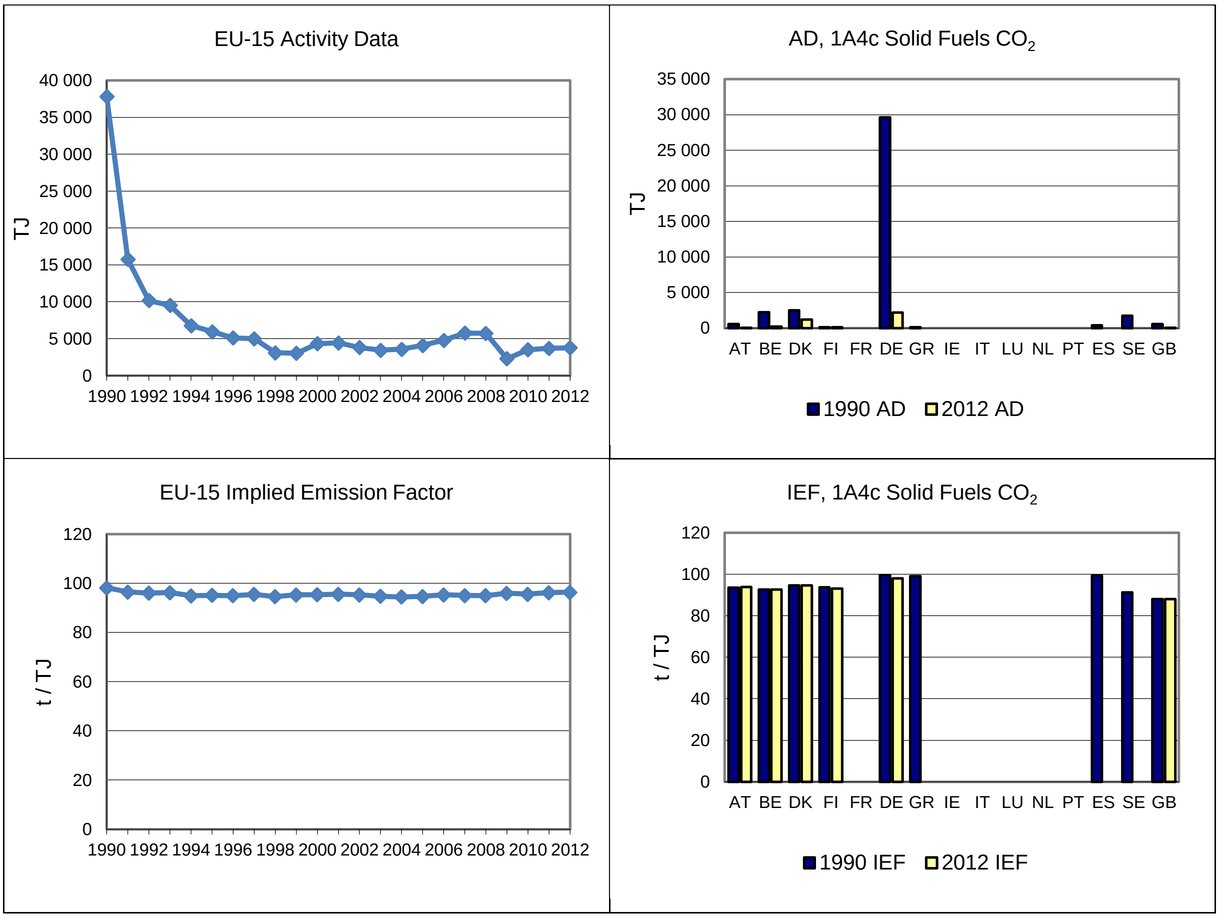
Table 3.83 1A4c Agriculture/Forestry/Fisheries, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	51	4	3	1%	-1	-22%	-48	-94%	T2	CS
Belgium	208	19	19	5%	0	0%	-188	-91%	T1	D
Denmark	238	113	111	31%	-2	-1%	-127	-53%	T1	D
Finland	13	13	10	3%	-3	-24%	-4	-28%	T3	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	2 948	202	215	59%	13	6%	-2 733	-93%	CS	CS
Greece	11	NO	NO	-	-	-	-11	-100%	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	37	NO	NO	-	-	-	-37	-100%	NA	NA
Sweden	157	NO	NO	-	-	-	-157	-100%	NA	NA
United Kingdom	48	4	4	1%	0.04	1%	-45	-93%	T2	CS
EU-15	**3 712**	**355**	**362**	**100%**	**7**	**2%**	**-3 350**	**-90%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.81 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Fuel consumption in the EU-15 decreased by 90 % between 1990 and 2012. The implied emission factor of EU-15 was 96.4 t/TJ in 2012.

Figure 3.81 1A4c Agriculture/Forestry/Fisheries, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries –Gaseous Fuels (CO_2)

In 2012, CO_2 from gaseous fuels had a share of 18 % within source category 1A4c (compared to 12 % in 1990). Between 1990 and 2012 the emissions increased by 28 % (Table 3.84). All Member States reported increasing emissions except for Finland, Denmark and Sweden. The highest increase occurred in Spain (+12 111 %). Between 2011 and 2012 EU-15 emissions decreased by 4 %. This source is dominated by the Netherlands were natural gas is used for greenhouse horticulture.

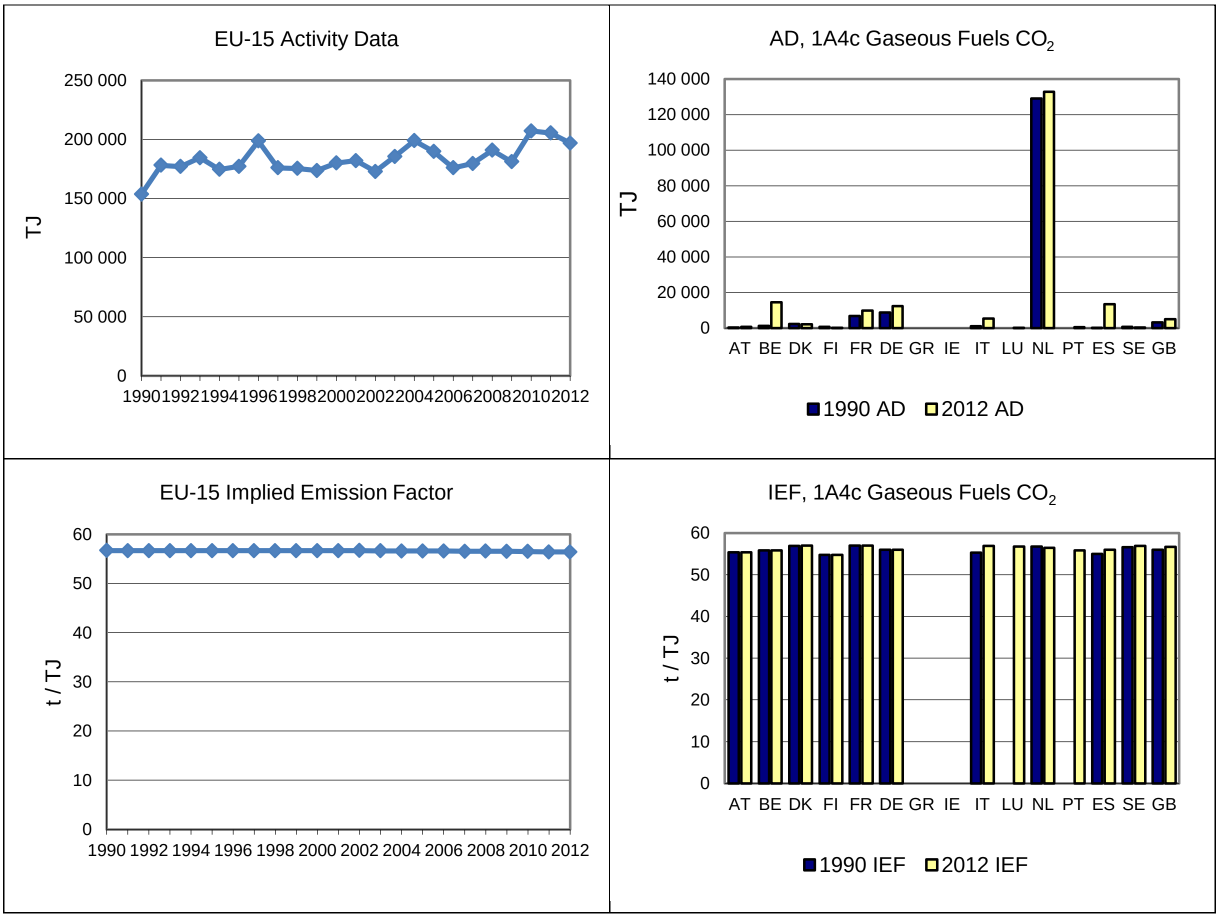
Table 3.84 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	20	32	32	0.3%	0.4	1%	12	59%	T2	CS
Belgium	67	732	809	7%	77	10%	742	1107%	T1	D
Denmark	126	140	119	1%	-22	-16%	-8	-6%	T3	CS
Finland	32	9	10	0.1%	1	14%	-22	-68%	T1	CS
France	383	554	557	5%	3	1%	174	45%	T2	CS
Germany	485	649	695	6%	45	7%	210	43%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	52	309	306	3%	-3	-1%	255	493%	T2	CS
Luxembourg	NO	0.1	0.1	0.001%	-0.001	-1%	0.1	-	T2	CS
Netherlands	7 330	7 683	7 509	68%	-174	-2%	179	2%	T2	CS
Portugal	NO	27	29	0.3%	2	6%	29	-	T2	D, CR
Spain	6	1 108	752	7%	-356	-32%	746	12111%	T2	CS
Sweden	33	18	18	0.2%	0.01	0.04%	-16	-47%	T1	CS
United Kingdom	182	327	282	3%	-44	-14%	101	55%	T2	CS
EU-15	**8 716**	**11 589**	**11 118**	**100%**	**-472**	**-4%**	**2 401**	**28%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.82 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by the Netherlands, accounting for 68 % of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-15 increased by 28 % between 1990 and 2012. The implied emission factor of EU-15 was 56.4 t/TJ in 2012.

Figure 3.82 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.5 Other (CRF Source Category 1A5) (EU-15)

Source category 1A5 Other includes emissions from stationary and mobile military fuel use including air craft. In 2012 category 1A5 contributed to 6251 Gg CO_2 equivalents of which 95 % CO_2, 0.2 % CH_4 and 5 % N_2O.

Table 3.85 provides an overview of Member States' source allocation to Source Category 1A5 Other.

Table 3.85 1A5 Other: Member States' allocation of sources

Member State	Source allocation to 1A5 Other	Source
Austria	Mobile: Military use	CRF Table 1.s.2
Belgium	Mobile: Military use	CRF Table 1.s.2
Denmark	Mobile: Military use	CRF Table 1.s.2
Finland	Stationary: Other non-specified, Non-specified emissions of Fuels from non-energy use, Indirect N_2O emissions from NO_X Mobile: other non-specified	CRF Table 1.s.2
France	Emissions are 'Not occuring'	CRF Table 1.s.2
Germany	Military: stationary and mobile	CRF Table 1.s.2

Member State	Source allocation to 1A5 Other	Source
Greece	Emissions are 'Not occuring'	CRF Table 1.s.2
Ireland	Emissions are 'Not occuring'	CRF Table 1.s.2
Italy	Mobile: other non-specified	CRF Table 1.s.2
Luxembourg	Emissions are 'Included elsewhere' or 'Not occuring'	CRF Table 1.s.2
Netherlands	Mobile: military use	CRF Table 1.s.2
Portugal	Stationary: other non-specified . Emissions are reported for 1990-1994 and 'Not occuring' from 1995 on. Mobile: other non-specified	CRF Table 1.s.2
Spain	Emissions are 'Not occuring'	CRF Table 1.s.2
Sweden	Stationary: other non-specified Mobile: Military use and Other non-specified	CRF Table 1.s.2
United Kingdom	Mobile: military use	CRF Table 1.s.2

Figure 3.83 shows the total trend within source category 1A5 and the dominating emission sources: CO_2 emissions from 1A5b Mobile and from 1A5a Stationary. Total GHG emissions of source category 1A5 decreased by 72 % between 1990 and 2012. Germany has the most influence to the overall trend, it reports minus 92 % CO_2 emissions since 1990 and contributes to 40 % in 1990. The German NIR states that only military sources (incl. aircraft) are included in its inventory. Since 2001 the United Kingdom has a main share and contributes 59 % to CO_2 emissions in 2012. The United Kingdom reports military aircraft and naval vessels within this category.

Figure 3.83 1A5 Other: Total and CO_2 emission and activity trends

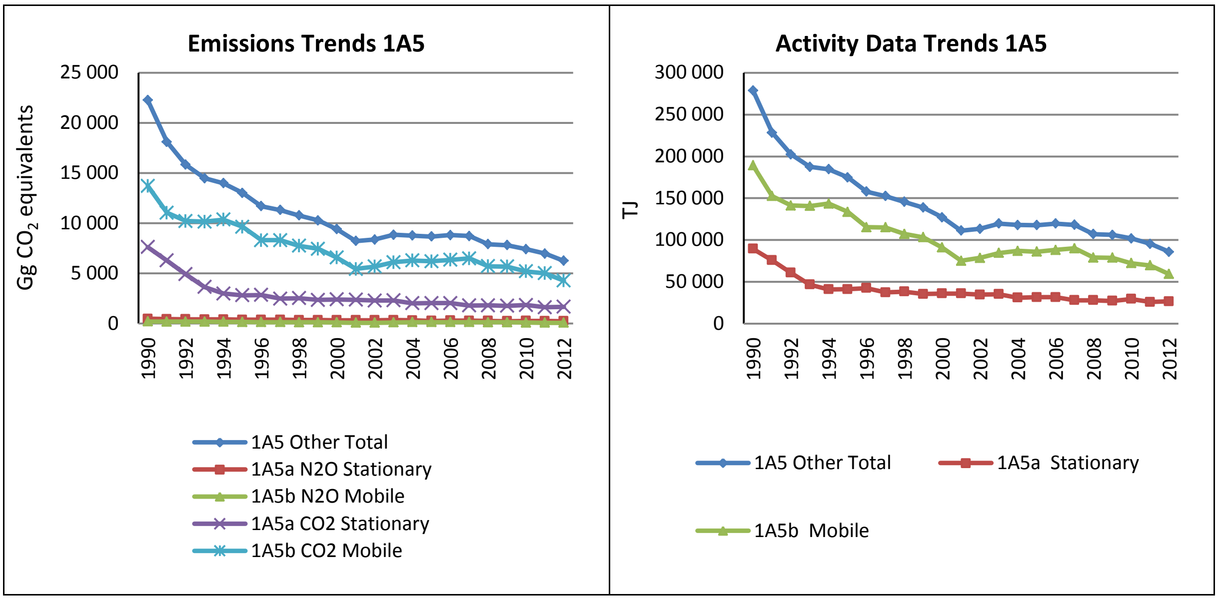


Table 3.86 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other accounted for 0.2 % of total GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from this source decreased by 72 % in the EU-15. Between 1990 and 2012, the largest reduction in

absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.86 1A5 Other: Member States' contributions to CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)
Austria	36	48	35	47
Belgium	167	46	165	45
Denmark	120	117	119	116
Finland	1 783	1 594	1 330	1 361
France	NO	NO	NO	NO
Germany	12 117	986	11 811	975
Greece	NO	NO	IE,NO	IE,NO
Ireland	NO	NO	NO	NO
Italy	1 120	355	1 046	326
Luxembourg	29	0	26	NO
Netherlands	577	348	566	341
Portugal	105	49	104	48
Spain	0	0	IE,NO	IE,NO
Sweden	863	166	846	164
United Kingdom	5 337	2 547	5 285	2 522
EU-15	**22 255**	**6 257**	**21 333**	**5 946**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.87 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A5 Other for 1990 and 2012 and main explanations for the largest recalculations in absolute terms.

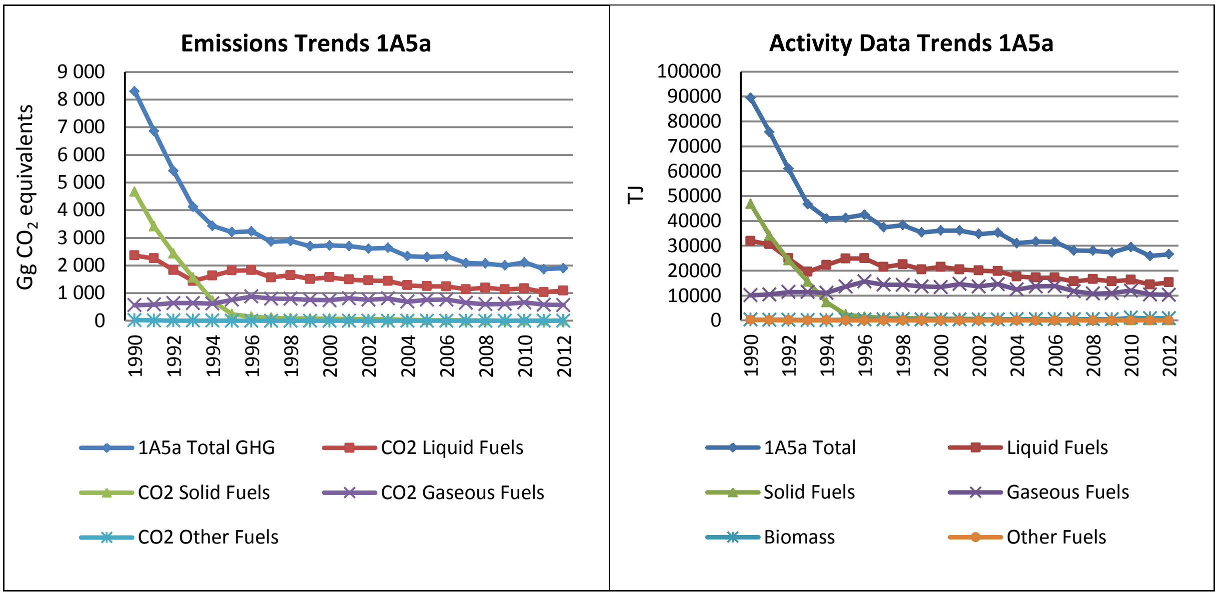
Table 3.87 1A5 Other: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	4	2.5	-4	-8.9	Reallocation of military offroads consumptions following ICR 2012.
Denmark	0	0.0	0	0.0	
Finland	-5	-0.3	-100	-7.1	Updates in other categories are reflected here.
France	0	0.0	0	0.0	
Germany	0	0.0	-17	-1.4	Final NCV available. Revised due to first-time consideration of biofuels in mobile sources of CRFs 1.A.3.e, 1.A.4.b and c, and 1.A.5. (see NIR) + revised NEB 2011. Biofuel use newly included.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**0**	**0.0**	**-121**	**-1.8**	

3.2.5.1 Stationary (1A5a) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5a Stationary accounted for 0.05 % of total EU-15 GHG emissions in 2012. Figure 3.84 shows the emission trend within the categories 1A5a, which is mainly dominated by CO_2 emissions from solid and liquid fuels for 1990 to 1993 and dominated by liquid and gaseous fuels after from 1994 on. The reduction in the early 1990s was driven by CO_2 from solid fuels. Total emissions decreased by 77 %, mainly due to decreases in emissions from solid fuels (-99.8 %) and liquid fuels (-53.9 %).

Figure 3.84 1A5a Stationary: Total and CO_2 emission and activity trends



Only two Member States (Germany and Finland) reported emissions from this key source in 2012 (Table 3.88). Between 1990 and 2012, Finland had a decrease of 9 % and Germany of 92 %. Portugal reports emissions from 1990 to 1994 only. Luxembourg reports emissions 1990 to 2003 only. This led to an EU-15 decrease of 78 %. Between 2011 and 2012 CO_2 emissions increased by 3 %.

Table 3.88 1A5a Stationary: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	1 272	1 124	1 157	69%	33	3%	-115	-9%
France	NO	NO	NO	-	-	-	-	-
Germany	6 329	499	516	31%	17	3%	-5 813	-92%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-
Luxembourg	3	NO	NO	-	0	-	-3	-100%
Netherlands	NA	NA	NA	-	-	-	-	-
Portugal	9	NO	NO	-	-	-	-9	-100%
Spain	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Sweden	NA	NA	NA	-	-	-	-	-
United Kingdom	IE,NO	IE,NO	IE,NO	-	-	-	-	-
EU-15	**7 612**	**1 624**	**1 673**	**100%**	**50**	**3%**	**-5 939**	**-78%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2012 CO_2 from solid fuels had a share of 0.4 % within source category 1A5a (compared to 56 % in 1990). Between 1990 and 2012, the emissions decreased by nearly 100 % (Table 3.89). In 2012 only Germany reported emissions for this key source.

Table 3.89 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

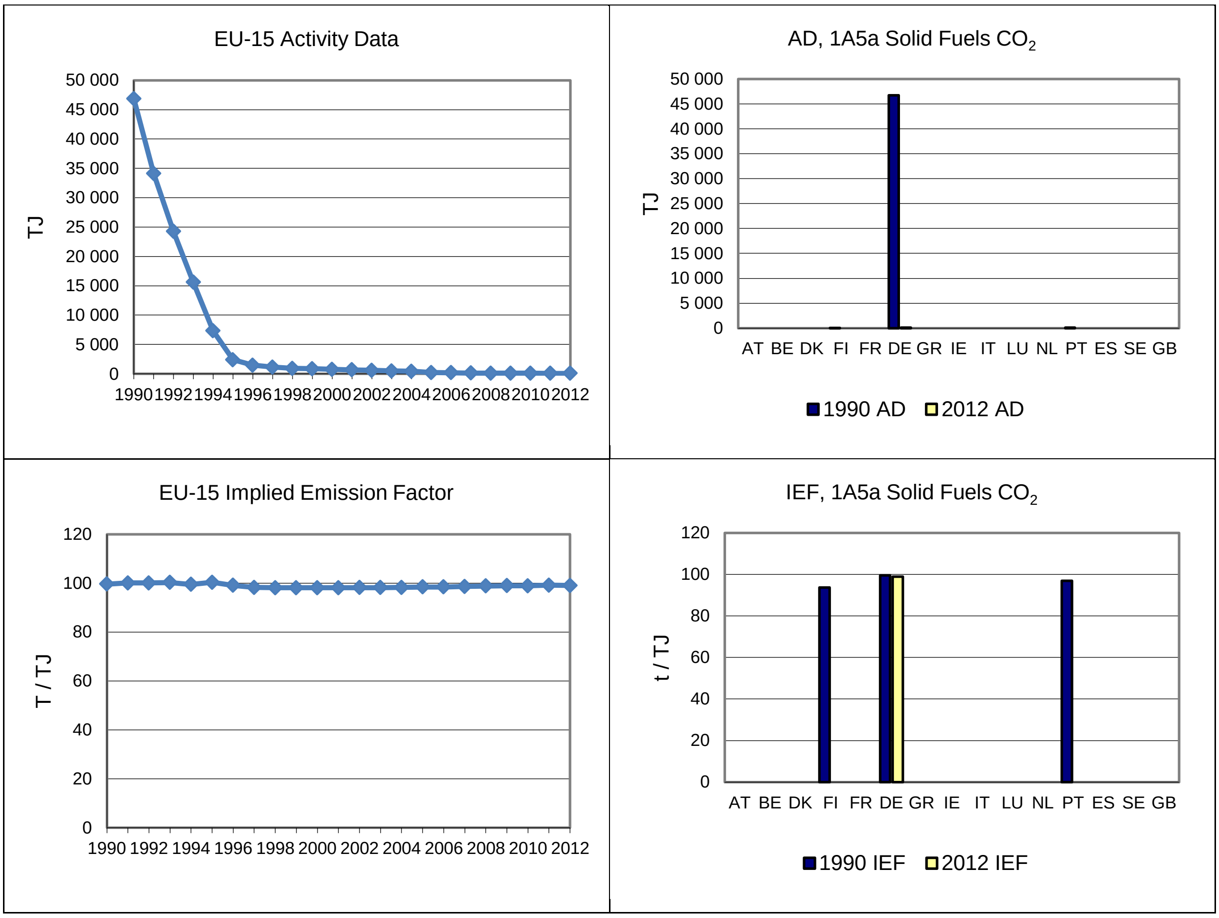
Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1	NO	NO	-	-	-	-1	-100%	NA	NA
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	4 657	8	8	100%	0.1	1%	-4 650	-100%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NA	NA	NA	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NA
Portugal	9	NO	NO	-	-	-	-9	-100%	NA	NA
Spain	NO	NO	NO	-	-	-	-	-	NA	NA
Sweden	NA	NA	NA	-	-	-	-	-	NA	NA
United Kingdom	IE	IE	IE	-	-	-	-	-	NA	NA
EU-15	**4 667**	**8**	**8**	**100%**	**0**	**1%**	**-4 659**	**-100%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.85 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Germany accounts for 100 % of EU-15 CO_2 emissions from this source category since 1995.

Fuel combustion in the EU-15 decreased by 99.8 % between 1990 and 2012. The implied emission factor is 99 t/TJ in 2012.

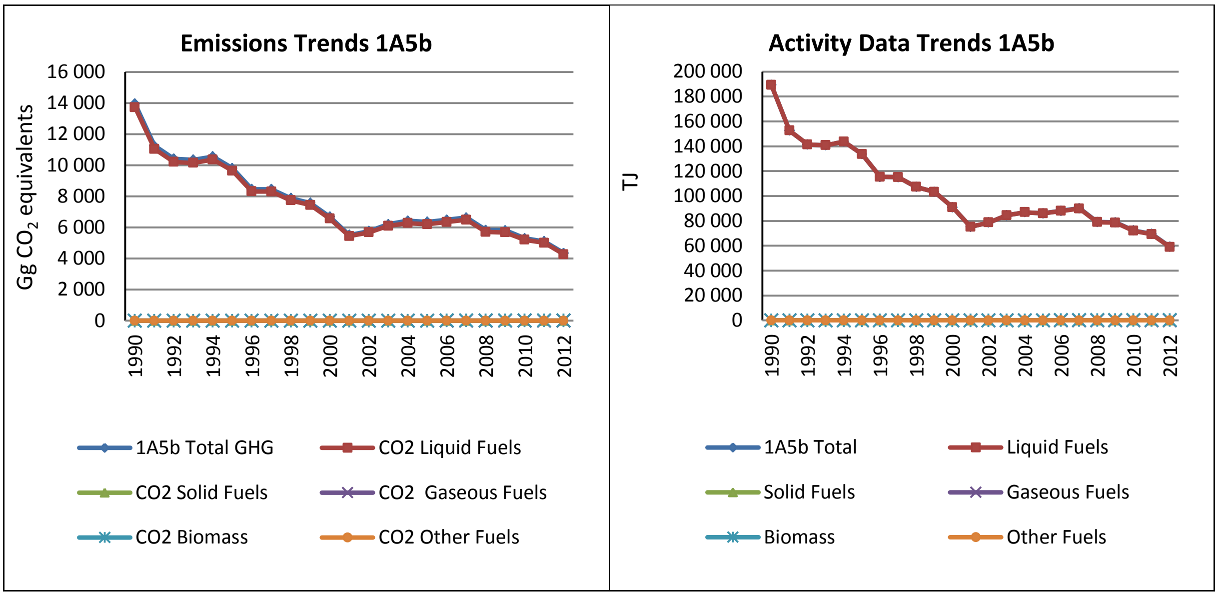
Figure 3.85 1A5a Stationary, solid fuels: Activity Data and Implied Emission Factors for CO_2



3.2.5.2 Mobile (1A5b) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5b Mobile accounted for 0.1 % of total EU-15 GHG emissions in 2012. Figure 3.86 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 69 %.

Figure 3.86 1A5b-Mobile: Total and CO_2 emission trends



Five Member States reported emissions as ‘Not occurring’ or "Included elsewhere". The United Kingdom had the highest emissions in 2012 and – together with Germany - decreased the most in absolute terms between 1990 and 2012. Finland reported an increase of 252 %. Between 2011 and 2012 Germany, Italy and the United Kingdom had the highest absolute decrease. The EU-15 emissions decreased by 15 % between 2011 and 2012 (Table 3.90).

Table 3.90 1A5b Mobile: Member States’ contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	35	47	47	1%	1	1%	12	35%
Belgium	165	45	45	1%	0.1	0.2%	-120	-73%
Denmark	119	193	116	3%	-77	-40%	-3	-3%
Finland	58	180	204	5%	24	13%	146	252%
France	NO	NO	NO	-	-	-	-	-
Germany	5 482	686	459	11%	-227	-33%	-5 023	-92%
Greece	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1 046	495	326	8%	-169	-34%	-720	-69%
Luxembourg	23	NO	NO	-	-	-	-23	-100%
Netherlands	566	355	341	8%	-14	-4%	-225	-40%
Portugal	95	77	48	1%	-29	-37%	-47	-49%
Spain	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Sweden	846	184	164	4%	-20	-11%	-682	-81%
United Kingdom	5 285	2 751	2 522	59%	-229	-8%	-2 763	-52%
EU-15	**13 721**	**5 012**	**4 273**	**100%**	**-740**	**-15%**	**-9 448**	**-69%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

1A5b Mobile – Liquid Fuels (CO_2)

In 2012, CO_2 from liquid fuels had a share of 98 % within source category 1A5b (compared to 98 % in 1990). Between 1990 and 2012 the emissions decreased by 69 % (Table 3.89). France, Greece, Ireland, Luxembourg and Spain report emissions as ‘Not occurring’, or ‘Included Elsewhere’. The highest decrease in absolute terms was achieved in Germany and the United Kingdom (-52%), while Finland had the largest increases.

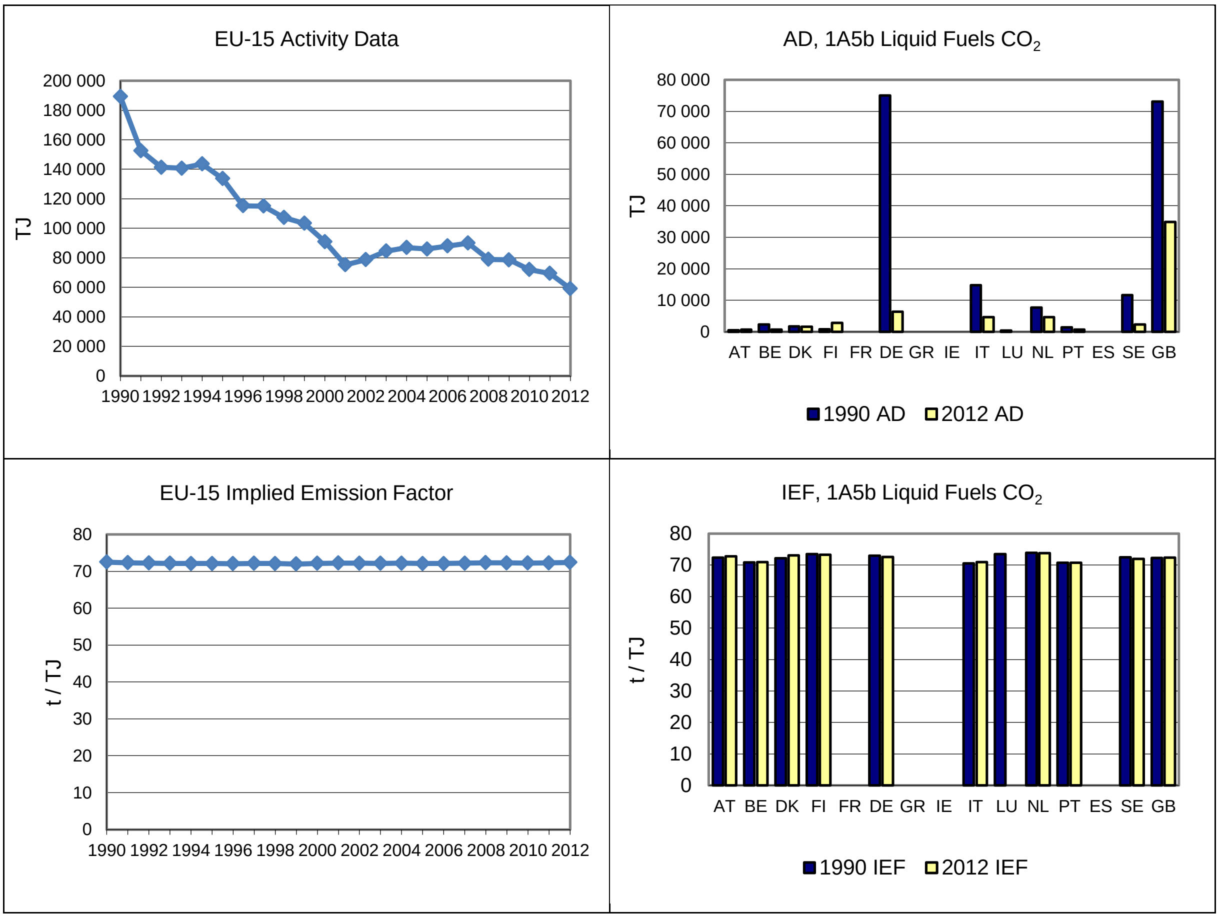
Table 3.91 1A5b Mobile, liquid fuels: Member States’ contributions to CO_2 emissions and information on method applied and emission factor

Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	35	47	47	1%	1	1%	12	35%	T2	CS
Belgium	165	45	45	1%	0.1	0.2%	-120	-73%	T1	D
Denmark	119	193	116	3%	-77	-40%	-3	-3%	T1	CS
Finland	58	180	204	5%	24	13%	146	252%	T1	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	5 482	686	459	11%	-227	-33%	-5 023	-92%	CS,T1	CS,D
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	1 046	495	326	8%	-169	-34%	-720	-69%	T2	CS
Luxembourg	23	NO	NO	-	-	-	-23	-100%	NA	NA
Netherlands	566	355	341	8%	-14	-4%	-225	-40%	D,T2	D
Portugal	95	77	48	1%	-29	-37%	-47	-49%	T1	CR,D
Spain	IE	IE	IE	-	-	-	-	-	NA	NA
Sweden	846	184	164	4%	-20	-11%	-682	-81%	T1	CS
United Kingdom	5 285	2 751	2 522	59%	-229	-8%	-2 763	-52%	T2,T3	CS
EU-15	**13 721**	**5 012**	**4 273**	**100%**	**-740**	**-15%**	**-9 448**	**-69%**		

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Figure 3.87 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Italy and the United Kingdom; together they cause 77 % of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-15 decreased by 69 % between 1990 and 2012. The implied emission factor of EU-15 was 72.4 t/TJ in 2012.

Figure 3.87 1A5b Mobile, liquid fuels Activity Data and Implied Emission Factors for CO_2

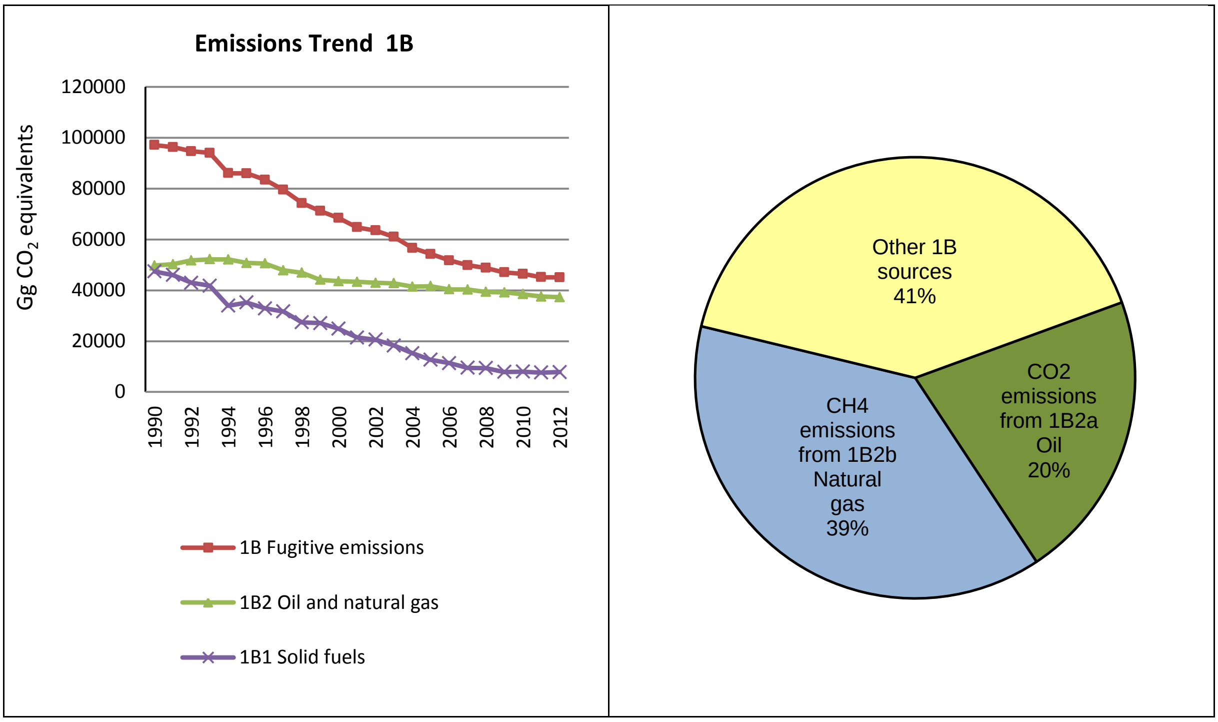


3.2.6 Fugitive emissions from fuels (CRF Source Category 1.B) (EU-15)

This chapter describes gaseous or volatile emissions which occur during extraction, handling and consumption of fossil fuels. In the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions are defined as intentional or unintentional releases of gases from anthropogenic activities that in particular may arise from the production, processing, transmission, storage and use of fuels. Emissions from combustion are only included where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities). Evaporative emissions from vehicles are included under Road Transport as Subsection 1A3b v (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2012, in terms of CO_2 equivalents, about 60% of emissions from source category 1B were fugitive CH_4 emissions while about 39% were fugitive CO_2 emissions. Together, they represented 1.2% of total GHG emissions in the EU-15. Fugitive GHG emissions have been steadily declining (Figure 3.88). Between 1990 and 2012, the total fugitive GHG emissions decreased by 54 %. This was mainly due to the decrease in underground mining activities: underground mining activity decreased by 88 % since 1990 (Figure 3.91) and decreases CH_4 emissions from category 1B1a i underground mines are responsible for 74% of the total decrease of fugitive emissions. Between 1990 and 2012, GHG emissions from 1B1 Solid Fuels decreased by 83 % Figure 3.89), while emissions from 1B2 Oil and Natural Gas decreased only by 25 % (Figure 3.89). While emissions from these two sources (1B1 Solid Fuels and 1B2 Oil and Natural Gas) each were responsible for roughly 50 % of total fugitive emissions in 1990, fugitive emissions from 1B1 Solid Fuels represented only 17 % of total fugitive emissions in 2012 (Figure 3.88).

Figure 3.88 1B Fugitive Emission from Fuel: GHG Emissions trend and proportion of fugitive emissions within source category



Fugitive emissions includes four key sources:

- 1B1a Coal Mining (CH_4)
- 1B2a Oil (CO_2)
- 1B2b Natural Gas (CH_4)

- 1B2c Venting and Flaring (CO_2)

The two largest key sources (CH_4 emissions from 1B2b Natural Gas and CO_2 emissions from 1B2a Oil) account together for 59 % of total fugitive GHG emissions (Figure 3.88).

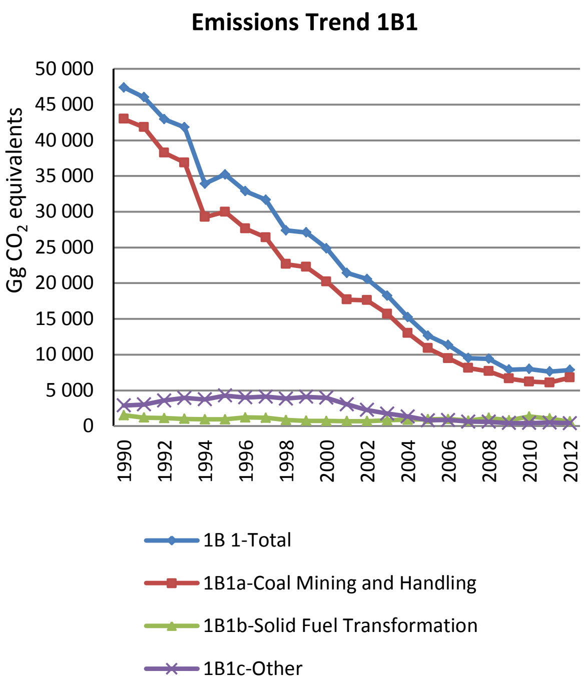
3.2.6.1 Fugitive emissions from Solid Fuels (1B1) (EU-15)

In the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions from solid fuels are defined as the total release of methane during coal mining and post-mining activities. Combustion emissions from colliery methane recovered and used are excluded here and reported under Fuel Combustion Emissions. Coal mining data reported to the IEA include also peat extraction, which is not included in the CRF. Three member States part of EU-15 (Finland, Ireland and Sweden) have peat extraction but no coal mining.

In 2012 fugitive emissions from solid fuels accounted for 0.2 % of the total GHG emissions in the EU-15 and 17 % of total fugitive emissions in the EU-15:

- 86 % of these emissions were CH_4 emissions from coal mining. The emissions arise due to the natural production of methane when coal is formed. Methane is partly stored within the coal seam and escapes when mined. Most CH_4 emissions resulted from underground mines; surface mines were a smaller source.
- 7 % of these emissions were CO_2 emissions due to solid fuel transformation
- Since 1990 fugitive CH_4 emissions from 1B1 Solid fuels have been steadily decreasing, caused by the reduction of coal mining

Figure 3.89 1B1 Fugitive Emissions from Solid Fuels: Trend



In 2012 three countries, Germany, the United Kingdom and Greece represented 88 % of total fugitive GHG emissions from solid fuels (Table 3.92).

Table 3.92 1B1 Fugitive Emissions from Solid Fuels: Member States Contribution

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	N2O emissions in 2012 (Gg)
Austria	12	IE,NA,NO	12	0.90	IE,NA,NO	IE,NA,NO
Belgium	330	5	330	5	NA,NO	NA,NO
Denmark	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Finland	NO	NO	NO	NO	NO	NO
France	4 065	33	4 065	33	NA,NO	NA,NO
Germany	20 254	3 374	20 242	3 371	12	2
Greece	1 095	1 329	1 095	1 329	NO	IE,NO
Ireland	NE, NO	NO	NE,NO	NO	NE,NO	NO
Italy	127	62	127	62	0	0
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	436	303	33	20	403	284
Portugal	84	IE, NO	74	8	10	1
Spain	1 835	525	1 818	502	18	23
Sweden	5	9	0.0	0.0	5	9
United Kingdom	19 157	2 213	18 302	1 986	855	227
EU-15	**47 401**	**7 862**	**46 098**	**7 316**	**1 302**	**546**

For methodological issues and remarks on completeness see). Table 3.93
Abbreviations explained in the Chapter 'Units and abbreviations'

Between 1990 and 2012 fugitive CH_4 emissions from solid fuels decreased by 83 % (Table 3.92). Large reductions (in absolute terms) were observed in Germany and in the United Kingdom, while emissions actually increased by about 21% in Greece (Table 3.92). Table 3.93 provides information on the methodologies used by EU-15 Member States.

Table 3.93 1B1 Fugitive Emissions from Solid Fuels: Methodological Issues according to NIRs (submitted in 2013) and Member State information of EU-15 Member States

Member State	Methodology
Austria	**General:** This category covers methane emissions from one brown coal surface mine. CH_4 emissions from this category decreased by more than 50% from 1990 to 1999 due to lower mining activities. Before coal mining was stopped in 2007 emissions decreased sharply between 2003 and 2004. **Activity data:** are taken from the national energy balance and statistical year books (e.g. yearbook of the Association of Mining and Steel). **Emission factor: The** CORINAIR default emission factor 214g CH_4/Mg coal is used for emissions from brown coal surface mines. **Changes (NIR 2014):** CH_4 emissions from Charcoal transformation are covered in category 1.B.1.b. Fugitive emissions from production of coke oven coke are included in 1.A.2.a Iron and Steel. For the most recent years (2005-2012) Austria uses the data from the National Energy Balance to calculate emissions from charcoal production. For the years 1990-2004 an average production amount of 1 000 t was assumed, as the Na-tional Energy Balance only provides data for this fuel category starting from 2005. For charcoal transformation the default emission factor of the revised IPCC 1996 guide-lines (Table 1-14) has been applied for CH_4 (1 000 kg/TJ).

Member State	Methodology
Belgium	**General:** *Coal mining and handling (category 1B1a):* During the in-country review in June 2007, the expert review team of UNFCCC detected some missing underground mining activities in the Belgian greenhouse gas emission inventory. In the beginning of the nineties until 1992 there still was some mining activity in the Flemish region. Until 1999 energetic mining activities remained existent. These activities consisted of an auto-producer of electricity that was active until 1996 (the waste of the coal was used to produce electricity) and of energy needed for the sorting machines which were active until 1999. The latter energetic activities are allocated to the category 1A1c. *Solid fuel transformation (category 1B1b):* Emissions during the coke production are caused by the loading of the coal into the ovens, the oven/door leakage during the coking period and by extracting the coke from the ovens. **Activity data:** federal statistics, delivered by corresponding industry, activity data, production data of coke, are directly reported by the companies involved. **Emission factor:** IPCC 2006 guidelines, CITEPA, EMEP/EAA air pollutant emission inventory guidebook 2009 (400 g CH_4/ton cokes)
Denmark	**General:** Coal mining does not occur
Finland	**General:** There are no emissions reported under this sector in Finland. Emissions from the peat production are reported in the LULUCF sector (category Wetlands, CRF 5.D 2) consistent with the GPG LULUCF 2003. There are no coalmines in Finland.
France	**General:** closure of surface mines 2002, closure of underground mines 2004, methane emissions after closure are accounted under 1B1c **Activity data:** plant specific for 1B1b, bottom up approach according to site specific data, Tier 2/3 depending on sub-sector, for closed mines: a tier 2 is used **Emission factor:** specific EF for sites, Tier 2/3 depending on site, EMEP/CORINAIR 350 g CH_4/Mg coke
Germany	**General**: hard coal mining Tier 3, brown coal Tier 2 Coal mining (1B1a): mainly emissions from current mining (coalseam methane, CSM) Emissions from hard coal dressing are included in 1B1b. For hard coal emissions from closed coal mines (coalmine methane, CMM) are included in 1B1c. Because of the chosen method of calculation, for brown coal all emissions are included in 1B1a (ii). **Activity data:** Statistik der Kohlenwirtschaft, national statistics **Emission factor**: country specific, study FHG ISI (1993), German lignite-industry association, Deutsche Montan Technologie GmbH. The emission factors for non-greenhouse gases from coking plants were mainly taken from BFI (2012)
Greece	**General:** only brown coal surface mines **Activity data:** national energy balance **Emission factor:** IPCC Good Practice Guidance (Default)
Ireland	**General:** coal mining does not occur
Italy	**General**: CH_4 emissions from coal mining referred to only two mines with very low production in the last ten years, one of which was underground and produced coal and the other, on the surface, produced lignite. The surface mine stopped the activity in 2001. CH_4 emissions from solid fuel transformation referred to the coke production in the iron and steel industry, which was also decreasing in the last years. CO_2 and N_2O emissions from 1B1 are not occurring. Solid fuel production - the CO_2 emissions have been calculated by mining and post mining activities. Moreover the post mining CH_4 emission factors for

Member State	Methodology
	underground mine have been revised and post mining CH_4 emissions for surface mine have been calculated. **Activity Data:** National Energy Balance **Emission Factor**: IPCC Guidelines (1997), Corinair Guidebook
Luxembourg	**General:** This source category does not exist in Luxembourg.
Netherlands	**General:** The Netherlands currently has only one on-site coke production facility at the iron and steel plant of Tata Steel. A second independent coke producer in Sluiskil discontinued its activities in 1999. The fugitive emissions of CO_2 and CH_4 from both coke production sites are included here. There are no fugitive emissions from coal mining and handling activities (1B1a) in the Netherlands; these activities ceased with the closing of the last coal mine in the early 1970s. **Activity data:** individual company data, national energy statistics (CBS); “IEA Renewable Information 2012”. **Emission factor:** country specific, IPCC default values. The following emission factors have been used:1990-1997: 0.03 kg CH_4/kg charcoal (IPCC 1996 Guidelines); 1998-2010: 0.0000111 kg CH_4/kg charcoal (Reumermann,P.J Frederiks, B., proceedings 12th European conference on Biomass for Energy, Industry and Climate protection, Amsterdam, 2002).
Portugal	**General:** Since 1990 in Portugal there was extraction of coal at only two coal mines, but both were latter closed down in 1992 and 1994 and did not resume activity since. **Activity data:** General-Directorate for Energy and Geology (DGEG). **Emission factor:** emission factors from IPCC96 (IPCC,1997) **Changes:** AD revision and first reported emissions from abandoned mines emissions.
Spain	**Activity Data**: national studies, AITEMIN (Asociación de Investigación Tecnológica de Equipos Mineros) **Emission Factor**: country specific **Changes (NIR2014):** For 2010 and 2011 data from production of coke located outside the integrated steel industry has been revised. It was detected that the value of production actually corresponded to sales of coke, which has not been considered in changes in inventories. This modification affects CH_4 emissions, since in the carbon balance used to estimate emissions of CO_2 was correct
Sweden	**General:** There are no coalmines in Sweden and hence no fugitive emissions from coalmines occur. SO_2 emissions from quenching and extinction at coke ovens are reported in CFR 1B1b. Flaring of coke oven gas from the coke oven is reported in CRF 1B1c since submission 2004. Since submission 2010, flaring of blast furnace gas in the blast furnace and steel converter gas in the steel converter are reported under CRF 2C1.
United Kingdom	**General:** Methane emissions from closed coal mines are accounted for within Sector 1B1a of the UK inventory. Carbon emissions from coke ovens are based on a carbon balance approach. **Activity data:** saleable coal production statistics (national study) **Emission factor:** UK Coal Mining Ltd data, national studies, US EPA **Changes (NIR 2014):** 1B1b: Correction to method to derive the emission factor. From 2008 onwards the calculation of the emission factor (which is derived from an emissions total divided by coal activity) had not accounted for all activity, and hence the EF was too high. Revision to carbon balance approach to use AD and EFs from ISSB/Tata in preference to

Member State	Methodology
	DUKES stats and historic EF defaults. Replacement of default emission factors from superseded version of the EMEP/EEA Emission Inventory Guidebook with factors from 2006 IPCC Guidelines.

○ CH_4 from Coal Mining (1B1a)

Fugitive emissions from coal mining correspond to the total emissions from:

- underground mining (emissions from underground mines, brought to the surface by ventilation systems),
- surface mining (emissions primarily from the exposed coal surfaces and coal rubble, but also emissions associated with the release of pressure on the coal),
- post-mining (emissions from coal after extraction from the ground, which occur during preparation, transportation, storage, or final crushing prior to combustion).

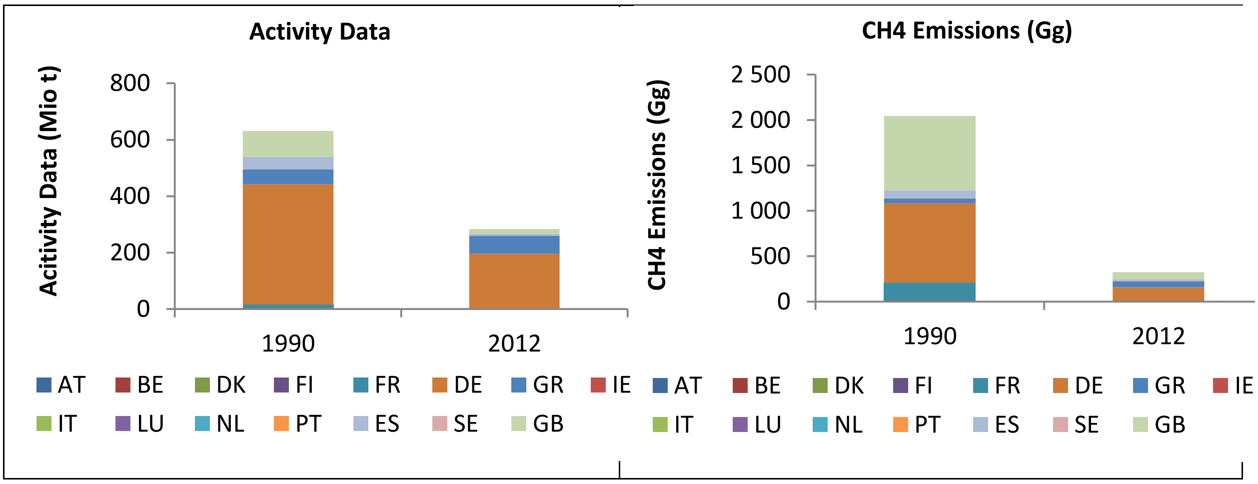
CH_4 emissions from 1B1a coal-mining accounted for 0.2 % of total GHG emissions in 2012 and for 15 % of all fugitive emissions in the EU-15. CH_4 emissions from this source decreased by 84 % in the EU-15 between 1990 and 2012 but increased by 11 % between 2011 and 2012 due to increases in Germany and Greece (Table 3.94). In 2012 Germany and the United Kingdom accounted together for 73 % of EU-15 CH_4 emissions from 1B1a. They both used higher tier methods for the estimation of emissions from 1B1a and both had substantially reduced their emissions between 1990 and 2012 due to the decline of coal mining (Figure 3.90).

Table 3.94 1B1a Coal Mining: Member States contribution to CH_4 emissions and information on method applied and emission factor

Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	11	IE,NO	IE,NO	-	-	-	-11	-100%	NA	NA
Belgium	299	NO	NO	-	-	-	-299	-100%	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	4 016	NA,NO	NA,NO	-	-	-	-4 016	-100%	NA	NA
Germany	18 415	2 612	3 346	49%	733	28%	-15 070	-82%	T2	CS
Greece	1 095	1 238	1 329	20%	91	7%	233	21%	T1	D
Ireland	NE,NO	NO	NO	-	-	-	-	-	NA	NA
Italy	60	21	18	0.3%	-3	-13%	-41	-69%	T1	CS,D
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NA
Portugal	74	8	8	0.1%	-0.2	-2%	-67	-90%	T1	D
Spain	1 794	614	489	7%	-125	-20%	-1 306	-73%	CS,T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	17 212	1 595	1 595	24%	0	0%	-15 617	-91%	T2	CS
EU-15	**42 976**	**6 088**	**6 784**	**100%**	**696**	**11%**	**-36 192**	**-84%**		

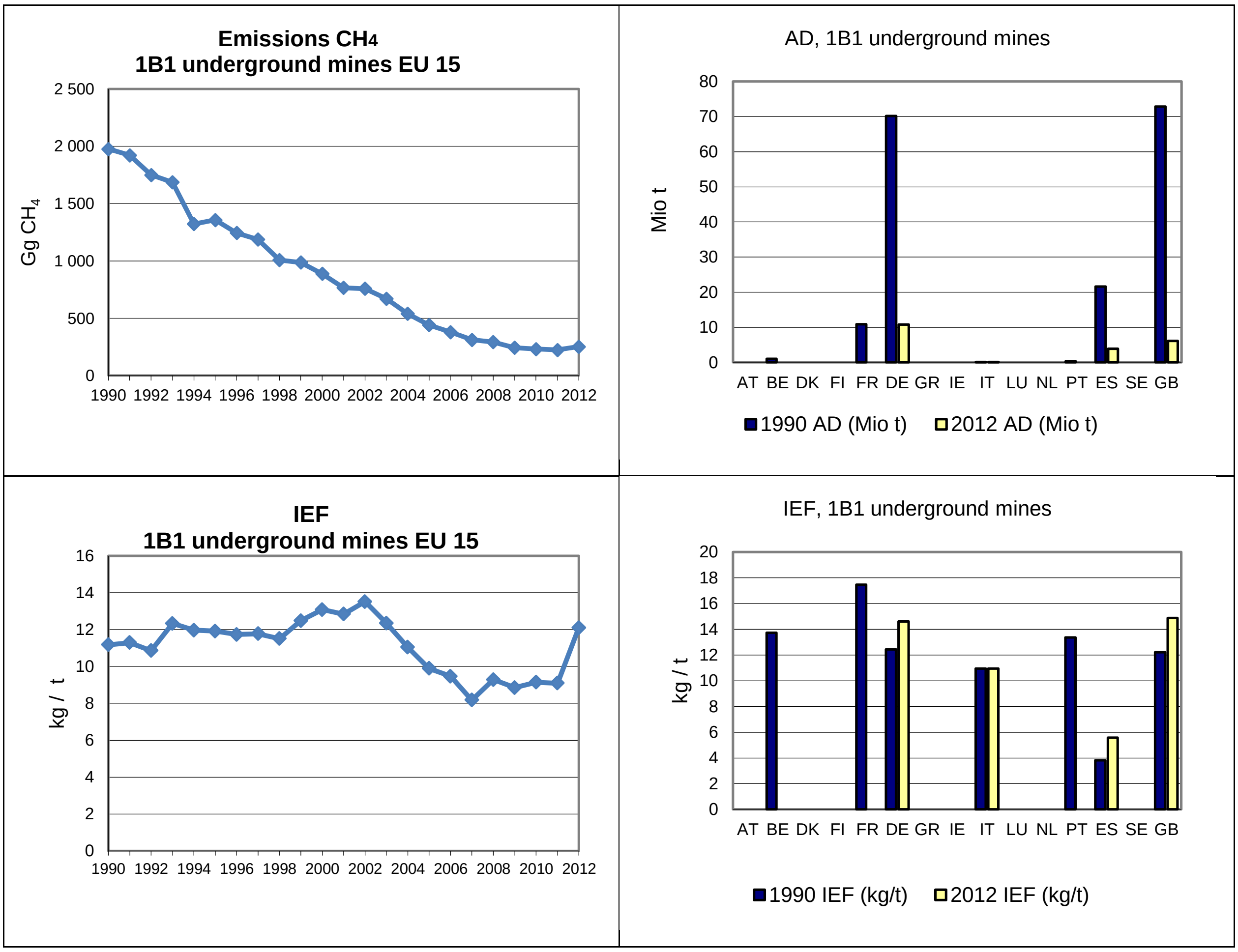
For methodological issues and remarks on completeness see Table 3.93.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.90 1B1a Coal Mining and Handling: Contribution of MS to CH_4 Emission and Activity Data



In 2012 most fugitive emissions from coal mines were due to underground mines. Within the EU-15 coal mining in underground mines decreased substantially (88 %) (Figure 3.91). The strong change in underground mining activities is opposed by a moderate change in the implied emissions factor for CH_4 emissions (with a maximum of 13.51 kg/t (2002) and a minimum of 8.17 kg/t (2007).

Figure 3.91 1B1ai Underground Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4



Overall, in the EU-15 coal production from surface mines decreased by 42 % between 1990 and 2012 (Figure 3.92). Coal mining in surface mines decreased in all Member States except in Greece (Figure 3.92).

Figure 3.92 1B1aii Surface Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4

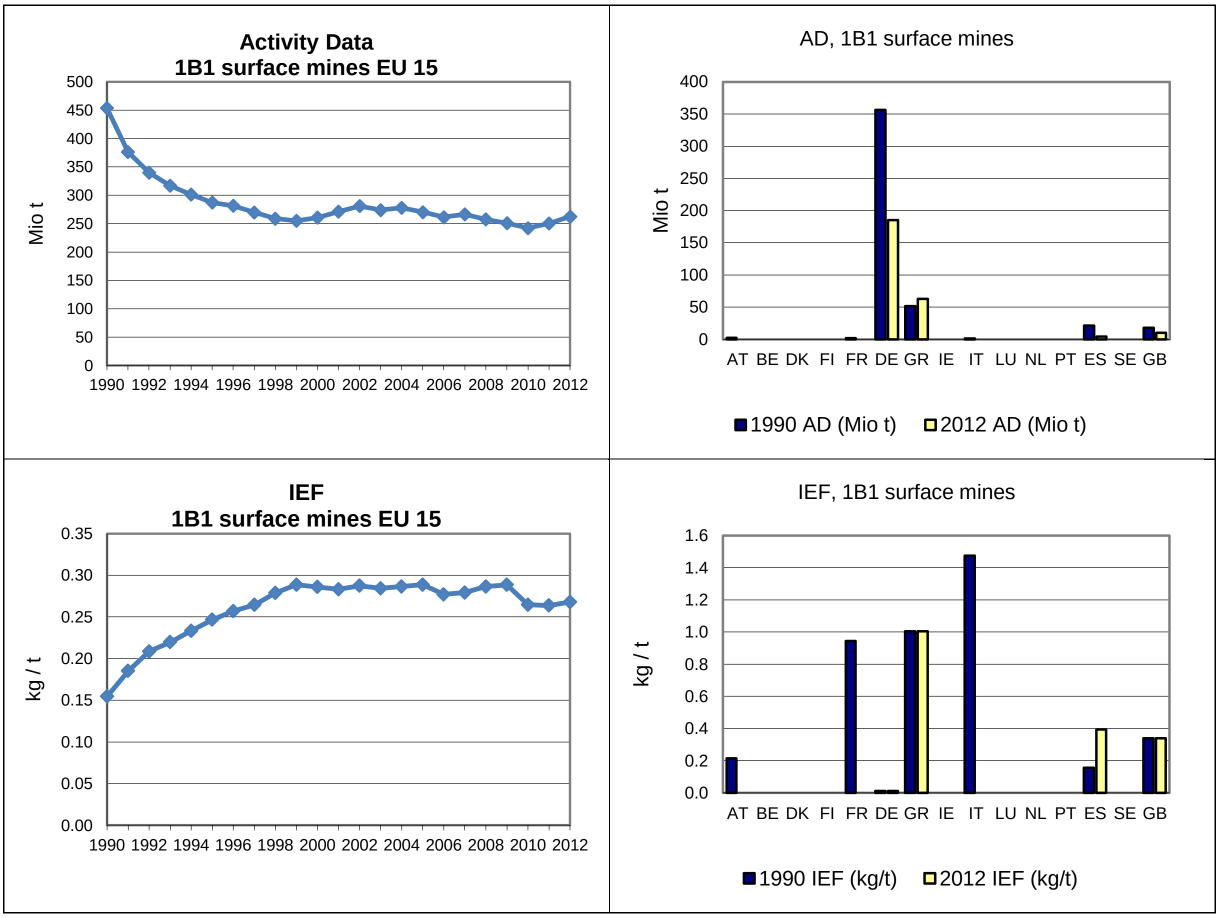


Table 3.95 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2011.

Table 3.95 1B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	1	5.9	1	100.0	CH4 emissions from charcoal production were estimated and reported for the first time.
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	54	122.0	Updated data: improved accuracy.
Germany	2	0.01	2	0.1	Production of char coal is now included.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	8	12.6	8	0.0	Coal production data has been revised based on statistical data from Geological Resources reports from DGEG. Previously it was wrongly assumed that one of the mines was an underground mine and the other was an open cast mine. From revised data obtained from DGEG experts, both mines are now considered underground mines. (1990-2011)
Spain	0	0.0	0	0.0	
Sweden	0	-0.2	0	0.0	During submission 2013 it was concluded that one of the operators did not take into account any intermediate stock change of produced coke in the carbon mass balance used when calculating the CO2 emissions, i.e. large amounts of carbon assumed to be released into the atmosphere was actually stored in the coke stocks. For submission 2014 the operator has delivered a revised time series, 2005-2012, of CO2 emissions allocated on different subcategories (CRF 1.A.1.c, 1.A.2.a, 1.B.1.c and 2.C.1.2). The current calculation model (see section 4.4.1.2.2) has been updated according to the new information from the operator. Due to the fact that an average CO2 IEF 2003-2007 is used in the calculation model to calculate the CO2 emissions and the amounts of derived energy gases (CH4, N2O, NMVOC and CO emissions) for 1990-2002, the new information also affects the reported emissions for previous years.
UK	-4	0.0	-3	-0.2	Emission factor for coke oven gas updated from Corinair to IPCC default.
EU-15	**7**	**0.0**	**62**	**0.9**	

○ **Emissions from Other (1B1c)**

Four member states report CH_4 emissions in this sector, two are also reporting CO_2 emissions. The description of the subcategories are presented in Table 3.96.

Table 3.96 Description of subcategories in sector 1B1c for CO_2- and CH_4-emissions for reporting Memberstates

Member state	Emission	Subcategory
Germany	CO_2, CH_4	Abandoned mines (CH_4, CO_2), Flaring of gas (CO_2)
France	CH_4	Abandoned mines
UK	CH_4	Closed Coal Mines
Sweden	CO_2, CH_4	Flaring of gas

3.2.6.2 Fugitive emissions from oil and natural gas (1B2) (EU-15)

Fugitive emissions from oil and natural gas correspond to the total fugitive emissions from oil and gas activities. Fugitive emissions may arise from equipment exhaust (non-combustion), leakages, upsets and mishaps at any point in the chain from production through final use. Emissions from flaring are also included (the combustion is considered a non-productive activity) (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

Fugitive emissions from 1B2 Oil and natural gas include all emissions from exploration, production, processing, transport, and handling of oil and natural gas. They account for 1.0 % of the total GHG emissions in 2012 and for 83 % (Figure 3.93) of all fugitive emissions in the EU-15.

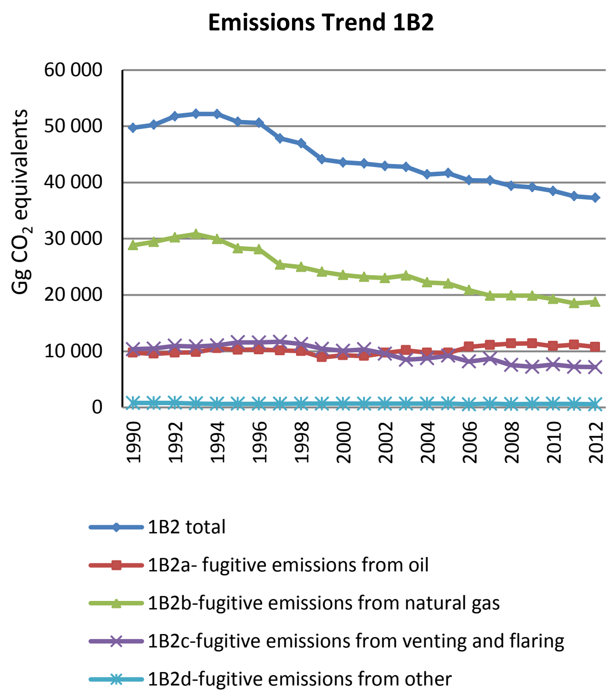
Of all fugitive emissions from oil and natural gas, in 2012:

- 46% were CH_4 emissions from natural gas (exploration, production, processing, transport and distribution)
- 26 % were CO_2 emissions from oil (exploration, production, transport, refining and storage and distribution)
- 15 % were CO_2 emissions due to flaring

This source category includes three key source categories:

- CO_2 from 1B2a Oil
- CH_4 from 1B2b Natural Gas
- CO_2 from 1B2c Venting and Flaring

Figure 3.93 1B2-Fugitive Emissions Oil and Natural Gas: Trend



Fugitive emissions from oil and natural gas arose in all Member States (Table 3.97). Total greenhouse gas emissions from 1B2 decreased by 25 % between 1990 and 2012 (Figure 3.92). This trend was mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 33 % over that period.

In 2012, 75% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: France, Germany, Italy and the United Kingdom (Table 3.93). The largest reductions (in absolute terms) were observed in the United Kingdom (mainly CH_4 emissions) and in Italy (both CH_4 and CO_2 emissions), while emissions increased most in Spain (Table 3.97).

Table 3.97 1B2 Fugitive emissions from oil and natural gas: Member States' contributions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)
Austria	325	480	102	237	223	243
Belgium	613	472	84	92	528	380
Denmark	372	327	327	221	44	106
Finland	231	172	219	133	11	38
France	5 947	4 579	4 420	3 396	1 500	1 167
Germany	9 731	7 256	1 943	1 454	7 787	5 802
Greece	162	208	70	9	92	199
Ireland	131	24	IE,NO	IE,NO	131	24
Italy	10 654	7 177	3 344	2 223	7 298	4 943
Luxembourg	16	40	0	0	16	40
Netherlands	2 418	1 526	775	791	1 643	735
Portugal	309	1 388	268	991	38	395
Spain	2 270	3 864	1 656	3 293	613	571
Sweden	369	943	292	874	77	66
United Kingdom	16 179	8 807	5 778	3 550	10 359	5 215
EU-15	**49 727**	**37 263**	**19 278**	**17 264**	**30 361**	**19 924**

For methodological issues and remarks on completeness see Table 3.92.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.98 provides information on the methodologies used by EU-15 Member States.

Table 3.98 1B2 –Fugitive Emissions from Oil and Gas: Methodological Issues according to NIRs (submitted in 2014) and Member State information of EU-15 Member States

Member State	Methodology
Austria	**General:** 1 B 2 a i Oil Exploration, 1 B 2 a iii Transport, 1 B 2 b Natural Gas Exploration and 1 B 2 b i Natural Gas Production/Processing, except CO_2 emissions from processing of sour gas, are included in 1 B 2 a ii. CO_2 emissions from 1 B 2 a iv Refining/Storage due to combustion are included in 1 A 1 b Petroleum Refining, fugitive CO_2 emissions are assumed to be negligible. 1 B 2 a v Distribution of oil products also includes storage in storage tanks and refinery dispatch station – only NMVOC emissions are estimated as CH_4 emissions are assumed to be negligible. CO_2 emissions from 1 B 2 c Venting/Flaring are included in 1 A 1 b Petroleum Refining. CH_4 emissions from 1 B 2 c Venting/Flaring are included in 1 B 2 a iv Petroleum Refining **Activity data:** national energy balance, Association of the Austrian Petroleum Industry, Austrian Natural Gas and District Heat Association., E-Control (Austrian Energy Regulator) **Emission factor:** IPCC Reference Manual, country specific; Refining: EF emission factor of 745 kg CH_4/PJ crude oil input;
Belgium	**General**: CO_2 of the refineries were allocated to the sectors 1A1a for the involved combined heat-power installations of the refineries, 1B2c for the flaring emissions and 1A1b for the total emissions excluding the emissions of the combined heat-power installations and excluding the emissions from flaring activities. The emissions of CH_4 reported in 1B2a also contain the emissions of flaring activities, as a consequence these CH_4 emissions are allocated in category 1B2a and not in category 1A1b. 1B2a3: methodology according to GPG 1.B.2.b iv/distribution: emissions are determined on the basis of the length of gas distribution pipelines. 1.B.2.b.iii/transmission: estimation are on the basis of measurements and calculations (taken into account pressure, distance, volume).

Member State	Methodology
	Activity data: The activity data reported under category 1B2a are obtained directly from the companies involved through their reporting obligations in the Flemish region via the annual integrated environmental report. The activity data is the amount of crude oil used in the refineries. There is no crude oil production in Belgium. Crude oil used in the Belgian refineries enters Belgium via the pipeline Rotterdam-Antwerp. The activity data (import of crude oil in Belgium) derives from the federal petroleum balance of the Federal Ministry of Economy in Belgium. The activity data reported in the category 1B2b is the annual total natural gas amount consumed in Belgium. These activity data originate from SYNERGRID, the federation of the grid operators of gas and electricity in Belgium. **Emission factor:** plant specific, country specific
Denmark	**General:** 1B2a: Fugitive emissions from oil include emissions from extraction, stor-age, and transmission of crude oil, distribution of oil products and fugi-tive emissions from refining. Emission data for offshore extraction of oil and gas are not available separately, and consequently emissions from gas extraction are included in 1B2a 1B2b: Fugitive emissions from natural gas include emissions from trans-mission and distribution of natural gas. Emissions from gas extraction are included in1B2a. 1B2c: Venting and flaring include activities onshore and offshore. Flaring occur both offshore and onshore in gas treatment and storage plants and in refineries. Venting occurs in gas storage plants. Venting of gas is as-sumed to be negligible in extraction and in refineries as controlled vent-ing enters the gas flare system. **Activity data:** Activity data used in the calculations of the emissions from oil and gas pro-duction and loading of ships are shown in Table 3.5.6. Data are based on in-formation from the Danish Energy Agency (2013a) and from the environ-mental reports from DONG Oil Pipe A/S (DONG Oil Pipe A/S, 2013). Data on the amount of crude oil processed in the two Danish refineries are given by the refineries in their annual environmental report (A/S Dansk Shell, 2013 and Statoil A/S, 2013). The Danish Energy statistics contains data on the sale of gasoline that are the basis for estimating emissions of NMVOC from service stations. Transmission rates for 1990-1998 refer to annual environmental reports of DONG Energy. In 1999-2006 transmission rates re-fer to the Danish Gas Technology Centre (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007). From 2008 onwards transmission rates refer to Ener-ginet.dk. Venting and flaring: in DK are two natural gas storage facilities. Both are obligated to make an environmental report on annual basis. **Emission factor:** EMEP/EEA Guidebook (2009), IPCC Good Practice Guidance (2000), country specific, national studies, UK Emission Factor Database ,Danish EPA
Finland	**General:** There is no exploration or production of oil or natural gas in Finland.CO_2, CH_4 and N_2O emissions from flaring at oil refineries and in the petrochemical industry, fugitive methane emissions from oil refining and methane emissions from gas transmission and distribution were included. Oil refining: The fugitive methane emissions from the refining and storage of oil have been calculated on the basis of 1996 IPCC GL using the default emission factors for oil refining and data from Energy Statistics (Energy Statistics, 2013) on oil refining activities.

Member State	Methodology
	Flaring: Estimates of carbon dioxide emissions from flaring are calculated using data from VAHTI system and emission factors of used fuels in ILMARI calculation system. Natural gas transmission: Fugitive emissions from gas transmission are calculated by Gasum Oy (Gasum, 2013). Calculations are based on measurements for the years 1996-2012. Emissions of earlier years have been estimated with Gasum Oy (Hyvärinen E. 2000) at Statistics Finland based on the volume of transmitted gas and knowledge of malfunctions and repairing works when gas could have been released. Natural gas distribution: Emissions from gas distribution are also partly based on measurements (1996-2012) made by Helsinkikaasu Oy (Tolonen M., 2013) and partly on rough estimates (1991-1994) based on the volume of total distributed gas. This method is close to linear interpolation in accordance with GPG 2000. There were no emissions from gas distribution in 1990. The reason for this is that natural gas has been distributed in the old parts of the distribution network beginning from 1991. So called “town gas”, which was earlier distributed in those parts, did not contain substantial amounts of methane. **Activity data:** Energy Statistics (Energy Statistics, Yearbook 2009), flares reported to the VAHTI system **Emission factor:** Emission factors for calculating emissions from the refining and storage of oil are based on the default factor given in 1996 IPCC GL, since country-specific factors are not available. The IPCC Guidelines offer a wide range for the emission factors. Due to lack of knowledge on the applicability of the factors to Finnish circumstances, the mean value of the factors is used (EF = 880 kg methane / PJ oil refined). Plant and fuel specific emission factors are used for calculation emissions from flaring. **Changes:** Roundings of emission data were removed Section 3.6.5.
France	**General:** Emissions from exploration, production, transport, refining were included. There are 14 refineries in France. The fugitive CO_2 emissions from the gas extraction site ‘bassin de Lacq’ decreased along with production strongly. The production of petrol emits CO_2 and CH_4, but compared to the transformation of petroleum products much less. **Activity data:** national and plant statistics **Emission factor**: country specific, extraction Tier 1 (liquid) and 3 (gaseous fuel), refining Tier 2/3, pipeline compressors (tier 3), transport Tier 2/3
Germany	**General**: Emissions from 1 B 2 b i are included in 1 B 2 a i Tier-2-Method (IPCC) **Activity data**: Jahresbericht des Wirtschaftsverbandes Erdöl- und Erdgasgewinnung e.V. (WEG), Jahresbericht Mineralöl-Zahlen, Mineralölwirtschaftsverband **Emission factor**: IPCC GPG default emission factors, country specific
Greece	**General**: Activities related to primary production (extraction), processing, storage and transmission/ distribution of crude oil, petroleum products and natural gas are included in this sector.The introduction of natural gas in the Greek energy system started in 1996. Emissions estimated according to the Tier 1 methodology described in the IPCC Good Practice Guidance (IPCC 2000). Emissions from crude oil transport are reported under venting, while emissions from LPG transport are reported under Other (1.B.2d - Other) **Activity data:** national energy balance, Public Gas Corporation, international institutes and databases **Emission factor:** IPCC Guidelines, IPCC Good Practice Guidancev
Ireland	**General:** Ireland has no oil industries and therefore fugitive emissions of greenhouse gases are limited to those associated with natural gas production and distribution. **Activity data:** energy balance, reports to the department of communications energy and natural resources (DCENR) under the OSPARConvention

Member State	Methodology
	Emission factor: country specific
Italy	**General**: Fugitive CO_2 emissions reported in 1B2 referred to fugitive emissions in refineries during petroleum production processes, e.g. fluid catalytic cracking and flaring, and emissions from the production of oil and natural gas. CH_4 emissions reported in 1B2 referred mainly to the production of oil and natural gas and to the transmission in pipelines and distribution of natural gas. CO_2 and CH_4 fugitive emissions from oil exploration are included in those from production because no detailed information is available. N_2O emissions from flaring in oil exploration and in refining activities are reported under oil flaring. Emissions from transport and distribution of oil result as not occurring. CO_2 and CH_4 emissions from gas exploration are also included in those from production while CH_4 emissions from other leakage are included in distribution emission estimates. **Activity Data:** National Energy Balance, specific industry data **Emission factor**: IPCC GPG (2000) **Methodological :** CO_2 and CH_4 from 1B2C.1.1. Disaggregation of fugitive emissions from oil among venting, flaring and production. Addition of natural gasoline production; CO_2 and CH_4 from 1B2C.2.1. Disaggregation of fugitive emissions from oil among venting, flaring and production. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Addition of natural gasoline production N_2O from 1B2C.2.1. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D CO_2 and CH_4 from 1B2C.2.2. Disaggregation of fugitive emissions from oil among venting, flaring and production CO_2 from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Reallocation of fugitive emissions from petroleum refining between production processes and flaring CH_4 from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D N_2O from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Addition of N_2O emissions from flaring in refineries
Luxembourg	**General:** In Luxembourg, fugitive emissions only occur from natural gas transmission, distribution and leakages (IPCC Sub-categories 1B2b3, 1B2b4 and 1B2b5). Other fugitive emissions are not occurring in Luxembourg. With regards to natural gas, methane emissions from leaks or accidental events are included in IPCC sub-categories 1B2b3 – Transmission and 1B2b4 – Distribution, hence notation key IE used in IPCC sub-category 1B2b5 – Other Leakage. **Activity Data:** national natural gas consumption: national statistics **Emission factor**: 2006 IPCC Guidelines default emission factors for natural gas transmission and distribution. (2006 IPCC Guidelines Tier 1 approach has been applied).
Netherlands	**General:** The fugitive emissions – mostly CH_4 – from category 1B2 comprise non-fuel combustion emissions from flaring and venting, emissions from oil and gas production, emissions from gas transport (compressor stations), gas distribution networks (pipelines for local transport), oil refining and emissions from hydrogen plants. The fugitive CO_2 emissions from refineries are included in the combustion emissions reported in category 1A1b. In addition, the combustion emissions from exploration and production are reported under 1A1c. From the 2007 submission the process emissions of CO_2 from a hydrogen plant of a refinery (about 0.9 Tg CO_2 per year) are reported in this category. Refinery data specifying these fugitive CO_2 emissions are available from 2002 onwards (environmental report from the plant) and re-allocated from 1A1b to 1B2a-iv for 2002 onwards. **Activity data:** plant and country specific **Emission factor:** company-specific emission factors are used (per plant).. Since 2004, the gas distribution sector annually records the number of leaks found per material, and any

Member State	Methodology
	future possible trends in the emission factors will be derived from these data.
Portugal	**General:** Extraction and production of crude oil did never occur in the Portuguese territory. Therefore, fugitive emissions comprised only those resulting from refining, storage and transport of crude oil, other raw materials, intermediate products and final products - particularly gasoline - from terminal receiving of crude oil and other petroleum products till delivering to final consumer. There is no production of natural gas in Portugal. The use of natural gas in Portugal was initiated only in 1997 (DGEG). All natural gas is imported and received through shipping transport from Algeria and Nigeria as Liquefied Natural Gas (LNG). There are also no major processing operations in Portugal. **Activity data:** plant and country specific, GALP (the company operating all refineries in Portugal), PETROGAL, TRANSGAS, General-Directorate for Energy and Geology (DGEG) **Emission factor:** IPCC Good Practice (IPCC,2000), EMEP/CORINAIR, plant specific, USEPA
Spain	**Activity Data:** OILGAS, Enciclopedia Nacional del Petróleo, Petroquímica y Gas, SEDIGAS **Emission factors:** estadística de prospección y producción de hidrocarburos, country specific, EMEP/CORINAR Guidebook, IPCC GPG 2000
Sweden	**General:** According to 2006 IPCC Guidelines, emissions from hydrogen production plants should be reported in this sector. Since 2005, one such facility is in operation in Sweden, and another one was taken into operation in 2006. Emissions from these facilities are reported in CRF 1B2ai in accordance with 2006 IPCC Guidelines. In Sweden, crude oil is transported to and from the country by tankers. In response to recommendations from the UNFCCC expert review teams, Sweden estimates for the first time in the 2010 submission inventory emissions of CH_4 from transport of crude oil. **Activity data:** plant specific, report to the EU ETS system, Statistics Sweden, Swedish EPA **Emission factor:** plant specific, country specific and default, IPCC guidelines, 2000 Good Practice Guidance **Changes(NIR 201**4) - 1.B.2.A.5: Emissions of NMVOC are revised 1990 – 2011 due to updated activity data (fuel consumption) from the Swedish Road Administration road emission model HBEFA. Minor corrections of NMVOC emissions from gasoline stations for 2010 and 2011. The recalculations led to changes in reported NMVOC emissions between a decrease of 0.061 Gg to an increase of 0.004 Gg. - Transmission of natural gas CFR 1.B.2.B.3: In previous submissions CO_2 and CH_4 fugitive emissions from natural gas transmission pipeline and storage were estimated using the default method from the IPCC Good Practice Guidance. In submission 2014 a national method for estimating the fugitive emissions of natural gas (transmission and storage of gas) has been developed for the period 1990 to 201292 see section 3.3.2.2.5.
United Kingdom	**General:** Emissions occurred from oil and gas production facilities, gas and oil terminals, gas processing facilities, oil refineries, gas transmission networks, storage and distribution of petrol and gas leaks at the point of use (i.e. leaks from residential and commercial gas appliances). Emissions from fuel combustion at upstream oil and gas production facilities is reported within IPCC source category 1A1c Other Energy Industry; emissions reported in 1B2 comprise process, fugitive, venting and flaring emissions.. Most of the UK's oil and gas production occurs offshore but there are a number of mostly small onshore production sites as well. **Activity data:** Oil and Gas UK trade association (through their annual emissions reporting mechanism to the UK regulatory agency (the Department of Energy & Climate Change), called the Environmental Emissions Monitoring System (EEMS), for years prior to 1995 emission totals are based on an internal Oil and Gas UK summary report produced in 1998, UK Petroleum Industry Association, UK Energy Statistics

Member State	Methodology
	Emission factor: plant specific and aggregated, calculated by UK Institute of Petroleum **Changes (NIR 2014)**: Addition from 2007 onwards of new data on VOC emissions from an oil storage tank farm regulated under a separate permit to the main terminal installation, for one oil terminal in the UK. The emissions data are used in conjunction with EEMS data on activity and VOC emissions to derive new activity estimates for the site. Revised gas activity data in DUKES (DECC, 2013) Minor revisions to flaring estimates for two onshore terminals (Barrow, CATS) based on revised analysis of EUETS data and the PI totals for the sites. Revised gas leakage estimates provided by one gas network operator from 2007 onwards, following inventory agency consultation to reconcile outlier data. Addition of emissions from onshore oil processing sites from the Pollution Inventory, leading to higher estimates for 2011 and 2012 compared to previous years, reflecting new installations and activities in the UK. Revisions to installation emission estimates for a number of UK sites, including one increase due to revised PI data, and one decrease due to correction of an assumption in the 2013 submission data to reflect the down-turn in operation of one of the main osshore rig process emission sources. Minor revisions to flaring estimates have been made for two onshore gas terminals (Barrow, CATS) based on revised analysis of EUETS data and the Pollution Inventory totals for the sites. In addition, there have been revisions to reported emissions of nitrous oxide from one terminal (Frigg) within the SPRI. These installation-specific revisions have a small knock-on effect to the overall emission factors for CH_4 and N_2O for the source.

- **CO_2 from Oil (1B2a)**

Fugitive emissions from oil correspond to fugitive emissions from oil exploration, fugitive emissions from the production of crude oil, fugitive emissions resulting from the loading and unloading of crude oil from tankers, fugitive emissions from the refining of oil and from storage in tanks and emissions (primarily NMVOCs) from transport and handling of oil products. (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

CO_2 emissions from 1B2a ‘Fugitive CO_2 emissions from oil’ account for 0.3 % of total EU-15 GHG emissions in 2012 and for 21 % of all fugitive emissions in the EU-15. Between 1990 and 2012, CO_2 emissions from this source increased by 17 % in the EU-15 (Table 3.99). By contrast, during the same period 1990-2012, CH_4 emissions of this source category were reduced by 24 %.

Together France, Italy and Spain accounted for 73 % of the EU-15 total CO_2 emissions of 1B2a ‘Fugitive CO_2 emissions from oil’ (Table 3.99). All three Member States used higher tier methods for the estimation of 1B2a (Table 3.99). During the period 1990-2012, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Netherlands and in Spain (Table 3.99).

Table 3.99 1B2a Fugitive CO_2 emissions from oil: Member States' contributions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	43	145	145	2%	0	0%	102	237%	CS	PS
Belgium	0.01	0.02	0.02	0.0002%	0.001	6%	0.004	27%	T1	D
Denmark	2	4	4	0.04%	-0.4	-9%	1	56%	T2,T3	OTH
Finland	1.0	1.4	1.4	0.01%	-0.1	-4%	0.4	38%	CS	D
France	2 951	3 379	2 743	29%	-636	-19%	-208	-7%	T1,T2,T3	CS
Germany	65	56	58	1%	2	3%	-7	-11%	CS,T1,T2	CS,D
Greece	0.3	0.03	0.03	0.0003%	-0.001	-4%	-0.2	-	T1	D
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	2 366	1 455	1 393	15%	-62	-4%	-973	-41%	T1,T2	CS,D
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	0	846	728	8%	-118	-14%	728	-	CS,T1	CS,D
Portugal	215	791	811	8%	20	2%	596	278%	D	D
Spain	1 477	2 227	2 870	30%	643	29%	1 393	94%	T1,T2	D,PS
Sweden	219	807	801	8%	-6	-1%	582	266%	T2,T3	CS,PS
United Kingdom	859	187	35	0%	-151	-81%	-824	-96%	T2	CS,PS
EU-15	**8 199**	**9 898**	**9 590**	**100%**	**-308**	**-3%**	**1 391**	**17%**		

For methodological issues and remarks on completeness see Table 3.98. Abbreviations explained in the Chapter 'Units and abbreviations'.

○ **CH_4 from Natural gas (1B2b)**

Fugitive emissions from natural gas correspond to emissions from the production of gas, gas gathering systems and gas separation plants, emissions from pipelines for long distance and local transport of methane, compressor stations and their maintenance facilities, and the release of gas at point of use, including residential, commercial, industrial and electricity generation users (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

CH_4 emissions from 1B2b 'Fugitive CH_4 emissions from natural gas' account for 0.5 % of total EU-15 GHG emissions in 2012 and for 38 % of all fugitive emissions in the EU-15. Between 1990 and 2012, CH_4 emissions from this source decreased by 33 % in the EU-15 (Table 3.98).

In 2012, 82% of the EU-15 CH_4 emissions from 1B2b were emitted by three Member States: Germany, Italy and the United Kingdom (Table 3.100). All three Member States used higher tier methods for the estimation of the emissions from 1B2b. The emission decreases between 1990 and 2012 observed in the United Kingdom (-53 %), Germany (-23%) and in Italy (-33 %) contributed most significantly to the overall reduction in the EU-15 between 1990 and 2012.

Various parameters (e.g. pipelines length, PJ gas consumed, m^3 gas produced, see Table 3.103) were used as activity data for calculation of the sub categories of 1B2b by Member States and thus a meaningful implied emission factor could not be calculated for the EU-15.

Table 3.1001B2b Fugitive CH_4 emissions from natural gas: Member States' contributions and information on method applied and emission factor

Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	96	107	110	1%	3	3%	14	14%	T2,T3	CS
Belgium	519	395	374	2%	-22	-5%	-145	-28%	CS,M	CS
Denmark	9	7	3	0.02%	-3	-51%	-6	-64%	CS	CS
Finland	4	26	27	0.2%	1	6%	23	658%	T1,T2	CS,D,PS
France	1 343	1 052	1 117	7%	65	6%	-226	-17%	T1,T2,T3	CS
Germany	6 966	5 373	5 368	31%	-4	-0.1%	-1 598	-23%	CS,T2,T3	CS
Greece	10	131	134	1%	3	2%	124	1297%	T1	D
Ireland	131	27	24	0.1%	-4	-14%	-107	-82%	CS	CS
Italy	7 063	4 775	4 709	27%	-66	-1%	-2 354	-33%	T1,T2	CS,D
Luxembourg	16	39	40	0.2%	1	2%	24	147%	T1	D
Netherlands	373	410	405	2%	-5	-1%	31	8%	T2,T3	CS
Portugal	NO	124	353	2%	229	185%	353	-	CR,OTH	CR,OTH
Spain	420	481	489	3%	9	2%	70	17%	CS,T1	CS,D
Sweden	56	38	43	-	5	13%	-12	-22%	T2	CS
United Kingdom	8 541	3 965	3 979	23%	14	0.3%	-4 562	-53%	T2,T3	CS,PS
EU-15	**25 547**	**16 949**	**17 175**	**100%**	**226**	**1%**	**-8 371**	**-33%**		

For methodological issues and remarks on completeness see Table 3.98.
Abbreviations explained in the Chapter 'Units and abbreviations'.

○ **CO_2 from Venting and Flaring (1B2c)**

Fugitive emissions from venting and flaring correspond to the release and/or combustion of excess gas at facilities for the production of oil or gas and for the processing of gas (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2012 fugitive CO_2 emissions from 1B2c Venting and Flaring accounted for 0.2 % of total GHG emissions and for 12 % of all fugitive emissions in the EU-15. The United Kingdom used a higher tier method for the estimation of emissions from 1B2c and was responsible for nearly two thirds of the emissions from this source (Table 3.101).

Between 1990 and 2012, CO_2 emissions from this source decreased by 21 % in the EU-15 (Table 3.101).

Table 3.1011B2c Fugitive CO_2 emissions from venting and flaring: Member States' contributions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	IE	IE	IE	-	-	-	-	-	NA	NA
Belgium	84	93	92	2%	-1	-1%	8	10%	T3	PS
Denmark	325	252	217	4%	-35	-14%	-108	-33%	CS,T3	CS,PS
Finland	122	88	100	2%	12	14%	-21	-18%	CS	CS
France	652	402	449	8%	48	12%	-203	-31%	T1,T2,T3	CS
Germany	474	402	407	7%	5	1%	-68	-14%	CS	CS
Greece	70	9	9	0.2%	-0.3	-4%	-61.31	-	T1	D
Ireland	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Italy	293	313	318	6%	5	2%	25	9%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	774	53	62	1%	8	16%	-713	-92%	T2	PS
Portugal	52	66	107	2%	41	63%	54	103%	D	D
Spain	179	290	422	8%	131	45%	243	136%	CS,T1,T2	CS
Sweden	70	72	73	1%	1	1%	3	5%	T2	CS,PS
United Kingdom	3 920	3 664	3 266	59%	-397	-11%	-654	-17%	T3	CS,PS
EU-15	**7 015**	**5 702**	**5 522**	**100%**	**-181**	**-3%**	**-1 494**	**-21%**		

For methodological issues and remarks on completeness see Table 3.98.
Abbreviations explained in the Chapter 'Units and abbreviations'.

- **Emissions from Other (1B2d)**

Four member states report CO_2 emissions in this sector, one is also reporting CH_4 emissions. The description of the subcategories are presented in Table 3.102.

Table 3.102 Description of subcategories in sector 1B2d for CO_2- and CH_4-emissions for reporting Memberstates

Member state	Emission	Subcategory
Finland	CO_2	NMVOC emissions
Greece	CO_2	LPG Transport,
Italy	CO_2, CH_4	Flaring in Refineries
Portugal	CO_2	Geothermal

Table 3.103 1B2b Fugitive CH_4 emissions from natural gas: Information on activity data, emission factors by Member State

		1990					2012				
Member State	**GHG source category**	**Activity data**			**Implied emission factor (kg/unit)**	**CH4 emissions (Gg)**	**Activity data**			**Implied emission factor (kg/unit)**	**CH4 emissions (Gg)**
		Description	**Unit**	**Value**			**Description**	**Unit**	**Value**		
Austria	**Natural Gas**					**4.59**					**5.25**
	i. Exploration			1288	IE	IE			1807	IE	IE
	ii. Production (4) / Processing	gas produced	10^6 m^3	1288	IE	IE	gas produced	10^6 m^3	1807	IE	IE
	iii. Transmission	Pipelines length (km)	km	3628	494.56	1.79	Pipelines length (km)	km	7109	385.94	2.74
	iv. Distribution	Distribution network length	km	11672	239.81	2.80	Distribution network length	km	29260	85.62	2.51
	v. Other Leakage	Gas consumed	PJ	NO	NO	NO	Gas consumed	PJ	NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
Belgium	**Natural Gas**					**24.71**					**17.79**
	i. Exploration								NO	NO	NO
	ii. Production (4) / Processing								NO	NO	NO
	iii. Transmission	(e.g. PJ gas consumed)	PJ	341	5979.11	2.04	(e.g. PJ gas consumed)	PJ	604	4163.42	2.51
	iv. Distribution	PJ gas consumed	PJ	341	66474.61	22.67	PJ gas consumed	PJ	604	25299.78	15.27
	v. Other Leakage								NO	NO	NO
	at industrial plants and power stations								NO	NO	NO
	in residential and commercial sectors								NO	NO	NO
Denmark	**Natural Gas**					**0.45**					**0.16**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	Gas produced	10^6 m^3	5137	IE	IE	Gas produced	10^6 m^3	5617	IE	IE
	iii. Transmission	Gas transmission	10^6 m^3	2739	69.45	0.19	Gas transmission	10^6 m^3	5365	2.59	0.01
	iv. Distribution	Gas distributed	10^6 m^3	1749	147.44	0.26	Gas distributed	10^6 m^3	2752	53.24	0.15
	v. Other Leakage	Incl. in transmission		IE	IE	IE	Incl. in transmission		IE	IE	IE
	at industrial plants and power stations			IE	IE	IE			IE	IE	IE
	in residential and commercial sectors			IE	IE	IE			IE	IE	IE
Finland	**Natural Gas**					**0.17**					**1.29**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	(e.g. PJ gas produced)		NO	NO	NO	(e.g. PJ gas produced)		NO	NO	NO
	iii. Transmission	PJ gas consumed	PJ	92	1855.49	0.17	PJ gas consumed	PJ	126	1872.83	0.24
	iv. Distribution	PJ gas distributed via local networks	PJ	5	NO	NO	PJ gas distributed via local networks	PJ	9	116477.19	1.05
	v. Other Leakage	t of natural gas released from pipelines		NO	NO	NO	t of natural gas released from pipelines		NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
France	**Natural Gas**					**63.94**					**53.19**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	PJ Production	PJ	309	2372.14	0.73	PJ Production	PJ	76	78.94	0.01
	iii. Transmission	PJ Consumed	PJ	1055	14663.89	15.48	PJ Consumed	PJ	1597	7286.88	11.64
	iv. Distribution			1055	45224.32	47.73			1597	26011.53	41.55
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO

		1990					2012				
Germany	**Natural Gas**					**331.72**					**255.64**
	i. Exploration	numbers of wells drilled	number	IE	IE	IE	numbers of wells drilled	number	IE	IE	IE
	ii. Production (4) / Processing	production and processing	TJ	631232	94.93	59.92	production and processing	TJ	341510	5.53	1.89
	iii. Transmission	high pressure pipelines	km	36760	231.72	8.52	high pressure pipelines	km	64023	249.11	15.95
	iv. Distribution	distribution net	km	245852	813.26	199.94	distribution net	km	439466	423.22	185.99
	v. Other Leakage	gas consumed	TJ	893519	70.89	63.34	gas consumed	TJ	1301080	39.82	51.81
	at industrial plants and power stations		TJ	IE	IE	14.07		TJ	IE	IE	10.14
	in residential and commercial sectors	gas consumed	TJ	893519	55.14	49.27	gas consumed	TJ	1301080	32.03	41.67
Greece	**Natural Gas**					**0.46**					**6.37**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	Natural gas production	10^6 m^3	123	3708.46	0.46	Natural gas production	10^6 m^3	6	415.00	0.00
	iii. Transmission	Length of transmission pipeline	km	NO	NO	NO	Length of transmission pipeline	km	1348	2539.38	3.42
	iv. Distribution	Length of distribution mains	km	NO	NO	NO	Length of distribution mains	km	4794	615.00	2.95
	v. Other Leakage	(e.g. PJ gas consumed)		11567	IE	IE	(e.g. PJ gas consumed)		300672	IE	IE
	at industrial plants and power stations	NG consumption		5783	IE	IE	NG consumption		150336	IE	IE
	in residential and commercial sectors	NG Consumption		5783	IE	IE	NG Consumption		150336	IE	IE
Ireland	**Natural Gas**					**6.24**					**1.13**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	PJ of Gas produced	PJ	79	14330.75	1.13	PJ of Gas produced	PJ	8	1786.33	0.01
	iii. Transmission	(e.g. PJ gas consumed)		IE	IE	IE	(e.g. PJ gas consumed)		IE	IE	IE
	iv. Distribution	PJ of gas consumed	PJ	24	214519.35	5.12	PJ of gas consumed	PJ	71	15814.72	1.12
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	NO	NO	NO	(e.g. PJ gas consumed)	PJ	NO	NO	NO
	at industrial plants and power stations		PJ	NO	NO	NO		PJ	NO	NO	NO
	in residential and commercial sectors		PJ	NO	NO	NO		PJ	NO	NO	NO
Italy	**Natural Gas**					**336.33**					**224.23**
	i. Exploration	0.0%		36	158.15	0.01	0.0%		4	83.93	0.00
	ii. Production (4) / Processing	PJ of Gas produced	PJ	17296	2899.60	50.15	PJ of Gas produced	PJ	8511	1599.96	13.62
	iii. Transmission	(e.g. PJ gas consumed)	0	45684	822.12	37.56	(e.g. PJ gas consumed)	0	78300	488.53	38.25
	iv. Distribution	PJ of gas consumed	PJ	20632	12049.80	248.61	PJ of gas consumed	PJ	34736	4961.97	172.36
	v. Other Leakage			NA	IE	IE			NA	IE	IE
	at industrial plants and power stations			NA	IE	IE			NA	IE	IE
	in residential and commercial sectors			NA	IE	IE			NA	IE	IE
Luxembourg	**Natural Gas**					**0.77**					**1.91**
	i. Exploration	gas exploration		NO	NO	NO	gas exploration		NO	NO	NO
	ii. Production (4) / Processing	gas produced		NO	NO	NO	gas produced		NO	NO	NO
	iii. Transmission	gas consumed	TJ	18	13120.17	0.24	gas consumed	TJ	44	13195.32	0.58
	iv. Distribution	gas consumed		17933	30.07	0.54	gas consumed		44005	30.24	1.33
	v. Other Leakage	(specify)		IE	IE	IE	(specify)		IE	IE	IE
	at industrial plants and power stations	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE
	in residential and commercial sectors	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE

		1990					2012				
Netherlands	**Natural Gas**					**17.79**					**19.27**
	i. Exploration	number of wells drilled/tested	number	NA	IE	IE	number of wells drilled/tested	number	NA	IE	IE
	ii. Production (4) / Processing	gas produced	PJ	2300	IE	IE	gas produced	PJ	2409	IE	IE
	iii. Transmission	gas transported	PJ	2648	2137.02	5.66	gas transported	PJ	3251	2062.75	6.71
	iv. Distribution	natural gas distribution network	10^3 km	100	121283.21	12.13	natural gas distribution network	10^3 km	124	100952.82	12.57
	v. Other Leakage			IE	IE	IE			IE	IE	IE
	at industrial plants and power stations			IE	IE	IE			IE	IE	IE
	in residential and commercial sectors			IE	IE	IE			IE	IE	IE
Portugal	**Natural Gas**					**NO**					**16.81**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	5264	3193.68	16.81
	iv. Distribution	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	IE	IE	IE
	v. Other Leakage			NO	NO	NO			IE	IE	IE
	at industrial plants and power stations	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
	in residential and commercial sectors	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
Spain	**Natural Gas**					**19.99**					**23.30**
	i. Exploration			IE	IE	IE			NO	NO	NO
	ii. Production (4) / Processing	PJ gas produced (NCV)	PJ	51	70657.76	3.62	PJ gas produced (NCV)	PJ	2	70657.76	0.17
	iii. Transmission	PJ gas (NCV)	PJ	198	837.17	0.17	PJ gas (NCV)	PJ	1183	496.43	0.59
	iv. Distribution	PJ gas consumed (NCV)	PJ	206	78856.89	16.21	PJ gas consumed (NCV)	PJ	1190	18937.78	22.54
	v. Other Leakage	(e.g. PJ gas consumed)	0	NE	NE	NE	(e.g. PJ gas consumed)		NE	NE	NE
	at industrial plants and power stations			NE	NE	NE			NE	NE	NE
	in residential and commercial sectors			NE	NE	NE			NE	NE	NE
Sweden	**Natural Gas**					**2.65**					**2.07**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	Length of pipeline	km	320	6.74	0.00	Length of pipeline	km	620	40.54	0.03
	iv. Distribution	Length of pipeline	km	NA	NA	2.65	Length of pipeline		NA	NA	2.04
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
United Kingdom	**Natural Gas**					**406.71**					**189.47**
	i. Exploration			225518	15.66	3.53			36671	45.00	1.65
	ii. Production (4) / Processing			1709	12758.51	21.81			1465	2201.52	3.22
	iii. Transmission			1395830	6.55	9.14			1992125	3.47	6.92
	iv. Distribution	Final gas consumption	GWh	1396	264819.47	369.64	Final gas consumption	GWh	1992	87953.71	175.21
	v. Other Leakage			1385	1864.62	2.58			1597	1540.29	2.46
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			1384768	1.86	2.58			1597036	1.54	2.46

Table 3.104 and Table 3.105 provide information on the contribution of Member States to EU-15 recalculations in CO_2 and CH_4 from 1B2 'Oil and natural gas' for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 3.104 1B2 Fugitive CO_2 emissions from Oil and natural gas: Contribution of MS to EU recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	2	0.8	0.2	0.1	Activity data and IEF for the time series 1990-2011 has been updated for transmission and distribution according to annual environmental reports and the latest national energy statistics, respectively.
Finland	0	0.0	0	0.0	
France	297	7.2	1 057	36.1	1B2a: Error correction: improved accuracy. New data: improving completeness. Change of use: improving transparency. 1B2b: Refinement of reporting: improving the completeness and transparency. 1B2c: Filtering method that takes into account new data: improved accuracy.
Germany	201	11.5	160	11.5	Updated data by association. New emission factor derived from a study.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	1	0.3	-78	-7.9	CO2 Emission Factor for Geothermal was revised.
Spain	0	0.0	-19	-0.8	CO2 emissions reported by a refinery plant associated to the sulphur recovery activity have been reallocated under category 1.A.1.b (These emissions come from the consumption of refinery gas in burners asssociated to the sulphur recovery plants).
Sweden	-12	-4.0	0	0.0	Reallocation of distribution losses of gas works gas that were reported in 1B2A5 in previous submissions.
UK	0	0.0	-86	-2.1	Revision to carbon balance apprach to use AD and EFS from ISSB/Tata in preference to DUKES stats and historic EF defaults.
EU-15	**489**	**2.6**	**1 035**	**6.2**	

Table 3.105 1B2 Fugitive CH_4 emissions from Oil and natural gas: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	25	12.9	-4	-1.9	Application of harmonised EF for whole time series.
Belgium	0	0.0	0	0.0	
Denmark	1	1.8	0	0.0	The CH4 Efs are updated for one town gas distribution company following an update of the estimated fugitive losses per distribution. The recalculation has changed the CO2 emission by 0.01 ktonnes and CH4 emission by (-0.09) - 0.07 ktonnes, corresponding to < 0.003% and (-2) % - 2% of the total fugitive CO2 and CH4 emission.
Finland	0	0.0	0	0.8	Roundings of emissions was deleted.
France	15	1.0	6	0.5	1B2a: Error correction: improved accuracy. New data: improving completeness. Change of use: improving transparency. 1B2b: Refinement of reporting: improving the completeness and transparency. 1B2c: Filtering method that takes into account new data: improved accuracy.
Germany	-305	-3.8	25	0.4	New emission factor derived from a study.
Greece	0	0.0	0	0.0	
Ireland	0	0.0	-0.02	-0.1	Update of activity data for gas distribution.
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-0.6	-0.4	Recalculations for this source category comprise only the revision of the 2003, 2008, 2009, 2010 and 2011 energy balance data (2003, 2008-2011).
Spain	0	0.0	0	0.0	
Sweden	2	2.1	-49	-44.9	A national method for estimating emissions of CO2 and CH4 from natural gas, biogas and gaswork gas distribution network has been developed
UK	1	0.0	51	1.0	Small corections to EF to ensure all sources included
EU-15	**-261**	**-0.9**	**29**	**0.1**	

3.2.6.3 Completeness

In the ARR 2013 the ERT encourages the European Union to review the coverage of emissions from leakage at industrial plants and power stations, as well as leakage in the residential and commercial sectors and, as appropriate, either revise the notation key or include these emissions, considering, if necessary, EFs used elsewhere in Europe.[31]

The EU and Spain checked this issue again and conclude as follows: Regarding the Revised IPCC Guidelines there are no emission factors for other leakage given for Western Europe. The US EPA study[32] from 1994, which is the basis for the provided emission factors in Table 1-58 of the Revised 1996 IPCC Guidelines, refers to EFs from 1990 and Section 5.3.1 of the study clearly says that 'rest of the World' includes the remaining countries of Asia, Africa, the Middle East, Oceania, Latin America and Canada. The same study confirms that all EU-15 Member States are classified as 'Western Europe'. The IPCC Guidelines apply identical definitions in pages 1.122 and 1.123. It is therefore clear that the default EF from 'rest of the world' is not applicable to Spain.

Table 1-57 of the Revised 1996 IPCC Guidelines includes the results from a study by Schneider-Fresenius et al. from 1989 but there are no EFs for estimating emissions from 'other leakage'. It provides a range of representative CH_4 EFs for Western Europe but refers to natural gas processing,

[31] UNFCCC (2014). FCCC/ARR/2013/EU Report of the individual review of the annual submission of European Union submitted in 2013

[32] US EPA (1994) International Anthropogenic Methane Emissions, Estimates for 1990 (Report to Congress). EPA 230-R-93-010, US Environmental Protection Agency, Office of Mobile Sources, Ann Arbor, MI, USA.

transmission and distribution, where Spain already reports emissions. Therefore it is not relevant for estimating emissions from ‘other leakage’.

Table 1-62 of the Revised 1996 IPCC Guidelines is about different studies from the 1980s and early 1990s which include EFs for Western Europe but only relevant for gas production and processing, where Spain already reports emissions. So, overall, none of these tables seem to be relevant for the case under question.

Regarding the use of country-specific information, the only Western European Member States that provide emission estimates for this subcategory are UK and Germany. UK states in its NIR [GB NIR,2013] that an IPCC method is not available for the category other leakage and UK used country-specific data and reports to use a country-specific tier 3 method from a recent consultation with gas network operators and from modelling exercise in 2010/2011 and emissions were included for the first time in the 2012 inventory submission. Similarly also Germany states in its NIR [DE NIR, 2013], that ‘no decision tree or other guidelines are available for determination of emissions from ‘other leakages’ from distribution and that also EMEP Emission Inventory Guidebook does not provide any instructions relative to this ‘other leakage’ category. Germany reports to use a country-specific Tier 2 method. The German EF has been determined in a specific research project in 2010. Summarizing, there is no Western European country that reports emissions in this subcategory that is using any IPCC default EF and that applies an EF from ‘rest of the world'.

In addition, the ‘other leakage’ subcategory is not very clearly defined in the 1996 IPCC Guidelines. Reporting instructions of 1996 IPCC Guidelines define this subcategory for “Release of gas at point of use, including residential, commercial, industrial and electricity generation users” which defines the sectors in which other leakages occur (residential, commercial, industry, electricity generation), but not the exact activity and processes that should be summarized as other leakages. Lacking a clear description of the exact leakage events that should be estimated, it is difficult to report the notation key ‘included elsewhere’ because only for a clearly defined activity, it is possible to be certain that emissions are included elsewhere.

Finally, Spain has available information from Sedigas, the Spanish gas association, that further clarifies the situation. "From Sedigas in its response to the Spanish inventory agency confirmed we can communicate that the tightness of gas installations at the point of use in Spain are thoroughly very controlled and regulated in accordance with regulation in our country in UNE-60670 (parts 8, 10, 11 and 12). This UNE standard is mandatory as indicated in Royal Decree 919/2006 Technical Safety Regulation of Distribution and Utilization of gaseous fuels). Regarding UNE standard 60670 and the Royal Decree RD 919/2006, the main specifications related to tightness required for gas installations below 5 bar are: (1) Tightness shall be verified before commissioning. (This tightness test shall be carried out the gas installer); (2) When commissioning the gas installation, the distribution company shall verify the tightness of the installation as well; (3) Tightness of the connection of the gas installation to gas appliances shall be verified by personnel in charge of commissioning gas appliances; (4) Tightness shall be verified at periodic check-up of gas installations. (mandatory for gas distribution companies for all gas installations every five years). Furthermore, gas is odorized prior to its use in the installation with the objective of detect as soon as possible any gas leakage." Thus, from this overview of controls and checks performed in accordance with the legislation in Spain, no emissions from ‘other leakage’ seem to occur in Spain and appropriate measures have been taken to prevent occurance. Given the lack of a precise definition of the subcategory ‘other leakage’ discussed above, Spain prefers using the notation key NE.

3.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 1 an overview of the Member States’ contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.106 shows the total EU-15 uncertainty estimates for the sector 'Energy' excluding 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. For those emissions for which no split by source category was available, uncertainty estimates were made for stationary combustion as a whole. The highest level uncertainty was estimated for N_2O from 1A2e and the lowest for CO_2 from 1A1a and 1A2f. With regard to trend CH_4 from 1A1a shows the highest uncertainty estimates, CO_2 from 1A1a the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 3.106 Sector 1 Energy (excl. 1A3b and 1B): Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	CO_2	488 821	495 758	1%	3%	0.002%
1.A.1.a Public electricity and heat production	CH_4	179	1 745	874%	104%	9.2%
1.A.1.a Public electricity and heat production	N_2O	2 912	3 419	17%	50%	0.2%
1.A.1.b Petroleum refining	CO_2	50 071	50 066	0%	4%	0.01%
1.A.1.b Petroleum refining	CH_4	16	14	-13%	30%	0.03%
1.A.1.b Petroleum refining	N_2O	263	166	-37%	114%	0.2%
1.A.1.c Manufacture of solid fuels	CO_2	70 175	16 530	-76%	6%	0.03%
1.A.1.c Manufacture of solid fuels	CH_4	84	12	-86%	86%	0.9%
1.A.1.c Manufacture of solid fuels	N_2O	691	179	-74%	22%	0.2%
1.A.2.a Iron and Steel	CO_2	56 515	39 057	-31%	4%	0.01%
1.A.2.a Iron and Steel	CH_4	104	63	-39%	26%	0.3%
1.A.2.a Iron and Steel	N_2O	242	231	-5%	208%	0.6%
1.A.2.b Non-Ferous Metals	CO_2	2 366	2 114	-11%	9%	0.004%
1.A.2.b Non-Ferous Metals	CH_4	2	2	6%	64%	0.1%
1.A.2.b Non-Ferous Metals	N_2O	21	9	-54%	84%	0.4%
1.A.2.c Chemicals	CO_2	9 391	9 110	-3%	12%	0.1%
1.A.2.c Chemicals	CH_4	10	11	10%	73%	0.2%
1.A.2.c Chemicals	N_2O	37	29	-22%	286%	1.6%
1.A.2.d Pulp, Paper and Print	CO_2	3 573	2 583	-28%	5%	0.02%
1.A.2.d Pulp, Paper and Print	CH_4	42	58	39%	62%	0.1%
1.A.2.d Pulp, Paper and Print	N_2O	137	150	9%	168%	0.5%
1.A.2.e Food Processing, Beverages and Tobacco	CO_2	6 752	3 703	-45%	5%	0.02%
1.A.2.e Food Processing, Beverages and Tobacco	CH_4	10	6	-42%	78%	0.3%
1.A.2.e Food Processing, Beverages and Tobacco	N_2O	60	19	-69%	389%	1.1%
1.A.2.f Other	CO_2	158 075	96 131	-39%	3%	0.01%

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.2.f Other	CH_4	192	187	-2%	23%	0.05%
1.A.2.f Other	N_2O	1 434	916	-36%	66%	0.1%
1.A.4.a Commercial/Institutional	CO_2	82 144	59 255	-28%	6%	0.03%
1.A.4.a Commercial/Institutional	CH_4	1 244	102	-92%	89%	1.1%
1.A.4.a Commercial/Institutional	N_2O	191	142	-25%	152%	3.0%
1.A.4.b Residential	CO_2	184 080	137 489	-25%	6%	0.02%
1.A.4.b Residential	CH_4	2 367	1 508	-36%	107%	0.3%
1.A.4.b Residential	N_2O	1 086	634	-42%	176%	0.4%
1.A.4.c Agriculture/Forestry/Fisheries	CO_2	29 578	22 598	-24%	9%	0.03%
1.A.4.c Agriculture/Forestry/Fisheries	CH_4	215	200	-7%	63%	0.2%
1.A.4.c Agriculture/Forestry/Fisheries	N_2O	363	311	-14%	203%	0.2%
1.A.5 Other	CO_2	14 967	3 098	-79%	10%	0.04%
1.A.5 Other	CH_4	240	8	-97%	25%	0.3%
1.A.5 Other	N_2O	542	243	-55%	63%	0.3%
1.A (where no subsector data were submitted)	all	903 784	756 795	-16%	2%	1.0%
1.A.1 (where no subsector data were submitted)	all	94 427	86 872	-8%	6%	3.2%
1.A.2 (where no subsector data were submitted)	all	181 243	149 790	-17%	4%	1.2%
1.A.3 (where no subsector data were submitted)	all	128 881	148 204	15%	3%	0.4%
1.A.4 (where no subsector data were submitted)	all	135 078	144 796	7%	4%	2.2%
Total - 1.A (where no subsector data were submitted)	**all**	**903 784**	**756 795**	**-16%**	**1.6%**	**0.2%**
Total - 1.A.1	**all**	**707 639**	**654 760**	**-7%**	**2.5%**	**0.6%**
Total - 1.A.2	**all**	**420 207**	**304 171**	**-28%**	**2.3%**	**0.7%**
Total - 1.A.4	**all**	**436 345**	**367 037**	**-16%**	**3.2%**	**1.2%**
Total - 1.A.5	**all**	**15 749**	**3 348**	**-79%**	**10.0%**	**3.9%**
Total - 1.A	**all**	**3 184 033**	**2 851 333**	**-10%**	**1.1%**	**0.4%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

Table 3.107 shows the total EU-15 uncertainty estimates for the sector 1.B ‘Fugitive emissions’ and the uncertainty estimates for the relevant gases for each source category. The highest level uncertainties were estimated for N_2O from 1B1 and the lowest for CH_4 from 1B2; the highest trend uncertainties were estimated for N_2O from 1B1, the lowest for CH_4 from 1B2.

Table 3.107 1B Fugitive Emissions: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid Fuels	CO_2	430	296	-31%	15%	0.05%
1.B.1 Solid Fuels	CH_4	40 904	5 935	-85%	24%	0.2%
1.B.1 Solid Fuels	N_2O	0.2	0.1	-25%	32%	0.6%
1.B.2. Oil and Natural Gas	CO_2	13 184	12 078	-8%	10%	0.1%
1.B.2. Oil and Natural Gas	CH_4	29 504	19 068	-35%	9%	0.04%
1.B.2. Oil and Natural Gas	N_2O	58	56	-4%	84%	0.1%
1.B (werhe no subsector data were submitted)	all	8 021	5 338	-33%	87%	11.0%
Total - 1.B	**all**	**92 101**	**42 770**	**-54%**	**12.4%**	**6.9%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

Table 3.108 shows the total EU-15 uncertainty estimates for the sector 1A3 ‘Transport’ and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N_2O from 1A3d and the lowest for CO_2 from 1A3b. With regard to trend N_2O from 1A3c and 1A3e show the highest uncertainty estimates, CO_2 from 1A3b the lowest.

Table 3.108 1A3 Transport: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.3.a Civil aviation	CO_2	9 473	10 822	14%	9%	0.02%
1.A.3.a Civil aviation	CH_4	8	5	-40%	62%	0.2%
1.A.3.a Civil aviation	N_2O	83	80	-3%	176%	0.3%
1.A.3.b Road transport	CO_2	522 354	577 668	11%	4%	0.01%
1.A.3.b Road transport	CH_4	3 206	587	-82%	28%	0.2%
1.A.3.b Road transport	N_2O	4 249	4 421	4%	58%	0.3%
1.A.3.c Railways	CO_2	4 250	1 823	-57%	6%	0.05%
1.A.3.c Railways	CH_4	6	3	-52%	63%	0.3%
1.A.3.c Railways	N_2O	96	47	-52%	144%	0.5%
1.A.3.d Navigation	CO_2	19 118	14 384	-25%	19%	0.1%
1.A.3.d Navigation	CH_4	44	30	-31%	66%	0.1%
1.A.3.d Navigation	N_2O	251	172	-31.6%	233%	0.7%
1.A.3.e Other	CO_2	8 089	6 871	-15%	25%	0.03%
1.A.3.e Other	CH_4	21	16	-24%	32%	0.1%
1.A.3.e Other	N_2O	179	91	-49%	71%	0.5%
1.A.3 (where no subsector data were submitted)	all	128 881	148 204	15%	3%	0.4%
Total - 1.A.3	**all**	**700 308**	**765 222**	**9%**	**2.8%**	**0.6%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

3.4 Sector-specific quality assurance and quality control (EU-15)

There are several activities for improving the quality of GHG emissions from energy: Before and during the compilation of the EU GHG inventory, several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency.

In the second half of the year, the EU internal review is carried out for selected source categories. In 2005, the EU internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production' and 1.B 'Fugitive emissions from fuels'. In 2008, N_2O from road transport were subject to the EU internal review. In 2012 a comprehensive review was carried out for all sectors and all EU Member States in order to fix the base year 2020 under the EU Effort Sharing Decision. (ESD review 2012). This review also covered the energy sector of the MS GHG inventories (peer review).

Since the inventory 2005 plant-specific data is available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see

Section 1.4.2). During the ESD review 2012 consistency checks were carried out between EU ETS data and the inventory estimates.

In 2014, additional quality checks of the EU NIR chapter energy were carried out in order to improve the consistency between the CRF tables and the EU NIR and consistency of tables and figures with text in the EU NIR.

Eurostat energy data

During the initial checks carried out before the compilation of the EU GHG inventory Eurostat energy data is used for cross checking the sectoral and reference approach of the MS submissions. This cross check between the European energy reporting system and the EU GHG inventory system is an important QA/QC element of the EU GHG inventory compilation.

The quality of the EU GHG inventory is directly affected by the quality of Member States and EU energy statistics systems. EU energy statistics are collected by Eurostat on the basis of the EU energy statistics regulation[33]. The energy statistics regulation was adopted as part of the energy package and establishes a common framework for the production, transmission, evaluation and dissemination of comparable energy statistics in the EU.

This regulation aims at collecting detailed statistical data on energy flows by energy commodity at annual and monthly level. It ensures harmonised and coherent reporting of national energy data, which is indispensable for the assessment of EU energy policies and targets. The content and structure of this regulation reflects the essence of the existing European statistical system, a system that is part of the international energy statistical system, and is in direct link with the national statistical structures (classifications) and methodologies. It also has concrete links to other statistical domains, such as economic, environment, trade and business statistics. These links provide an additional dimension in safeguarding data quality assurance.

The European energy statistics system and the quality of the EU inventory is directly affected by this regulation that:

- ensures a stable and institutional basis for energy statistics in the EU,
- guarantees long-term availability of energy data for EU policies,
- reinforces available resources for the production of the basic energy statistics at national level.

The energy statistics regulation helps improving the QA/QC of the EU inventory as it:

- makes available more detailed energy statistics by fuel,
- allows the estimation of CO_2 emissions from energy with the reference and sectoral approach,
- assures the quality of the underlying energy statistics,
- improves timeliness of energy statistics,
- provides a formal legal framework assuring consistency between national and Eurostat data.

Moreover, Article 6, paragraph 2 stipulates that:

'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'.

It also foresees the further development of the energy statistics system setting a time frame for the production of more detailed data on renewable energy and final energy consumption, stating:

[33] REGULATION (EC) No 1099/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2008 on energy statistics as amended by Commission Regulation (EU) No 147/2013 of 13 February 2013

'With a view to improving the quality of energy statistics, the Commission (Eurostat), in collaboration with the Member States, shall make sure that these statistics are comparable, transparent, detailed and flexible by:

a) reviewing the methodology used to generate renewable energy statistics in order to make available additional, pertinent, detailed statistics on each renewable energy source, annually and in a cost effective manner. The Commission (Eurostat) shall present and disseminate the statistics generated from 2010 (reference year) onwards

b) reviewing and determining the methodology used at national and Community level to generate final energy consumption statistics (sources, variables, quality, costs) based on the current state of play, existing studies and feasibility pilot-studies, as well as cost-benefit analysis yet to be conducted; and evaluating the findings of the pilot studies and cost benefit analysis with the view to establishing breakdown keys for final energies by sector and main energy uses and gradually integrating the resulting elements in the statistics from 2012 (reference year) onwards.'

The first annual statistics were submitted to Eurostat on the basis of Energy Statistics Regulation in November 2010. Since then the following improvements were observed:

- Submissions are getting more timely than before 2010, resulting to the availability of complete reference approach tables by the end of February each year;
- More detailed data can be used for the calculation of the reference approach, (e.g. availability of data on international aviation);
- More detailed energy balances are published by Eurostat.

3.5 Sector-specific recalculations (EU-15)

Table 3.109 shows that in the energy sector the largest recalculations in absolute terms in 1990 and 2011 were made for CO_2. In relative terms, the largest recalculations are found in N_2O emissions. They were -4.8 % and -1.3 % in 1990 and 2011, respectively.

Table 3.109 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2011 by gas in Gg (CO_2-eq.) and percentage

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-2 695	-0.1%	5 153	1.2%	2 343	0.6%	-50	-0.2%	-54	-0.3%	212	2.0%
Energy	1 082	0.0%	-678	-0.7%	-1 419	-4.8%	NO	NO	NO	NO	NO	NO
2011												
Total emissions and removals	-11 579	-0.4%	8 425	2.9%	5 586	2.1%	-441	-0.6%	-233	-6.7%	-78	-1.3%
Energy	9 056	0.3%	-237	-0.6%	-361	-1.3%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 3.110 provides an overview of Member States' contributions to EU-15 recalculations. In absolute terms, Germany had the most influence on CO_2 recalculations in the EU-15 in 2011. The German recalculations are due to revisions of energy balance data, which are reported in chapter 3.6 in the source categories subchapters. Further explanations for the largest recalculations by Member State are provided in Section 10.1.

Table 3.110 Sector 1 Energy: Contribution of Member States to EU-15 recalculations for 1990 and 2011 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2011					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	28	0.1	NO	NO	NO	20	-3	-1	NO	NO	NO
Belgium	-106	-8	33	NO	NO	NO	-532	57	64	NO	NO	NO
Denmark	63	6	2	NO	NO	NO	145	17	2	NO	NO	NO
Finland	-0.01	0.03	-0.05	NO	NO	NO	-75	-1	-2	NO	NO	NO
France	-668	-56	-1	NO	NO	NO	1 387	41	24	NO	NO	NO
Germany	204	-382	-1 119	NO	NO	NO	12 439	-284	97	NO	NO	NO
Greece	-444	-2	-7	NO	NO	NO	-487	-2	-8	NO	NO	NO
Ireland	0.0008	0	0	NO	NO	NO	69	-1	2	NO	NO	NO
Italy	0	1	-21	NO	NO	NO	-700	-67	-35	NO	NO	NO
Luxembourg	0.03	0.00007	0.0003	NO	NO	NO	13	0	1	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	525	4	7	NO	NO	NO
Portugal	-137	8	-0.01	NO	NO	NO	-224	9	-22	NO	NO	NO
Spain	799	-59	47	NO	NO	NO	-3 473	131	16	NO	NO	NO
Sweden	58	2	-289	NO	NO	NO	32	-66	-380	NO	NO	NO
UK	1 313	-214	-63	NO	NO	NO	-82	-72	-125	NO	NO	NO
EU-15	**1 082**	**-678**	**-1 419**	**NO**	**NO**	**NO**	**9 056**	**-237**	**-361**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.6 Comparison between the sectoral approach and the reference approach (EU-15)

The IPCC reference approach for CO_2 from fossil fuels for the EU-15 is based on Eurostat energy data (Eurostat database, February 2014). This submission includes the reference approach tables for 1990–2012.

Energy statistics are submitted to Eurostat by Member States on an annual basis with the five joint Eurostat/IEA/UNECE questionnaires on solid fuels, oil, natural gas, electricity and heat, and renewables and wastes. On the basis of this information Eurostat compiles the annual energy balances which are used for the estimation of CO_2 emissions from fossil fuels by Member State and for the EU-15 as a whole.

The Eurostat data for the EU-15 IPCC reference approach includes activity data and net calorific values as available in the Eurostat database. For the calculation of CO_2 emissions, the IPCC default carbon emission factors are used.

The IPCC reference approach method at EU-15 level is a three-step process.

- **Step 1:** For each Member State, annual data on energy production, imports, exports, international marine bunkers and stock changes are available in the Eurostat database in fuel specific units (kt – 1000 tonnes for oil & petroleum products and TJ – terajoules (GCV – Gross Calorific Value) for natural gas), as these are reported to Eurostat by the reporting countries via the Joint Annual Questionnaires; in these Annual Questionnaires also the calorific values for each and every energy product are reported to Eurostat. Eurostat uses the calorific values provided by each reporting country each year, to transpose the reported in specific units quantities into common energy units (toe – tonnes of oil equivalent and TJ – terajoules (NCV – Net Calorific Value)). Should the reporting country fail to deliver the calorific values, then – and only then - Eurostat applies default calorific values. For the energy products "Patent Fuel", "Coke Oven Coke", "Gas Coke", "Coal Tar", "BKB/PB" fixed calorific values are applied.
- **Step 2:** The EU-15 CRF Table 1.A(b) are calculated by adding the relevant Member State activity and emission data, as calculated under Step 1. The net calorific values provided for the EU-15 in CRF Table 1.A(b) are calculated from dividing apparent consumption in TJ by apparent consumption in fuel-specific units for each fuel. Therefore, these net calorific values

are 'implied calorific values'; there are no fuel-specific net calorific values available at EU-15 level.

- **Step 3:** For the calculations of carbon stored in Tables 1.A(d), Eurostat data on non-energy use of fuels are used, as reported by Member States in the joint questionnaire. For the fraction of carbon stored weighted averages of the the EU-15 Member States are calculated whereas for carbon emission factors IPCC default values are taken (IPCC, 1997).

Table 3.111 shows the apparent energy consumption from fossil fuel combustion from 1990 to 2012 as provided in Tables 1.A(b). Total fossil fuel energy consumption was 6 % below 1990 levels in 2012. Large increases had gas consumption (+52 %), whereas solid fuel combustion declined by 34 %.

Table 3.112 compares EU-15 CO_2 emissions calculated with the IPCC reference approach based on Eurostat data and the sectoral approach available from Member States. The reference approach and the sectoral approach, decreased by 10.5 % and 11.6 % respectively between 1990 and 2012; the percentage differences between the two data sets are below +/-1.0 % for all years.

Table 3.111 Reference Approach: Apparent EU-15 energy consumption (in PJ) (Eurostat data)

Fuel types	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Liquid Fuels	21,978	23,123	23,211	23,373	22,931	22,137	22,053	20,719	20,643	19,687	18,881
Solid Fuels	12,477	9,881	9,022	8,954	9,275	9,206	8,388	7,279	7,629	7,727	8,210
Gaseous Fuels	9,352	11,537	14,216	16,018	15,833	15,700	16,121	15,199	16,337	14,592	14,179
Total	**43,807**	**44,541**	**46,450**	**48,345**	**48,039**	**47,042**	**46,562**	**43,197**	**44,609**	**42,005**	**41,270**

Table 3.112 IPCC Reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO_2 emissions	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Sectoral approach	3.137	3.083	3.149	3.245	3.238	3.177	3.111	2.882	2.961	2.822	2.808
Reference approach	3.147	3.082	3.153	3.249	3.241	3.177	3.123	2.883	2.967	2.816	2.781

Table 3.113 provides an overview for EU-15 and by EU-15 Member State on differences between the Eurostat and national reference approach for 2012. The table shows that for EU-15 the differences are very small. However, for some Member States the two data sets show larger differences. The main reasons for diverging energy data are:

- the use of different calorific values (CV);
- differences in the basic energy balance data reported by Member States to Eurostat (in the joint questionnaires) and to the Commission and the UNFCCC (in the CRF tables).

Explanations for significant differences are as follows:

Denmark includes waste under solid fuels in order to make the reference approach more consistent with the sectoral approach.

Table 3.113 Comparison between Eurostat and national reference approach for apparent consumption for EU-15 for 2012 (CRF 1.A)[34]

MS	Gaseous fuels			Liquid fuels			Solid fuels		
	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %
AT	310,434	310,433	0.0%	469,979	483,851	3.0%	135,700	136,267	0.4%
BE	601,476	601,475	0.0%	862,026	866,831	0.6%	124,237	124,021	-0.2%
DE	2,923,195	2,966,298	1.5%	4,144,014	4,242,609	2.4%	3,364,135	3,413,861	1.5%
DK	145,886	145,885	0.0%	261,071	258,062	-1.2%	103,567	120,431	16.3%
ES	1,180,240	1,181,551	0.1%	2,064,725	2,027,269	-1.8%	634,043	637,215	0.5%
FI	125,819	125,848	0.0%	336,649	332,068	-1.4%	191,144	192,330	0.6%
FR	1,600,211	1,605,645	0.3%	3,120,443	3,220,953	3.2%	472,776	507,434	7.3%
GR	153,325	150,030	-2.1%	499,496	494,187	-1.1%	340,627	339,255	-0.4%
IE	168,076	168,449	0.2%	248,405	235,328	-5.3%	98,984	96,307	-2.7%
IT	2,568,838	2,567,407	-0.1%	2,379,804	2,501,927	5.1%	682,513	672,127	-1.5%
LU	44,006	44,005	0.0%	102,621	102,620	0.0%	2,236	2,250	0.6%
NL	1,372,877	1,372,754	0.0%	1,284,873	1,260,451	-1.9%	342,946	343,857	0.3%
PT	164,651	165,391	0.4%	380,970	387,768	1.8%	122,865	122,046	-0.7%
SE	42,144	42,356	0.5%	501,965	511,196	1.8%	91,876	88,260	-3.9%
UK	2,777,984	2,772,837	-0.2%	2,418,341	2,478,732	2.5%	1,607,850	1,610,839	0.2%
EU-15	14,179,162	14,220,365	0.3%	19,075,382	19,406,883	1.7%	8,315,499	8,406,499	1.1%

3.7 Responses of EU-15 Member States to UNFCCC Reviews

Table 3.114 provides an overview of EU-15 member state's response to the UNFCCC Review findings in the Energy sector (excluding transport and fugitive emissions).

Table 3.114 EU-15 member State's responses to UNFCCC review findings in 2013 in the Energy sector (excluding transport and fugitive emissions)

Sector	Gas	Member State	UNFCCC review findings	MS response
Comparison of the reference approach with the sectoral approach and international statistics	-	AT (2013)	24. Specifically, the ERT notes that in CRF table 1.A(c) the difference in energy consumption for liquid fuels between the reference and sectoral approaches is 1.9 per cent. In its NIR, Austria reported that this difference is largely attributed to the reference approach treating the mix of diesel and gasoline with biofuels as full fossil carbon. In response to a question raised by the ERT during the review, Austria explained that the way to address this problem would be to calculate the carbon content of gasoil and diesel oil in the reference approach in such a way that biofuels are considered for 2005 onwards, whereby biogenic carbon from biofuels is accounted for separately. For 2011, an 8.5 per cent share of biofuels in diesel oil would lead to a carbon content of 18.78 t carbon (C)/TJ instead of the current 20.20 t C/TJ. During the review, Austria provided information showing that if such an approach were followed, the difference between the reference and sectoral approaches for liquid fuels would be significantly lower than for the years 2005–2011. The ERT notes such information provided by Austria and recommends that Austria report, in its next annual submission, the carbon content of gasoil and diesel oil in	Austria has addressed this issue in the NIR 2014 and has calculated the carbon content of gasoil in the reference approach in a way that biofuels are considered for 2005 onwards in the sectoral approach. (NIR: Chapter 3.2.1, p.76)

([34]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

Sector	Gas	Member State	UNFCCC review findings	MS response
			the reference approach in such a way that biofuels are considered from the year 2005 onwards, whereby biogenic carbon from biofuels is accounted for separately.	
Stationary combustion – liquid, solid and biomass fuels – CO_2, CH_4 and N_2O3	CO_2, CH_4, N_2O3	AT (2013)	25. In response to a question raised by the ERT during the review, the Party provided its mass balance approach for 2011 and demonstrated how all of the inputs and outputs in the iron and steel production processes and the carbon flows are accounted for in the energy and industrial processes sectors and reported in the CRF tables. Austria also demonstrated how it validates carbon emission data from the European Union's Emission Trading System (EU ETS) with data received from Statistik Austria. The ERT noted that the prepared mass balance and the verification procedure demonstrated no potential underestimation of emissions. The ERT welcomes Austria's effort and strongly recommends that the Party include the carbon mass balance in the form of a process flow diagram in its NIR.	A process flow diagram will be included in the NIR 2014 for the Submission to the UNFCCC on April 15 2014. (NIR Chapter 3.2.11.1 Fig 13, p 103)
Stationary combustion – liquid, solid and biomass fuels – CO_2, CH_4 and N_2O3	CH_4	AT (2013)	29. The ERT observed that CH_4 emissions from coke production in iron and steel production are reported under manufacturing industries and construction. The ERT notes that, in line with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the Revised 1996 IPCC Guidelines), CH_4 emissions from coke production should be reported under manufacture of solid fuels and other energy industries. Therefore, the ERT recommends that Austria report emissions from coke production separately under manufacture of solid fuels and other energy industries. Austria provided comments to a draft version of this report and explained that, in line with the Revised 1996 IPCC Guidelines, in modern coke ovens CH_4 from coke production is typically collected and used as a fuel source, which is the case in Austria. The ERT agrees with this assessment and recommends that Austria transparently report this information in its next annual submission and use the appropriate notation key "IE" (included elsewhere).	No answer provided in NIR.
Stationary combustion – liquid, solid and biomass fuels – CO_2, CH_4 and N_2O3	CH_4, N_2O	AT (2013)	31. The ERT also noted that the Revised 1996 IPCC Guidelines contain EFs for charcoal for CH_4 (table 1-7 in volume 3) and N_2O (table 1-8 in volume 3). In response to the list of potential problems and further questions raised by the ERT, the Party submitted revised estimates of CH_4 and N_2O emissions from charcoal consumption, calculated using data from the IEA joint questionnaire collected for the period 1990–2011 and by applying the default EFs from the Revised 1996 IPCC Guidelines. The calculations resulted in an increase in the estimated biomass-related CH_4 emissions for other sectors – residential, from 163.62 Gg CO_2 eq to 165.06 Gg CO_2 eq for 2011, and also resulted in minor changes to the estimated N_2O emissions.	Emissions from charcoal consumption are now estimated. (NIR Chapter 3.2.13; page 150)

Sector	Gas	Member State	UNFCCC review findings	MS response
			The ERT agrees with the revised estimates and recommends that the Party transparently document the methods used to estimate CH_4 and N_2O emissions from charcoal use in its NIR.	
1 Energy - Sector overview	-	BE (2012/2013)	No findings from the review 2013 and 2012 reported for the Energy Sector in the NIR and its annexes.	
Energy, Feedstocks and non-energy use of fuels	CO_2	DK (2012)	42. Include a reference in CRF table 3.A-D to clarify the reporting of CO_2 emissions from white spirits	A reference was added in the CRF.
Energy, Feedstocks and non-energy use of fuels	-	DK (2012)	Document and justify in the NIR why a carbon storage factor of 1.00 has been used	The documentation in the NIR Chapter 3.4 has been improved as has the documentation in the CRF In CRF Table 1A.(c) a reference to NIR chapter 3.4 have been added. In CRF Table 1A (c) the following comment have been added: Non-energy use of fuels is not included in sector 1A in the Danish National Approach (IE). Fuel consumption for non-energy is subtracted in Reference Approach to make results comparable. This has been done by setting the fraction stored equal to 1. In CRF Table 1A(d) the following comments have been added: 1.AD.2 Lubricants: All emissions from the non-energy use of the three fuels identified in the Danish energy statistics are included in the Industrial Processes and the Solvent and Other Product Use sectors. In order to make the reference approach comparable with the sectoral approach the fraction of carbon stored has been set to 1. This is to exclude it from the comparison with the sectoral approach. The relevant emissions are included in the sectors identified in the table. 1.AD.3 Bitumen: All emissions from the non-energy use of the three fuels identified in the Danish energy statistics are included in the Industrial Processes and the Solvent and Other Product Use sectors. In order to make the reference approach comparable with the sectoral approach the fraction of carbon stored has been set to 1. This is to exclude it from the

Sector	Gas	Member State	UNFCCC review findings	MS response
				comparison with the sectoral approach. The relevant emissions are included in the sectors identified in the table. 1.AD.10 White Spirit:All emissions from the non-energy use of the three fuels identified in the Danish energy statistics are included in the Industrial Processes and the Solvent and Other Product Use sectors. Inorder to make the reference approach comparable with the sectoral approach the fraction of carbon stored has been set to 1. This is to exclude it from the comparison with the sectoral approach. The relevantemissions are included in the sectors identified in the table.
Energy, Stationary combustion: solid and liquid fuels	CO_2	DK (2012)	44. Reflect the results of the analysis of the CO_2 EFs for fuel oil in the NIR	The analysis of the CO_2 emission factors for fuel oil like in the case ofcoal did not yield any useable results. (See chapter 3.2.5)
1 Energy - Sector overview	-	FR (2012)	41. In the previous review report it was identified that the geographical coverage of the AD provided in the NIR for the energy sector was not always consistent, and, in some cases, it was not completely transparent to which submitted CRF tables (Convention or Kyoto Protocol) the data referred. The ERT reiterates the strong recommendation in the previous review report11 that France, in its next annual submission, refer to the CRF tables submitted under the Kyoto Protocol or, when this is not the case, clearly indicate to which territorial aggregation the information refers.	No answer provided in NIR.
1 Energy - Sector overview	-	FR (2012)	42. The description of the energy sector is generally transparent, but for some categories there is a lack of explanation for the variation in the implied emission factor (IEF) time series (see paras. 48 and 49 below). In order to improve transparency, the ERT recommends that France provide more detailed explanations for variations in the IEF time series in its next annual submission.	No answer provided in NIR.
Comparison of the reference approach with the sectoral approach and international statistics	-	FR (2012)	44. Several differences between the data reported in the CRF tables (reference approach) and international statistics (data reported to the International Energy Agency (IEA)) were identified during previous stages of the review; for example, liquefied petroleum gas imports in 2010 were 14 per cent higher when calculated using the reference approach than IEA data; and exports of natural gas in 2010 were 4 per cent higher according to IEA data than reported in the CRF tables. In response to questions raised by the ERT during the review, France explained that the reference approach was prepared using data provided	No answer provided in NIR.

Sector	Gas	Member State	UNFCCC review findings	MS response
			by MEDDE to IEA and any differences are due to the use of different net calorific values and the use of a provisional energy balance for 2010 for the calculation of the emission estimates using the reference approach. The ERT recommends that France continue to improve the consistency of the AD used in the inventory (sectoral approach), the national energy balance (reference approach), and international sources of information. France identified in the NIR plans for the further harmonization of the data used in the inventory and the national energy balance, especially for emissions from iron and steel production and steam cracking. The ERT encourages France to report on the progress made in its next annual submission.	
Feedstocks and non-energy use of fuels	CO_2	FR (2012)	46. The ERT concluded that the reporting on feedstocks and non-energy use of fuels is not transparent and has not improved since the Party's previous annual submission. CRF table 1.A(d) includes estimates of the quantities of feedstocks and non-energy use of fuels, showing estimates of the carbon stored in the non-energy use of fuels, but does not include information on the associated CO_2 emissions and where these were allocated: in the column "associated CO_2 emissions of feedstocks and non-energy use of fuels" all fuels are reported as included elsewhere ("IE"), except for other petroleum products; and not applicable ("NA") is reported in the column "allocated under". The ERT reiterates the recommendation in the previous review reports that France improve the transparency and completeness of the information reported in CRF table 1.A(d) in its next annual submission.	No answer provided in NIR.
Stationary combustion: gaseous and other fuels – CO_2	CO_2	FR (2012)	47. The trend in the CO_2 IEF for gaseous fuels in the electricity and heat production category is unstable: a constant value (57.00 t/TJ) is used for the period 1990–2004, while variable values (in the range of 56.45–57.00 t/TJ) are reported for 2005 onwards. The CO_2 IEF for gaseous fuels for petroleum refining also shows an unstable time series: a constant value (57.00 t/TJ) is reported for the period 1990–2004 and variable values (in the range of 55.23–57.01 t/TJ) for 2005 onwards. The ERT recognized that the variation is due to the application of data from the European Union emissions trading system (EU ETS), which increases the accuracy of estimates for the most recent years, but noted that changes in the IEFs over the years are usually smaller. Therefore, the ERT recommends that France, in its next annual submission, analyse the variations in the IEF time series, taking into consideration the uncertainty of the values reported and the need to ensure time-series consistency, and provide the appropriate justification for such variations in the NIR.	No answer provided in NIR.
Stationary combustion:	CO_2	FR	48. The CO_2 IEF for other fuels in the electricity and heat	No answer provided in NIR.

Sector	Gas	Member State	UNFCCC review findings	MS response
gaseous and other fuels – CO_2		(2012)	production category increased by 18.4 per cent between 1990 (84.74 t/TJ) and 2010 (100.32 t/TJ). The ERT noted that the NIR does not include an explanation for this. In response to questions raised by the ERT during the review, France informed the ERT that the category other fuels corresponds mainly to waste consumed by incineration plants with energy recovery, and that the increase in the IEF in recent years resulted from the increase in the incineration of municipal waste, which has the highest EF. The ERT recommends that France include more information to explain this IEF trend in the NIR of its next annual submission.	
Stationary combustion: gaseous and other fuels – CO_2	CO_2	FR (2012)	49. With regard to the manufacture of solid fuels and other energy industries, the trend in the CO_2 IEF for gaseous fuels is not stable: the values ranged between 52.52 and 54.42 t/TJ for the period 1990–1998, while a lower constant value (36.25 t/TJ) was reported for 1999–2001 and a higher constant value (57.00 t/TJ) was reported for 2002–2008; and for 2009 and 2010 AD and emissions are reported as not occurring ("NO"). The ERT noted that the NIR does not contain explanations for changes in this IEF. Therefore, the ERT recommends that France provide information to explain this IEF trend in the NIR in its next annual submission.	No answer provided in NIR.
Stationary combustion: gaseous and other fuels – CO_2	CO_2	FR (2012)	50. In response to questions raised by the ERT during the review, France explained to the ERT that AD on the amount of MSW incinerated with energy recovery were provided by ADEME on the basis of a survey (named ITOM) that is conducted every two years. When preparing the 2011 annual submission, the most recent AD available were for 2008 and emissions for 2009 were estimated on the basis of the data for 2008 using a forecast scenario which is included in France's fifth national communication. Concerning the 2012 annual submission, the results of the ITOM survey for 2010 were not available and the most recent AD available for the preparation of the inventory were for 2008. However, the estimated emissions for 2009 were recalculated on the basis of a forecast scenario prepared under the mechanism for monitoring GHG emissions (reported to the European Commission). France informed the ERT that the ITOM survey, including data for 2010, would be available for the preparation of the next annual submission. The ERT recommends that France ensure that it includes explanatory information in the NIR, in its next annual submission, when it has performed recalculations.	No answer provided in NIR.
1 Energy - Sector overview	-	FI (2013)	26. In the previous review report, the ERT noted that the AD in the energy sector presented in the NIR were aggregated in terms of both categories and fuels, making it difficult to interpret the fluctuations in the time series of implied emission factors (IEFs) and consequently causing the same questions to arise regularly during reviews. In the follow-up to recommendations made in the previous	The qualitative information on the most important fuels included in the other fuels categories is presented in Tables 3.2-7 and 3.2-8. Possibility to provide disaggregated data will be

Sector	Gas	Member State	UNFCCC review findings	MS response
			review report, Finland provided qualitative information regarding the most important fuels included in the other fuels categories; however, disaggregated data were not provided. In response to a question raised by the ERT during the review, Finland stated that further disaggregation would require changes to the entire time series and inventory system, which would not be resource efficient to implement for one year. Therefore, this will only be considered for the 2015 annual submission. The ERT accepts that these changes may be resource-heavy and therefore recommends that efforts be made to provide disaggregated data in the 2015 annual submission.	considered for the 2015 annual submission. (see NIR: Section 3.2.2.3 and 3.2.6)
Feedstocks and non-energy use of fuels	-	FI (2013)	33. Finland has reported information on the non-energy use of fuels in the subcategory feedstocks and non-energy use of fuels (CRF table 1.A(d)). The ERT noted that in the case of lubricants, the additional information part of the CRF table is not complete. In response to a question raised by the ERT during the review, Finland stated that it is awaiting clarification of the assumptions and allocation of emissions related to the use of lubricants (postponed until the 2014 annual submission). The ERT recommends that Finland complete the additional information part of CRF table 1.A(d) for lubricants.	Missing additional information part has been added to the CRF Table 1A(d).(see NIR: Section 3.4.2.1)
Feedstocks and non-energy use of fuels	-	FI (2013)	34. In the previous review report, the ERT noted that for lubricants and coke the fraction of carbon stored was reported as 0.33 and 0.46, respectively, in CRF table 1.A(d) with the indication that the remaining carbon has been included in the reporting on fuel combustion. However, it was not completely clear from the CRF tables and the NIR how the emissions were allocated. In response to a question raised by the ERT during the review, Finland provided detailed information on the assumptions and allocation of emissions related to the use of lubricants. The ERT reiterates the recommendation made in the previous review report that Finland include this information in its annual submission.	The NIR descriptions have been improved. An additional table has been included.(see NIR: Section 3.4.2.1, Table 3.4-1)
Feedstocks and non-energy use of fuels	-	FI (2013)	35. A discrepancy exists between the liquid fuels data given in CRF tables 1.A(c) and 1.A(d) for the years 2002 and 2011 (–0.04 PJ and 1.2 PJ, respectively). In response to a question raised by the ERT during the review, Finland stated that these were due to errors in the tables (table 1.A(c)). The ERT recommends that Finland correct these in its annual submission.	This discrepancy has been corrected.(see NIR: Section 3.4.2.1)
Stationary combustion: all fuels – CO_2	CO_2	FI (2013)	40. The ERT noted that, in annex 3 to the NIR, Finland has described a study that examined the applicability of the default EF to Finnish conditions and that the study concluded that the default EF was suitable. However, the ERT also noted that the rapid decrease in the CO_2 EF between 2007 and 2008 could indicate that the emissions for the preceding years have been overestimated. The ERT agrees with the finding of the previous review report and recommends that Finland investigate the time-series consistency of the CO_2 EF; for example, Finland could explore whether there have been changes in the country of origin of the coal or whether changes in the net calorific value of coal could explain the decrease in the CO_2 EF and report thereon in its NIR. In response to the draft review report Finland informed the ERT that the applicability of the default EF in Finland for the years 2004–2007 could be further investigated, but that Finland will not prioritize this matter over more urgent development needs. The ERT agrees that this is not a matter of urgency and that other improvements should be given higher priority.	The applicability of the CO_2 emission factor for coal to the Finnish conditions has been described in the NIR. (See NIR: Section 3.2.3 and Annex 3)
Stationary combustion: all fuels – CO_2	CO_2	FI (2013)	42. The ERT recommends that Finland include the improvement or revision of the time-series consistency of the CO_2 EF for liquid fuels used in petroleum refining in the inventory improvement plan and report thereon in its annual submission. In response to the draft review report Finland informed the ERT that work on finding the reason for the decrease in the IEF has been initiated, but currently there is no clear explanation available and therefore it would not be possible to clarify the issue in the 2014 annual submission.	This matter has been addressed in the NIR. (see NIR: Section 3.2.3 and 3.2.6)

Sector	Gas	Member State	UNFCCC review findings	MS response
1 Energy - Sector Overview	-	DE (2013)	21. Recalculations are listed in the NIR by category but are in some cases not transparently explained and quantified. For example, in the NIR (page 159) it is stated that a recalculation for public electricity and heat production was required "for the period as of 2004 as a result of revision of the applicable waste model". The ERT further noted that this issue was not mentioned in CRF table 8(b). In response to a question raised by the ERT during the review, Germany explained that previously a comparison between the energy and the waste statistics was possible only at an aggregated level. For the 2013 annual submission, very detailed waste incineration data according to the classification of the European Waste Catalogue became available. Additional data on the amount of waste combusted in co-incineration plants (hard coal and lignite fired power plants) were also available from the coal association and the European Union emissions trading scheme (EU ETS). The ERT commends the Party for the improvements but recommends that the Party include sufficient explanatory information justifying recalculations in the NIR to improve transparency.	Issue has been resolved
1 Energy - Sector Overview	-	DE (2013)	22. The national energy balance, prepared by AGEB, is the main data source for the sectoral and reference approaches. The previous review reports noted several issues related to the national energy balance of Germany (such as the timelines of reporting; differences between the preliminary and the final energy balance; and the complexity of the compilation process). The ERT noted several improvements made in the 2013 annual submission. In particular, in 2012 AGEB began to submit an annual joint quality report to UBA, which documents the QA measures carried out in the preparation of energy balances. AGEB also prepared the "Energy Data Action Plan for inventory improvement" in 2012, **FCCC/ARR/2013/DEU 13** which outlines actions to be taken to address recommendations made in the 2011 review report. The ERT commends the Party for these improvements and recommends that the Party report on any further progress achieved. To further increase the transparency of the inventory, the ERT also reiterates the encouragement in the previous review report to include in the NIR details of primary fuel types for the entire time series.	No answer provided in NIR.
1 Energy - Sector Overview	-	DE (2013)	23. The ERT noted that Germany has used EU ETS data for the verification of some emission estimates. According to the NIR, a formalized procedure has been agreed for the relevant annual data exchange. The ERT reiterates the encouragements made in the previous review reports that Germany continue to use the EU ETS data to verify EFs and/or emission estimates and to analyse any significant differences between the two data sources and report on this in the NIR.	See Chapter 18.7.4 of the NIR comparison of ETS emission factors and NCVs with inventory data

Sector	Gas	Member State	UNFCCC review findings	MS response
1 Energy - Sector Overview	-	DE (2013)	24. The ERT noted that Germany continues to report emissions under manufacturing industries and construction in an aggregated manner: 69.7 per cent of the total emissions from manufacturing industries and construction in 2011 are reported in the subcategory other. In response to a question raised by the ERT during the review, Germany explained that QA/QC is easier at an aggregated level and a further disaggregation would increase the complexity of the inventory but not improve the quality. However, the Party mentioned that it is continuing to work on that issue. The ERT reiterates the recommendation made in the previous review report that Germany continue to assess the possibility of preparing emissions data at the level of disaggregation in the CRF tables, and report on progress in ist next annual submission.	The possibility of preparing emissions data for manufacturing industries and construction at the level of disaggregation in the CRF tables has been assessed. See Chapter 3.2.9.11.1 of NIR
1 Energy - Sector Overview	-	DE (2013)	25. The ERT noted that in general, quantitative uncertainties for AD and EFs at an aggregated level are available in the NIR (table 387), but quantitative uncertainty estimates are not provided in the category-specific sections of the NIR. In response to questions raised by the ERT during the review, Germany provided the ERT with the spreadsheets which included category-specific uncertainties for AD, EFs and combined uncertainty of emissions according to the fuel type. The ERT recommends that the Party include brief information on quantitative uncertainties in the category-specific sections in the NIR.	No answer provided in NIR.
Comparison of the reference approach with the sectoral approach and international statistics	-	DE (2013)	27. In 2011, total CO_2 emissions estimated using the reference approach were 0.8 per cent lower than those estimated using the sectoral approach. However, at the primary fuel level the comparison results in larger differences, as presented in CRF table 1.A(c), especially for liquid fuels (10.5 per cent) and solid fuels (–7.4 per cent). Similar differences in emissions exist for all years since 1990. There are no explanations for the differences at the fuel level provided in the NIR. Therefore, the ERT reiterates the recommendation made in the previous review report that Germany include a detailed analysis of emission differences at the primary solid, liquid and gaseous fuel levels in the NIR.	See chapter 20 of NIR: explanation of differences between reference and sectoral approach at fuel level
Comparison of the reference approach with the sectoral approach and international statistics	all	DE (2013)	28. The ERT noted that in 2011, the total apparent consumption reported in the CRF tables is 3 per cent lower than that reported to IEA. The ERT reiterates the recommendation made in the previous review report that Germany compare the inventory data with the corresponding IEA data at the primary fuel type level and explain the differences in the NIR.	See Chapter 3.2.1.2.1 of the NIR provides an explanation for the reasons.
Feedstocks and non-energy use of fuels	-	DE (2013)	30. The ERT noted that Germany continues to use carbon storage fractions for natural gas (0.90) and liquefied petroleum gas 0.55) that differ significantly from the defaults contained in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter	The named fractions of carbon stored have been reset to IPCC defaults. - see NIR 2014, chapter 20, Annex 4

Sector	Gas	Member State	UNFCCC review findings	MS response
			referred to as the Revised 1996 IPCC Guidelines) (0.33 and 0.80, respectively) and the NIR did not provide proper justifications for these differences. In response to a question raised by the ERT during the review, Germany explained that the values have not yet been changed to IPCC defaults owing to a mistake and also explained that for the 2014 annual submission, the Party will revise the carbon storage fractions. The ERT welcomes the planned improvement and reiterates the recommendation made in the previous review report that the Party provide justifications for the carbon storage fractions and for any recalculations performed.	
Feedstocks and non-energy use of fuels	-	DE (2013)	31. As noted in the previous review reports, additional information for feedstocks and non-energy use of fuels in CRF table 1.A(d) has not been reported for any of the years. The ERT considers that inclusion of this information would increase the transparency of the reporting and facilitate understanding of the overall energy balance. The ERT reiterates the recommendation made in previous review reports that Germany include this additional information in CRF table 1.A(d).	Additional information has been included in the respective table of CRF table 1.A(d).
Stationary combustion: solid fuels – CO_2	CO_2	DE (2013)	32. The ERT noted that the overall trend of the CO_2 implied emission factor (IEF) in the solid fuel category for petroleum refining has decreased between 1990 (93.09 t/TJ) and 2011 (40.00 t/TJ) by 57.0 per cent. The CO_2 IEF has been constant since 1997. In 2011, the CO_2 IEF was the lowest among the reporting Parties (40.00–262.48 t/TJ) and below the range of the IPCC default values (94.60–106.70 t/TJ). In response to a question raised by the ERT during the previous stages of the review, Germany stated that this decrease can be explained by the use of coke oven gas in 2011 instead of lignite, which was used in 1990. The ERT reiterates the recommendation made in the previous review report that Germany provide a brief explanation of this issue to improve transparency.	See Chapter 3.2.7.1 of NIR improved trend description
1.A.4.a Commercial/ Institutional – solid fuels	CH_4	DE (2013)	35. The CH_4 IEF for solid fuels in the subcategory commercial/institutional has a decreasing trend: from 239.90 kg/TJ in 1990 to 108.91 kg/TJ in 2011 (–54.6 per cent). In 2011 the CH_4 IEF was considerably higher than the IPCC default value (10.0 kg/TJ), and third highest among the reporting Parties (range from 0.071 to 427.34 kg/TJ). In response to a question raised by the ERT during the review, Germany explained that a countryspecific EF for CH_4 has been derived from measurement values and it can be explained by a relatively large share of small appliances with high CH_4 emissions. The ERT recommends that Germany provide a brief explanation of this issue in its NIR to improve transparency.	No answer provided in NIR.

Sector	Gas	Member State	UNFCCC review findings	MS response
1.A.2.a Iron and Steel-gaseous fuels	CH_4	DE (2013)	36. The ERT has identified several large inter-annual changes in the CH_4 IEF for the subcategory iron and steel, including from 0.72 kg/TJ in 2002 to 5.44 kg/TJ in 2003 (increase of 652.7 per cent) and from 2.78 kg/TJ in 2008 to 0.86 kg/TJ in 2009 (decrease of 69.2 per cent). In response to a question raised by the ERT during the review, Germany explained that the fuel category gaseous fuels includes both natural gas and pit gas. Natural gas is mostly used in boilers and power plants, mixed with blast furnace gas, oxygen furnace gas and coke oven gas. Pit gas is burned in engines with considerably higher CH_4 emissions. The relationship between the two fuel types changes every year, mainly due to the availability of pit gas. The ERT recommends that Germany provide a brief explanation of this issue in its NIR to increase transparency.	No answer provided in NIR.
Comparison of the reference approach with the sectoral approach and international statistics	-	GR (2013)	22. The ERT noted that there were differences between the reported net calorific values (NCVs) and those in the International Energy Agency (IEA) reports. In response to previous review stages in 2013, Greece explained that the NCVs used by the inventory team are based on plant-specific AD and obtained from EU ETS reports instead of energy balance data and consequently they are different from those used by the IEA. The ERT recommends that Greece provide a detailed comparison between the NCVs used by the IEA and those used by the inventory team in the reference approach of the annual inventory submission, as well as the specific AD obtained from the verified EU ETS reports, in a tabular format, in order to improve the transparency of its reporting.	No answer provided in NIR.
Feedstocks and non-energy use of fuels	-	GR (2013)	24. Greece explained in the NIR that data on the non-energy use of fuels are derived from the national energy balance and from plant-specific data from the verified EU ETS reports. The emissions from fuel combustion are attributed to the energy sector while the emissions from production processes (i.e. ammonia and hydrogen production) are attributed to the industrial processes sector, with the exception of liquid fuels used as feedstock in ammonia production for the years 1990–1993 and 1995–1998, which are included under the energy sector. The ERT reiterates the recommendation from the previous review report that Greece, in its next annual submission, reallocate emissions from liquid fuels used as feedstock in ammonia production from the energy sector to the corresponding category in the industrial processes sector for the years 1990–1993 and 1995–1998, in order to ensure that its reporting is in line with the IPCC good practice guidance.	Please refer to chapter 3.2.4.4.2 of the NIR.
1 Energy - Sector Overview	N_2O, CH_4	IE (2012)	38. Ireland reported substantial recalculations of N_2O and CH_4 emissions from road transportation. In 2008, these recalculations represented a downward revision of 23.0 per cent in N_2O emissions (38.15 Gg CO_2 eq) and of 15.1 per cent in CH_4 emissions (4.07 Gg CO_2 eq). During the review, Ireland provided very transparent and detailed comparisons of emissions from the “Computer programme to calculate emissions from road transport” (COPERT) version 4.6.1, used in Ireland’s previous submission, and COPERT version 4.8.0, used in Ireland’s latest submission. This latest version of the COPERT model includes all vehicle technologies up to Euro VI for passenger cars, Euro VI for heavy duty vehicles and Euro	This inventory submission also used a revised COPERT version from COPERT 4 version 8.0 to COPERT 4 version 9.1 (See NIR chapter 3.2.1.3.2 and 3.7. as well as tables 3.7 and 3.8)

Sector	Gas	Member State	UNFCCC review findings	MS response
			III for motorcycles. In addition, the ERT found that significant recalculations in CH_4 and N_2O emissions were caused by a software bug in COPERT version 4.6.1, which misallocated the hot and cold emissions of these GHGs (and ammonia), as well as a correction in the N_2O hot EF of urban buses standard Euro III. The ERT recommends that Ireland ensure its future NIR submissions include a clear description of the main reasons (i.e. improvements) behind the recalculations when changing from one version of COPERT to another.	
Comparison of the reference approach with the sectoral approach and international statistics	CO_2	IE (2012)	39. The difference between the reference approach and the sectoral approach was 0.60 per cent in 2009. However, the ERT noted the overall difference for fossil fuels is small because of the netting of positive (solid fuels) and negative (liquid and gaseous fuels) differences. There is a significant discrepancy between CO_2 emissions from the sectoral and the reference approach for solid fuels (4.2 per cent). The categories residential and public heat and electricity production are the largest consumers of solid fuels in the energy sector in Ireland. During the review the ERT asked the Party to clarify whether the difference could be explained by lower CO_2 emissions from EU ETS combustion installations using coal compared with CO_2 emissions calculated from the AD in the energy balance. The Party provided the ERT with a comparison of emissions from solid fuels from EU ETS and the energy balances at a more disaggregated level for all years between 1990 and 2009. The comparison suggests that the difference could be explained by the application of a constant net calorific value (NCV) for all years using the energy balance data, whereas the CO_2 estimates reported in the CRF tables correspond to verified EU ETS emissions. Ireland informed the ERT that the issue would be solved with the harmonization of the energy balance and EU ETS AD. The ERT recommends that the Party ensure as much consistency as possible between the AD reported in the CRF tables and in its energy balance.	Differences between the Reference and Sectoral approaches in this submission for the year 2011 are <1.0 % (see CRF 2011, Table 1Ac)
Comparison of the reference approach with the sectoral approach and international statistics	-	IE (2012)	40. During the review, the Party stated that its inventory agency will request the compiler of Ireland's energy statistics to investigate the differences between apparent consumption reported to UNFCCC and that reported to the International Energy Agency. The ERT welcomes Ireland's proactive approach. The ERT also recommends that the Party investigate the differences between the AD submitted in its CRF tables with the energy balances reported to Eurostat under the EU regulation on energy statistics, which has legal provisions aimed at ensuring the consistency of energy data in the energy balances with AD in the CRF tables.	See answer above.
Reference and sectoral	CO_2	IE (2012)	42. Ireland's reporting of feedstocks and non-energy use is	Every effort is made to

Sector	Gas	Member State	UNFCCC review findings	MS response
approaches: Feedstocks and non-energy use of fuels: lubricants			generally transparent and consistent with the Revised 1996 IPCC Guidelines. During the review, a minor issue was the reporting of white spirit in CRF table 1.A(d) on feedstocks and non-energy use. There is no fraction reported for carbon stored and thus 100 per cent is assumed to be emitted as CO_2. However, the same table shows that only 15.33 Gg of carbon from lubricants was emitted in 2009, implying that 100 per cent of white spirit consumption had been stored. Ireland informed the ERT that all white spirit is reported as part of the total non-energy consumption (feedstocks) and that the inventory agency would include this minor liquid fuel use as being stored in CRF table 1.A(b) in its future submissions. The ERT recommends that the Party ensure full consistency between tables 1.A(b) and 1.A(d) in future annual submissions.	report feedstocks in a consistent manner in the CRF Submission. (see CRF Table 1.A(b) and 1.A(d)
Stationary combustion: all fuels – CO_2	CO_2	IE (2012)	46. The previous review report concluded that the implied EFs to derive CO_2 emissions from energy industries are not comparable with those of other Parties. CO_2 emissions reported by Ireland are from the EU ETS, whereas the underpinning AD in the CRF tables are from the energy balances. The current ERT believes that CO_2 emissions from energy industries are accurate and complete, and that the time series is consistent because of the use of identical AD from the EU Directive from large combustion plants. However, the implied emission factors (IEFs) in the CRF tables are calculated on the basis of AD not used in the estimation of CO_2 emissions. During the review, the Party informed the ERT that the issue regarding the energy data in the national energy balance and the corresponding energy data reported through the EU ETS are being harmonized to ensure that both are fully consistent. This would mean that the energy data reported in the next energy balance will be the same as the EU ETS data. The ERT looks forward to this improvement and recommends that Ireland use consistent AD, EFs and emissions in its 2012 annual submission.	Improvements were made in the consistency of data reported under EU ETS and the national energy balance in Submission 2012 (1990-2010 data) and continued in this submission 2013.
Stationary combustion: all fuels N_2O, CH_4	CH_4, N_2O	IE (2012)	47. Ireland uses the energy balances to estimate CH_4 and N_2O emissions in energy industries. The previous review report "strongly recommended" that the Party use consistent data for estimating emissions of GHGs in its future annual submissions. The current ERT believes that the Party is making significant efforts to improve the consistency of the AD reported in the energy balance and in the EU ETS regarding CO_2 emissions. The ERT also argues that the accuracy of the reporting of Ireland's second most important category energy industries and gas (CO_2) should not be at the expense of ensuring full consistency in the estimation of non-CO_2 gases. The harmonization of the energy balances and EU ETS AD may lead to improvements in the estimation of CH_4 and	See above. Energy data reported from EU ETS and the national energy balance are fully harmonised for Energy Industries, CRF 1.A.1.a.

Sector	Gas	Member State	UNFCCC review findings	MS response
			N_2O emissions. The ERT recommends that the Party include transparent information, including on how to ensure time-series consistency, about the potential recalculations of emissions of non-CO_2 gases in its future annual submissions.	
Feedstocks and non-energy use of fuels	-	IT (2013)	22. Italy provided comments in the CRF tables with regard to the allocation of some fuels to naphtha in order to explain the negative figures obtained for the fraction of carbon stored in some fuels as a result of an input and output balance calculation. For lubricants, the Party estimated the carbon stored as the difference between the amount of lubricants and the amount of recovered lubricant oils. During the review, Italy also provided more information on the balance of input and output and explained that fractions of carbon oxidized are derived from actual carbon oxidized quantities calculated by the Party through this balance. As these fractions are derived from actual measurements they do not correspond to any default values and may vary over time. The fractions are country-specific and therefore more suitable to the country's conditions. The ERT recommends that Italy include information on the specific calculation of the fraction of carbon oxidized in the NIR of its next annual submission.	Additional information has been provided in the NIR (§ 3.8.2)
Stationary combustion: solid fuels – CH_4	CH_4	IT (2013)	25. The previous review report encouraged Italy to disaggregate process-related emissions from the iron and steel subcategory and to report process-related emissions in the industrial processes sector. In response to a question raised by the ERT, the Party stated that CH_4 process emissions for pig iron and steel production are already allocated to the industrial processes sector; fugitive CH_4 emissions from coke production are reported under fugitive emissions; and CH_4 emissions from the combustion of fuels are allocated to the energy sector. The ERT recommends that Italy include more detailed information in the NIR on the calculations performed by the Party to disaggregate and allocate emissions, so as to improve transparency of reporting.	Additional information has been provided in the NIR (§ 3.4.2)
Stationary combustion: gaseous fuels, biomass – CO_2, CH_4 and N_2O	CH_4, N_2O	IT (2013)	26. In public electricity and heat production, while CO_2 emissions dropped by 1.5 per cent, CH_4 and N_2O emissions rose in the same period by 13.9 per cent and 11.1 per cent, respectively. In response to questions raised by the ERT during the review, the Party explained that this is due to the increase in natural gas and biomass use, which drives the trend of the category. The ERT recommends that the Party include this explanation in the NIR in order to improve the transparency of the report.	Additional information has been provided in the NIR (§ 3.3.1)
Stationary combustion: other fuels – CH_4	CH_4	IT (2013)	27. In response to a recommendation made in the previous review report, Italy provided information in the NIR on the other fuels used for the public electricity and	Additional information has been provided in the NIR (§ 3.4.3)

Sector	Gas	Member State	UNFCCC review findings	MS response
			heat production, commercial/institutional and chemicals subcategories. For public electricity and heat production, other fuels include minor amounts of other liquid, solid and gaseous fuels from a mix of industrial wastes such as plastics, rubber and solvents, and synthesis gas from heavy residual fuel, while for the commercial/institutional subcategory other fuels refers to the amount of fossil waste burned in incinerators with energy recovered. For chemicals, other fuel includes the consumption of residual gases from chemical processes. Although transparency has been improved with the provision of this information, EFs have only been reported in the NIR for public electricity and heat production. The ERT reiterates the recommendation made in the previous review report that Italy include in the NIR the EFs used in all subcategories.	
Comparison of the reference approach with the sectoral approach and international statistics	-	LU (2013)	22. However, imported lubricants were not included in CRF table 1.A(b) (see para. 30 below), which will cause an increase in CO_2 emissions from the reference approach and affect the differences between the sectoral and reference approaches for liquid fuels. In addition, in the NIR (table 3.13, p. 158), the Party also explained that fuels used in marine activities need to be subtracted from the reference approach where they are still included. The ERT recommends that Luxembourg enter all fuels used in the country in the reference approach estimates and improve its QC procedures prior to submitting the annual submission.	No answer provided in NIR
Comparison of the reference approach with the sectoral approach and international statistics	-	LU (2013)	23. Further, the difference in gaseous fuels between the sectoral and reference approaches is 3.9 per cent for 2011. In response to questions raised by the ERT during the review, Luxembourg clarified that there seems to be a discrepancy between the plant-specific data for non-metallic minerals and the energy balance data. The plant-specific data, which are higher than the energy balance data, are used in the inventory, and the Party suggested that this could lead to an overestimation of emissions in the sectoral approach. The Party also indicated that it is planning to provide further quantitative assessment of the differences between the sectoral and reference approaches. The ERT welcomes these efforts, and notes that it is also possible that the plant-specific data may be more accurate than using the energy balance. The ERT recommends that Luxembourg evaluate the possible discrepancy between the two approaches and, if appropriate, clearly explain the differences in the CRF tables and the NIR.	No answer provided in NIR
Stationary combustion: solid and other fuels – CO_2	CO_2	LU (2013)	After 2002, the CO_2 IEF ranges from 97.40 t/TJ (2003) to 95.45 t/TJ (2010). The rationale for these observed trends is not well described in the NIR. The ERT recommends that Luxembourg provide additional information in the NIR on the underlying reasons for the change in IEF to ensure time-series consistency.	No answer provided in NIR
Stationary combustion: liquid fuels – N_2O	N_2O	LU (2013)	31. In response to questions raised by the ERT during the review, Luxembourg explained that the comparatively high N_2O IEF is due to the use of off-road vehicles under the above-mentioned subcategories. Based on the Party's explanation, the ERT concludes that these subcategories mainly include emissions from off-road vehicles. The ERT considers that the splitting of fuels used for off-road vehicles is necessary in order to improve transparency, and recommends that the Party report emissions from off-	No answer provided in NIR

Sector	Gas	Member State	UNFCCC review findings	MS response
			road vehicles under the category mobile (other).	
Other sectors (commercial/ institutional): biomass fuels – CO_2	CO_2	LU (2013)	33. Consistent with the IPCC good practice guidance, CO_2 emissions from biomass should be reported under memo items. Therefore, the ERT recommends that Luxembourg review the constant and comparatively low IEF for biomass and either revise it or provide an explanation in the related sections of the NIR. The ERT also recommends that the Party appropriately report these CO_2 emissions as a memo item.	No answer provided in NIR
1 Energy Sector overview	-	NL (2013)	23. The ERT reiterates the recommendation made in the previous review report that the Netherlands improve its QC procedures to ensure that all information is consistently reported in the NIR, the CRF tables and other national inventory documentation, such as the Monitoring Protocols, in order to improve the transparency of the inventory	Improvements were made in the consistency between methods description in NIR and CRF and Protocols (reference: Sectoral section in the NIR and CRF tables)
1 Energy Sector overview	-	NL (2013)	24. The ERT reiterates the recommendation made in the previous review report that the Netherlands review the appropriateness of the IPCC default EFs used, with the aim of calculating more country-specific EFs, giving priority to the fuels with the largest proportions of emissions from fuel combustion, and report on progress in the NIR.	A more detailed description of the methodology has been included. Due to confidentiality, detailed data on fuel consumption and emission factors per CRF category and fuel is not presented in the NIR, but is available for the reviewers upon request and also see 41(Methodical issues as described in NIR 3.2.6, 3.2.7 and 3.2.9)
1 Energy Sector overview	-	NL (2013)	25. The ERT noted that the Netherlands uses data from the European Union emissions trading system (EU ETS) for the verification of some emission estimates. The differences are explained by variations in the coverage of reporting (e.g. the reporting of biomass is not included in the EU ETS data, and industrial processes are not reported under the EU ETS for certain categories). The ERT welcomes this verification activity and reiterates the recommendation made in the previous review report that the Netherlands continue to perform it.	This is an annual activity since emission year 2006 (see publication: De Ligt, 2014)
1 Energy Sector overview	-	NL (2013)	26. In cases where PRTR data are rejected, the country-specific EFs are used to calculate the emissions from these companies (using data from the national energy statistics and, where possible, plant-specific energy data). This situation only occurs as an exception and the emissions are recalculated when the data from these companies become available. However, the present ERT noted that this process is not transparently reported in the NIR. The ERT reiterates the recommendation made in the previous review reports that the Netherlands improve the transparency of its reporting by including in the NIR a more transparent description of the QC procedures performed for the plant-specific data.	Improved text in 3.2.6 (with reference to the general QC for plant specific data and graphs with the CO_2 emissions from the iron and steel industry is added. (3.2.6.2, 3.2.7, 3.2.9 and 4.3.3 to 4.3.5 Figures 3.7 and 3.8)
Stationary combustion: liquid fuels – CO_2	CO_2	NL (2013)	31. As noted in the previous stages of the review, the CO_2 implied emission factor (IEF) for liquid fuels used in public electricity and heat production decreased by 15.0 per cent between 1990 (76.70 t/TJ) and 2011 (65.20 t/TJ). The IEFs reported for the period 2004–2010 (54.11–63.24 t/TJ) are lower than for all other reporting Parties (54.11–86.77 t/TJ). […] In response to a question raised by the ERT in the previous stages of this review, the Netherlands explained that the low IEFs occur due to the hydrogen content in the chemical waste gas which is allocated to this category. The Party also explained that the amount of chemical waste gas and its hydrogen content vary from year to year. To improve the transparency of its reporting, the ERT reiterates the recommendation made in the previous review report that the Netherlands provide a more transparent description in the NIR, including additional	See response to para 24

Sector	Gas	Member State	UNFCCC review findings	MS response
			information on the AD and EFs, to justify the low value of the IEF.	
1.A.1 Energy Industries	-	PT (2013[35])	The ERT recommends Portugal to report the emissions resulting from the use of limestone for desulphurization in the industrial processes sector instead of reporting in the combustion sector to able comparability across parties	Emissions from the use of limestone for desulphurization are reported in the 2014 submission in CRF 2A3 (Limestone and Dolomite Use) (see NIR section 3.3.1.1. and 4.3.1.3)
Feedstocks and Non-Energy Use of Fuels	-	PT (2013)	Coke, oven coke, coking coal and sub-bituminous coal are misallocated as BKB/patent fuel, other bituminous coal and lignite. Portugal is advised to report emissions under the correct fuel within CRF table 1.A (b) because there is a possible estimation accuracy compromised since the default EF for coke oven coke is higher than that for BKB/patent fuel, while that for sub bituminous coal is lower than for lignite	The problem was corrected: previous quantities misallocated as BKB/patent fuel have been reclassified as coking coal.
1 Energy Sector overview	-	ES (2013)	17. In response to a question raised by the ERT during the review, Spain provided the ERT with the energy balance prepared by the inventory team for use in the calculation of the emission estimates and the one provided to IEA and Eurostat, and explained the differences noted between the different AD used in the two energy balances (see also paras. 21, 22 and 26 below). The ERT reiterates the recommendation made in the previous review reports that the Party include the official energy balance as submitted to IEA and Eurostat in the NIR and explain the differences between this energy balance and the one used for the inventory for each category and fuel.	No answer provided in NIR.
1 Energy Sector overview	-	ES (2013)	18. The ERT noted that Spain does not include, in the NIR, background information on the plant-specific CO_2 EFs and the net calorific values (NCVs) used for the emission estimates. This makes it impossible for the ERT to replicate the emission estimates. In response to a question raised by the ERT during the review week, Spain provided the ranges for the plant-specific CO_2 EFs by fuel and by category used for the inventory. The ERT found this information very useful for the review. Therefore, the ERT recommends that Spain provide plant-specific NCVs and EFs in the corresponding chapters in its NIR.	No answer provided in NIR.
1 Energy Sector overview	-	ES (2013)	19. The ERT noted that the Party has used the notation key "NA" to report emissions and implied emission factors (IEFs) in cases where the Party has reported AD as not occurring ("NO") (e.g. solid fuel combustion in petroleum refining in CRF table 1.A(a), and fugitive emissions from oil exploration in CRF table 1.B.2). In response to a question raised by the ERT during the review regarding the use of the notation key "NA" to report emissions and IEFs, Spain stated that in its next annual submission it will revise the assignment criteria for the notation key. The ERT recommends that the Party ensure the appropriate use of the notation keys and provide justification for their use in the NIR and in the CRF tables.	No answer provided in NIR.
Comparison of the reference approach with the sectoral approach and	all	ES (2013)	21. The comparison of the apparent fuel consumption reported in the CRF tables and the national energy balance reported to IEA highlights discrepancies within the range of 2–3 per cent for all years of the time series, with the values in the CRF tables systematically lower. Responding to the questions raised during the earlier stages of the review, Spain explained that it considers the main source of these differences to be the NCVs applied	No answer provided in NIR.

[35] In 2013 Portugal was subject to an In-Country Review. A draft ARR 2013 was not yet published to this date (May 2014). Nevertheless, Portugal already provides in the NIR 2014 answers to recommendations raised during the review which are presented here.

Sector	Gas	Member State	UNFCCC review findings	MS response
international statistics			to the apparent fuel consumption AD which are expressed in physical units (units of mass or volume) in the national energy balance reported to IEA. In CRF table 1.A(b), the factors reported are averaged values derived from the data used in the sectoral approach. In the NIR, Spain states that an energy working group (GT-Energía) was set up in 2012 in order to harmonize the fuel balances used in the inventory with the data reported to IEA and Eurostat, but the Party does not indicate any outcomes from the working group. In response to a question raised by the ERT during the review, Spain explained that in 2012 GTEnergía concentrated on the analysis of natural gas and some oil products, such as petroleum coke. Spain also explained, in its response, that in 2013 GT-Energía created a system for coordinating national energy data via its national focal point at the Ministry of Industry, Energy and Tourism (MINETUR), and new priorities and urgent needs are being identified for the 2014 workplan of this working group. The ERT recommends that Spain include detailed information on the progress of the work of GT-Energía in its next annual submission.	
Stationary combustion: all fuels – CO_2, CH_4 and N_2O4	-	ES (2013)	25. In the previous review reports it was recommended that Spain enhance the use of plant-specific data in order to improve the quality of the inventory, in particular by improving the national system so that data available at the regional level could be obtained by the inventory team. In response to a question raised by the ERT concerning the inclusion of new plant-specific data in the 2013 inventory submission compared with the previous submission, Spain stated that there are only two combined-cycle power plants in Spain, from which information has been obtained via specific individualized questionnaires. The ERT reiterates the recommendation made in the previous review report that the Party enhance the national system in order to be able to correct and use more plant-specific data in its emission estimates. The ERT also reiterates the recommendation made in the previous review report that Spain report on its achievements on this issue in its next annual submission.	No answer provided in NIR.
Other (energy): liquid and gaseous fuels – CO_2, CH_4 and N_2O	-	ES (2013)	30. The previous review reports raised the issue of the lack of transparency of the reporting on military fuel consumption, and recommended that Spain include information on military fuel consumption and the associated emissions for the category other (energy) in the NIR. The ERT noted that this issue has not been addressed in the 2013 annual submission. In response to a question raised by the ERT during the review, Spain explained that, for the next annual submission, it plans to separate the fuel used for tactical military equipment and report this information at a more detailed level in the NIR. To that end, Spain is planning to gather information from the Ministry of Defence for the whole time series. The ERT reiterates the recommendation made in the previous review report that Spain include the military fuel consumption and the associated emissions in the corresponding section of the NIR.	No answer provided in NIR.
1 Energy - Sector Overview	-	SE (2013)	28. The ERT therefore recommends that Sweden appropriately explain in the NIR of its next annual submission the reasons for the use of a particular database for the various inventory categories and, if various data sets are used, how these data sets are reconciled. The Party should also explain why a specific database is chosen to estimate the national GHG inventory emissions for a particular category.	Not yet implemented: ARR 2013 was published on 28 February 2014 when inventory was already compiled.
Comparison of the reference approach with the sectoral approach and international statistics	-	SE (2013)	32. The ERT therefore strongly recommends that Sweden minimize the differences in the energy balance between the reference and sectoral approaches in future annual submissions so as to reduce the differences in the emission estimates between the two approaches, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the Revised 1996 IPCC Guidelines).	Not yet implemented: ARR 2013 was published on 28 February 2014 when inventory was already compiled.

Sector	Gas	Member State	UNFCCC review findings	MS response
Stationary combustion: liquid, solid and gaseous fuels – CO_2	CO_2	SE (2013)	38. These detailed balances were provided by Sweden during the review, which helped to clarify the reporting of emissions and energy consumption and enhanced transparency. The ERT therefore strongly recommends that Sweden provide detailed energy and carbon mass balances for the iron and steel industry in the NIR of its next annual submission, and also make this a regular feature in the NIR of its future annual submissions.	Not yet implemented: ARR 2013 was published on 28 February 2014 when inventory was already compiled.
Stationary combustion: liquid, solid and gaseous fuels – CO_2	CO_2	SE (2013)	40. Sweden explained that the use of liquid fuels in the commercial/institutional category has decreased considerably since the 1990s because biomass fuels have replaced heating oils to a large extent. The use of propane/butane, however, has increased in recent years. The CO_2 EF for propane/butane is 65.10 t/TJ and the CO_2 EFs for domestic heating oil and residual fuel oil are 74.26 t/TJ and 76.20 t/TJ, respectively. Hence, the high share (around 50 per cent) of propane/butane in recent years has resulted in low aggregate IEFs for liquid fuels. The ERT agreed with the explanation provided by Sweden. The ERT recommends that Sweden include this information and explanations in its next annual submission.	Not yet implemented: ARR 2013 was published on 28 February 2014 when inventory was already compiled.
1 Energy - Sector Overview	-	UK (2012)	36. The ERT recommends that the United Kingdom make efforts to incorporate all available and/or updated energy information in DUKES, in order to ensure the consistency of all AD used in the energy sector. In addition, in order to improve the quality of the AD, the ERT recommends that the United Kingdom, through DECC, ensure that data on all energy consumption by all major energy-producing companies, apart from electricity and heat production and refinery activities (e.g. upstream oil and gas production and petrochemical plants), are included in the United Kingdom's energy balance in DUKES.	Efforts have been made to incorporate all additional and/or updated information in DUKES. A table was included within the 2013 NIR to explain any deviations from DUKES activity data and to show completeness and consistency of the energy sector. (see NIR 2013)
1 Energy - Sector Overview	-	UK (2012)	41. The ERT recommends that the United Kingdom, in its next annual submission, improve its use of EU ETS data within the GHG inventory estimates by ensuring that aggregated AD by fuel and category for EU ETS installations are included in the United Kingdom's energy balance in DUKES and can be reconciled with the United Kingdom's energy statistics, in order to provide more complete and accurate energy use allocation for use in the GHG inventory across the time series.	The DECC DUKES team have representatives at the NISC. There is a programme of continuous improvement to ensure completeness.
1 Energy - Sector Overview	-	UK (2012)	43. (a) The units used by the United Kingdom for the AD and EFs are different from those used by most other reporting Parties. The ERT acknowledges the improvements made in the 2012 annual submission, including the provision of EFs on an energy basis provided in the Excel file that was submitted alongside the NIR and is referenced below the tables of EFs in annex 3 to the NIR. However, the ERT recommends that the United Kingdom complete the improvement regarding the use of comparable units (e.g. t CO_2/TJ for the carbon EFs and PJ for consumption of gaseous fuels).	Comparable units are used within the CRF and a new 'additional information' spreadsheet is submitted alongside the UNFCCC submission showing all emission factors in energy terms. (see NIR 2013)
1 Energy - Sector Overview	-	UK (2012)	44. The ERT noted that the QA/QC procedures applied during the compilation of the inventory seem to be limited to the process of estimating emissions. In response to questions raised by the ERT during the review on the energy sector, the national experts were able to provide the ERT with further clarification on the emission trends or on the specific allocation of emissions which appeared (among other things) to be available as a result of the documentation on the QA/QC procedures. Conversely, the QA/QC procedures performed by the United Kingdom in the context of completing the CRF tables appear to be limited to checks of reported emissions, with fewer checks on AD and notation keys, since the ERT noted several inconsistencies in different CRF tables. In addition, the ERT identified a number of places in the CRF tables where the notation keys used were incorrect. During the review, the United Kingdom recognized the need to improve the QA/QC procedures performed during the last step of compilation of the inventory. The ERT recommends that the United Kingdom implement its planned efforts in this regard in its next annual submission.	The QA/QC plan has been updated to ensure better procedures. This is an ongoing programme of improvement.

Sector	Gas	Member State	UNFCCC review findings	MS response
1 Energy - Sector Overview	-	UK (2012)	45. (c) The amount of natural gas used as feedstock reported in CRF table 1.A(d) did not correspond with the amount of natural gas reported under ammonia production in the industrial processes sector. Therefore, the ERT recommends that the United Kingdom improve the consistency of the information reported in the different sectors in its next annual submission, in particular in relation to the cases indicated above.	A table was included within the 2013 NIR to explain any deviations from DUKES activity data and to show completeness and consistency of the energy sector. (See NIR 2013)
Comparison of the reference approach with the sectoral approach and international statistics	-	UK (2012)	49. The apparent consumption in the United Kingdom's reference approach corresponds closely to the IEA data. For 2010, there is a difference of 0.4 per cent in the total apparent consumption between the reference approach and the IEA data (the apparent consumption in the CRF tables is lower than that of the IEA data). For specific fuels, however, there are significant differences, especially for natural gas liquids (NGL). Both data sets are based on DUKES, and although there are some small definition issues regarding the inclusion of the OTs, this specific difference seems to be due to an editorial error in the CRF tables. The ERT reiterates the recommendation in the previous review report that the United Kingdom investigate the reasons for the differences and improve the QC procedures to be performed prior to the submission of the CRF tables.	A review of the reference approach has been conducted for the 2014 submission.
Comparison of the reference approach with the sectoral approach and international statistics	-	UK (2012)	50. The ERT noted that the United Kingdom uses the notation key "NA" in CRF table 1.A(b) for the reference approach for a large number of cells. During the review, the United Kingdom explained the ERT that it uses the notation key "NA" when activities have never occurred in the country. The ERT recommends that the United Kingdom reconsider this use of the notation key "NA" and closely follow the definitions of the notation keys provided in the UNFCCC reporting guidelines.	A review of the reference approach has been conducted for the 2014 submission.
Feedstocks and non-energy use of fuels	-	UK (2012)	53. In response to a recommendation in the previous review report, the United Kingdom has ensured consistency between CRF tables 1.A(b) (reference approach) and 1.A(d) (feedstocks and non-energy use of fuels). Data on feedstock use are taken from the non-energy use as reported in DUKES. The references for the storage fractions reported in CRF table 1.A(d) are not available in the NIR. Further, the ERT noted the United Kingdom has not yet provided additional information in CRF table 1.A(d) on the categories where feedstocks are used. Therefore, the ERT reiterates the recommendation in the previous review report that the United Kingdom provide additional information on the categories where feedstocks are used and recommends that the United Kingdom provide the references for the storage fractions in its next annual submission.	Additional information to be included. (See NIR 2013)

Table 3.115 provides an overview of EU-15 member state's response to the UNFCCC Review findings for transport.

Table 3.115 EU-15 member State's responses to UNFCCC review findings in 2013 for transport

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 submission	MS comment
Road transportation	CO_2, CH_4, N_2O	AT	Include an explanation that the fuel consumed for ground activities at airports and harbours is reported under fuel export	The approach in the Austrian inventory is as follows: After calculating fuel consumption for in-land road transport and off-road transport using a bottom-up approach (GLOBEMI, GEORG), the sum of this fuel used is compared with the total fuel sold from the national energy balance (for details see 1.A.3.b Road Transport). The difference is then allocated to fuel export, which includes fuel consumption for ground activities at airports and harbours as well, including fuel consumption by unregistered vehicles. As the fuel consumption reported under fuel export is included in the national totals32, an underestimation of emissions can be excluded.
Road transportation	CH_4, N_2O	AT	Revise the modeling approach for CH_4 and N_2O emission estimations from biomass separately from gasoline and diesel oil, and report this	As recommended by the ERT during the ICR 2013 (ARR 2013 para 34), Austria plans to report CH_4 and N_2O emissions from biomass and fossil parts separately. As the CH_4 and N_2O EF used are based on measurements, a revision of the modelling approach may not be an adequate method and alternative ways for splitting emissions in CRF Table 1.A(a) have to be considered.
Road transportation: liquid fuels	N_2O	DE	Provide a brief explanation for the development of the N_2O IEF for diesel oil in road transportation	Please check NIR 2014, pp. 211-212
Road transportation: liquid fuels	CO_2	FI	Include the correct range of values in its annual submission	Correct range of values has been added tot he NIR (see Table 3.2.3 NIR 2014)
Civil aviation: liquid fuels	CO_2, CH_4 and N_2O	FI	The ERT noted that in its 2013 annual submission, Finland indicated that it would receive data from Eurocontrol in August 2013 and that it would evaluate, based on these data, whether the option of using Eurocontrol data in the future is a valid one, or whether any identified alternatives will need to be explored further. The ERT encourages Finland to report on the outcome of this evaluation in its annual submission and to indicate whether this improvement is expected to go ahead.	Increased use of emission data for aviation from Eurocontrol's by 2014/2015 (depends on data availiability)

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 submission	MS comment
Road transportation	CO_2, CH_4 and N_2O	GR	Improve the description of the recalculations for the whole time series, as well as the description of the calculation for the fuel consumption ratio of lubricants in road transportation to justify the time-series consistency. Complete its improvement plan and reflect any updates in the AD.	Please refer to chapter 3.2.5.2 and 3.2.5.5 of the NIR. No recalculations have been performed in road transport category related to lubricants in both this and previous submission. For the years 1990-2010 we calculated lubricants emissions by applying a fuel consumption ratio as described in NIR page 114. This calculation was followed for years 1990-2010 in both 2012 and 2013 submission (not for year 2011).
Navigation: liquid fuels	CO_2, CH_4 and N_2O	GR	Explain the cause of the fluctuation in the consumption of fuel in domestic navigation throughout the time series.	In Greece, the AD (fuel consumption by fuel type) for navigation, separated between National and International navigation, are obtained from the national energy balance, which is submitted to the EUROSTAT and other international statistics agencies. Hence, these data are verified and accepted as reliable. The consumption fluctuations are affected by the existing national economic conditions and international circumstances.
Navigation: liquid fuels	CO_2, CH_4 and N_2O	GR	Start a process aimed at providing a more accurate estimate of CO_2 emissions associated with this category by gathering information on the number of arrivals and departures, destination and fleet composition and, if necessary, take into consideration the experiences of other Parties in gathering these data. Establish and present a plan to improve the collection and the quality of data on fuel consumption for vessel categories and ship movement information.	Please refer to chapter 3.2.5.2 and 3.2.5.5 of the NIR.
International bunker fuels		GR	Greece explained in the NIR that the GHG emissions from domestic and international navigation are estimated based on the national energy balance and using a tier 1 approach. The GHG emissions from international aviation and domestic aviation are estimated according to the tier 2 approach by using landing/take-off data from the Civil Aviation Organization. In response to a question raised by the ERT during the review, the Party further explained that the separation of fuel consumption between international and national use is performed by the entity responsible for compiling the national energy balance (MEECC) based on surveys and data gathered from all companies operating in Greece that supply fuel for aviation and navigation use. The ERT recommends that, in order to improve the transparency of its reporting,	Please refer to chapter 3.2.2 of the NIR

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 submission	MS comment
			Greece provide, in the NIR of its next annual submission, an explanation of how in the energy balance the annual fuel consumption for domestic transport is separated from the consumption for international transport based on the fuel supply data from supplier companies, in order to demonstrate the accuracy of its emission estimates for domestic aviation and navigation.	
International bunker fuels		LU	Transparently describe the methodology used to split national and international (bunker) fuel consumption to ensure, in particular, that civil aviation emissions are accurately estimated. Describe, and if possible quantify, in the NIR any rounding issues in the IEA questionnaires that could result in discrepancies with the CRF tables.	No information was found in the NIR
Road transportation: liquid fuels	CO_2	LU	Insert the reference table for an overview of the CO_2 IEF for lubricants and include detailed information on lubricant consumption in the tables on road transportation Update to the newer CRF Reporter software (v.3.7.3) in order to avoid possible inconsistencies between the CRF tables and the NIR and enhance QC activities prior to submission.	No information was found in the NIR
Road transportation: liquid fuels	N_2O	LU	Incorporate the findings from the study that aims to better understand emissions from road transportation in the inventory and report thereon	No information was found in the NIR
Road transportation: liquid fuels	CO_2	NL	Report on the progress made regarding re-evaluation of country-specific CO_2 EFs and include the findings of the assessment in a future annual submission	The new N_2O EFs have been used and documented in the NIR 2013. Progress on the CO_2 EFs is documented in paragraph 3.2.8.
Other transportation: liquid fuels	CO_2, CH_4 and N_2O	NL	Correct the identified error in the use of notation keys.	Not corrected in the CRF
International bunker fuels	All fuels	IT	The NIR states that there is a discrepancy of 11.4 per cent in fuel consumption in international marine bunkers between IEA (the higher figure) and the CRF tables because the energy statistics used by IEA are not updated. In response to a question raised by the ERT during the review, Italy explained that every year ISPRA provides a complete time series of domestic and international data to MED, which is responsible for the official communication to IEA. The ERT encourages the Party to further investigate the process of sending	No answer was found in the NIR

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 submission	MS comment
			information to IEA in order to ensure that recalculations to the time series are reflected in the IEA figures.	
Fuel combustion: diesel	CO_2, CH_4, N_2O	BE	Report off-road emissions from: industrial activities under other(manufacturing industries and construction); ground activities in airports and harbours, and any off-road activities not otherwise reported under agriculture/forestry/fisheries or manufacturing industries and construction, under other transportation; and military transport under other (fuel combustion activities)	Corrected
Road transportation: liquid fuels	CO_2, CH_4, N_2O	BE	Improve the consistency between the provisional and final values in the energy balance in future annual submissions	No relevant information was found in the NIR
Road transportation: liquid fuels	CO_2, CH_4, N_2O	BE	Obtain data on the NCVs and carbon content from the fuel suppliers and estimate the CO_2 emissions from gasoline in order to develop and use more accurate EFs. Otherwise, use the default CO_2 EF of 73 t/TJ from table 1-36 of the reference manual of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories	Corrected (2014 NIR, pp.93)
Road transportation: liquid fuels	CO_2, CH_4, N_2O	BE	Include the revised estimates of CH_4 and N_2O emissions from consumption of diesel, gasoline and liquefied petroleum gas in road transportation	Emissions of CH_4 and N_2O are since the 29th October 2012 submission also based on the amounts of fuel sold of the federal petroleum balance in combination with COPERT 4 emission factors. The compiled emissions of each region based on COPERT 4 v10.0 modelling are hereby corrected/increased according the ratio between the fuel used (consumptions compiled by regional models) and the fuel sold (provided by federal statistics) to get consistency with the methodology used to calculate the emissions of CO_2. This approach is of course carried out by fuel type and was approved by the ERT of the UNFCCC 2012 in-country review during the 'Saturday paper' process.

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 submission	MS comment
Road transportation: liquid fuels	CO_2, CH_4, N_2O	BE	Improve the transparency of the input parameters for the models used to estimate CH_4 and N_2O emissions, as well as the description of the method used to calculate the emissions, in order to ensure the consistency of the total fuel sales with the total fuel consumption according to the regional models in the NIR	Regional results from Copert models with correction fuel sold/fuel used
Road transportation: liquid fuels	CO_2, CH_4, N_2O	BE	Ensure a consistent time series of CH_4 and N_2O emissions from road transportation and transparently document how this consistency has been achieved in the NIR	Regional results from Copert models with correction fuel sold/fuel used
Road transportation: liquid fuels	CO_2, CH_4, N_2O	BE	Improve the transparency of the reporting by including background information on the biofuel use in the country and make efforts to report the CH_4 and N_2O emission estimates separately	Emissions of CH_4 and N_2O from biomass (bio-gasoil and bio-ethanol) are reported separately for the first time during the 2013 submission consistently for the 3 regions.
Civil aviation: liquid fuels	CO_2, CH_4, N_2O	BE	Include the revised estimates of CO_2 emissions from kerosene used in civil aviation	Corrected (NIR 25014, pp.94)
Civil aviation: liquid fuels	CO_2, CH_4, N_2O	BE	Consult with Belgocontrol in relation to obtaining the necessary AD to estimate emissions from civil aviation, either by region or for the country as a whole	Corrected (NIR 2014, pp.94)
International bunker fuels	All fuels	DK	Provide explanations in the NIR on the large inter-annual variations in CO_2 emissions from international bunker fuels for the years 2008–2010	Explanations on the fluctuations in the trend have been included in the NIR (Please check Chapter 3.3.1 of NIR 2014)
International bunker fuels	All fuels	DK	Include data on international bunkers for lubricants in CRF table 1.C and improve the associated QC procedures	Data for lubricants used in international bunkers were included in the 2014 submission. The QC procedures have been updated. (Please check CRF 2014)
Road transportation: liquid fuels	CO_2, CH_4 and N_2O	DK	Provide brief descriptions of the methods used to obtain the fleet and mileage data necessary for the COPERT IV model	The description has been improved in the NIR. (please check Chapter 3.3.2 in NIR 2014)
Aviation: liquid fuels	CO_2, CH_4 and N_2O	DK	Provide information on the number of domestic landings and take-offs (LTOs) per representative aircraft type for each of the Danish airports, including flights between Denmark and Greenland/the Faroe Islands, the average LTO fuel consumption and the EFs per representative aircraft type	Information has been included (please check Annex 3B-10 in NIR 2014)
Road transportation: liquid fuels	CO_2	PT	Develop country-specific parameters (e.g. hydrogen/carbon ratios and EFs) for gasoline and diesel oil	No new developments
Railways: liquid fuels	CO_2	PT	Consistently use the same CO_2 EF for the same type of diesel oil consumed	Implemented (please check Section 3.3.3.3 of NIR 2014)

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 submission	MS comment
International bunker fuels (aviation)	All fuels	ES	Include in the NIR background information on the methodology used and document the use of expert judgement in the estimation of emissions from aviation	Implementation unclear to the EU team
International bunker fuels (aviation)	All fuels	ES	Document the differences in the total fuel consumption estimated by MECETA (and used in the inventory) and the IEA/Eurostat energy balance	Implementation unclear to the EU team
International bunker fuels (maritime)	All fuels	ES	Include in the NIR background information on fleet characterization and the estimation methodology used, including the use of expert judgement, and include a trend analysis	Implementation unclear to the EU team
Other categories	CO_2, CH_4 and N_2O	ES	Include information on fuel consumption and the associated emissions	Implementation unclear to the EU team
Civil aviation: liquid fuels	CO_2	FR	To ensure consistency when preparing future planned recalculations	Implementation unclear to the EU team
Road transportation: liquid fuels	CO_2	FR	To obtain country-specific values for the carbon content of the diesel and gasoline sold in France for the estimation of CO_2 emissions	The CO_2 emission factor is calculated from the equations of COPERT, using default model ratios for H/C. The complexity of the process of producing the fuel, does not facilitate the estimation of country specific ratios in France.
Road transportation: liquid fuels	CO_2	FR	To report separately the AD for biodiesel and bioethanol in the NIR	Corrected
International bunker fuels	CH_4 and N_2O	IE	Estimate and report CH_4 and N_2O emissions from marine bunker fuel use	Emissions of CH_4 and N_2O have been estimated for all years from 1990-2011 in this submission (2013). Please check Chapter 3, section 3.5 in NIR 2013 and CRF Table 1.C
Other transportation: liquid fuels	CO_2, CH_4 and N_2O	IE	Use the appropriate notation key to report emissions from ground activities at airports and harbours	No response was found in the NIR and no correction was made in the CRF

Table 3.116 provides an overview of EU-15 member state's response to the UNFCCC Review findings for fugitive emissions.

Table 3.116 EU-15 member State's responses to UNFCCC review findings in 2013 for fugitive emissions

Category	Gas	Member State	UNFCCC review findings for the 2013 submission	MS response
Solid fuel transformation : biomass	CH_4	Austria	During the ICR 2013 the ERT noted that CH_4 fugitive emissions from charcoal production are not reported, and considers this as a case of underestimation (potential problem). In the ARR 2013 the ERT recommends to describe the method used for estimation.	Charcoal production is now considered in the inventory and the method is described in the NIR.
Oil and natural gas	CH_4	Austria	The ERT noted that the calculation method changed between 2006 and 2007 due to use of different EFs and that the new methodology was not applied consistently across the whole time series. The ERT recommends	The method for estimating CH_4 emissions has been adapted accordingly to achieve time series

Category	Gas	Member State	UNFCCC review findings for the 2013 submission	MS response
			Austria to recalculate the complete time series using the same oil and gas production EF.	consistency.
		Belgium	No inventory review report for 2013 available by the time of compilation of this NIR. No review finding in 2012.	-
-	-	Denmark	No inventory review report for 2013 available by the time of compilation of this NIR. No review finding in 2012.	-
-	-	Finland	No review finding.	-
Fugitive emissions from fuels	CO_2, CH_4 N_2O	France	No inventory review report for 2013 available by the time of compilation of this NIR. ARR 2012: The ERT recommends that France clearly describe the allocation of emissions from petroleum refining in the NIR of its next annual submission.	For 1B2a section, the emission factors have been updated, as well as consumption of the FCC whose oil and gas consumption were transferred to CRF 1A1B (combustion emissions). In addition, flaring emissions were transferred to CRF 1B2c
Oil and natural gas: gaseous fuels	CH_4	Germany	Provide an explanation of the fluctuations of the CH_4 emissions from natural gas production/processing.	No information found.
Coal mining and handling	CH_4	Greece	Report any progress for the estimates of CH_4 emissions from this category resulted from the bilateral QA exercise in October 2013.	The inventory team has contacted the inventory teams of some countries that apply a CS EF for CH_4 emissions associated to surface lignite mining. However, the countires that were approached have developed a CS EF for surface mining based on measurements from underground mines, which are located in the vicinity of the surface mines. Since in Greece, there are no underground mines in the vicinity of surface mines, this method cannot be applied. Nevertheless, the inventory team plans to contact more inventory teams and gather information of how these countries have estimated national EFs for surface mining, in order to develop respective national EF for Greece.
-	-	Ireland	No inventory review report for 2013 available by the time of compilation of this NIR.	-

Category	Gas	Member State	UNFCCC review findings for the 2013 submission	MS response
			No review finding in 2012.	
Oil and natural gas	CO_2, CH_4, N_2O	Italy	Review and correct the comments in the CRF tables.	The comments in the CRF have been corrected.
Oil and natural gas: natural gas transmission	CH_4	Luxembourg	Provide the country-specific rationale for selecting the EF from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories or if this cannot be provided, use the EF from the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories	Emission factors from the 2006 IPCC Guidelines were selected as these better reflect the modern and regularly serviced transmission and distribution natural gas networks in Luxembourg.
Oil and natural gas: natural gas distribution	CH_4	Luxembourg	Transparently explain the causes for the decrease in CH_4 emissions from natural gas distribution between 2010 and 2011.	Fluctuations in the timeseries occur due to maintenance stops of large industrial plants such as the 350 MW CHP gasturbine (Twinerg), the closure of iron and steel facilites (2012- Arcelor-Mittal Schifflange) or more heat demand due to colder winters.
Solid fuel transformation : solid fuels	CO_2	Netherlands	Correctly allocate CO_2, CH_4 and N_2O emissions from fuel combustion from on-site coke production in iron and steel plants.	The trend in CO_2 emissions of the iron and steel plant is presented in a graph in the energy chapter, including emissions of fuel conbustion from on-site coke production.
Oil and natural gas: liquid and gaseous fuels	CO_2	Netherlands	Improve reported activity data for oil refining and storage.	Work is ongoing to be more transparent in the reporting for this sector. The sector is improving their data gathering and verification and improved activity data are expected in next submission.
Oil and natural gas: liquid and gaseous fuels	CO_2	Netherlands	Review the use of the notation keys, correct the identified error and improve the QC procedures related to the information provided in the CRF tables	We replaced NE by IE for other leakage.
1.B.2 Fugitive emissions (oil)	-	Portugal[36]	Fuel used for ammonia production net subtracted from the energy sector could possibly result in double counting. It’s advised that Portugal reports it appropriately by revising the methodologies used for	Under Development

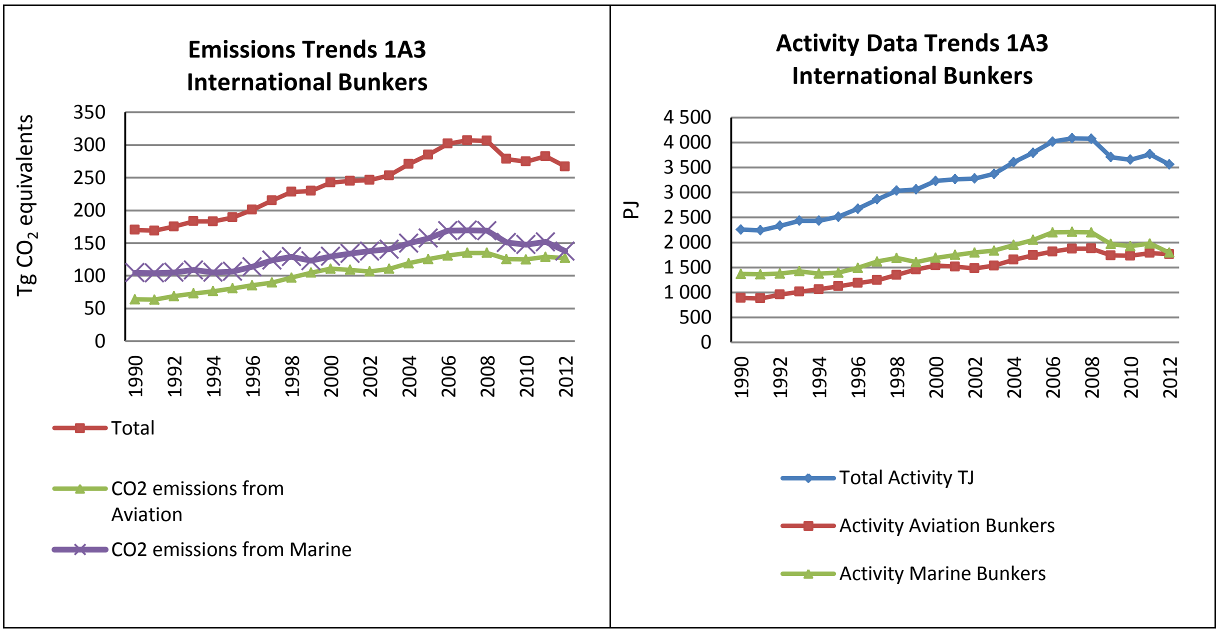
[36] Provisional findings of the In-Country Review 2013. ARR 2013 not yet published.

Category	Gas	Member State	UNFCCC review findings for the 2013 submission	MS response
			reporting non-energy use of fuels and making sure there is no double counting.	
1.B.2 Fugitive emissions (oil)	-	Portugal	Emissions resulting from the non-energy use fuels and subtracted from the energy sector aren't estimated. It's advised that Portugal reports it appropriately by revising the methodologies used for reporting non-energy use of fuels and making sure there is no double counting.	Non-energy use of fuels are being further analyzed.
-	-	Spain	No relevant review finding	-
-	-	Sweden	No relevant review finding	-
-	-	United Kingdom	No inventory review report for 2013 available by the time of compilation of this NIR. No review finding in 2012.	-

3.8 International bunker fuels (EU-15)

International bunker emissions include emissions from Aviation bunkers and Marine bunkers. The emissions of the EU inventory are the sum of the international bunker emissions of the Member States ([37]). Between 1990 and 2012, greenhouse gas emissions from international bunker fuels increased by 57 % in the EU-15. CO_2 emissions from “Marine bunkers” account for 52 % of total greenhouse gas emissions from international bunkers in 2012, CO_2 from “Aviation bunkers” accounts for 48 % (Figure 3.94).

Figure 3.94 International bunker fuels: GHG emission trend and activity data



3.8.1 Aviation bunkers (EU-15)

This source category includes emissions from flights that depart in one country and arrive in a different country (include take-offs and landings for these flight stages).

CO_2 emissions from Aviation Bunkers equal 4 % of total GHG emissions in 2012 but are not included in the national total of GHG emissions (Table 3.117).

The Member States France, Germany, Spain and the United Kingdom contributed more than two thirds to the EU-15 emissions from this source. All Member States increased emissions from Aviation bunkers between 1990 and 2012.

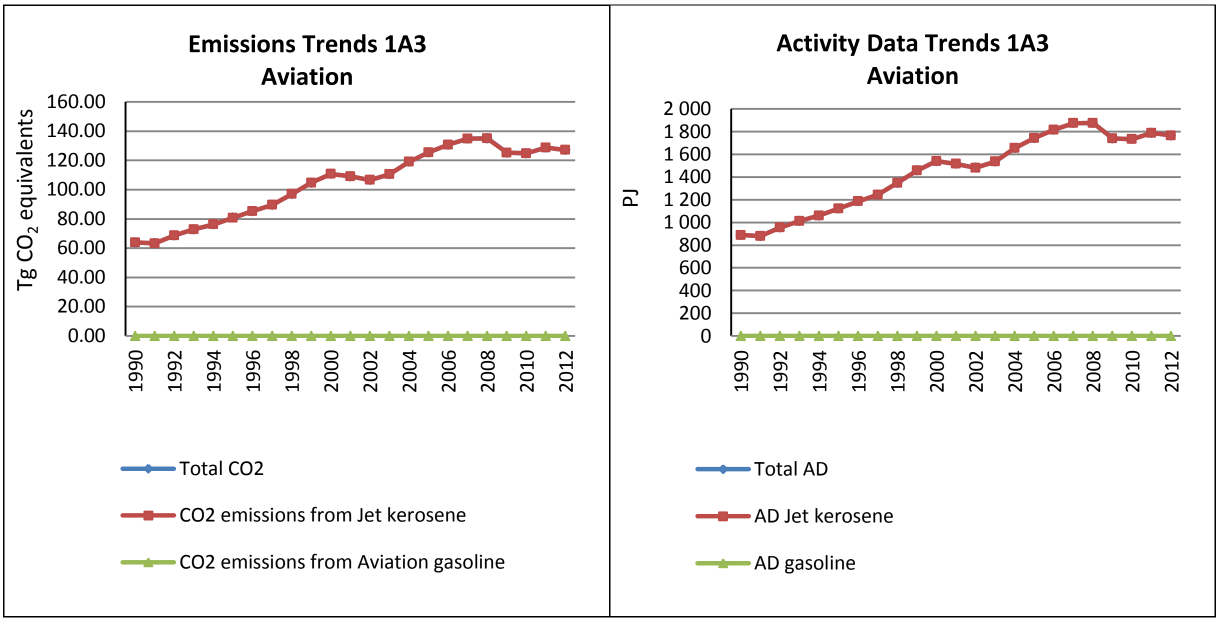
([37]) The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within ‘one country’. This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers ‘national fuel statistics’ for domestic aviation. As the EU is neither a country nor a nation, the EU’s interpretation of the good practice guidance is that the emission estimate at EU level has to be the sum of Member States estimates for domestic air or marine transport as they are the countries or nations addressed in the definition and decision trees of the IPCC good practice guidance.

Table 3.117 Aviation bunkers: Member States' contributions to CO_2

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 1990-2012		Change 2011-2012	
	1990	2011	2012		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	886	2 168	2 073	1.6%	1 187	134%	-96	-5%
Belgium	3 095	4 374	4 041	3.2%	946	31%	-334	-8%
Denmark	1 736	2 492	2 510	2.0%	773	45%	17	1%
Finland	1 008	1 957	1 889	1.5%	881	87%	-68	-4%
France	8 657	16 604	16 153	12.7%	7 496	87%	-451	-3%
Germany	12 022	23 561	25 301	19.9%	13 279	110%	1 741	7%
Greece	2 439	2 268	2 514	2.0%	75	3%	246	10%
Ireland	1 070	2 074	1 742	1.4%	672	63%	-333	-19%
Italy	4 161	9 726	9 316	7.3%	5 155	124%	-410	-4%
Luxembourg	394	1 219	1 114	0.9%	720	182%	-105	-9%
Netherlands	4 540	10 448	10 114	8.0%	5 574	123%	-334	-3%
Portugal	1 461	2 699	2 720	2.1%	1 259	86%	21	1%
Spain	5 566	13 984	13 492	10.6%	7 926	142%	-492	-4%
Sweden	1 335	2 269	2 163	1.7%	828	62%	-106	-5%
United Kingdom	15 571	32 912	32 018	25.2%	16 447	106%	-894	-3%
EU-15	**63 940**	**128 754**	**127 158**	**100.0%**	**63 218**	**99%**	**-1 596**	**-1%**

CO_2 emissions from jet kerosene account for 100 % of total emissions from "Aviation bunkers" in 2012 (Figure 3.95). All Member States, increased emissions from jet kerosene between 1990 and 2012. Member States with the highest increase between 1990 and 2012 in percent were Austria, Italy, Luxembourg and Spain.

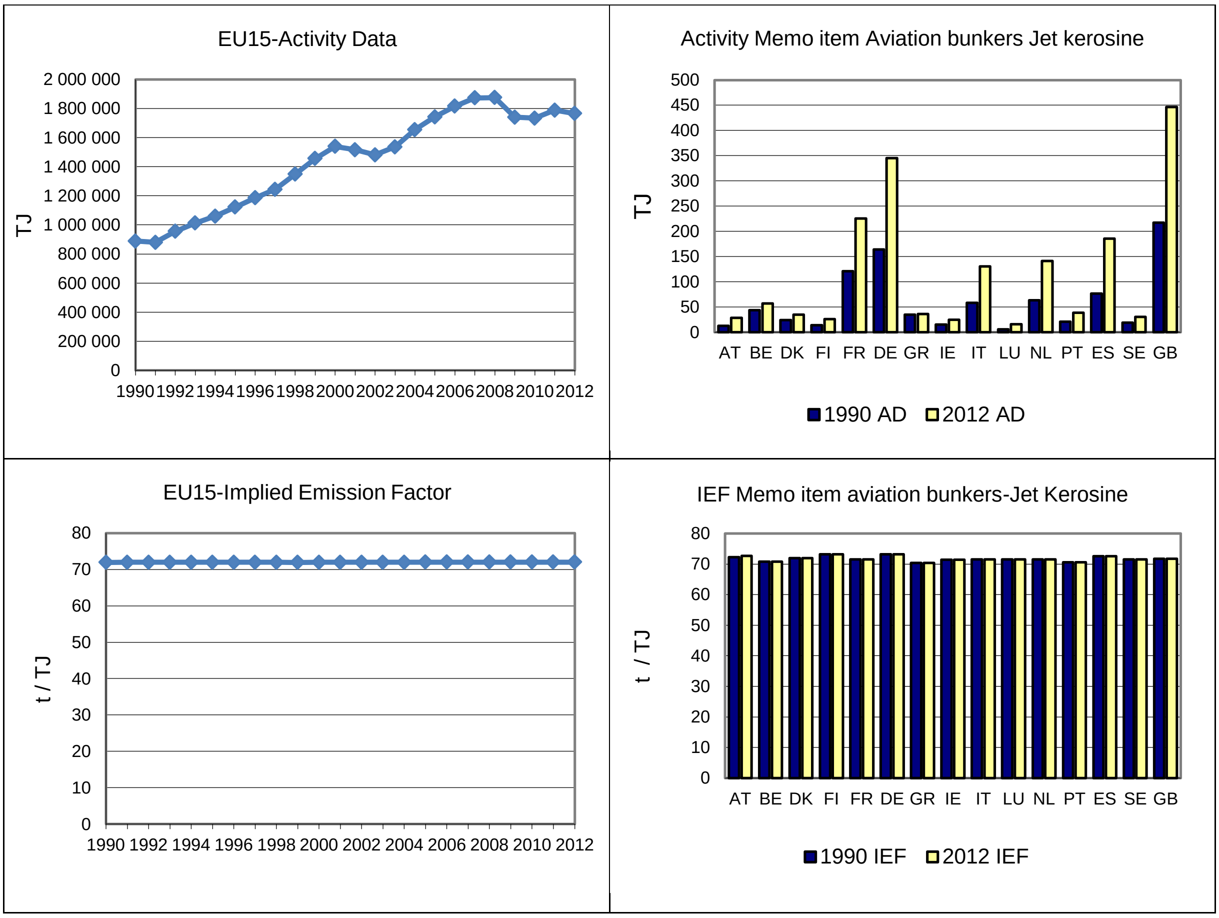
Figure 3.95 Aviation bunkers: Trend of CO_2 Emissions and Activity Data



3.8.1.1 Aviation Bunkers – Jet Kerosene (CO_2)

Figure 3.96 provides an overview of activity data and emission factors for EU-15 and those Member States contributing most to EU-15 emissions. Fuel combustion of EU-15 increased by 99 % between 1990 and 2012. The EU-15 implied emission factor was at 72.02 t/TJ in 2012.

Figure 3.96 Aviation bunkers, Jet kerosene: Activity Data and Implied Emission Factors for CO_2



3.8.2 Marine bunkers (EU-15)

This source category includes emissions from fuels used by vessels of all flags that are engaged in international water-borne navigation. The international navigation may take place at sea, on inland lakes and waterways and in coastal waters. Marine bunkers include emissions from journeys that depart in one country and arrive in a different country. Marine bunkers exclude consumption by fishing vessels (see Other Sector - Fishing).

CO_2 emissions from “Marine bunkers” equal 4 % of total GHG emissions in 2012 and are also not included in the national total of GHG emissions. Between 1990 and 2012, CO_2 emissions from Marine bunkers increased by 31 % in the EU-15 (Table 3.118).

The Member States Belgium, the Netherlands and Spain contributed most to the emissions from this source (65 %) in 2012. Between 1990 and 2012, Denmark, Finland and Greece decreased emissions from Marine bunkers whereas all the other Member States increased them. The Member States with the highest increase in absolute terms were Belgium, the Netherlands and Spain.

Table 3.118 Marine bunkers: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 1990-2012		Change 2011-2012	
	1990	2011	2012		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	39	44	46	0.03%	7	18%	1	3%
Belgium	13 303	21 894	19 604	14.2%	6 301	47%	-2 290	-12%
Denmark	3 012	2 104	1 513	1.1%	-1 500	-50%	-591	-39%
Finland	1 835	612	357	0.3%	-1 478	-81%	-255	-71%
France	7 890	8 430	7 968	5.8%	77	1%	-462	-6%
Germany	7 915	8 729	8 161	5.9%	245	3%	-568	-7%
Greece	8 082	8 897	7 279	5.3%	-802	-10%	-1 618	-22%
Ireland	57	334	397	0.3%	340	600%	63	16%
Italy	4 389	7 190	5 648	4.1%	1 259	29%	-1 541	-27%
Luxembourg	0.1	0.1	0.1	0.0%	0	59%	0	-3%
Netherlands	34 357	48 217	43 429	31.5%	9 071	26%	-4 789	-11%
Portugal	1 386	1 932	2 085	1.5%	699	50%	152	7%
Spain	11 527	27 279	26 645	19.4%	15 118	131%	-634	-2%
Sweden	2 228	5 878	5 769	4.2%	3 542	159%	-109	-2%
United Kingdom	8 716	10 287	8 763	6.4%	47	1%	-1 525	-17%
EU-15	**104 738**	**151 828**	**137 664**	**100.0%**	**32 926**	**31%**	**-14 165**	**-10%**

CO_2 emissions from residual fuel oil account for 87 % of total emissions from "Marine bunkers" in 2012 (Figure 3.97). Between 1990 and 2012, CO_2 emissions from residual fuel oil increased by 46 % in the EU-15. All Member States, except for Denmark and Finland, increased emissions from residual oil between 1990 and 2012. Member States with the highest increase in percent were Spain and Sweden.

CO_2 emissions from gas/diesel oil account for 13 % of total emissions from "Marine bunkers" in 2012. Between 1990 and 2012, CO_2 emissions from gas/diesel oil decreased by 19 % in the EU-15.

Figure 3.97 Marine bunkers: Trend of CO_2 Emissions and Activity Data

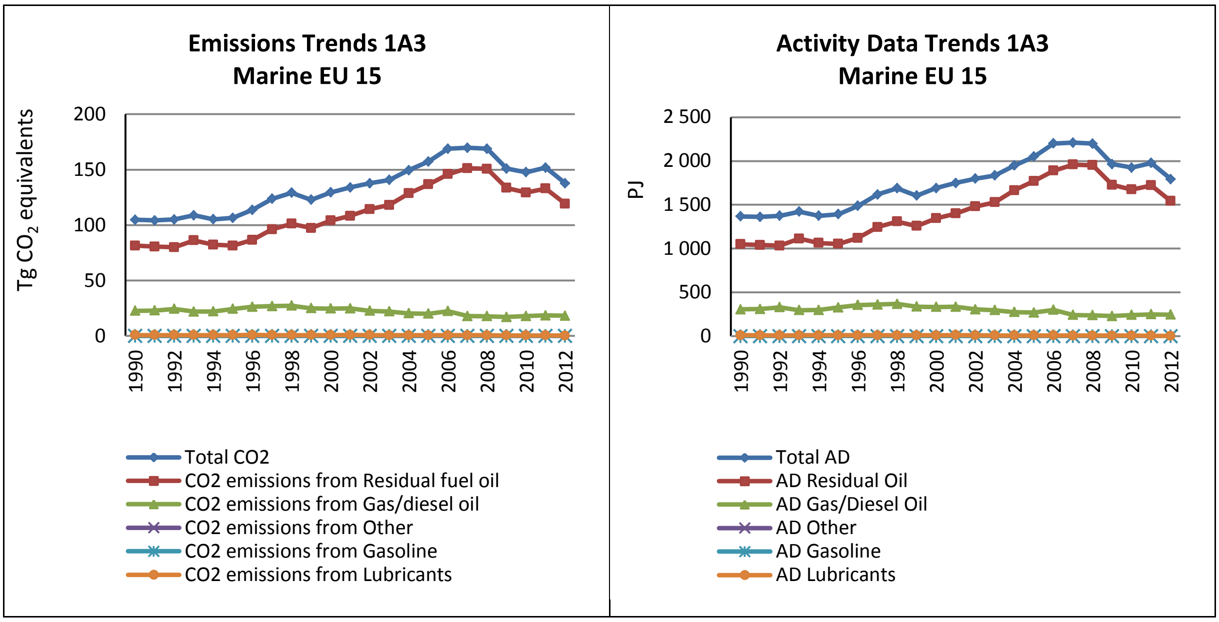
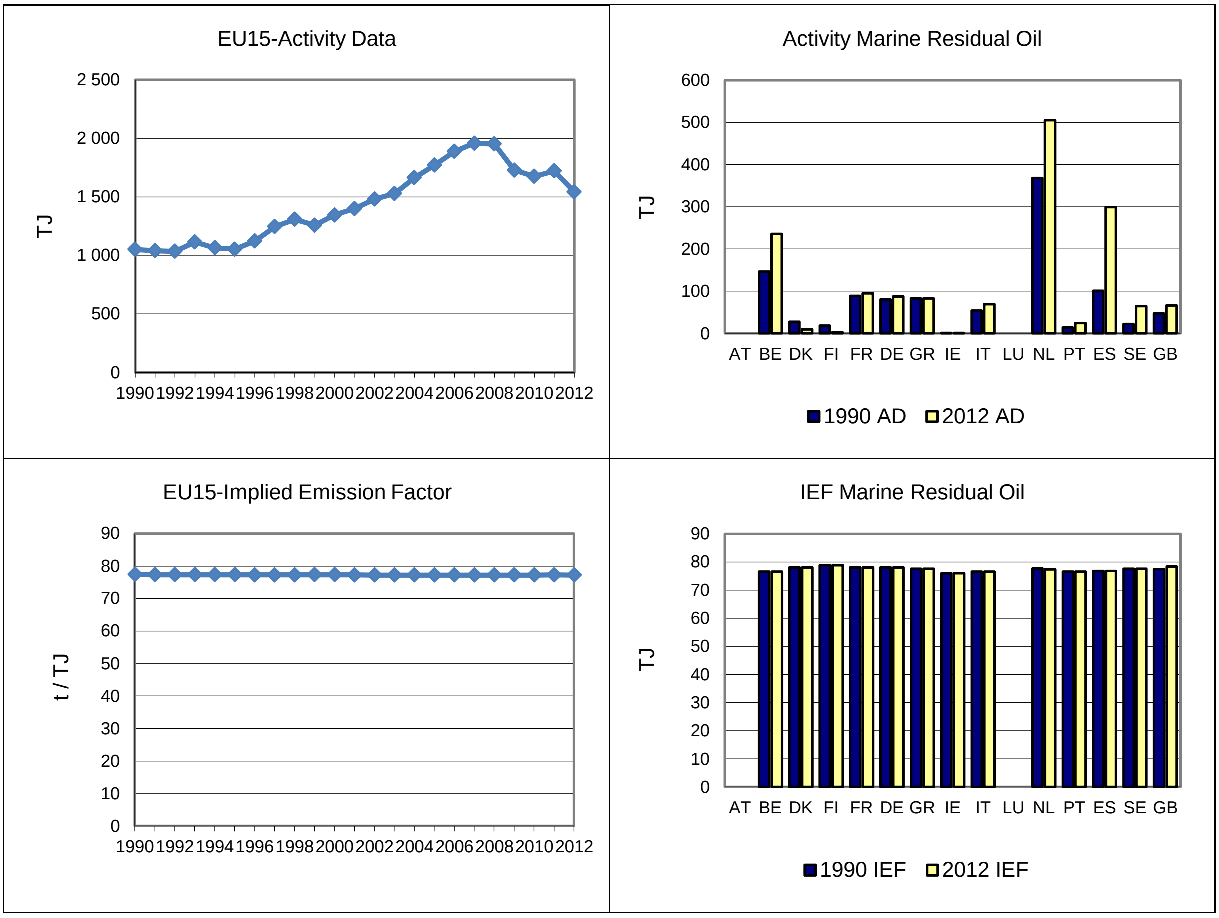


Figure 3.98 and Figure 3.99 provide an overview of activity data and emission factors for residual oil and gas/diesel oil for EU-15 and those Member States contributing most to EU-15 emissions.

3.8.2.1 Marine Bunkers – Residual Oil (CO_2)

Combustion of residual oil in the EU-15 increased by 46 % between 1990 and 2012. The EU-15 implied emission factor was at 77.24 t/TJ in 2012.

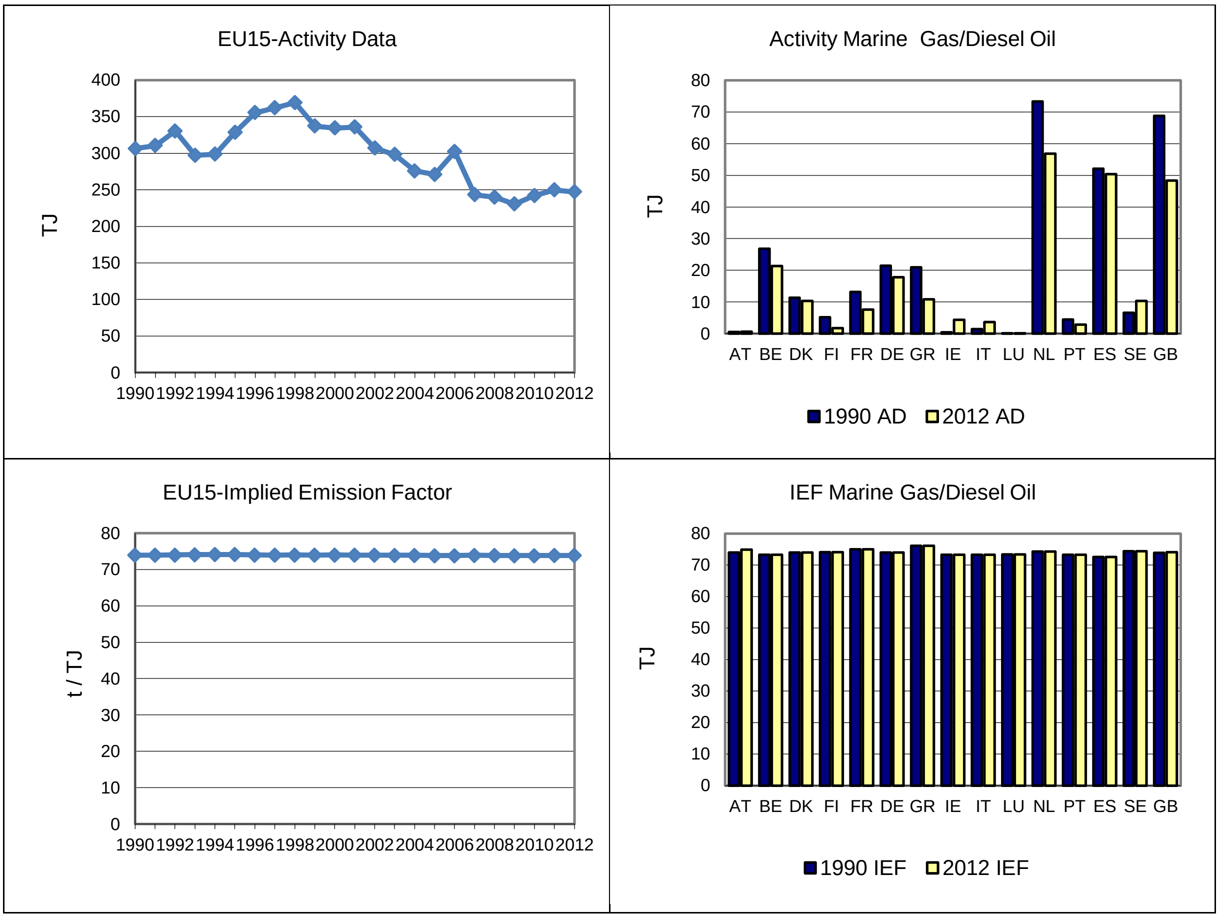
Figure 3.98 Marine bunkers' – Residual Oil: Activity Data and Implied Emission Factors for CO_2



3.8.2.2 Marine Bunkers – Gas/Diesel Oil (CO_2)

Combustion of gas/diesel oil in the EU-15 decreased by 19 % between 1990 and 2012. The EU-15 implied emission factor was at 73.88 t/TJ in 2012.

Figure 3.99 Marine bunkers, Gas/Diesel Oil: Activity Data and Implied Emission Factors for CO_2



3.8.3 QA/QC activities

3.8.3.1 Collaboration with Eurocontrol - 2007 Study

The European Topic Centre on Air and Climate Change conducted a study in 2007 based on aviation emission estimates from Member States and calculations by the European Organisation for the Safety of Air Navigation (Eurocontrol). The purpose of the study was to compare emissions reported by Member States with modelling results provided by Eurocontrol to assess the quality of the emissions estimates and help identify areas in need for improvement. The calculations by Eurocontrol are based on flight movement data using an independent data set whereas most Member States use fuel sale statistics. The study assessed three questions: (i) how consistent are estimates for total fuel consumption between the two data sets; (ii) how consistent are estimates for the share of domestic aviation between the two data sets; (iii) does the consistency between the two estimates depend on the type of methodology applied by Member States. The main conclusions of the study were:

Comparing country estimates for fuel burn, CO_2 emissions and NO_X with Eurocontrol calculations is a genuine quality assurance exercise which can help both sides in improving their data. Despite significant uncertainties in the estimates the comparison was able to identify countries for which the differences could not be easily explained and where countries as well as Eurocontrol might need to do further analysis. Especially for the share of domestic aviation Eurocontrol data might be of use to several countries in the future.

The analysis showed that although in theory CO_2 estimates from aviation do not depend on the tier chosen, in practice countries applying higher tiers also had more consistent carbon dioxide emission estimates. One of the reasons might be that the application of higher tiers requires detailed statistics in the aviation sector which might also be reflected in the fuel sale estimates.

The use of bottom-up data for the determination of the split between domestic and international aviation could improve the accuracy of inventory estimates. The small country approach is a good and very easy methodology for countries without domestic IFR/GAT aviation; research projects can produce good estimates for the share of domestic emissions. Out of the 29 countries assessed those applying expert judgement or top-down data had the highest discrepancies compared to Eurocontrol.

In general, the European countries tend to overestimate domestic emissions. This is a conservative approach as it increases the emissions included in the emission reduction commitment under the Kyoto Protocol. For the same reason it would be in the interest of the concerned countries to improve their estimates: greenhouse gas emissions from aviation have increased substantially since 1990 and overestimating the domestic share will exacerbate the efforts for reaching the national targets. Applying the share of domestic aviation as calculated by Eurocontrol to total fuel consumption in the EU-15 leads to an overestimation of domestic emissions from aviation by 6.2 Mt CO_2 in 2005.

3.8.3.2 Collaboration with Eurocontrol during 2012/13

At the end of 2010 the European Commission signed a framework contract with Eurocontrol regarding 'support to the European Commission in relation to climate change policy and the implementation of the EU ETS'. The support project is organised in different Work Packages corresponding to the different areas identified in the framework contract.

One of these Work Packages (WP) pertains to the improvement of GHG and air pollutant emissions inventories submitted by the 27 Member States and the European Union to the UNFCCC and to the UNECE. The main objective of the WP is to assist EU Member States improve the reporting of annual greenhouse gas (and other air pollutant) emission inventories by e.g. estimating the fuel split domestic/international using real flight data from Eurocontrol. The European Environment Agency and its European Topic Centre on Air Pollution and Climate Change Mitigation assist DG CLIMA regarding the technical requirements.

To support the 2013 inventory process, MS recevied fuel and emissions data for the year 2011 as calculated by EUROCONTROL using a TIER 3 methodology applying the Advanced Emisssions Model (AEM) as well as documentation on how these data have been calculated (available upon request). This is a follow up of ERT recommendations made to perform QA exercises and to make data from EUROCONTROL available to member states on a regular basis. The European Environment Agency has made an overview of the methodologies used by MS to calculate emissions from civil and international aviation and made a comparison between EUROCONTROL data and MS data on fuel consumption, CO_2 emissions and implied emission factors. The findings and the EUROCONTROL and MS methodology descriptions results have been shared with MS (documentation available upon request).

Next steps include the evaluation of time series of civil and international aviation emissions. Time series calculated by EUROCONTROL are expected in fall of 2013. Based on the experience gained during this QA/QC process recommendations will be made to EUROCONTROL to safeguard and improve time-series calculations for use by MS.

Under a new framework contract with DG CLIMA, EUROCONTROL could rerun the AEM model to calculate time series for the period 2005-2012. Countries are encouraged to provide feedback on applying these EUROCONTROL data for the year 2011 so that suggestions and questions could be taken into account in the new model run.

As shown in the NIR 2011, comparing emissions reported by Member States with independent modelling results such as performed by EUROCONTROL is a genuine quality assurance exercise and assists in identifying areas in need for improvement of aviation emission calculations. The EU's ARR 2011 report mentions "The ERT again recommends that the European Union continue such QA exercises, that it try to address the issues identified, and that it continue to work on making data from EUROCONTROL available to member States on a regular basis".

3.9 Feedstocks and non-energy use of fuels

Following a recommendation of the expert review team the EU now uses weighted average fractions of carbon stored in order to potentially reduce the differences for apparent consumption between the reference approach and the sectoral approach for all fuels and for the complete time series from 1990-2012.

Table 3.119 provides an overview of the fraction of carbon stored by fuel as used in the EU GHG inventory 2012. These values are compared with the IPCC default values and the weighted average values of the EU-15 MS.

Table 3.119 Fraction of carbon stored from Table 1A(c) used by the EU-15 Member States compared with IPCC default values and the values used in the EU GHG inventory 2012

	Weighted average based on EU-15 MS GHG inventories 2014 for the year 2012	**IPCC default fractions**	**Values used in the EU GHG inventory for the year 2012**
Naphtha	0.79	0.75	0.79
Lubricants	0.77	0.50	0.77
Bitumen	1.00	1.00	1.00
Coal Oils and Tars	0.78	0.75	0.78
Natural Gas	0.42	0.33	0.42
Gas/Diesel Oil	0.64	0.50	0.64
LPG	0.84	0.80	0.84
Ethane	0.86	0.80	0.86

Table 3.120 provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.120 Information related to feedstocks and non-energy use from Member States' NIRs

MS	Information on feedstocks and non-energy use of fuels	Source
Austria	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all fuels except for coke oven coke, of which the amount of carbon stored in steel was calculated. **Lubricants** manufacture: emissions are assumed to be included in total emissions from category 1.A.1.b petroleum refinery. use: emissions from the use of motor oil are included in CO_2 emissions from transport. VOC emissions from lubricants used in rolling mills are considered in category 2.C.1. It is assumed that other uses of lubricants do not result in VOC or CO_2 emissions due to the low vapour pres-sure of lubricants. disposal: emissions from incineration of lubricants (waste oil) are either included in categories 1.A.1.a and 1.A.2 if waste oil is used as fuels or in category 6.C respectively if energy is not re-covered. **Bitumen** manufacture: emissions from the production of bitumen are assumed to be included in total emissions of category 1.A.1.b petroleum refinery. use: indirect CO_2 emissions from the use of bitumen for road paving and roofing that should be reported in categories 2.A.5 and 2.A.6 are included in sector 3 solvent and other product use. disposal: CO_2 emissions from the disposal from bitumen are assumed to be negligible. Recy-cling is not considered. **Natural Gas** manufacture: emissions from the use of natural gas as a feedstock in ammonia production are accounted for in the industrial processes sector (category 2.B.1). use/disposal: not applicable, no CO_2 emissions result from the use or disposal of ammonia. **Coke oven coke** manufacture: emissions from the production of coke are considered in category 1.A.2.a. use: CO_2 emissions from coke used in iron and steel industry are reported under 2.C. disposal: not applicable **Other bituminous coal** In [IEA JQ 2013] non energy use is reported for the manufacture of electrodes. manufacture: No information about emissions from manufacture of electrodes is currently avail-able. Therefore it is not clear if emissions are not estimated or not applicable. use: Emissions from the use of electrodes are considered in category 2.B.4 carbide production and 2.C metal production. disposal: not applicable **Other oil products** emissions of category 1.A.1.b petroleum refinery. CO_2 emissions from solvent use are consid-ered in sector 3 solvent and other product use. use: CO_2 emissions from solvent use are considered in sector 3. disposal: emissions from the disposal of plastics in landfills are considered in 6.A and from the use of plastic waste as a fuel in 1.A.2; emissions from the incineration of plastic in waste without energy recovery is included in 6.C; emissions from incineration of plastics in waste with energy recovery are considered in 1.A.1.a and 1.A.2.	Austria's National Inventory Report 2014, Mar 2014, pp.79

MS	Information on feedstocks and non-energy use of fuels	Source
Belgium	The emissions of non-energy use of fuels and related emissions (emissions from recovered fuels from processes) are reported under categories 1A2c, 2B1 and 2B5. In Flanders, a recalculation of the non-energy use and related CO_2 emissions was performed during the 2005 submission, based on the results of a study conducted in 2003 [43]. The default % of carbon stored in the IPCC Guidelines were considered to be inaccurate in the Flemish situation. The default % of carbon stored in the 1996 IPCC guidelines are not well defined: it is not clear what is included or excluded in these default % (f.i. is the waste phase included or not?). Belgium participated in a European network on the CO_2-emissions from non-energy use (see website http://www.chem.uu.nl/nws/www/nenergy/) and one of the conclusions of this network is that the new IPCC guidelines need to give more information on this subject. In our opinion, the guidelines are also not very clear on the allocation of the resulting emissions: in the CRF table 1.A(d), as part of the reference approach, a country should specify in the documentation box where these emissions are allocated. This problem of allocation should be tackled too. The result of the study made a recalculation possible for all years. The effect of the recalculation was greater in the more recent years because the petrochemical industry has expanded its activities in the beginning of the nineties (that's one of the reasons why the sector 1A2c 'other fuels' is a key source for the trend assesment). Since the petrochemical industry is important in Flanders and Belgium and the emissions from the feedstocks are a key source in the Belgian inventory, the study mentioned above was conducted to get more detailed, country-specific information. A distinction is made between: 1. The use of recovered fuels from cracking units or other processes where a fuel is used as raw material and where part of this fuel (or transformed product) is recovered for energy purposes. These emissions are reported under category 1A2c 'other fuels'. This is the largest source of CO_2 emissions. This includes other fuels in the chemical sector, a result of recovered fuels in the steam cracking units in petrochemical industry (approx. 2/3) and other recovered fuels from the chemical industry (approx. 1/3). These recovered fuels are reported directly in the yearly surveys carried out by the chemical federation in cooperation with the VITO [1]. The choice was made to allocate these fuels under 'other fuels' and not 'liquid fuels' or 'gaseous fuels', for transparency reasons. 2. CO_2 emissions occurring during chemical processes, for example the production of ammonia based on natural gas or the production ethylene oxide (and production of acrylic acid from propene, production of cyclohexanone from cyclohexane, production of paraxylene/metaxylene, etc) where CO_2 is formed in a side reaction (reported respectively under 2B1 and 2B5 other). These CO_2 emissions result from the same surveys in the chemical sector in Flanders as those reported under 1A2c. In the survey, more sources of emissions from chemical processes are reported than are described in the IPCC 1996 guidelines. Emissions of flaring activities in the chemical industry are re-allocated during the 2013 submission to the category 6C instead of the category 2B5 before. 3. Waste treatment of final products is not included in the study. This is practically impossible due to import/export of plastic products, etc. (it is also not clear if the waste phase is included in the default IPCC carbon stored % or not). The emissions of waste incineration are therefore calculated separately and are reported under the sector of waste (category 6C) or under the sector of energy (category 1A1a), whether or not energy recuperation takes place during the process.	Belgium´s Greenhouse Gas Inventory 1990-2012, Mar 2014, pp.66

MS	Information on feedstocks and non-energy use of fuels	Source
Denmark	Three fuels are used for non-energy purposes: lubricants, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 11.5 PJ in 2012. The CO_2 emission from oxidation of lube oil during use was 32 Gg in 2012 and this emission is reported in the industrial processes sector. The reported emission corresponds to 20 % of the CO_2 emission from lube oil consump-tion assuming full oxidation. This is in agreement with the 2006 IPCC Guidelines (IPCC, 2006) methodology for lube oil emissions. Methodology and emission data for lube oil are shown in NIR Chapter 4.8. For white spirit the CO_2 emission is indirect as the emissions occur as NMVOC emissions from the use of white spirit as a solvent. The indrect CO_2 emission from white spirit was 17 Gg in 2012 corresponding to 62 % of the CO_2 emission from white spirit assuming full oxidation. The NMVOC emis-sion data for white spirit are shown in NIR Chapter 5, Table 5.4. The CO_2 emission from bitumen is included as part of the emission from the source sectors 2A5 Asphalt roofing and 2A6 Road paving with asphalt.	Denmark's National Inventory Report 2014 Mar 2014 pp. 281
Finland	To calculate the emissions from the non-specified burning of feedstocks there is a separate module in ILMARI. The ILMARI system includes point source (bottom-up) data on feedstock combustion in the petrochemical industry as well as recycled waste oil combustion in different branches of industry, and they are reported in corresponding subcategories of 1.A 2. These specified energy uses of feedstock and lubricants are subtracted from the corresponding total amounts of feedstock and lubricants. For the rest of the feedstock 100% of carbon is estimated to be stored in products (mainly plastics). For the rest of lubricants, 33% of carbon is estimated to be stored in products (recycled lubricants) and 67% of carbon released as CO_2 either in burning of lubricants in motors or illegal combustion of waste oil in small boilers. These non-specified emissions from burning of feedstocks (which are not included in 1.A 2) are included in category 1.A 5. As a result to question raised by the ERT the calculation of feedstock and lubricants was checked. There were a few corrections (on missing data cell in 2002 and three non-updated preliminary data cells). Also missing additional data was added to CRF Table 1A(d) (Lubricants). Emissions from natural gas used as feedstock are calculated and reported in sector 2.B 5.	Greenhouse Gas emissions in Finland 1990-2012, Mar 2014 p. 117
France	The fossil fuels are consumed for different purposes, for energy use and non-energy use (raw material, intermediate material as well as reducing agent). All types of fuels are differentiated and reported accordingly in the energy balance. The differences of the fuel types (solid, liquid and gaseous) are explained in the following: With regard to the consumption of solid fuels (coal and coke coal) the energy balance accounts all types of use of these fuels as energy consumption and they are well distinguished after energy use and non-energy use in the inventory as well. The solid fuels which are used as reducing agents as well as intermediate material are considered in the CRF category 2C in steel and ferro-alloys production. The petroleum products for non-energy use are principally consumed on site of petrochemical installations. This usage is well investigated by an exhaustive survey conducted by the national statistics authority. According to the survey approximately 14% of the consumption of petroleum products is used for non-energy use, mainly as primary material. This survey defines the quantities of different oil products that are consumed in steam crackers reported under CRF 2B5. Emissions which are related to the combustion of motor oil are considered in CRF category 1A3. The emissions of recovered oil which is combusted during cement production are reported under category CRF 1A2. Those which are burned in waste incinerators are reported under CRF 6. The non-energy use of natural gas is occurring in the ammoniac, hydrogen and hydrocyanic acid production and is reported under CRF 2B.	Rapport National D'Inventaire pour la France Mar 2014 p.90-91 translation

MS	Information on feedstocks and non-energy use of fuels	Source
Germany	The great majority of the coal, oil and gas that Germany uses is used for energy-related purposes. The remainder of the coal, oil and gas is used as feedstock for production processes. This consumption enters into the balance as "non-energy use" (NEU). In the German Energy Balance, this consumption is listed separately, in line 43. The chemical industry is the leading user of fossil fuels for non-energy-related purposes. The German chemical sector uses such fuels in production of basic chemicals such as ammonia, ethylene und propylene, which are used, in additional production steps, to make such important products as fertilisers and plastics. Additional applications include production of graphite electrodes, asphalt for road construction and a range of waxes and lubricants. Table 379 (see below) presents a comparison of a) the consumption listed in line 43 and b) reported emissions of CO_2 and NMVOC from use of fossil fuels in non-energy-related applications. Emissions from non-energy-related applications were correlated with the various relevant fuels in keeping with Table 1.3 from Volume 3 of IPCC-GL 2006 and in accordance with information provided by producers and experts. In some cases, we had to make our own estimates of the applicable correlation with individual fuels. The comparison highlights a discrepancy between the carbon quantities reported in line 43 and the relevant emissions, especially in the case of mineral oils. In 2010, NMVOC and CO_2 emissions correlated with about 9 % of non-energy-related consumption; some 91 % of nonenergy-related consumption is tied to indirect emissions. To compare a) the carbon used in connection with the fuels and b) the resulting emissions, one must also take relevant products' entire life cycles into account. Such life cycles include production, use and disposal of products – and exports. In source category CRF 1.A, Germany reports (inter alia) emissions from waste incineration for energy-related purposes. Many products are not disposed of in the same year in which they are produced. In some products, carbon can be bound up for considerable periods of time. In asphalt, for example, bitumen carbon can remain stored for especially long periods. Other products, such as plastics, are exported as tradeable goods. Waste is also exported to other countries. Such products, along with the carbon they contain, cannot be taken into account in the carbon balance for Germany considered in the present context. They are responsible for a significant discrepancy between the carbon quantities used, and those emitted, in non-energy-related consumption in Germany. The carbon quantities used in non-energy-related consumption are considerably greater than the carbon quantities that would correspond to the reported CO_2 and NMVOC emissions from non-energy-related use of fossil fuels. To determine whether the quantities listed in the Energy Balance as "non-energy-related consumption" actually show up in the relevant feedstock quantities, the fossil-fuel carbon stored in relevant products was balanced. In the chemical industry, fossil fuels are used in crackers, reforming processes and production of synthetic gases. In crackers and reforming, the most important products resulting from such processes are ethylene, propylene, 1,3-butadiene, benzene, toluene and xylene; in production of synthetic gases, the most important such products are ammonia and methanol. The products produced in refineries include bitumen, lubricants and paraffins, waxes and vaseline. Bitumen is used in a range of applications, including road surfaces and bitumen sheeting for roofs. Lubricants are used in road vehicles and machines (inter alia). For purposes of comparison with Energy Balance line 43, the produced quantities of the listed products were obtained from data of the Federal Statistical Office. Those data were then stoichiometrically converted into proportional CO_2 equivalents. For methanol, ethylene, propylene, 1,3-butadiene, benzene, toluene and xylene, the carbon content was stoichiometrically converted, via the molar masses of the products and of CO_2, into CO_2 equivalents. Then, the pertinent CO_2 equivalent emissions were split among the three feedstocks used in Germany (naphta, LP gas and other mineral-oil products). One way to achieve suitable groupings is to distribute the emissions and products' carbon content among the various fuels involved.	National Inventory Report for the German Greenhouse Gas Inventory 1990-2012 Apr 2014 p. 781

MS	Information on feedstocks and non-energy use of fuels	Source
Greece	Non-energy fuel use concerns the consumption of fuels as raw materials (e.g. in chemical industry, metal production) for the production of other products, or the use of fuels for non-energy purposes (e.g. bitumen). Part of the carbon content of fuels is stored in final products and is not oxidized into carbon dioxide for a certain time period. The fraction of the carbon contained in final products and the time period for which carbon is stored in them, depend on the type of fuel used and of the products produced. The oxidation of the carbon stored in final products occurs either during the use of the product (e.g. solvents) or during their decomposition (e.g. through combustion). It should be noted that emissions during production processes (e.g. ammonia and hydrogen production) should be reported under the sector of industrial processes, while emissions from burning of products should be reported under the waste sector or energy sector (as long as energy exploitation takes place). Non-energy use of fuels in Greece refers to the consumption of: - naphtha, natural gas, and lignite (for the period 1990 – 1991) in chemical industry, - petroleum coke in the production of non-ferrous metals, - lubricants in transport (including off-road transportation), - bitumen in construction and - other petroleum products in the industrial and residential sectors The calculation of carbon dioxide emissions from non-energy use of fuels is based on the relevant consumption by fuel type (Table 3.9) and the fraction of the carbon stored by fuel type (Table 3.10). Data on the non-energy consumption of fuels derive from the national energy balance. However, plant specific data derived from verified ETS reports and information provided by specific greek industries resulted to the improvement of reallocation of non-energy use fuels from the energy to the industrial processes sector: - The non-energy use of natural gas for ammonia production has been reallocated to industrial processes sector in the 2012 submission, by using data from ETS reports and plant specific information. Non-energy use of lignite is accounted in the industrial processes sector and refers only to ammonia production (in one installation for 1990 and 1991) and as a result the fraction of carbon stored is equal to 0. The operation of this installation ended at 1998 while it did not produce ammonia for the period 1992 – 1998. - The non-energy use of natural gas for hydrogen production is included in the industrial processes sector, by using data from ETS reports and information from Public Gas Corporation. - No data regarding non-energy use in the iron and steel industry are reported in the national energy balance and, as a result, CO_2 emissions from the use of fuels as reduction agents, are only reported under the industrial processes sector. - Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, by using data from ETS reports and plant specific information, emissions from solid fuels for ferroalloys production are reallocated to the industrial processes sector, as from 2010 submission. - The non-energy use of petroleum coke (see Table 3.9) refers exclusively to the primary aluminium production. Given that the relevant emissions are reported under the industrial processes sector, petroleum coke consumption is not taken into account in the energy sector. On the basis of t above-mentioned clarifications, the possibility to double-count or underestimate CO_2 emissions from the non-energy use of fuels is minor.	Annual Inventory submission to the EC Mar 2014 pp.79
Ireland	Naphtha was previously the only petroleum product to be considered in relation to non-energy fuel-use, where the carbon is not fully released as in combustion. The IPCC default value of 0.50, 1.00 and 1.00 are used for the proportion of carbon stored in lubricants, bitumen and white spirit respectively. Ireland's only oil refinery is a small hydroskimming refinery where there is no production of other petroleum products normally used for non-energy purposes, such as bitumen, lubricants, plastics and asphalt. The expanded SEAI energy balance sheets now record the import of some of these products, thereby allowing improved completeness in the Reference Approach estimation of CO_2 emissions and carbon storage. A significant amount of natural gas feedstock was traditionally used in ammonia production in Ireland but the company closed in 2003 and there is consequently no feedstock use of natural gas since then.	Ireland National Inventory Report 2014 Mar 2014 p. 76

MS	Information on feedstocks and non-energy use of fuels	Source
Italy	Data are based on a detailed yearly report available by Ministry of Economic development (MSE, several years [b]). The report summarizes answers from a detailed questionnaire that all operators in Italy fill out monthly. The data are more detailed than those normally available are by international statistics and refer to: • input to plants (gross input); • quantities of fuels returned to the market (with possibility to estimate the net input); • fuels used internally for combustion; • quantities stored in products. National energy balances include only the input and output quantities from the petrochemical plants; so in the petrochemical transformation process the output quantity could be greater than the input quantity, in particular for light products as LPG, gasoline and refinery gas, due to chemical reactions. Therefore it is possible to have negative values for some products (mainly gasoline, refinery gas, fuel oil). For this matter, for the reporting on CRF tables, these fuels have been added to naphtha. The quantities of fuels stored in products, in percentage on net and gross petrochemical input, are estimated with these data, see Table 3.36 for details by product and Table 3.35 for the overall figure. Specifically, the amount of quantity stored in products for each fuel is calculated as the difference between input (petrochemical input) and output (returns to refinery and internal consumption and losses); carbon stored is therefore calculated from the amounts of fuels stored (in tonnes) multiplied by the emission factors (tC/t) reported in Table 3.36. Non-energy products quantity amount stored from refineries are reported in the BEN and the carbon stored is estimated with emission factors reported in Table 3.37. For lubricants the net carbon stored results from the difference between the amount of lubricants and the amount of recovered lubricant oils. In response to previous review recommendation, in the CRF tables we report the “gross” fuel input amount so that the fractions of carbon oxidized could be derived. As these fractions are derived from actual measurements they do not correspond to any default values and may vary over time. As can be seen from the value reported for the year 2012, there is a sizeable difference of the estimated quantities of fuel stored in product if reference is made to “net” or “gross” input. Moreover the estimation of quantities stored in products are quite different from those reported in the Revised 1996 IPCC Guidelines for National GHG Inventories, Reference Manual, ch1, tables 1-5 (IPCC, 1997). An attempt was made to estimate the quantities stored in products using IPCC percentage values (tables 1-5 of the IPCC Guidelines) and the amount of fuels reported as “petrochemical input” in Table 3.36. The resulting estimate of about 4,792 Gg of products, for the year 2012, is almost 50% bigger than the quantities reported, 3,174 Gg.	Italian Greenhouse Gas Inventory 1990-2012 National Inventory Report 2014, March 2014, pp.103-104

MS	Information on feedstocks and non-energy use of fuels	Source
Luxembourg	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all. Lubricants Manufacturing: manufacturing of lubricants does not occur in Luxembourg. Use: Lubricants are either used in road transportation (motor oil and greases) or in the manufacturing and construction industry (mainly greases). According to the Revised 1996 IPCC Guidelines it can be assumed that 50%of the carbon content of the total quantity of lubricants sold is stored in the product (IPCC default fraction of carbon stored for lubricants). The remaining 50% is considered to be emitted as CO_2. Although the Revised 1996 IPCC GLs recommend to allocate emissions from lubricant uses to the respective categories were uses occur and the IPCC GPG state that "lubricants should be accounted for in other emission categories, as very little is combusted directly in the transportation sector", Luxembourg chose to report CO_2 emissions from lubricant use under category 1A3b - Road transportation - Liquid Fuels - Other Liquid Fuels - Lubricants, as it lacks specific information on lubricant use (i.e. lubricant type, quantities used per category, fraction of lubricant oxidised per lubricant type, etc.). Indeed, when approximating the emissions from lube oil use of Luxembourg's road vehicle fleet, with the COPERT model, emissions are approximately identical to those as estimated with the IPCC default fraction. Carbon stored from lubricant use is reported in CRF Table 1A(d) feedstocks and non-energy use. Activity data reported under 1A(d) feedstocks and non-energy use originates from the energy balance as published from the national statistics institute (STATEC), and represents the total amount of lubricants used in Luxembourg, whereas AD reported under 1A3b - Road transportation - Liquid Fuels - Other Liquid Fuels - Lubricants represents only the amount of lubricants supposed to be oxidised (i.e. 50%). CO_2 emissions from lubricants use were calculated using the default IPCC values (default carbon content of 20.0 kg C/GJ, all carbon assumed to be oxidised). For CH_4 and N_2O emissions from lubricants use, it is assumed that these emissions are included under the 1A3b Road Transportation fuels Diesel, Gasoline and LPG as these emissions are calculated based on real world emission factors (COPERT model), thus including contributions of lubricants, hence notation key IE used. Disposal: incineration of lubricants (waste oil) does not occur in Luxembourg. Waste oil is either recycled or exported. Bitumen Manufacturing: manufacturing of bitumen does not occur in Luxembourg. Coke oven coke Manufacturing: not occurring. All coke used in the iron and steel industry is imported. Use: CO_2 emissions from coke used in iron and steel industry are reported under 2.C.1 – Iron and Steel Production. Other bituminous coal Manufacturing: Manufacturing of electrodes from anthracite used in the electric arc furnaces does not occur in Luxembourg. Use: Emissions from the use of electrodes in the iron and steel production are considered in category 2.C.1 – iron and steel production. Disposal: not applicable. Other oil products Manufacturing: not occurring. All products such as white spirits, etc. are imported. Use: CO_2 emissions from solvent and other products use are considered in sector 3. Disposal: emissions from the disposal of plastics in landfills are considered in 6.A and emissions from incineration, with energy recovery, of waste plastics are considered in 1 A 1 a.	Luxembourg's National Inventory Report 1990-2012 Mar 2014 p. 24f

MS	Information on feedstocks and non-energy use of fuels	Source
Netherlands	49 per cent of the gross national consumption of petroleum products was used in non-energy applications. These fuels were mainly used as feedstock (naphta) in the petro-chemical industry and in products in many applications (bitumen, lubricants, etc.). Also a fraction of the gross national consumption of natural gas (6 per cent, mainly in ammonia production) and coal (2 per cent, mainly in iron and steel production) was used for non-energy applications and hence not directly oxidised. In many cases, these products are finally oxidised in waste incinerators or during use (e.g. lubricants in two-stroke engines). In the reference approach, these product flows are excluded from the calculation of CO_2 emissions.	Greenhouse Gas Emissions in the Netherlands National Inventory report 2014 1990-2012 p. 62
Portugal	Emissions of greenhouse gas emissions from feedstock use are only clearly accounted in the inventory in the following situations: - emission of CO_2 resulting from use of feedstock sub-products as energy sources. That is the case of emissions from consumption of fuel gas in refinery and petrochemical industry; - emission of CO_2 liberated as sub-product in production processes such as ammonia production; - emission of NMVOC from fossil fuel origin, and occurring from solvent use and evaporation. Although in this case it is not possible to establish which part results from feedstock consumption in Portugal in the energy balance; However, some potential emissions are not estimated or are only partly estimated. Those that are estimated in the reference approach but not in sectoral approach are: - emissions from mineral oil use as lubricants; - emissions from wear of bitumen in roads. It is evident that more efforts should be made to estimate other emissions from feedstock use, although it is expected that reporting guidelines should give more clear guidance in the future.	Portuguese National Inventory Report on Greenhouse Gases 1990-2012 Mar 2014 p.3-215
Spain	The consumption of fuel for non-energy use is accounted for in the energy balance. The quantities of each fuel type are included in the reference approach. For each fuel type a split into two parts is given: a) the part that stays in the product and b) the part that is set free and causes the corresponding CO_2 emissions. Main sources are information directly from the plant or industry association about the use of fossil fuels, such as non-energy inputs following the sector/process to determine types of fuels, determined types of fuels from the quantity consumed for this purpose as retention carbon products, such as CO_2 emissions versus its complementing and replacing the figures reported in the above mentioned sources . Following sectors / processes - in most cases on individual plant level - are investigated: i) sodium carbonate; ii) calcium carbide and silicon ; iii) silicon ; iv) ferroalloys (ferrosilicon, ferromanganese and silicon manganese); v) ammonia ; vi) glass; vii) electrical steel mills ; viii) aluminum (anode manufacture); ix) hydrogen in the refining industry emplaced x) refinery plants. The exploitation of this information has led to a revision in the inventory figures for natural gas, petroleum coke, coal coke and coal (anthracite) and other fuels whose registered consumption for non-energy use is minor , such as coking coal , diesel , LPG, fuel oil, gas and refinery steel or wood.	Inventario de emisiones de gases de efecto invernadero de Espana años 1990-2012, March 2014,p. 1.35, Annex 4, p. A4.3 translation

MS	Information on feedstocks and non-energy use of fuels	Source
Sweden	Activity data on feedstocks and non-energy use of fuels is collected from the quarterly fuel statistics. As also noted in Annex 2 section 1.1.1, in the survey form for the quarterly fuel statistics, respondents are among many other things asked to specify whether fuels are used as raw materials or for energy purposes. This facilitates the use of data for CRF table 1.A.d, non-energy use of fuels. As mentioned in section 3.2.1, data on natural gas used as feedstock cannot be reported for the years 2004-2008 due to confidentiality reasons (this activity started in 2004, and for the years 2009 and later, the company using natural gas as feedstock has given permission to publish this data. It is not possible to get a "retroactive" permission to publish data reported in the survey before 2009). Net calorific values and carbon emission factors are the same as in CRF 1AB. The parameter "fraction of carbon stored" has been set to 1.00 for all fuels. This is done because otherwise the emissions corresponding to CRF 2 and 1.B in the sectoral approach would not be accounted for in CRF 1.A.d but in 1.A.b, which would cause systematic differences in the comparison 1.A.c.	National Inventory Report 2014 Sweden Mar 2014 p.123

MS	Information on feedstocks and non-energy use of fuels	Source
United Kingdom	During 2013, an extensive review of the information on non energy use of fuels was commissioned by DECC including a review of available data sources (such as EUETS) and consultation with industry, regulators, trade associations and statistical agencies to assess the best available data to inform UK inventory estimates. This study led to a number of revisions to the approach to reporting the UK GHG inventory, although the impact on the Sectoral Approach inventory totals was very low. **Naphtha, LPG, Refinery fuel gas / OPG, gas oil and Ethane:** 1A1a: Scrap tyre combustion in power stations (1994 to 2000 only). Fossil carbon in MSW combustion in energy from waste plant. Emissions of carbon from chemical feedstock via combustion of products such as synthetic rubbers and plastics. 1A1b: Other petroleum gas use in refineries (2004 to 2012 only). Re-allocated from non-energy use as EU ETS and trade association data indicates that DUKES data on OPG combustion are an under-report. 1A2c: Other petroleum gas use in petrochemical facility combustion. Re-allocated from non-energy use as EU ETS and operator data indicates that DUKES data on OPG combustion are an under-report. These emissions were reported under 1A2f in the 2013 submission, but have now been re-allocated to 1A2c as these are entirely emissions from chemical and petrochemical production facilities. 1A2f: Carbon in energy recovery from waste solvent and mixed general waste containing fossil carbon, in cement kilns. Industrial combustion of waste solvents. Scrap tyre combustion in cement kilns. Emissions of carbon from chemical feedstock via combustion of products such as synthetic rubbers and solvents. 2B5: Energy recovery from process gases in the chemical industry. Release of carbon from breakdown of chemical products such as soaps, detergents and pesticides after use. Emissions of carbon from chemical feedstock via breakdown of products. 6C: Fossil carbon in chemical waste incineration. Fossil carbon in MSW incineration. Fossil carbon in clinical waste incineration. Emissions of carbon from chemical feedstock via combustion of products such as synthetic rubbers and plastics. **Lubricants:** 1A1a: Waste oil combustion in power stations. 1A2f: Waste oil combustion in unclassified industry (including road-stone coating plant), Waste oil combustion in cement kilns. Lubricant combustion in industrial engines. 1A3a: Lubricant combustion in aircraft engines. 1A3b: Lubricant combustion in road vehicle engines. 1A3d: Lubricant combustion in marine shipping engines. 1A4c: Lubricant combustion in agricultural engines. 6C: Incineration of waste oil. **Bitumen**: No known UK applications that lead to GHG emissions **Petroleum coke:** 1A2f, 1A4b, 2C1, 2C3: Based on reported energy use data by specific industries within datasets such as EU ETS and also from direct dialogue with industry representatives, the inventory agency re-allocates a small proportion of the reported "NEU" allocation from DUKES, and reports emissions within the UK GHG inventory. This re-allocation generates emissions for the mineral processing sector (1A2f) and for petcoke use in the domestic sector (1A4b). There are also non-combustion, emissive uses of petcoke in the UK through the use of petcoke-derived anodes in the metal processing industries. Emissions from these uses of petcoke are reported in 2C1 (electrode use in electric arc furnaces) and 2C3 (anode use in aluminium manufacture). Note that DUKES already includes allocations of petcoke use as a fuel in combustion in power stations (1A1a) and refineries (1A1b), which are included in the UK GHG inventory. **Other oil:** 2B5: Carbon released from use of petroleum waxes. Uses of petroleum waxes includes candles, with carbon emitted during use. **Natural Gas:** 2B1: Ammonia production leading to either direct release of CO_2 or associated chemical production (of methanol) with subsequent release of carbon originating in the natural gas feedstock.	UK Greenhouse Gas Inventory, 1990 to 2012 Mar 2014 pp. 99-112

4 INDUSTRIAL PROCESSES (CRF SECTOR 2)

This chapter starts with an overview on emission trends in CRF Sector 2 Industrial processes. Then for each EU-15 key source overview tables are presented including the Member States (MS)' contributions to the key source in terms of level and trend, and information on methodologies and emission factors. The quantitative uncertainty estimates are summarised in a separate section. Finally, the chapter includes a section on recalculations and on sector-specific QA/QC activities. In addition, overviews of Member States' responses to UNFCCC review findings for industrial processes source categories are provided.

4.1 Overview of sector (EU-15)

CRF Sector 2 Industrial Processes is the third largest sector contributing 7 % to total EU-15 GHG emissions in 2012. The most important GHGs from this sector are CO_2 (4 % of total GHG emissions), HFCs (2 %) and N_2O (0.2 %). The emissions from this sector decreased by 31 % from 354 Tg in 1990 to 243 Tg in 2012 (Figure 4.1). In 2012, the emissions decreased by 3 % compared to 2011. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from Eastern European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in hydrochlorofluorocarbons (HCFC) production. The large decrease in 2009 was driven by reductions in cement production and a significant drop in the iron and steel production as a consequence of the economic crisis. In 2010 emissions increased again due to the recovery of steel production whereas cement production continued to decline. In addition, the comparatively small increase in emissions reflects a siginifcant drop in emissions from adipic acid production due to installation of additional off-gas treatment in German adipic acid production plants. In 2011 and 2012 emissions decreased in several important industrial sectors such as steel production, cement production and chemical industry. The main reasons are declining steel production, lower construction activity in important EU-15 MS (in particular Italy and Spain due to economic recession) and emission reduction measures in nitric acid production in several EU-15 Member States.

The key sources in this sector are:

- 2 A 1 Cement Production: (CO_2)
- 2 A 2 Lime Production: (CO_2)
- 2 A 3 Limestone and Dolomite Use: (CO_2)
- 2 B 1 Ammonia Production: (CO_2)
- 2 B 2 Nitric Acid Production: (N_2O)
- 2 B 3 Adipic Acid Production: (N_2O)
- 2 B 5 Other: (CO_2)
- 2 C 1 Iron and Steel Production: (CO_2)
- 2 C 3 Aluminium production: (PFC)
- 2 E 1 By-product Emissions: (HFC)
- 2 E 1 By-product Emissions: (SF_6)
- 2 E 2 Fugitive Emissions: (HFC)
- 2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)
- 2 F 3 Fire Extinguishers: (HFC)
- 2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)

Figure 4.1 CRF Sector 2 Industrial Processes: EU-15 GHG emissions for 1990–2012 in CO_2 equivalents (Tg)

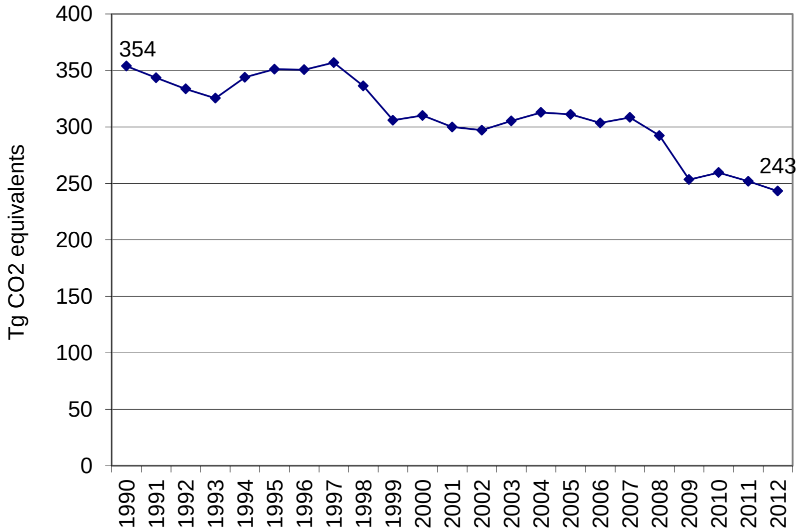
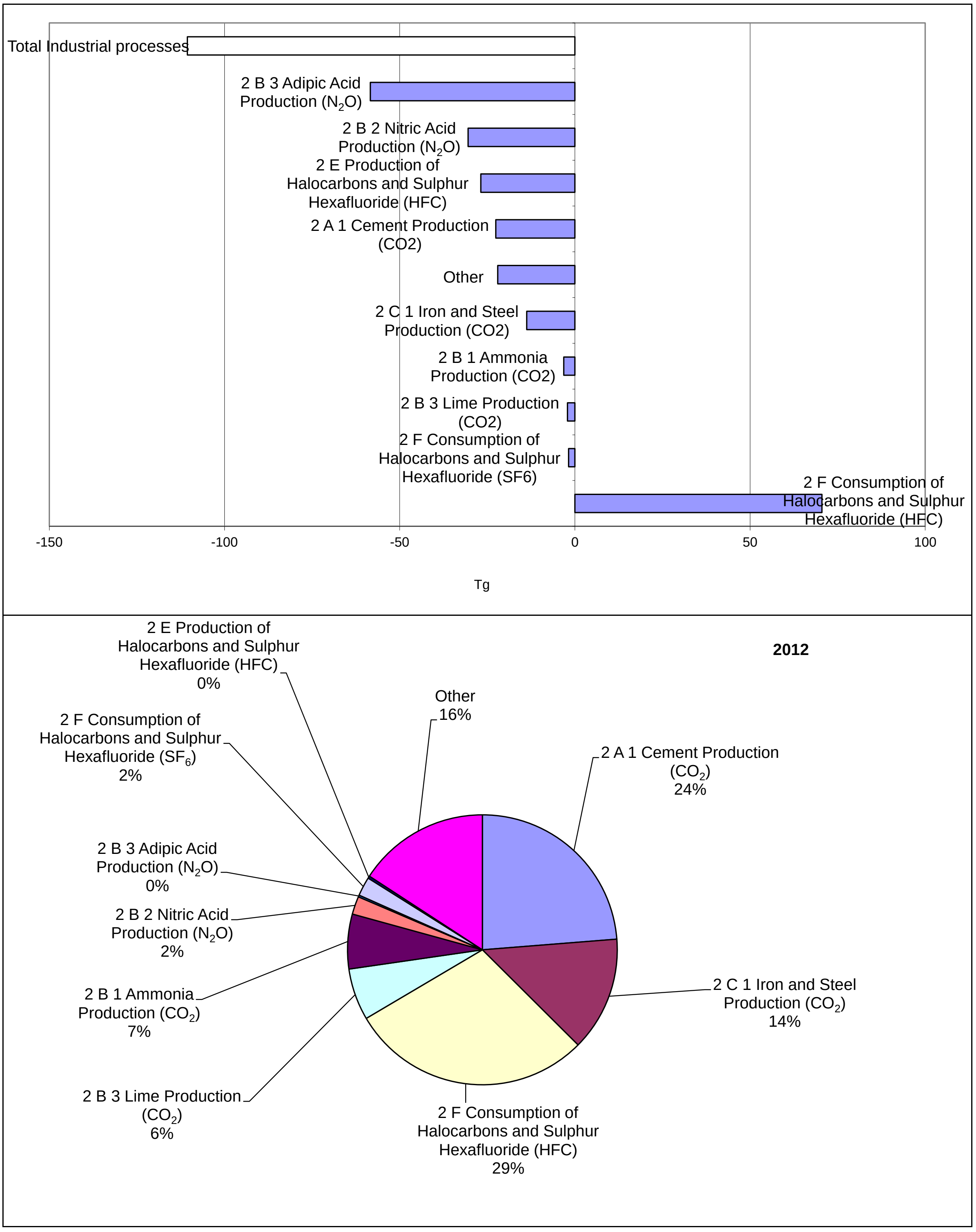


Figure 4.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in production of halocarbons and SF_6 (HFCs). Additional N_2O emission reductions were achieved in nitric acid production. Large HFC emission increases can be observed from consumption of halocarbons and SF_6 due to the replacement of ozone depleting substances (ODS) that are being phased out under the Montreal Protocol (main applications of halocarbons include refrigeration and air conditioning, foam blowing, fire protection, aerosols). Figure 4.2 shows that the three largest key sources account for about two thirds of total process-related GHG emissions in the EU-15 in 2012.

Figure 4.2 CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2012 in CO_2 equivalents (Tg) and share of largest key source categories in 2012



4.2 Source categories (EU-15)

4.2.1 Mineral products (CRF Source Category 2A) (EU-15)

The source category 2A Mineral Products includes three key categories: CO_2 from 2A1 Cement Production, CO_2 from 2A2 Lime Production and CO_2 from 2A3 Limestone and Dolomite Use. In source category 2A1 Cement Production by-product CO_2 emissions occur during the production of clinker, an intermediate component in the cement manufacturing process. Source category 2A2 Lime Production accounts for CO_2 emitted through the calcination of the calcium carbonate in limestone or dolomite for lime production. Source category 2A3 Limestone and Dolomite Use covers a number of industrial applications generating CO_2 through the heating of limestone or dolomite, such as in metallurgy (iron and steel), ceramics production, non-metallurgical magnesia production or environmental pollution control (flue gas desulphurization). Sugar refining, CO_2 emissions from glass production are reported under 2A5 Other.

Table 4.1 summarizes Member States' emissions from Mineral Products in 1990 and 2012. CO_2 emissions from Mineral Products have decreased by 6 % since 2011 and by 25 % since 1990. A large part of this drop has been since 2007, driven by the decrease in cement production due to the economic crisis. Only three Member States (Sweden, Ireland and the Netherlands), have higher CO_2 emissions in 2012 compared to their 1990 levels.

Table 4.1 2A Mineral Products: Member States total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)	CH4 emissions in 1990 Gg CO2 equiv.	CH4 emissions in 2012 Gg CO2 equiv.
Austria	3 274	2 946	3 274	2 946	NA	NA
Belgium	5 751	4 691	5 751	4 691	NA,NO	NA,NO
Denmark	1 069	972	1 069	972	IE,NA	IE,NA
Finland	1 269	1 165	1 269	1 165	NO	NO
France	16 525	11 668	16 525	11 668	NA	NA
Germany	22 615	18 942	22 615	18 942	NA	NA
Greece	6 802	3 741	6 802	3 741	NA,NO	NA,NO
Ireland	1 117	1 392	1 117	1 392	NO	NO
Italy	21 303	13 968	21 303	13 968	NA	NA
Luxembourg	623	435	623	435	NO	NO
Netherlands	1 172	1 189	1 172	1 189	NO	NO
Portugal	3 499	3 280	3 493	3 263	6	17
Spain	15 427	11 844	15 427	11 844	NA	NA
Sweden	1 722	2 146	1 722	2 146	NA	NA
United Kingdom	10 528	6 504	10 505	6 501	24	3
EU-15	**112 696**	**84 885**	**112 667**	**84 864**	**29**	**20**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.1 2A1-Cement Production

CO_2 emissions from Cement Production account for 2 % of total EU-15 GHG emissions in 2012. In 2012, CO_2 emissions from Cement Production were 28 % below 1990 levels in the EU-15 (Figure 4.3).

Figure 4.3 2A1 Cement Production: EU-15 CO_2 emissions

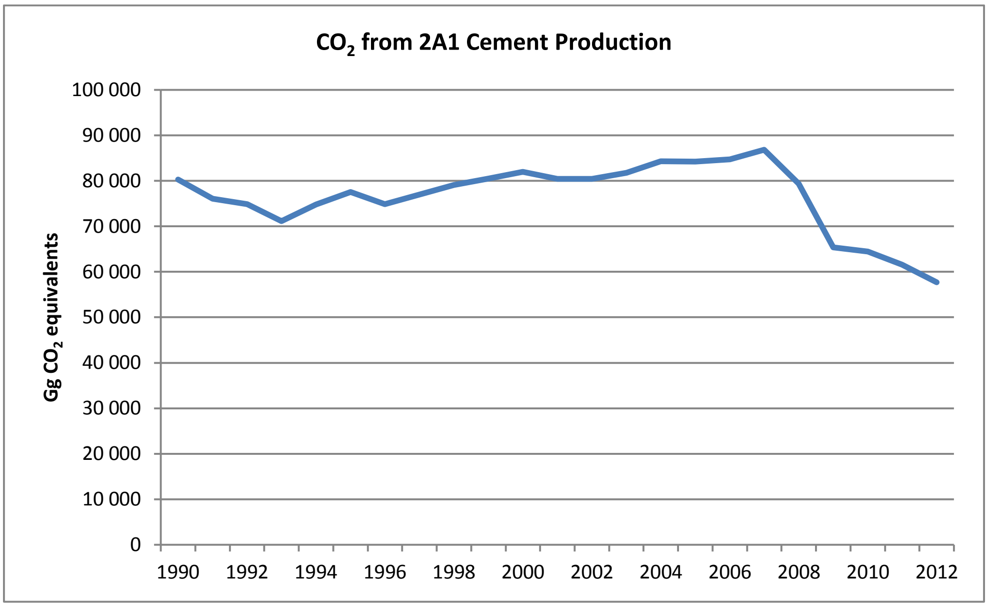


Table 4.2 provides information on emission trends of the key source CO_2 from 2A1 Cement Production by Member State. In 2012, Germany, Italy and Spain were the largest emitters accounting for 23 %, 17 % and 15 % respectively of EU-15 cement related emissions. Emissions from 2A1 Cement Production show a significant drop after 2007 in all Member States due to the economic crisis which decreased construction activities in all countries. In 2012 CO_2 emissions decreased by 6 % across the EU-15. Comparing to 2011, only Greece, Ireland and Sweden had significant increases in emissions from Cement Production. The decrease in emissions was due to a widespread fall in demand for cement, in Portugal for example, when comparing 2011 with 2012 clinker production data, there is a general decrease in 2012 volume. This decrease is due to a demand decrease in Portugal, Spain and North Africa market.

Table 4.2 2A1 Cement production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	2 033	1 666	1 673	3%	7	0%	-361	-18%	CS,T1	PS
Belgium	2 824	2 762	2 643	5%	-119	-4%	-181	-6%	T3	PS
Denmark	882	862	871	2%	9	1%	-11	-1%	CS	PS
Finland	734	564	500	1%	-64	-11%	-234	-32%	T2	CS
France	10 937	8 065	7 501	13%	-563	-7%	-3 436	-31%	T2, T3	PS
Germany	15 146	13 131	13 028	23%	-103	-1%	-2 118	-14%	CS	CS
Greece	5 762	2 430	3 099	5%	669	28%	-2 662	-46%	CS	PS
Ireland	884	966	1 177	2%	211	22%	293	33%	T2	PS
Italy	16 084	12 583	10 071	17%	-2 512	-20%	-6 013	-37%	T2	CS,PS
Luxembourg	570	411	375	1%	-36	-9%	-195	-34%	T2	CS,PS
Netherlands	416	351	308	1%	-43	-12%	-108	-26%	CS	PS
Portugal	3 176	2 813	2 550	4%	-263	-9%	-626	-20%	T3	OTH
Spain	12 279	9 523	8 754	15%	-768	-8%	-3 525	-29%	T2	CS
Sweden	1 272	1 359	1 477	3%	117	9%	205	16%	T2	PS
United Kingdom	7 295	4 096	3 716	6%	-380	-9%	-3 580	-49%	T2	CS
EU-15	**80 294**	**61 581**	**57 743**	**100%**	**-3 838**	**-6%**	**-22 552**	**-28%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.3 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement Production for 1990 and 2012. All EU-15 Cement Production emissions are estimated with higher Tier methods and most MS use plant-specific emission factors.

The implied emission factors per tonne of clinker produced range from 0.49 t CO_2/t of clinker produced for Luxembourg to 0.54 t CO_2/t of clinker produced for Belgium and Ireland. Except for Portugal, all MS use country-specific and plant-specific emission factors. Because the UK indicated that emission factors and activity data for the production of cement are commercially sensitive and therefore confidential an EU-15 implied emissions factor (IEF) was calculated based on the emissions and activity of the remaining EU-14. These accounted for 94% of EU-15 emissions in 2012 and have comparable types of activity data. The EU-15 IEF is 0.53 t CO_2/t of clinker produced.

In the period 1990 to 2012 only Denmark and Austria have noticeable decrease in the IEF. The IEF in the Netherlands shows some fluctuations after 2005 due to the use of an average EF for the earlier years and plant-specific parameters. There is no significant change in the IEFs for the other member states.

The EF in Denmark decreased primarily during 1990 and 1996 (-18 %) which is due to the ratio white/grey cement and the ratio rapid cement (GKL-clinker)/basis cement (FHK-clinker)/low alkali cement (SKL-RKL-clinker). The ratio white/grey cement is known from 1990-1997 with maximum in 1990 and thereafter decreasing.

Table 4.3 2A1 Cement Production: Information on methods applied and emission factors for CO_2 emissions

			1990				2012			
Member State	Method applied	Emission factor	Activity data		Implied emission factor	CO_2 emissions	Activity data		Implied emission factor	CO_2 emissions
			Description	(kt)	(t/t)	(Gg)	Description	(kt)	(t/t)	(Gg)
Austria	CS,T1	PS	Clinker production	3694	0.55	2033	Clinker production	3206	0.52	1673
Belgium	T3	PS	Clinker production	5292	0.53	2824	Clinker production	4869	0.54	2643
Denmark	CS	PS	Clinker production	1406	0.63	882	Clinker production	1629	0.53	871
Finland	T2	CS	Clinker production	1470	0.50	734	Clinker production	1000	0.50	500
France	T2, T3	PS	Clinker production	20854	0.52	10937	Clinker production	14178	0.53	7501
Germany	CS	CS	Clinker production	28577	0.53	15146	Clinker production	24581	0.53	13028
Greece	CS	PS	Clinker production	10645	0.54	5762	Clinker production	5856	0.53	3099
Ireland	T2	PS	Clinker production	1610	0.55	884	Clinker production	2189	0.54	1177
Italy	T2	CS,PS	Clinker production	29786	0.54	16084	Clinker production	19204	0.52	10071
Luxembourg	T2	CS,PS	Clinker production	1048	0.54	570	Clinker production	758	0.49	375
Netherlands	CS	PS	Clinker production	770	0.54	416	Clinker production	610	0.51	308
Portugal	T3	OTH	Clinker production	6128	0.52	3176	Clinker production	4882	0.52	2550
Spain	T2	CS	Clinker production	23212	0.53	12279	Clinker production	16719	0.52	8754
Sweden	T2	PS	Clinker production	2348	0.54	1272	Clinker production	2769	0.53	1477
UK	T2	CS	Clinker production	C	C	7295	Clinker production	C	C	3716
EU15			**EU15 w/o UK (91%)**	**136 839**	**0.53**	**72 999**	**EU15**	**109 496**	**0.53**	**57 743**

Note: UK activity data and IEF are confidential. In order to improve comparability the EU AD value for the year 2012 is provided on the basis of the weighted average EF of the other 14 MSs.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table.4.4 summarizes the methodological information provided by EU-15 Member States in their national inventory reports for cement production. A large number of Member States use data collected from plants under the EU emission trading scheme.

Table.4.4 2A1 Cement Production: Summary of methodological information provided by Member States

Cement Production	
Member State	**Methodology overview**
Austria	For the period from 1990 to 2004, emissions are estimated using a country specific method similar to the IPCC Tier 2 methodology. AD (clinker production) as well as emission data are taken from studies of the Austrian cement production industry covering the period from 1995 to 2004. Determination of emission data took place by inspection of every plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes. Based on raw meal data and plant specific production data, total emissions from this source were calculated. With this methodology, no cement kiln dust (CKD) correction factor has to be considered. However, in the Austrian plants cement kiln dust is returned back into the process. Activity data and emissions for 2004–2012 were determined in line with the requirements of the EU ETS. Verified CO2 emissions, covering the whole cement industry in Austria, were reported directly by the Association of the Austrian Cement Industry.[NIR 2014]
Belgium	Clinker production data is collected directly from individual plants following the Tier 2 method. The calculation of the CO2 process emissions follows the guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC. The emissions are verified each year by an external agency. Since 2002, these emissions have been estimated by using plant-specific emission factors. An average emission factor by plant was estimated in 2002 and is applied on the complete time-series 1990-2001. Since 2002, the emission factor has varied each year and has been calculated directly by the plant. Since 2004, plant data has included information on the CaO and MgO content of the clinker and non-carbonate sources of CaO and MgO. The decarbonisation of the dust re-injected in the furnace is also taking account. The calculation is performed by the operators themselves and subject to independent review in the framework of the Emission Trading Scheme. The same approach cannot be applied to the emission factors for the entire time series because of a lack of plant-specific data on the MgO and CaO content of the clinker and non-carbonate sources of CaO and MgO. That is the reason why an average emission factor by plant was estimated in 2002 and applied on the complete time-series 1990-2001. [NIR 2014]
Denmark	The CO2 emissions factors were estimated from the loss of ignition determined for the different kinds of clinkers produced, along with the volumes of grey and white cements produced. Determination of loss of ignition takes into account all the potential raw materials leading to release of CO2 and omits the Ca-sources leading to generation of CaO in cement clinker without CO2 release. From 2005 onwards CO2 emissions determined for EU-ETS are used in the inventory. The EF depends on the ratio: white/grey cement and the ratio between three types of clinker for grey cement: GKL-clinker/FHK-clinker/SKL-RKLclinker. The ratio white/grey cement is known from 1990-1997 with maximum in 1990 and thereafter decreasing. The ratio: GKL-clinker/FHKclinker/ SKL-RKL-clinker is known from 1990-1997. Production of SKL/RKL-clinker peaks in 1991 and decreases hereafter. FKH-clinker is introduced in 1992 and increase to 35 % in 1997. EU-ETS reports provide detailed information of alternative fuels used in the production of clinker. The EFs for limestone and magnesium carbonate are in accordance with the stoichiometric factors and the EFs for the remaining raw materials and CKD are determined by individual analysis. [NIR 2014]
Finland	Emissions are calculated using a Tier 2 methodology. The amount of clinker produced annually is used as AD. Data for the years 1990-2006 are received directly from companies and for years 2007-2012 from EU ETS data. EFs used in the calculation of emissions from cement production are plant-specific provided by the industry for the whole time series (except for plant 3 where the mean of the two other plant is applied) and are corrected for CaO and MgO contents. Cement kiln dust data was available from 2 of the 3 companies and missing data was imputed using means of the data available. The clinker production data is complete and no imputation was necessary. [NIR 2014]
France	France uses a Tier 2 method for the earlier years and Tier 3 method for more recent years. The methodology based on national statistics (clinker statistics) from cement association and national EFs from industry. Emissions prior to 2004 use a factor calculated on the period 2008 – 2009. Since 2004 detailed plant-specific data with plant-specific EF and emissions reported under the EU-ETS are used. Since 2008, annual data from three sources is used: calcination of carbonates in the raw materials used to produce the clinker; the partial calcination of cement kiln dust or bypass dust; the non-carbonate carbon in raw materials. [NIR 2014]
Germany	Activity data from BDZ were used until 1994. As of 1995, following improvement of data collection within the association, activity data were compiled by the VDZ, and by its cement-industry research institute, via surveys of German cement plants. The emission factor used is 0.53 t CO2 / t cement clinker, which is based on mass-weighted EFs for individual plants, i.e. the VDZ determined the emission factor by aggregating plant-specific data relative to fractions of CaO and other metal oxides (MgO; in raw materials, and containing carbonate) in clinker. A research project confirmed this EF (VdZ, 2009). Cement kiln dust is recycled into the kiln. [NIR 2014]
Greece	For the years 2005-2012 detailed data have been accessed via the verified EU ETS reports of the plants with data on the quantities of carbonate raw material (CaCO3, MgCO3) used for the production of clinker. In recent years (2008 – 2012) the plants report also emissions from non-carbonate carbon (organic carbon). Emissions from the non-calcined CKD not recycled to the kiln have already been included in the emissions from carbonates reported by the plants. Emissions prior to 2005 are calculated using the Tier 2 methodology, based on clinker production. Following the change of the methodology to Tier 3, and according to the IPCC GPG, the overlap method has been used in order to ensure the consistency of the time-series. [NIR 2014]

Cement Production	
Member State	**Methodology overview**
Ireland	Plant-specific information relating to CO_2 emissions in 2002 and 2003 was obtained by the EPA for all cement plants for the development of Ireland's First National Allocation Plan. This method is fully consistent with the Tier 2 method in the IPCC good practice guidance and its application employs reliable data on clinker production, corrected as appropriate for CKD, and CaO content of the clinker. The reported process CO_2 emissions for each plant in 2002 and 2003 were calculated using the Tier 2 method. As the EU ETS subsequently became operational, plant specific CO_2 emissions and corresponding clinker production data are also available for all cement plants for the years 2004 through 2012 and these data are used directly to report emissions for category 2.A.1. The plant-specific emission factors for process CO_2 emissions in 2012 ranged from 0.530 to 0.546 t CO_2/ t clinker with a weighted average of 0.538 t CO_2/ t clinker, which is very similar to the 2011 values. [NIR 2014]
Italy	CO_2 emissions from cement production are estimated by the IPCC Tier 2 approach. Activity data comprise data on clinker production provided by ISTAT (ISTAT, several years). Emission factors are estimated on the basis of information provided by the Italian Cement Association (AITEC, several years) and by cement facilities in the framework of the European pollutant emission register (EPER, now E-PRTR) and the European emissions trading scheme. For the years from 1990 up to 2003 the resulting emission factor for cement production was equal to 540 kg CO_2/t clinker, based on the average CaO content in the clinker and taking into account the contribute of carbonates and additives. In lack of specific data from the plants, this value was suggested to the operators by AITEC (AITEC, 2004) on the basis of a tool provided by the World Business Council for Sustainable Development. From 2004, emission factors are based on the data reported within the frame of the EPER/EPRTR and of the European Emissions Trading scheme. The EF resulted in 518 kg CO_2/t clinker in 2008, in 528 kg CO_2/t clinker in 2009 (EF value for this year has been checked and revised in the present submission) and in 523 kg CO_2/t in 2011 based on the average CaO content in the clinker and taking into account the contribute of carbonates and additives. The average emission factor varies year per year as a consequence of the different circumstances (e.g. quality of the raw materials and operating conditions) at the about 54 clinker facilities. [NIR 2014]
Luxembourg	In Luxembourg, one clinker production plant is operating. During the production of clinker, limestone, which is mainly calcium carbonate ($CaCO_3$), is calcined to produce lime (CaO) and CO_2 as a by-product. Activity data, i.e. clinker production, is obtained annually from the plant operator. For the estimation of CO_2 emissions, the Tier 2 method of 2000 IPCC-GPG using clinker production data is applied. According to the operator of the plant, there is no calcined Cement Kiln Dust (CKD) to be lost from the system. Hence, the CKD Correction Factor equals 1.00. According to 2007 ETS Tier 3 method, the emission factor is based on the CaO and MgO content of the clinker. It is assumed that all the CaO and MgO are from carbonate source (e.g. $CaCO_3$ and $MgCO_3$ in limestone). Plant-specific CaO and MgO contents are available (chemical analysis done by the plant operator). [NIR 2014]
Netherlands	The CO_2 process emissions from this source category are from 2002 based on (measured) data reported by the single company in the Netherlands that produces clinkers. The methodology for measurements and for calculating emissions can be described as follows: The first carbonate input in the kiln is the raw material. The CO_2 emission is calculated on a monthly basis by multiplying the amount of raw material by a derived process EF. From every batch in a month a sample is taken just before the raw material is fed into the kiln. The process EFs and composition data for batches of raw material are determined in a laboratory. The EF is determined by measuring the weight loss of the sample (excluding the amount of organic carbon). The monthly EF is set as the average of all sample EFs determined that month. The second carbonate input in the kiln is sewage sludge. The CO_2 emission from this source is also calculated monthly by multiplying the amount of sewage sludge by the monthly derived process EF. Besides the CO_2 emissions resulting from calcination of the carbonate input in the kiln, the company considers the CO_2 emission from burning off the small amount of organic carbon in the raw material as a process emission. As a result, the total yearly process emissions of the company are the sum of all monthly emissions of the following sources: A. CO_2 from the calcination of the carbonate input of the raw material; B. CO_2 from the calcination of the carbonate input of sewage sludge; C. CO_2 from the burning of organic carbon in the raw material. [NIR 2014]
Portugal	EU-ETS method A from Annex VII of Decision 2007/589/EC is used from 2005 onwards. Calculation is based on the carbonate content of process inputs (including fly-ash or blast furnace slag) with cement kiln dust (CKD) and bypass dust deducted from raw material consumption (Tier 3). It is assumed a complete calcination (conversion factor = 1). For the period 1990-2004 emmissons are back cast based on clinker production data and on these plant specific IEF for the period 2005-2009. Plant specific IEFs (ton CO_2/ton clinker) are based on CO_2 reported under ETS and plant specific clinker production data from 2005 onwards. Clinker production since 2005 was received directly from each industrial plant. [NIR 2014]
Spain	The estimation of CO_2 emissions for this activity has been performed by using the Tier 2 method and by applying an emission factor per quantity of clinker produced. Clinker production data and the applied EF are obtained from associations of cement production (OFICEMEN). The EF was derived from data on ton of clinker produced for the period 2005-2009 as provided by OFICEMEN. The original source of the EFs are the data provided by the cement plants under the EU ETS. For the years prior to the start of the EU ETS, the average EF for 2005 was used. [NIR 2014]

Cement Production	
Member State	**Methodology overview**
Sweden	Cement production occurs at three facilities in Sweden (owned by one company), with one being dominant. Emissions have been estimated based on ETS data as well as direct information from the company based on clinker production. In line with the Good Practice Guidance Tier 2 methodology, plant-specific CO2 emission estimations in Sweden are based on clinker production and include emissions from by-pass dust and cement kiln dust (CKD) as well as emissions from organic carbon of raw meal. For 1990-2004, information from the company on CO2 emissions is based on clinker production and default EF from GHG protocol, CKD correction factor and organic carbon in raw meal. From 2005, the company reports plant-specific data on CO2 emissions to the EU ETS. The CO2 emissions are based on production of clinker and CaO content of clinker, but also include CO2 contained in released non-recycled dust (CKD and by-pass) as prescribed by the national guidelines for reporting to the EU ETS 92. Emissions of CO2 from organic carbon of raw meal are also included in the CO2 emissions reported in the EU ETS. [NIR 2014]
United Kingdom	The methodology used for estimating CO2 emissions from calcination is to use data provided by the Mineral Product Association (2011), which in turn is based on data generated by UK cement clinker producers for the purposes of reporting to the EU Emission Trading Scheme. The data are available for 2005 to 2012 only, and so the value for 2005 has been applied to earlier years as well. [NIR 2014]

Source: NIR 2014.

According to the analysis presented in Table.4.4 all MS estimate emissions with higher tier methods. Table 4.5 summarizes the recommendations from the 2013 UNFCCC inventory reviews in relation to the category 2A1 Cement Production. The overview shows that reports from the centralized and in-country reviews conducted in 2013 are not yet available a number of Member States.

Table 4.5 2A1 Cement Production: Findings of the 2013 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2014 inventory submissions

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/AUT).	No follow-up necessary.
Belgium	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/BEL). 2013 ARR not yet available.	No follow-up necessary.
Denmark	The ERT strongly recommends that Denmark implement the recommendation in the previous review report regarding the provision of information on imports and exports of cement for the years 1990–1997, in the next annual submission (FCCC/ARR/2012/DNK). 2013 ARR not yet available. The ERT recommends that Denmark provide relevant information on using the 'loss on ignition' method (accounting for the loss of CKD during calcination), which is in accordance with the EU ETS guidelines and the UNFCCC reporting guidelines, in its next annual submission (FCCC/ARR/2012/DNK). 2013 ARR not yet available.	The NIR provides data on imports and exports of cement for the years 1990–1997 and information on using the 'loss on ignition' method (accounting for the loss of CKD during calcination), (NIR 2014: Section 4.2.2).
Finland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
	(FCCC/ARR/2013/FIN).	
France	ERT recommends that France: (a) Report the number of plants applying a tier 2 or tier 3 method, with the corresponding AD and EFs used; (b) Increase transparency by reporting EFs and AD disaggregated by cement type (alumina and Portland); (c) Increase transparency by reporting on the share of non-carbonate carbon and cement kiln dust in the IEF (FCCC/ARR/2012/FRA). 2013 ARR not yet available.	France specifies the number of plants using a tier 2 or tier 3 method, with AD and EFs disaggregated by cement type (alumina and production de ciment classique) and reports on the share of non-carbonate carbon and cement kiln dust in the IEF.
Germany	The ERT noted that the CO_2 emissions from cement production reported in the NIR are higher than those reported in the EU ETS reports. The range of difference is from 1.2 per cent in 2005 to 7.3 per cent in 2011. The ERT commends Germany for providing this information and encourages the Party to include CO_2 emissions at the national level from the EU ETS report in the NIR for verification purposes, and to explain the significant difference. (FCCC/ARR/2013/DEU).	Not yet addressed.
Greece	In relation to non-carbonate carbon, ERT recommends that Greece complete its data collection for the whole time series and reflect the results in the inventory reporting in its next annual submission. (FCCC/ARR/2013/GRC)	In 2014 submission, there is a recalculation of emissions for the years prior to 2008, using the overlap methodology in order for emissions from non-carbonate carbon sources (TOC) to be taken into account for the whole time series.
Ireland	The ERT reiterates the recommendation that Ireland include information on the CaO and MgO content of the clinker in its next annual submission, in accordance with the IPCC good practice guidance submission (FCCC/ARR/2012/IRL). 2013 ARR not yet available.	Information on CaO and MgO content of clinker is provided to the inventory agency by the plant operators for all years from 2008 to 2012 but is not published in the inventory report as producers deem it confidential. Data available to ERT on request.
Italy	The ERT recommends that Italy in its next submission provide more information on the underlying drivers for the change in IEFs since 2003 and on how time-series consistency has been maintained. As an example, it could be clarified whether the lower IEFs are due to a change in the composition of the raw material, changes in the process or changes in estimation methods. The ERT also recommends that	Additional information about CO_2 IEF fluctuations has been provided in the NIR in §4.2.2. Fluctuation of the IEF is largely due the use of decarbonised material in amounts varying over time.

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
	Italy provide more information about the method used to determine process emissions from cement production under the EU ETS and indicate whether this method is based on kiln input or clinker output. (FCCC/ARR/2013/ITA)	
Luxembourg	According to CRF table 2(I).A–G, a country-specific EF of 0.5338 t CO_2/t clinker produced was used for 2011. This value is not consistent with the EF provided in table 4-5 of the NIR (where an EF of 0.5319 t CO_2/t clinker produced was reported for 2011). The ERT recommends that the Party ensure the consistency of the figures reported. (FCCC/ARR/2013/LUX).	In 2012 the raw material composition was changed so that it can no longer be assumed that all the CaO and MgO in the clinker are from carbonate source (e.g. CaCO3 and MgCO3 in limestone). To take into account the amount of (non-carbonate) CaO and MgO in the raw material and according to 2007 ETS method, the conversion factor is based on measurements twice a month of total carbon, organic carbon, CaO and MgO content in the raw material.
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/NLD)	No follow-up necessary.
Portugal	The ERT reiterates recommendation to provide more detailed information on the methodologies used to estimate emissions for the period 1990–2004, in order to improve the transparency of the reporting, and further describe how time-series consistency is ensured, in its next annual submission. The ERT encourages Portugal to provide information on the results of the QC comparison of plant specific and National Statistical Database data sources in its next annual submission (FCCC/ARR/2012/PRT). 2013 ARR not yet available.	For the period 1990-2004 we made a back cast based on clinker production data and on the plant specific IEF for 2005 to 2009. Portugal includes a comparison of plant specific and National Statistical Database data with generally consistent agreement.
Spain	The ERT recommends improving the transparency by including information on CaO and MgO content and CKD factor for the whole time series. In case the required information is not available in time for the next annual submission, the ERT recommends that the Party provide a qualitative assessment of the range of IEFs and their trend, on the basis of the composition of the raw material used in the country (FCCC/ARR/2012/ESP). 2013 ARR	Not yet addressed.

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
	not yet available.	
Sweden	The ERT recommends that Sweden include information on the composition of the raw material and on the bypass and cement kiln dust in the NIR of its next annual submission, especially for the years after which the EU ETS data were introduced, to increase transparency, and to ensure the QC of the facility data currently obtained from company environmental reports, EU ETS data and direct contacts with the facilities. (FCCC/ARR/2013/SWE)	Cement production occurs at three facilities in Sweden, owned by one company. From 2005, the company reports plant-specific data on CO_2 emissions to the EU ETS. The CO_2 emissions are based on produced clinker and its CaO and MgO content, but also include CO_2 contained in released non-recycled dust (CKD and by-pass). Also CO_2 emissions from organic carbon of raw meal are included in the CO_2 emissions reported in the EU ETS. The NIR includes a table with data on clinker production and total CO_2 emissions from clinker production. For the years prior to 2005 the table shows the calculated emissions from CKD and the resulting CKD correction factor as well as CO_2 emissions from organic carbon content of raw meal. The table differs from official reported data in that imported clinker is included in the reported data for emission year 2011. The number will be corrected in next year's submission.
UK	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/GBR). 2013 ARR not yet available.	No follow-up necessary.

Source: NIR 2014, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php

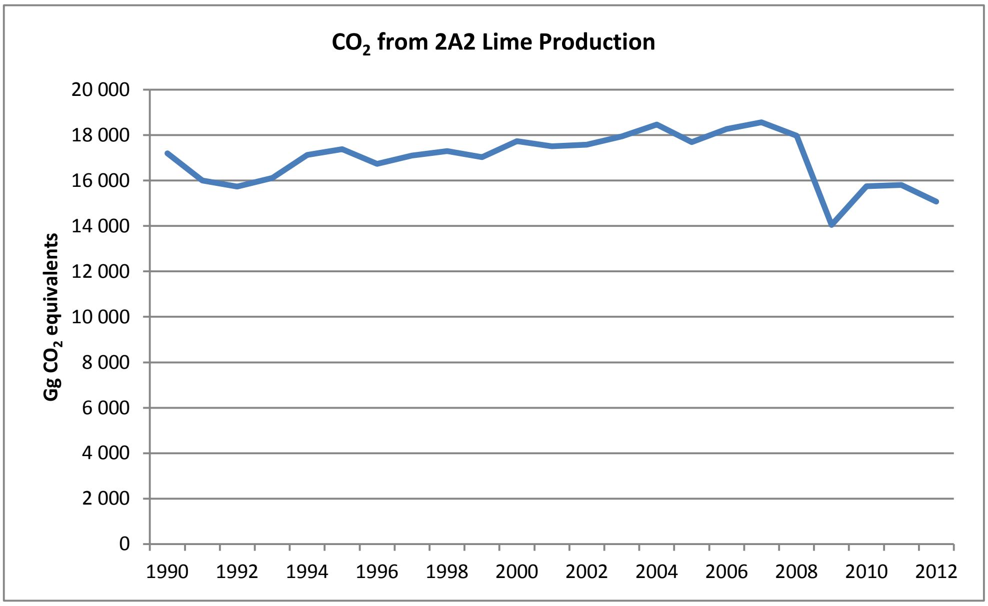
4.2.1.2 2A2 Lime Production

CO_2 emissions from 2A2 Lime Production account for 0.4 % of total GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from this source decreased by 12 % in the EU-15. Germany, France and Italy are the largest emitters with Germany contributing 31 % and both France and Italy 14 % of EU-15.

For the EU-15, compared to 2011, emissions decreased by 5 % The decrease of CO_2 emissions in the early nineties was dominated by emission reductions in Germany, Belgium, France and the UK due to a decreased production of lime and dolomite.

For the period 1993 to 1994 Lime Production related emissions in the EU-15 increased by 6 %. This increase was caused by a raised production rate of lime in Germany and France in that period (Figure 4.4). In 2009, lime production decreased sharply due to the economic crisis in all MS, many MS also showed decreasing lime production in 2007 and 2008. In 2012 lime production decreased again by 5 % compared to the previous year.

Figure 4.4 2A2 Lime Production: EU-15 CO_2 emissions



Germany was responsible for 31 % of the emissions from this source in 2012. The decrease of emissions in the early nineties was dominated by the drop in German lime production due to the sector's restructuring following German reunification, as well as of economic factors and development of competing and substitute products. In 2012, 7 Member States have reduced their emissions since 1990 and 6 Member States have increased emissions from this source category.

Table 4.6 2A2 Lime Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	396	605	569	4%	-36	-6%	173	44%	CS	CS,PS
Belgium	2 097	1 741	1 612	11%	-130	-7%	-485	-23%	T3	PS
Denmark	116	30	40	0.3%	10	35%	-75	-65%	CS	D
Finland	383	438	403	3%	-35	-8%	20	5%	T2	CS
France	2 588	2 111	2 161	14%	51	2%	-426	-16%	T2, T3	PS
Germany	5 868	4 927	4 620	31%	-306	-6%	-1 248	-21%	CS	D
Greece	404	193	209	1%	16	8%	-195	-48%	CS	PS
Ireland	214	199	214	1%	15	8%	0.3	0.1%	T2	PS
Italy	2 042	2 092	2 038	14%	-54	-3%	-4	-0.2%	T2	CS,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	IE	IE	IE	-	-	-	-	-	NA	NA
Portugal	197	334	318	2%	-16	-5%	120	61%	T3	OTH
Spain	1 146	1 468	1 239	8%	-229	-16%	93	8%	D	D, PS
Sweden	295	513	474	3%	-40	-8%	179	61%	D	D
United Kingdom	1 462	1 156	1 178	8%	22	2%	-285	-19%	T2	D
EU-15	**17 207**	**15 806**	**15 075**	**100%**	**-731**	**-5%**	**-2 133**	**-12%**		

Emissions of the Netherlands are included in 2D2 Food industries.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.6 shows information on methods applied and emission factors for CO_2 emissions from 2A2 Lime Production for 1990 to 2012. The table shows that all EU-15 MS that report emissions from lime production use lime production as activity data for calculating CO_2 emissions, except for the UK which uses limestone consumption. Because the UK activity data is inconsistent with that of the other MS an

EU-15 IEF was calculated based on the emissions and activity of the remaining EU-14. Thes account for 92 %of EU-15 emissions in 2012 have comparable types of activity data. The EU-15 IEF (excluding the UK) in 2012 is 0.73 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced range from 0.64 for Denmark to 0.79 for Finland. Approximately 96 % of EU-15 emissions are estimated using higher tier methodologies (country-specific, Tier 2 and Tier 3).

The IEFs from 1990 to 2012 in the inventories submission 2013 are reasonably stable over time. The IEF increased considerably in 2012 compared to the previous year in France, Denmark, and Spain. The IEF for Denmark has the largest decrease between 1990 and 2012 (-13.25 %). The largest fluctuations are for the Danish IEF between 2010 and 2011. Explanations for the development of the recent changes in implied emission factors are given in the following overview:

Implied Emission Factor Lime production, Denmark

Across the EU-15, the largest fluctuations are for the Danish IEF between 2010 and 2011. The ratio of CaO and MgO content varies over time, as does the production volume from different companies, and hence the IEF for lime production will vary.

Implied Emission Factor Lime production, Italy

The consistent trend of IEF was interrupted in 2004, when the IEF decreased by 11 % between 2004 and 2005. This break is caused by the use of data based on times series supplied in the framework of the EU ETS. An average emission factor that was supplied for the years 2000 to 2004 was also used for previous years. Data from the ETS submission for the first allocation plan was used for the years 2005 onwards.

Implied Emission Factor Lime production, Greece

The fluctuations in the IEF can be attributed to the fact that activity data reported are calculated using ElStat data for hydrated, non-hydrated and hydraulic lime, as described in the IPCC GPG, although the emissions are calculated according to the verified ETS reports, as provided by the plants. These fluctuations can also be attributed to the carbonates content of the raw material. Especially for 2010 and 2011 the CaCO3 content of the raw material was 94.62% and 94.09%, while for 2012 the calcium carbonate content was 93.73 %.

Implied Emission Factor Lime production, France

Small fluctuations of the IEF arise from the contribution of different lime types with different carbonate contents of the raw materials that lead to some fluctuations in the implied emission factors, in particular the EF for hydraulic lime can vary between 335 et 568 kg/t which impacts the IEF.

Implied Emission Factor Lime production, Spain

The implied emission factor for aggregated lime production was 0.69 t CO_2/t lime in 2009, which is very similar to those for subsequent years for which ETS data is available.

Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. Draft 2006 IPCC Guidelines define three tiers, an output-based approach that uses default values (Tier 1), an output-based approach that estimates emissions from CaO and CaO·MgO production and country-specific information for correction factors (Tier 2) and an input-based carbonate approach (Tier 3), the latter requiring plant-specific data. Lime production is covered under the EU emissions trading scheme and monitoring guidelines under the EU ETS (Commission Decision of 29/01/2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council) allow methods equivalent to either Tier 2 or Tier 3 above. The use of plant-specific data reported and verified under the EU ETS by Member States therefore can be considered as equivalent to Tier 2 or Tier 3 as defined in draft 2006 IPCC Guidelines.

Table 4.7 2A2 Lime Production: Information on methods applied, activity data, emission factors for CO_2 emissions

			1990				2012			
Member State	Method applied	Emission factor	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
			Description	(kt)			Description	(kt)		
Austria	CS	CS,PS	Lime Production	513	0.77	396	Lime Production	761	0.75	569
Belgium	T3	PS	Lime production	2661	0.79	2097	Lime production	2090	0.77	1612
Denmark	CS	D	Lime production	156	0.74	116	Lime production	62	0.64	40
Finland	T2	CS	Lime Production	488	0.78	383	Lime Production	513	0.79	403
France	T2, T3	PS	Lime Production	3589	0.72	2588	Lime Production	3289	0.66	2161
Germany	CS	D	Lime Production	7772	0.76	5868	Lime Production	6155	0.75	4620
Greece	CS	PS	Lime Production	491	0.82	404	Lime Production	273	0.76	209
Ireland	T2	PS	Lime Production	255	0.84	214	Lime Production	281	0.76	214
Italy	T2	CS,PS	Lime Production	2583	0.79	2042	Lime Production	2906	0.70	2038
Portugal	T3	OTH	Lime Production	276	0.72	197	Lime Production	455	0.70	318
Spain	D	D, PS	Lime Production	1601	0.72	1146	Lime Production	1729	0.72	1239
Sweden	D	D	Lime Production	389	0.76	295	Lime Production	633	0.75	474
UK	T2	D	Limestone consumption	3283	0.45	1462	Limestone consumption	2644	0.45	1178
EU15			**EU15 w/o UK (93%)**	**20 774**	**0.76**	**15 745**	**EU15**	**20 769**	**0.73**	**15 075**

Note: UK activity data and IEF are based on Limestone consumption. In order to improve comparability the EU AD value for the year 2012 is provided on the basis of the weighted average EF of the other 14 MSs.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.8 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category.

Table 4.8 2A2 Lime Production: Summary of methodological information provided by Member States

Lime Production	
Member State	**Methodology comment**
Austria	Emissions were estimated using a country specific method based on detailed production data. Activity data and emission values were reported by the Association of the Stone & Ceramic Industry. For 2005-2012 verified CO_2 emissions reported under the ETS were used for the inventory. The reported CO_2 emission data is based on detailed data of each of the seven lime production plants in Austria, including production volumes and the respective CaO and MgO contents of lime produced in the respective plant. For the years from 2005 onwards detailed, verified data from the ETS is available: some plants calculate emissions based on data of the raw material, most calculate emissions from data of produced lime; thus the activity data reported under the ETS for some plants is production volumes, for others the amount of used raw materials. For the calculation of an overall IEF the overall value of Austrian lime production as reported by the Association of the Stone & Ceramic Industry is used. The IEF depends on the quality (CaCO3/MgCO3 content) of the used limestone which ranges from 0.73 to 0.77 tonnes CO_2 per tonne lime produced - corresponding to the default range for purity of high calcium lime from 93-98%. [NIR 2014]
Belgium	From 1990 to 2002, the emissions of lime production were estimated by using default emission factors (790 kg CO_2/T lime and 910 kg CO_2/T dolomite lime) in three different plants and a plant-specific emission factor (754 kg CO_2/T lime) in the three others plants. This plant-specific emission factor was coming from analyses performed in 2002. Since 2003, all the emission factors are plant-specific (except for the dolomite lime in 2003 and 2004). The activity data are the lime and dolomite lime production and are collected directly from individual plants. The variations of the

Lime Production	
Member State	**Methodology comment**
	global emission factors are mainly due to the different proportions of lime and dolomite lime production over the years. A part of the lime production is coming from the kraft pulping process: the CO_2 liberated during the conversion of calcium carbonate to calcium oxide in the lime kiln in the kraft pulping process contains carbon which originates in wood. This CO_2 is not included in the net emissions, the low IEF lime (750-760 kg CO_2/t) for the lime production coming from the kraft pulping process is included in the lime production. [NIR 2014]
Denmark	The CO_2 emissions from the production of burnt lime (quicklime) as well as hydrated lime (slaked lime) has been estimated from the annual production figures, registered by Statistics Denmark, and emission factors. The EFs applied are 0.785 kg CO_2/kg CaO as recommended by IPCC (IPCC (1996), vol. 3, p. 2.8) and 0.541 kg CO_2/kg hydrated lime (calculated from company information on composition of hydrated lime). One Danish company – Faxe Kalk – is covered by the EUETS, however, the company only accounts for approximately 75 % of the Danish production of lime and hydrated lime (average from 1999-2008). A number of small companies accounts for the remaining of the Danish production. [NIR 2014]
Finland	Emissions were calculated using a Tier 2 methodology. Emissions from lime production are calculated by multiplying emission factors with lime output. Activity data are collected mainly directly from the industry but industrial statistics have also been used for earlier years. Emissions from 2005 onwards have been calculated using production data reported to the EU ETS data. The total amount of produced lime has also been checked from industrial statistics. The calculation method was slightly updated for the latest submission due to new information of activity data in EU ETS, as only pure lime (=CaO+MgO amounts) are used as activity data (impurities have been written off the amount of lime). For all other years (1990-2004) production amounts were recalculated using the assumption (Emissions permit, 2010) that about 6 per cent of the product is impurities. There are two emission factors used in Finland to calculate emissions of lime production. There is an emission factor for all five plants of a company and it is based on the actual CaO and MgO contents of lime derived from measurements of those five plants in Finland. It is a calculated mean value from emission and production data for the years 1998-2002. This emission factor has been used for the whole time series for those five plants. After the exclusion of impurities of produced lime, the mean value was also recalculated and used to calculate emissions of those five plants for the whole time series. Emissions of another company, plant was founded in 2003, are calculated using emission factors which are based on the yearly average of actual CaO and MgO contents in lime (GHG emissions permit, 2011). [NIR 2014]
France	Higher tier methodology considering three types of lime. AD from industrial associations are used until 2005 (plant-specific data were available for a subset of plants), since 2004 plant-specific AD for all installations are available. Stoichiometric EF for lime, and CS EF for hydraulic lime used based on national data. Average EFs for the three lime types are used until 1995 which were gradually replaced by plant-specific EF. To take into account impurities corrections have been undertaken to be in accordance with the methodology applied in the EU ETS. Lime production in sugar industry is estimates and a specific EF was derived [NIR 2014]
Germany	Country-specific EFs have been replaced default- EF based on stoichiometric relationships in the 2012 submission (EF lime 0.746 CO_2/t lime and EF dolomitic lime 0.867 t CO_2/t dolomitic lime). The approach conforms to the specifications in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000). The German Lime Association (BV Kalk) collects the

Lime Production	
Member State	**Methodology comment**
	production data for the entire time series, on a plant-specific basis, and makes them available for reporting purposes. The quantities produced by plants that are not included in the German Lime Association's association statistics are estimated on the basis of existing information (such as operator figures, data published in the framework of emissions trading) and then added to the German Lime Association's figures. This ensures that all of German lime production is taken into account. [NIR 2014]
Greece	For years 2005 - 2012, the calculation of carbon dioxide emissions from lime production is based on the collection of plant-specific data on the type (s) and quantity(ies) of carbonate(s) consumed to produce lime, as well as the respective emission factor(s) of the carbonates consumed. The principal carbonates detected in the Greek lime industry were CaCO3 and MgCO3. The activity data resulted in 447.90 kt of CaCO3 eq for the production of lime in 2012. The emission factor for CaCO3 is 0.44 and for MgCO3 0.522. As regards to the emissions from the non-calcined carbonate remaining in LKD, they have already been included in the emissions from carbonates reported by the plants, therefore an assumption of Fd=1 has been used to avoid double counting. The lime production of Greece refers to high-calcium and hydraulic lime. Both values are provided by the NSSG for the years 1993-2012, whereas for the years 1990-1993 the missing data have been calculated using the trend extrapolation method as described in the IPCC GPG. Hydraulic lime data for 2008 - 2012 are provided directly by the sole plant producing it in Greece. Lime production in the national statistics is reported as non-hydrated lime, hydrated lime and hydraulic lime. The hydrated lime production data are converted to non-hydrated lime using the correction for the proportion of hydrated lime as described in the IPCC GPG, using a water content of 28%. [NIR 2014]
Ireland	Statistical data on lime production in Ireland are obtained annually from the lime manufacturers. Lime producers provided their own estimates of CO_2 emissions from lime manufacture for the development of NAP1. These were calculated in accordance with the methods providing detailed information on emission estimates and activity data. The CO_2 estimates for lime production in 2012 have been obtained from the ETS returns to the Climate Change Unit of the EPA. The implied emission factor for aggregated lime production was 0.763 t CO_2/t lime in 2012, which is very similar to that for the other years for which ETS data are available. Data provided by the lime producers form the basis for emissions over the period 1990-2004. The implied emission factors for the 1990-2004 time-series indicated by the information supplied by the lime producers are in the range 0.753 to 0.877 t CO_2/t lime produced with an average of 0.82 t CO_2/t lime. EU ETS data for the years 2005 to 2012 are used to confirm the estimates for the years 1990-2004. [NIR 2014]
Italy	CO_2 emissions from lime have been estimated on the basis of production activity data supplied by ISTAT (ISTAT, several years) and by operators in the frame of the ETS reporting obligations adding the amount of lime produced and used in the sugar and iron and steel production sectors; emission factors have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association (CAGEMA, 2005). Since 2009, information available in the frame of the ETS reporting obligation has made activity data (including fuels and raw materials such as carbonates and additives, in compliance with a “lime kiln input” approach) available for the Italian lime industry at facility level together with CO_2 emissions data (combustion and process emissions). [NIR 2014]
Luxembourg	Not occurring. [NIR 2014]

Lime Production	
Member State	**Methodology comment**
Netherlands	Lime production is known to only occur in the sugar industry and is reported under category 2D2 Food and drink. [NIR 2014]
Portugal	EU-ETS method A from Annex VIII of Decision 2007/589/EC is used from 2005 onwards. Calculation is based on the amount of calcium carbonate and magnesium carbonate in the raw materials consumed (Tier 3). For the period 1990-2004, emissions were estimated based on lime production time series. From 2005 onwards, data on consumption of raw materials was obtained from EU-ETS. Lime production for the period 1990-2012, was obtained from National Statistics (INE) IAPI industrial survey. Lime production in the iron and steel industry was available from information received from the industry for the period 1991-1994. For the remaining years 1990 and 1995-2001 annual lime production, which data was unavailable, was forecasted using energy consumption as surrogate indicator. After year 2002 production of lime in this unit was interrupted and the production line dismantled. All lime produced in the iron and steel plant was high calcium lime. In the paper pulp industry the IAIT/IAPI surveys have no available information in lime production but only of limestone and dolomite consumption. Lime production had to be estimated from consumption of those carbon bearing materials and assuming the stoichiometric ratios of limestone and dolomite rock. Consumption of limestone and dolomite materials is available for the period 1989-2000 from National Statistics; for the period 1989-1991 from IAIT industrial survey, and from 1992 onwards from the IAPI industrial survey. [NIR 2014]
Spain	Higher tier methodology considering different types of lime. AD are obtained from lime producer association ANCADE. AD from non-commercial lime production was gathered by individual questionnaires from plants for lime production in steel industry, sugar production and production of calcium carbonates. Emissions from lime production in integrated steel plants are included in this category for the years 1990-1992. Emission factors are derived from IPCC guidelines depending on the quantities of the final product and the degree of purity. The purity degrees are derived from plant-specific data for each year and if such data was not available for individual plants, it was derived from adjacent years for which such information was available and in few cases from default parameters provided by WBSCD/WRI "The GHG Protocol: a corporate accounting and reporting standard." For dolomite in sinter emissions were estimates based on plant-specific information on CO_2 content in primary matter was used and for lime production in other industries the default EF from 1996 IPCC Guidelines. Separate EFs have been derived for the non-commercial lime production. [NIR 2014]
Sweden	The emissions of CO_2 from the production of lime are based on activity data on produced amounts of quicklime and hydraulic lime and dolomitic lime. As CO_2 emissions also depend on the production process, the methods for collecting activity data and estimating CO_2 emissions are described by data source. Activity data on used amounts of limestone for production of lime for sugar production are obtained directly from the sugar producing company. In earlier submissions the whole amount of lime produced and used within the sugar industry was reported as activity data without taking into account that a large amount of the produced lime is precipitated as CaCO3 in the carbonation process. Since submission 2010, only the part of CaO which is not recovered as CaCO3 is reported as activity data. Since the 2011 submission, detailed data on the quantities of lime used as make-up lime in the pulp and paper industry, and quantities of limestone and dolomite used for production of make-up lime, have been obtained from the Swedish Lime Association and The Swedish Lime Industry from 1995. Based on 2006 IPCC Guidelines, the purity of the

Lime Production	
Member State	**Methodology comment**
	limestone is set to 95% for the production of lime within the pulp and paper industry. The corresponding figure for dolomite is 100%. For all other production of quicklime, hydraulic lime and dolomite (mainly used in iron and steel production), detailed data from 1990 are obtained from the Swedish Lime Association. To avoid double counting of emissions, activity data for produced quicklime, hydraulic lime and dolomite lime in the sugar industry and the pulp and paper industry has been deducted. Based on 2006 IPCC Guidelines, the purity of the limestone is set to 95% for the production of lime in conventional lime mills. The corresponding figure for dolomite is 100%. The produced amounts of quick lime and dolomitic lime in conventional lime mills was very low in 2009 which led to a reduced amount of emitted CO_2 in 2009 compared to previous years. [NIR 2014]
United Kingdom	The UK method uses EU ETS data to determine emissions from 2005 onwards, Pollution Inventory (PI) data from 1994 to 2004 and British Geological Survey (BGS) data from 1990 to 1993. The EU ETS data consist of CO_2 emission estimates and activity data. The activity data takes various forms e.g. feedstock or product, depending upon site, and so the emissions data have been adopted, with the lime activity data then being back-calculated using a default emission factor of 121.5 t carbon/ kt limestone or dolomite. This emission factor is derived by assuming that 85% of UK lime production is from limestone and the remaining 15% is from dolomite (based on a recommendation from the EU's UNFCCC review). For limestone, an emission factor of 120 t carbon/kt limestone is then assumed, based on the stoichiometry of the chemical reaction, and for dolomite, the corresponding emission factor of 130 t carbon/kt dolomite is used. Prior to 2005 there are no EU ETS data, and data are also missing for 2005-2006 for some lime kilns because of UK exemptions from the EU ETS for some sites in those years. Therefore, between 1994 and 2004, CO_2 emission estimates for lime production are based on emissions data published for each site in the Pollution Inventory (PI). The PI data are mostly for total CO_2 i.e. include emissions from both decarbonisation and fuel combustion on a site, but estimates of the CO_2 from decarbonisation only are made using EU ETS data and PI data for 2006-2008, both of which give fuel combustion emissions separately from decarbonisation. For the period 1994-1997, there is less reporting of CO_2 in the PI and so site-specific CO_2 emissions are estimated based on other site-specific data such as emissions data for particulate matter from those sites in the relevant years. We have no PI data for the period 1990-1993 so BGS activity data are the only data available to calculate emissions. [NIR 2014]

Source: NIR 2014.

Table 4.9 summarizes the recommendations from the 2013 UNFCCC inventory reviews in relation to the category 2A2 Lime Production as well as the status of the review finding in the 2013 inventory submission.

Table 4.9 2A2 Lime Production: Findings of the 2013 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2014 inventory submissions

Member State	**Review findings and responses related to 2A2 Lime Production**	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
Austria	In relation to the production of lime as part of the process of sugar production, "the ERT recommends that Austria include a clear description of the process in its NIR, including a mass balance with data on the lime produced, the CO_2 produced by calcination, the coke consumed and the mass of the CaCO3 produced. Moreover, the ERT strongly recommends that Austria include in its NIR a description of the use of the total amount of CaCO3 obtained". (FCCC/ARR/2013/AUT)	Austria includes a clear description of the process in its NIR, this does not yet include a mass balance.
Belgium	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/BEL). 2013 ARR not yet available.	No follow-up necessary.
Denmark	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/DNK). 2013 ARR not yet available.	No follow-up necessary.
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/FIN)	No follow-up necessary.
France	The ERT recommended that France include information on the share of plant-specific data, in order to increase transparency (FCCC/ARR/2012/FRA). 2013 ARR not yet available.	France provides information on the share of plant-specific data.
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/DEU)	No follow-up necessary.
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/GRC)	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/IRL). 2013 ARR not yet available.	No follow-up necessary.
Italy	ERT recommends that Italy provide more information about the methods used to estimate emissions from lime production for the entire time series. Italy should also	Not yet addressed.

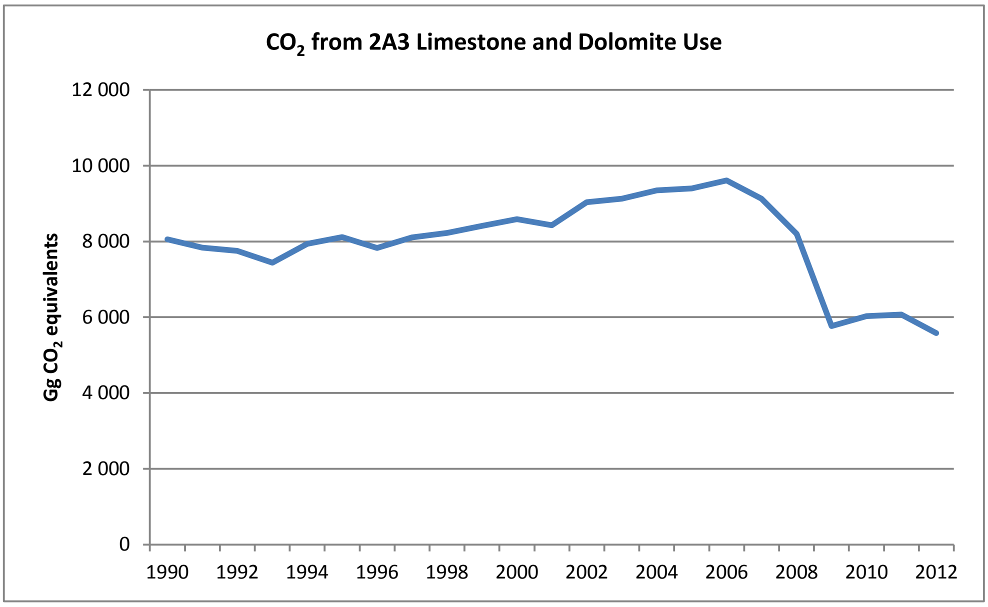
Member State	Review findings and responses related to 2A2 Lime Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
	clearly document whether the method is based on the amount of calcium and magnesium carbonate from the raw material, or on the amount of calcium and magnesium oxides in the lime produced for each of the periods. The ERT recommends more information about the underlying drivers for the change in the IEF since 2005 and on how time-series consistency has been maintained. As an example, it is not clear whether the lower IEFs are due to a change in the composition of the raw material, changes in the process or changes in the estimation methods. (FCCC/ARR/2013/ITA)	
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/LUX)	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/NLD).	No follow-up necessary.
Portugal	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/PRT). 2013 ARR not yet available.	No follow-up necessary.
Spain	The ERT recommends inclusion of detailed information on the revised estimates of CO_2 emissions from lime production (FCCC/ARR/2012/ESP). 2013 ARR not yet available.	NIR 2013 includes information on the revised estimates and a graphic comparison of 2013 and 2012 estimates of CO_2 emissions from lime production.
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/SWE)	No follow-up necessary.
UK	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/GBR). 2013 ARR not yet available.	No follow-up necessary.

Source: NIR 2014, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php

4.2.1.3 2A3 Limestone and Dolomite Use

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.2 % of total GHG emissions in 2012. Between 1990 and 2006, CO_2 emissions from this source increased by 19 % in the EU-15. From 2006 until 2012 emissions fell by 42 % (Figure 4.5).

Figure 4.5 2A3 Limestone and Dolomite Use: EU-15 CO_2 emissions



In 2012, Italy was responsible for 19 %, the UK for 21 % and France for 15 % of the emissions from this source. Total emissions from this source in 2012 are 31 % below 1990 levels, with the largest absolute reduction in Italy where use has more than halved since 1990.

Table 4.10 2A3 Limestone and Dolomite Use: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	203	268	256	5%	-12	-4%	52	26%	T1	D,PS
Belgium	428	206	102	2%	-104	-51%	-326	-76%	T3	CS,PS
Denmark	14	42	26	0.5%	-16	-39%	12	87%	CS,T1	CS,D
Finland	98	288	239	4%	-50	-17%	140	143%	T2	CS
France	1 392	849	820	15%	-29	-3%	-572	-41%	T2, T3	PS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	583	462	400	7%	-62	-13%	-182	-31%	CS,T1	CS,D
Ireland	0.2	1	0.4	0%	-1	-58%	0.3	189%	T2	PS
Italy	2 540	1 481	1 072	19%	-409	-28%	-1 468	-58%	T2	CS,D,PS
Luxembourg	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	481	600	559	10%	-41	-7%	78	16%	CS	D
Portugal	33	116	237	4%	121	105%	204	612%	D	D
Spain	1 005	667	550	10%	-117	-18%	-455	-45%	D	D, PS
Sweden	90	136	141	3%	6	4%	51	56%	CS	D
United Kingdom	1 191	960	1 178	21%	219	23%	-12	-1%	T2	CS,D
EU-15	**8 059**	**6 075**	**5 581**	**100%**	**-494**	**-8%**	**-2 478**	**-31%**		

Belgium reports emissions in the source category 2A7.

Germany reports emissions in the source categories where limestone and dolomite is used (1A1a, 2A1, 2A2, 2A4, 2A7, 2C1).

Luxembourg reports emissions in the source category 2A1 and 2A7.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.11 provides information on methods applied, activity data, emission factors for CO_2 emissions from 2A3 Limestone and Dolomite Use for 1990 to 2012. The table shows that almost all MS (except Italy) use limestone and dolomite consumption as activity data for calculating CO_2 emissions. In 2012 the EU-15 IEF is 0.49 t CO_2/t of limestone and dolomite consumption. The implied emission factors per tonne of limestone and dolomite consumption vary between 0.41 t CO_2/t for Belgium and Spain and 0.80 t CO_2/t for the UK. Different EFs arise from the occurrence and the allocation of different activities under 2.A.3. Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. The use of plant-specific data reported and verified under the EU ETS by Member States can be considered as equivalent to a Tier 2 or Tier 3 method. It is difficult to calculate a specific share of EU emissions calculated with higher tier methods in the absence of such IPCC definitions and due to the fact that MS's estimates are mostly composed by several sources with independent estimation methods, using partly higher tiers, partly default methods.

Table 4.11 2A3 Limestone and Dolomite Use: Information on methods applied, activity data, emission factors for CO_2 emissions

			1990				2012			
Member State	Method applied	Emission factor	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
			Description	(kt)			Description	(kt)		
Austria	T1	D,PS	Limestone and Dolomite Use	413	0.49	203	Limestone and Dolomite Use	563	0.45	256
Belgium	T3	CS,PS	Limestone and Dolomite Use	114	3.75	428	Limestone and Dolomite Use	245	0.42	102
Denmark	CS,T1	CS,D	Limestone and Dolomite Use	42	0.33	14	Limestone and Dolomite Use	58	0.44	26
Finland	T2	CS	Limestone and Dolomite Use	226	0.43	98	Limestone and Dolomite Use	540	0.44	239
France	T2, T3	PS	Limestone and Dolomite Use	3152	0.44	1392	Limestone and Dolomite Use	1865	0.44	820
Germany	NA	NA	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Greece	CS,T1	CS,D	Limestone Consumption	1249	0.47	583	Limestone Consumption	902	0.44	400
Ireland	T2	PS	Limestone Consumption	0.3	0.44	0.2	Limestone Consumption	1	0.43	0
Italy	T2	CS,D,PS	Carbonates input to brick, tiles, ceramic production	5773	0.44	2540	Carbonates input to brick, tiles, ceramic production	2436	0.44	1072
Netherlands	CS	D	Limestone and Dolomite Use	1093	0.44	481	Limestone and Dolomite Use	1276	0.44	559
Portugal	D	D	Limestone consumption	74	0.45	33	Limestone consumption	411	0.58	237
Spain	D	D, PS	Limestone and Dolomite Use	2285	0.44	1005	Limestone and Dolomite Use	1343	0.41	550
Sweden	CS	D	Limestone and Dolomite Use	194	0.47	90	Limestone and Dolomite Use	310	0.46	141
UK	T2	CS,D	Limestone and Dolomite Use	2689	0.44	1191	Limestone and Dolomite Use	1469	0.80	1178
EU15			**EU15**	**17 305**	**0.47**	**8 059**	**EU15**	**11 419**	**0.49**	**5 581**

Belgium reports emissions in the source category 2A7.

Germany reports emissions in the source categories where limestone and dolomite is used (1A1a, 2A1, 2A2, 2A4, 2A7, 2C1).

Abbreviations explained in the Chapter 'Units and abbreviations'.

A considerable increase of IEFs between 1990 and 2012 in the inventory submission 2014 could be observed for the UK and Denmark. On the other hand, the IEF of Belgium shows an important decrease. Explanations for the changes in implied emission factors are given in the following overview:

Implied Emission Factor Limestone and Dolomite Use, Belgium

Limestone and dolomite use includes the process CO_2 emissions in sinter plants, the flue-gas desulphurisation in electric power installations as well as process CO_2 emissions sugar plants and ceramic plants. The changes in IEF reflect changing contribution from these sources.

Implied Emission Factor Limestone and Dolomite Use, Denmark

The increase of the IEF is caused by the consideration of the occurrence and relevance of different activities included in this category: The activity data comprises the consumption of carbonates for production of mineral wool, consumption of CaCO3 for wet flue gas cleaning at waste incineration plants and combined heat and power plants. In the production of stonewool a number of raw materials contributing to CO_2 emission are used: bottom ash from coal-fired CHP, stonewool binder, stonewool waste, limestone, and dolomite. Activity data for production of mineral wool is not reported due to confidentiality reasons, therefore the total emissions are divided by the other activities only resulting in the increasing IEF. EU-ETS data for some years (1998-2002) combined with energy consumption has been used for extrapolation of the CO_2 emission from 1990-1997 and interpolation from 2003-2005. For wet flue gas cleaning at combined heat and power plants statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2005; from 2006 onwards consumption of limestone has been used. Waste incineration plants: statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2010. For wet flue gas cleaning at waste incineration plants produced amount of gypsum has been used as activity data for the period 1990-2010. Also for 2006 - 2012 information on consumption of CaCO3 at power plants has been compiled from environmental reports and used in the calculation of CO_2 emissions from flue gas cleaning. The change in applied statistics explains the increasing IEF from 2005 to 2006. Information on the generation of gypsum at waste incineration plants does not explicitly appear in the Danish waste statistics (Miljøstyrelsen, 2012). However, the total amount of waste products generated can be found in the statistics. The amount of gypsum is calculated by using information on flue gas cleaning systems at Danish waste incineration plants (Illerup et al., 1999; Nielsen & Illerup, 2002) and waste generation from the different flue gas cleaning systems (Hjelmar & Hansen, 2002). However, for 2011 and 2012 information of CaCO3 at the relevant plants has been compiled from environ-mental reports and used in the calculation of CO_2 emission from flue gas cleaning.

Implied Emission Factor Limestone and Dolomite Use, UK

The comparable high IEF (2012) is due to the inclusion of CO_2 emissions from gypsum produced in the flue gas desulphurisation process. The activity data does not reflect this particular process, and therefore the IEF is higher than might otherwise be expected. The increase of the IEF is caused by including CO_2 emissions from gypsum produced in the flue gas desulphurisation process but excluding this item in its activity rate.

CO_2 emissions occur also when limestone and/or dolomite is used in wet flue gas desulphurization (FGD) of flue gases in power generation. With its report of the review of the initial report of the European Union, the ERT recommends that the EU encourage member States which do not mention this category in their NIR to report where this category is included (FCCC/IRR/2007/EC, para 68). Table 4.12 provides an overview about the reporting of this category and Table 4.13 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category.

Table 4.12 2A3 Limestone and Dolomite Use: Information of wet flue gas desulphurization provided by Member States

Limestone and dolomite use		
Member State	**FGD included**	**Further information on wet flue gas desulphurization**
Austria	2.A.3	In this category CO_2 emissions from decarbonising of limestone in the iron and steel industry, limestone use for desulphurization and in chemical industry are considered. Activity data for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. The time series was constructed with the help of plant specific SO_2 emission declarations from the annual steam boiler database. [NIR 2014]

Limestone and dolomite use		
Member State	**FGD included**	**Further information on wet flue gas desulphurization**
Belgium	2.A.3	After receiving the ETS-data and consultation of these ETS-data the emissions due to the use of limestone in pollution control were completed for the 2012 submission in the category 2A3 and accounts for +/- 10-15 kton of CO_2 (from 1999 on). The limestone and dolomite use (category 2A3) includes the process CO_2 emissions in the flue-gas desulphurisation in electric power installations (2 in Flemish region) [NIR 2012, 2013 and 2014]
Denmark	2.A.3	The CO_2 emission from consumption of limestone for flue gas cleaning has been estimated from statistics on generation of gypsum (wet flue gas cleaning processes) and the stoichiometric relations between gypsum and release of CO_2. Statistics on the generation of gypsum from power plants are compiled in 2008. For calculation of CO_2 emission from flue gas cleaning information on consumption of CaCO3 at power plants from 2006 onwards has been compiled from environmental reports. The amount of gypsum is calculated by using information on flue gas cleaning systems at Danish waste incineration plants and waste generation from the different flue gas cleaning systems. However, for 2011 and 2012 information of CaCO3 at the relevant plants has been compiled from environmental reports and used in the calculation of CO_2 emission from flue gas cleaning. [NIR 2014]
Finland	2.A.3	Limestone and dolomite use includes the use in the energy industry for sulphur dioxide control. Most of the data for the whole time series have been received from individual companies and EU ETS and only a small part data of earlier years have been estimated using industrial statistics. [NIR 2014]
France	2.A.3	The category of limestone and dolomite use (2A3) includes the following sub-sectors: [...] the use of carbonates for the desulphurisation at industrial sites (3 heat plants and 4 power plants) and the use as neutralizer for acidic substances (one chemical plant). [NIR 2014]
Germany	1.A.1.a	Flue gas emissions are reported under 1A1a instead of 2A3. CO_2 emissions from flue-gas desulphurisation are included in 1.A.1.a Limestone use in flue-gas desulphurisation in public power stations. In the inventory, these CO_2 emissions were assigned to emissions from use of solid fuels, because such use is the reason for operation of the flue-gas desulphurisation systems and for the systems' CO_2 emissions. [NIR 2014]
Greece	2.A.3	The operation of flue gas desulphurization systems in Greece started in 2000. The estimation of emissions is based on data collected during the formulation of the NAP for the period 2005 – 2007. For years 2005-2012 data from verified installation ETS reports were used. The emission factor used (0.44 t CO_2 / t limestone) derives from the stoichiometry of the reaction. [NIR 2014]
Ireland	2.A.3	The CO_2 emissions reported under this category refer to those emissions associated with the use of limestone (CaCO3) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO_2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the

Limestone and dolomite use		
Member State	**FGD included**	**Further information on wet flue gas desulphurization**
		companies and an emission factor of 0.44 t CO_2/t limestone, which is the stoichiometric ratio of CO_2 to CaCO3. [NIR 2014]
Italy	2.A.3	CO_2 emissions deriving from the treatment of flue gases have been accounted for the whole time series in source category 2.A.3. [NIR 2014]
Luxembourg		The use of limestone and dolomite is accounted for in IPCC Sub-categories 2A1 – Cement Production and 2A7 – Other – Glass Production [NIR 2014]
Netherlands	2.A.3	The CO_2 emissions from this source category are based on consumption figures for limestone use – derived from plaster production figures – for flue gas desulphurisation (FGD) with a wet process by coal-fired power plants and for apparent dolomite consumption (mostly used for road construction). [NIR 2014]
Portugal	2.A.3	CO_2 emissions from wet flue gas desulfurization are estimated for large point sources in the sector of public electricity and heat production. Recalculations for Energy Industries sector comprise the allocation of CO_2 emissions from the desulfurization process, total CO_2 emissions from this abatement system were included together with the Limestone, Dolomite and Carbonate Use in CRF 2.A.3 [NIR 2014]
Spain	2.A.3	Category 2A3 includes emissions from the decarbonization of carbonates consumed for bricks and tiles as well as for the desulphurization of flue gas of power plants. Emissions from desulfurization are estimated based on individualized information was provided by the power plants. [NIR 2014]
Sweden	2.A.3	Activity data and CO_2 emissions from the use of limestone and dolomite within facilities producing glass and mineral wool, iron pellets and chemical products, and also use of limestone and dolomite for flue gas purification in energy producing facilities are reported in CRF category 2A3. The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite. [NIR 2014]
UK	2.A.3	Limestone is also used in flue-gas desulphurisation (FGD) plant used to abate SO_2 emissions from combustion processes. The limestone reacts with the SO_2 present in flue gases, being converted to gypsum, with CO_2 being evolved. Emissions are calculated using an emission factor of 69 t carbon/kt gypsum produced based on the stoichiometric relationship between gypsum and carbon dioxide formed in the FGD plant. Data on gypsum produced in FGD plant has previously been taken from the British Geological Survey (2012), but these data are not always consistent with site-specific emissions data available from EU ETS, and so now a composite series of activity data is used with BGS data for 1994-2004, and EU ETS data for 2005-2012. BGS data for 2005 are in very good agreement with EU ETS data for that year, and so it has been assumed that BGS data for 1994-2004 are also comparable with the later EU ETS data. [NIR 2014]

Source: NIR 2014.

Table 4.13 2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States

Limestone and Dolomite Use	
Member State	**Methodology comment**
Austria	In this category CO_2 emissions from decarbonising of limestone in the iron and steel industry and from limestone use for desulphurization in power plants, chemical and other industry are considered. CO_2 emissions from decarbonising of limestone and dolomite in glass industry are accounted for in 2.A.7.c Glass Production. Emissions were estimated using the methodology and the IPCC default EF for the years 1990-2004. AD for limestone used in blast furnaces for the years 1998 to 2002 was reported directly by the plant operator of the two integrated iron and steel production sites that operate blast furnaces. For the years before and after AD was estimated using the average ratio of limestone used per ton of pig iron produced of the years 1998-2002. From 2005 onwards verified CO_2 emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone use in the iron and steel and chemical industry. Under ETS plant operators are calculating the emissions on the basis of the Austrian Ordinance(45) regarding monitoring, reporting and verification of GHG emissions. The important part is §8(2) which defines the calculation-based approach as the methodology to be used. Annex 2 (7) provides the relevant TIERs for this approach. Activity data for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. The time series was constructed with the help of plant specific SO_2 emission declarations from the annual steam boiler database. For calculation of CO_2 emissions the IPCC default emission factors of 440 kg CO_2/t limestone and 477 kg CO_2/t dolomite were used. From 2005 onwards, ETS background data provided more detailed information on the actual carbon content of the limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values. [NIR 2014]
Belgium	The limestone and dolomite use (category 2A3) includes the process CO_2 emissions in the sinter plants, the flue-gas desulphurisation in electric power installations (2 in the Flemish region) and the sugar plants (4 installations in the Walloon region). This category doesn't include the following source categories in which CO_2 emissions are produced via limestone use in glass production (limestone fraction in the relevant raw materials). The allocation of these emissions in the category 2A7 is made to improve the harmonisation of reporting across EU Member States. Since 1990, sinter production has declined sharply in Wallonia. In 1990, there were 4 sinter plants and in 2011, the last sinter plant was closed. Until 2002, these emissions are calculated by using an IPCC 1996 emission factor of 200 kg CO_2/ton sinter. The emissions calculated involved combustion and process emissions. As the fuel consumption was known, combustion emissions were calculated and reported in the energy sector (fuel consumption x emission factor (table 3.1) and the remaining emissions were reported in the process sector ((200 kg CO_2/ton sinter) X (production of sinter) – (combustion emissions). These process emissions are originating from additive in the furnace as limestone. From 2005 on, CO_2 emissions (process and combustion emissions) have been obtained directly by the obliged reporting of the plants under the emission trading scheme. The total IEF in 1990 and 1991 differs from 200 kg CO_2/t as the production of one pelletization plant is taking into account with no process emissions. In the Flemish region, the process emissions originates from (1) production of fluid pig iron (category 2C1), (2) amount of lime used directly in the sinter factory to fix the alkalinity of the slags and (category 2A3) (3) the amount of lime used (indirectly) in the grinded mixture (mixture of ores, recovery products, MgCO3, CaCO3 etc. in the sinter factory. [NIR 2014]

Limestone and Dolomite Use	
Member State	**Methodology comment**
Denmark	In the production of stonewool a number of raw materials contributing to CO_2 emission are used: bottom ash from coal-fired CHP, stonewool binder, stonewool waste, limestone, and dolomite. Information on emissions of CO_2 has been obtained from confidential company reports to EU-ETS for 2006 onwards. Emissions are extrapolated for previous years. The CO_2 emissions from consumption of limestone for flue gas cleaning has been estimated from statistics on generation of gypsum (wet flue gas cleaning processes) and the stoichiometric relations between gypsum and release of CO_2: Statistics on the generation of gypsum from power plants were compiled in 2008. For calculation of CO_2 emission from flue gas cleaning information on consumption of CaCO3 at power plants from 2006 onwards has been compiled from environmental reports. The amount of gypsum is calculated by using information on flue gas cleaning systems at Danish waste incineration plants and waste generation from the different flue gas cleaning systems. However, for 2011 and 2012 information of CaCO3 at the relevant plants has been compiled from environmental reports and used in the calculation of CO_2 emission from flue gas cleaning. [NIR 2014]
Finland	Emissions were calculated using a Tier 2 methodology. Emissions from limestone and dolomite use are calculated by multiplying emission factors with activity data. Activity data are collected mainly directly from the industry but industrial statistics have also been used to calculate emissions at the beginning of the time series. Emission factors for calculating emissions from limestone and dolomite use are based on the IPCC default factors. The emission factors are modified by multiplying default emission factor with correction factors (0.93-1.00, based on information from the producers), because not all limestone and dolomite are calcinated completely in the various processes. Different factors have been used then more detailed information on the composition of limestone is available for some of the plants. If no information of composition has been received the correction factor 0.97, which is based on GPG for lime production, is used. (Default value for CaO or CaO and MgO content is 0.95, Table 3.4 Basic Parameters for the Calculation of Emission Factors for Lime Production). The average for the correction factor for the whole time series is 0.96 (range 0.95-0.98). The consumption of limestone and dolomite has been used as activity data when calculating emissions from limestone and dolomite use. Most of the data for the whole time series have been received from individual companies and EU ETS and only a small part data of earlier years have been estimated using industrial statistics. Also data on limestone and dolomite uses for which it was previously not clear if they produce emissions or not have been checked using industrial statistics and the web sites of companies. It was confirmed that these uses do not cause CO_2 emissions as limestone has been used for instance as coating and filler pigments in paper and cardboard, paint and plastic industry. [NIR 2014]

Limestone and Dolomite Use	
Member State	**Methodology comment**
France	This sector includes several activities: - decarbonization in the production of enamel production. AD is taken from annual declarations and an average EF is used. - for desulphurization AD is taken from annual declarations for recent years and interpolated based on certain years for which data is available. EF are available since 1999 and before the average EF 440 kg CO_2 / t lime is used. - the use of limestone to neutralize acidic substances. AD is taken from annual declarations for recent years and interpolated based on certain years for which data is available. EF are available since 1997 and before an average EF of 418 kg CO_2 / t product is used. - the use of limestone as primary material and additive (which ceased after the year 2008). Activity data and EFs are derived from plant-specific reporting since 2000 and is based on production data and an EF based on stoichiometric relationships for the years before . - production of magnesium was active from 1990 to 2002 and production data is available for this period and an EF is taken from literature. [NIR 2014]
Germany	Limestone consumption is reported in the sectors that use limestone and in 2A7 Other. The Section on 2A3 in the NIR presents a lime balance to ensure complete reporting [NIR 2014]
Greece	Estimate includes limestone use in metal production (steel, aluminium), magnesia, ceramics production and SO_2 scrubbing. AD and plant-specific EF from operators under EU ETS are used. Steel production: Data are generally plant specific, deriving from the EU ETS verified reporting of the plants (for the years 2005 onwards) and the reporting performed for the NAP formulation in the previous years. For 2012, the total CaCO3 equivalent amounts to 8.72kt. The abrupt reduction in emissions since 2011 can be attributed the cease of operation of one big plant. Primary aluminium production: Data on primary aluminium production are plant specific and confidential (there is only one plant in Greece). The emission factor used is 0.44, whereas the single carbonate estimated is CaCO3. Plant specific data on limestone consumption cover the years 1990 and 1998 onwards. The specific limestone consumption has been used for filling in missing data. Ceramics production: Carbonates consumption data (in the context of the ETS reports) have been used to estimate emissions in the years 2005-2012. Activity data refer to CaCO3 and MgCO3 consumption (emission factors 0.44 and 0.522 respectively). Limestone consumption data are available also for the period 2000-2004 (questionnaires of the plants under the NAP formulation). Missing data for the period 1990 – 1999 were filled in on the basis of the ceramics production trend reported by the ElStat for the same period. SO_2 scrubbing: The operation of flue gas desulphurization systems in Greece started in 2000. The estimation of emissions is based on data collected during the formulation of the NAP for the period 2000 – 2003 and concern limestone consumption in two power plants. Limestone consumption for 2004 was estimated assuming that the specific limestone consumption per electricity produced in those two power plants is kept constant at 2003 levels. For years 2005 onwards data from verified installation ETS reports were used. The emission factor used (0.44 t CO_2 / t limestone) derives from the stoichiometry of the reaction. Magnesia production: Emissions are estimated using information for the single plant operating in Greece for the years 1999-onwards and the produced quantities of magnesia that have been provided by the Hellenic Statistical Authority for the years 1990-1998. [NIR 2014]

Limestone and Dolomite Use	
Member State	**Methodology comment**
Ireland	The CO_2 emissions reported under this category refer to those emissions associated with the use of limestone (CaCO3) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO_2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO_2/t limestone, which is the stoichiometric ratio of CO_2 to CaCO3. A further minor use of limestone relevant to 2.A.3 Limestone and Dolomite Use in Ireland is its application in the purification of sugar produced from sugar beet. However, sugar production ceased in 2006 and the only information on emissions is that obtained under ETS in respect of 2005 and 2006. Since 2008, when the last brick and tile manufacturing plants closed, the only source of emissions in this sub-category is the use of limestone for flue gas desulphurisation at peat fired power plants [NIR 2014]
Italy	CO_2 emissions from limestone and dolomite use are related to the use of limestone and dolomite in bricks, tiles and ceramic production, paper production and also in the treatment of flue gases from power plants. In general about 86% of the total limestone and dolomite is used in the production processes of bricks and tiles; about 6.9% is used for the fine ceramic material; 6.9% is used in the treatment of flue gases in the power plants and about 0.1% is used in the paper industry. CO_2 emissions have been estimated for the whole time series; the overall CO_2 emission time series being mainly driven by the CO_2 emissions from the use of Limestone and Dolomites in the Bricks and Tiles sector (the same percentages are observed in the distribution of CO_2 emissions among the contributing sectors as for the limestone and dolomite used amounts). In the CRFs the total amount of limestone and dolomite used in these processes is reported, as activity data, and it has been estimated on the basis of the average content of CaCO3 in the different products. Detailed production activity data and emission factors have been supplied in the framework of the European emissions trading scheme and relevant data are annually provided by the Italian bricks and tiles industrial association and by the Italian ceramic industrial associations. [NIR 2014]
Luxembourg	The use of limestone and dolomite is accounted for in IPCC Sub-categories 2A1 – Cement Production and 2A7 – Other – Glass Production [NIR 2014]
Netherlands	The CO_2 emissions from this source category are based on consumption figures for limestone use for flue gas desulphurisation (FGD) with coal-fired power plants and in iron and steel production and for apparent dolomite consumption (mostly used for road construction). From 2000 onwards, data reported in the annual environmental reports of Tata Steel (Corus) are used to calculate the CO_2 emissions from the limestone use. For the period 1990–2000 the CO_2 emissions were calculated by multiplying the average IEF (107.9 kg CO_2 per ton of crude steel produced) over the 2000–2003 period by the crude steel production. CO_2 from limestone use = limestone use * f(limestone) * EFlimestone , where f is the fractional purity. Emissions from the use of limestone and dolomite use in the glass production sector are included in 2A7, Other. [NIR 2014]

Limestone and Dolomite Use	
Member State	**Methodology comment**
Portugal	Presently, in the inventory of GHG emissions, only CO_2 emissions resulting from production of calcium and magnesium nitrates and consumption of sodium carbonates in paper pulp production are reported in source category 2A3. CO_2 emissions are estimated from the quantification of carbon in original raw materials, and making a mass balance for the quantities of CO_2 that are liberated in the conversion process. Carbon content of materials consumed in Portugal was set from molecular stoichiometry. The consumption of sodium carbonate in the paper and pulp industry was determined from the statistical information from INE from 1990 to 2012. Concerning consumption of carbonaceous materials in the fertilizer industry – for the production of calcium and magnesium nitrates – are estimated from fertilizer production data and considering that stoichiometricly two moles of nitrogen require one mole of either CaCO3 or MgCO3. Fertilizer production data was also available from INE database from 1990 to 2012. The ceramic industry, more particularly the brick and tile industry and the pavement industry, consumes limestone, dolomite and the carbonates of sodium and barium, and all these substances were considered to result in decarbonization. For this industry sector, although the consumption of carbonate bearing materials is not known for the whole period, a consumption factor was developed based on the information received under the European Emission Trading Scheme (EU-ETS), and production of construction ceramics and pavement ceramics, which is available from INE's industry surveys IAIT and IAPI, was used to obtain the full time series. [NIR 2014]
Spain	Includes emissions from dolomite and lime use in bricks and tiles production and from flue gas desulphurization in power plants. AD for bricks and tiles are based on data from the industrial association (HISPALYT) and from plant-specific data from power plants. Data on desulphurization are derived from questionnaires directly send by the power plants. An EF based on the stoichiometric relation was used for bricks and tiles production. Plant-specific parameters for the EF are available for the emissions from desulphurization in power plants. [NIR 2014]
Sweden	This source category comprises of activity data, CO_2 emissions from the use of limestone and dolomite within facilities producing iron sinter, glass wool and mineral wool, chemical products, but also use of limestone and dolomite for flue gas purification. Activity data and CO_2 emissions from the use of limestone and dolomite within facilities producing glass and mineral wool, iron pellets and chemical products, and also use of limestone and dolomite for flue gas purification in energy producing facilities are reported in CRF 2A3. The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite. Data on the use of limestone and dolomite have been acquired from environmental reports, the ETS and through direct contacts with the companies. Sweden has chosen to not include in 2.A.3 (but in corresponding categories): · CO_2 emissions from the use of limestone and dolomite in primary and secondary production of steel (2.C.1.1, 2.C.1.2), · CO_2 emissions from the use of limestone and dolomite in other metal production (2.C.5), · CO_2 emissions from the use of limestone and dolomite in production of clay based products (2.A.7) and · CO_2 emissions from the use of limestone and dolomite in glass production (2.A.7.1). [NIR 2014]

Limestone and Dolomite Use	
Member State	**Methodology comment**
UK	The category includes limestone and dolomite use in iron and steel industry, for sinter production and for desulphurization of flue gases in power plants. Data on the usage of limestone and dolomite for steel production are available from the Iron & Steel Statistics Bureau (2012). Corus UK Ltd (now Tata Steel) has provided analytical data for the carbon content of limestone and dolomite used at their steelworks, and these have been used to generate emission factors of 111 t carbon/kt limestone and 123 t carbon/kt dolomite for sintering and basic oxygen furnaces. For the latest submission, these factors have been replaced with values based on EU ETS data. Emissions from Flue Gas Desulphurisation (FGD) are calculated using an emission factor of 69 t carbon/kt gypsum produced. This factor is based on the stoichiometric relationship between gypsum and carbon dioxide formed in the FGD plant. Data on gypsum produced in FGD plant has previously been taken from the British Geological Survey (2012),, but these data are not always consistent with site-specific emissions data available from EU ETS, and so now a composite series of activity data is used with BGS data for 1994-2004, and EU ETS data for 2005 onwards. BGS data for 2005 are in very good agreement with EU ETS data for that year, and so it has been assumed that BGS data for 1994-2004 are also comparable with the later EU ETS data. [NIR 2014]

Source: NIR 2014.

The preceding tables show that although further harmonization of the reporting on emissions from limestone consumption for flue gas desulphurization has continued, Table 4.13 shows that there is a large variety of single emission sources under this category. The reporting of diverse sources under 2A3 therefore will not lead to comparability within the EU or with other countries as the different underlying processes are not comparable. The comparability of emission sources will however improve with the use of 2006 IPCC Guidelines in the UNFCCC reporting where glass production will be a separate category and where specific subcategories for other process uses of carbonates are provided. The EU has discussed the issue of allocation of specific sources under limestone and dolomite use again in WG1 under the Climate Change Committee in February 2013. While completeness of the emissions in this source category could be further enhanced, MS still have different emission sources that are allocated under 2A3 and there are valid reasons for the choices of allocation of emissions from limestone and dolomite use in MS inventories.

Table 4.14 summarizes the recommendations from the 2013 UNFCCC inventory review in relation to the category 2A3 Limestone and Dolomite Use.

Table 4.14 2A3 Limestone and Dolomite Use: Findings of the 2013 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2014 inventory submissions

Member State	**Review findings and responses related to 2A3 Limestone and Dolomite Use**	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/AUT)	No follow-up necessary.
Belgium	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/BEL). 2013 ARR not yet available.	No follow-up necessary.

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
Denmark	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/DNK). 2013 ARR not yet available.	No follow-up necessary.
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/FIN)	No follow-up necessary.
France	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/FRA). 2013 ARR not yet available.	No follow-up necessary.
Germany	Germany continues to report CO_2 emissions from limestone and dolomite use as "IE" and the emissions are included in the categories where limestone and dolomite are consumed (e.g. under iron and steel production or public electricity and heat production (flue gas desulphurization)). However, according to the Revised 1996 IPCC Guidelines, emissions from limestone and dolomite use, except for cement production, lime production and agriculture, are to be reported in the category limestone and dolomite use. The ERT recommends that the Party reallocate CO_2 emissions from limestone and dolomite use following the Revised 1996 IPCC Guidelines. (FCCC/ARR/2013/DEU)	An overview of limestone and dolomite use is included in the 2013 submission.
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/GRC)	No follow-up necessary.
Ireland	The ERT reiterates the recommendation to include an explanation for the inter-annual fluctuation in CO_2 emissions, either in the introductory part of the chapter on the industrial processes sector or at the category level, in order to improve the transparency of the NIR in its next annual submission (FCCC/ARR/2012/IRL). 2013 ARR not yet available.	Detailed information on activity data, emissions and IEFs is included.
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/ITA)	No follow-up necessary.
Luxembourg	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
	(FCCC/ARR/2013/LUX).	
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/NLD)	No follow-up necessary.
Portugal	The ERT recommends that the Party enhance the transparency of the NIR by removing inconsistent information and by accurately describing the methodologies used to estimate emissions from limestone and dolomite use (FCCC/ARR/2012/PRT). 2013 ARR not yet available.	Portugal describes the methodology for the estimation of emissions; specifically the quantification of carbon in original raw materials, and a mass balance for the quantities of CO_2 that are liberated in the conversion process.
Spain	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/ESP). 2013 ARR not yet available.	No follow-up necessary.
Sweden	Limestone and dolomite use – CO_2 The ERT noted that Sweden has continued to choose not to report CO_2 emissions from the use of limestone and dolomite in primary and secondary production of steel, other metal production, production of clay-based products and glass production under this category. Sweden has recognized in the NIR the recommendations made in the previous review reports that the current reporting is not in line with the Revised 1996 IPCC Guidelines. However, Sweden reiterated that CO_2 emissions from these sources are small and that it is not considered to be good practice to spend resources on obtaining the underlying data in order to separate these emissions. The ERT recommends that Sweden report these emissions under the category limestone and dolomite use or, if it chooses to continue reporting under the various other subcategories, that Sweden clarify and explain, in its next annual submission, how the company environmental reports and EU ETS reporting are set up, how this creates difficulty for the separate reporting of emissions, but how the completeness of the reporting still ensured. (FCCC/ARR/2013/SWE)	Since the Centralized review of submission 2004 the ERT has repeatedly recommended Sweden to follow the guidelines. Since the CO_2 emissions from limestone and dolomite are small in some source categories it is not considered to be good practice to spend resources obtaining underlying data to separate these emissions. Sweden has chosen to not include in 2.A.3 (but in corresponding categories): CO_2 emissions from the use of limestone and dolomite in primary and secondary production of steel (2.C.1.1, 2.C.1.2), CO_2 emissions from the use of limestone and dolomite in other metal production (2.C.5), CO_2 emissions from the use of limestone and dolomite in production of clay based products (2.A.7) and CO_2 emissions from the use of limestone and dolomite in glass production (2.A.7.1).
UK	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/GBR). 2013 ARR not yet	No follow-up necessary.

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
	available.	

Source: NIR 2014, UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php

4.2.1.4 2A7 Other Mineral Products

Table 4.15 provides an overview of the emission sources reported in the category 2A7 Other Mineral Products in 2012 as well as total emissions in this category. Following respective recommendations from the UNFCCC review of the EU inventory, several attempts were made to harmonize the allocation of emissions in a more transparent way across MS. 1996 IPCC Guidelines recommend to include in the “inventory all other uses of limestone and dolomite which produce CO_2 emissions”, including glass manufacture and to allocate emissions from soda ash use in glass manufacture under 2A4. However, it is considered as a significant increase in transparency if all MS would report CO_2 emissions from glass production in a separate category under 2A7 which is an emission source in most MS. If a harmonized subcategory for emissions from glass production is reported by MS, this would allow a comparison of IEFs across countries for glass production as well as quality checks with EU ETS data. IEFs for a multitude of different activities reported under 2A3 are not really comparable due to the different nature of processes allocated under this category. Respective guidance was provided to MS, however UNFCCC ERTs to individual MS recommended to report different emission sources under 2A3 instead of a more transparent and comparable separation under 2A7 Other Glass production. In our view the recommendation of the 1996 IPCC Guidelines to “inventory all other uses of limestone and dolomite which produce CO_2 emissions” is not contradicting a separation under 2A7 ‘other mineral products’ if such allocation enhances the transparency and comparability across Parties. In 2013 all 15 MS reported CO_2 emissions from glass production as a separate category under 2A7. In addition, several MS separate emissions from bricks and tiles and ceramics production in this category (Austria, Belgium, Denmark, France, Germany, Ireland, Spain, Sweden, UK) and emissions from sinter production (Austria). Germany was the largest contributor to this category with 21 %, followed by Spain (18 %) in 2012.

Table 4.15 2A7 Other Mineral Products: Emission sources reported for the year 2012

Member State	2.A.7 Other Mineral Products	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 total
Austria	Glass production, sinter production, bricks and tiles (decarbonizing)	435	NA	NA	435	9%
Belgium	Glass Production, ceramics	335	NA,NO	NA,NO	335	7%
Denmark	Glass Production, Yellow bricks. Expanded clay	33	IE,NA	IE,NA	33	1%
Finland	Glass production	2	NO	NO	2	0.03%
France	Glass Production, Brick and Tile Production	673	NA	NA	673	14%
Germany	Glass Production, Ceramics, Bricks and Tiles (decarbonizing)	1024	NA	NA	1 024	21%
Greece	Glass Production	16	NA,NO	NA,NO	16	0%
Ireland	Glas production, Bricks and Tiles (decarbonizing)	0.03	NO	NO	0.03	0.001%
Italy	Glass production	547	NA	NA	547	11%
Luxembourg	Glass production	60	NO	NO	60	1%
Netherlands	Glass production	231	NO	NO	231	5%
Portugal	Glass Production	155	1	NO	171	3%
Spain	Glass production, Magnesite production, Porous Tiles, Non-porous Tiles	901	NA	NA	901	18%
Sweden	Glass production, Light expanded clay aggregate, Glass and mineral wool production	53	NA	NA	53	1%
UK	Fletton Brick Production	429	0.2	NE	433	9%
EU-15 Total		**4 895**	**1**	**0**	**4 914**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.16 provides information on the contribution of Member States to EU recalculations in CO_2 from 2A Mineral products for 1990 and 2012 and main explanations for the largest recalculations in absolute terms.

Table 4.16 2A Mineral products: Contribution of MS to EU recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	1	0.01	0	0.0	During this 2014 submission, the activity data in category 2A7 (glass production) were optimized in the Flemish region for the complete timeseries. Missing activity data of 1 company was added for the entire timeseries. Besides this, the missing emissions of CO2 of this company was added for the years 1990-2004.
Denmark	0	0.0	-2	-0.2	2A3 Limestone and dolomite use: Two point sources were by mistake not included in the previous submission.
Finland	2	0.1	7	0.5	AD of one limestone using plant have been included to the inventory.
France	0	0.0	47	0.4	Updated data: improved accuracy.
Germany	-52	-0.2	-84	-0.4	Insignificant update of production figure. Correction of corresponding AD in glass production. Update of production figure.
Greece	121	1.8	0	0.0	During the 2014 submission emissions from non-carbonate carbon sources (TOC) for the years before 1990-2008 were included and therefore a recalculation, using the overlap methodology, was used. This way the whole time series was updated improving the time-series consistency.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	23	0.1	Update of activity data.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-107	-3.1	2A2: AD revision based on IAPI. 2A3: a) Limestone and dolomite consumption data revision based on National Statistics data. b) Reallocation of CO2 emissions from the use of limestone in the desulphurization occurring in the energy sector (1A1a) to the industrial processes sector (2A3 - Limestone and Dolomite Use). 2A6: Correction of small error in the disaggregation of hot mix asphalt emissions between Drum Mix and Batch Plants.
Spain	0	0.0	-1	0.0	Revision of CO2 emissions estimate as a result of the corresponding revision of carbon balance according to the updated information on lime characteristics and carbonatation foam composition provided by one sugar beet production plant. Additionally, the final degree of purity in the finished product (quicklime) in a manufacturing plant has been revised.
Sweden	0	0.0	0	0.0	
UK	92	0.9	59	0.9	EUETS carbon emission factor data have been used for limestone and dolomite used in sintering and basic oxygen furnaces in steelworks. The data are available for the years 2007-2012 and the value for 2007 has also been adopted for earlier years as well.
EU-15	**163**	**0.1**	**-57**	**-0.1**	

4.2.2 Chemical industry (CRF Source Category 2B) (EU-15)

Chemical industry includes the following key categories: CO_2 from 2B1 Ammonia Production, N_2O from 2B2 Nitric Acid Production and from 2B3 Adipic Acid Production and CO_2 and N_2O from 2B5 Other Chemical Industry.

The source category 2B1 Ammonia Production covers CO_2 emissions that occur during the production of ammonia, a chemical used as a feedstock for the production of several chemicals. In most instances, anhydrous ammonia is produced by catalytic steam reforming of natural gas (mostly CH_4) or other fossil fuels. At plants using this process CO_2 is primarily released during regeneration of the CO_2 scrubbing solution, with additional but relatively minor emissions resulting from condensate stripping. The source category 2B2 Nitric Acid Production accounts for N_2O emitted as a by-product of the high temperature catalytic oxidation of ammonia (NH_3) in the production of nitric acid. Adipic Acid Production (2B3) also emits N_2O as a by-product when a cyclohexanone/cyclohexanol mixture is oxidized by nitric acid.

Table 4.17 summarises information on Member States' emissions from chemical industry in 1990 and 2012 for total GHG, CO_2 and N_2O. Between 1990 and 2012, CO_2 emission from 2B Chemical Industry increased by 2 %. The absolute increase in CO_2 emissions was largest in Germany and Belgium; the absolute reductions were largest in Italy and France. Between 1990 and 2012, N_2O emission from 2B Chemical Industry decreased by 92 %. The absolute decreases in N_2O emissions were largest in UK, France and Germany.

Table 4.17 2B Chemical Industry: Member States' contributions total GHG and CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)	N_2O emissions in 1990 Gg CO2 equiv.	N2O emissions in 2012 Gg CO2 equiv.	CH4 emissions in 1990 Gg CO2 equiv.	CH4 emissions in 2012 Gg CO2 equiv.
Austria	1 468	659	541	588	912	53	15	18
Belgium	4 590	3 546	647	2 087	3 943	1 455	0	4
Denmark	1 044	1	1	1	1 043	NA,NO	NA,NO	NA,NO
Finland	1 807	893	151	726	1 656	166	NA,NO	NA,NO
France	27 859	2 993	3 186	2 045	24 596	906	78	42
Germany	35 496	19 955	13 076	16 827	22 420	3 128	0	1
Greece	1 762	809	652	502	1 109	307	1	NA,NO
Ireland	2 026	NO	990	NO	1 035	NO	NO	NO
Italy	9 982	1 747	3 254	1 507	6 676	234	51	5
Luxembourg	NO	NO	NO	NO	NO	NO	NO	NO
Netherlands	11 095	4 580	3 744	3 209	7 096	1 119	255	252
Portugal	1 159	149	633	75	518	66	8	8
Spain	3 626	967	785	766	2 800	161	41	40
Sweden	969	212	126	130	835	74	8	7
United Kingdom	27 592	2 801	2 782	2 658	24 641	61	169	82
EU-15	**130 474**	**39 312**	**30 567**	**31 120**	**99 281**	**7 731**	**625**	**461**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.18 provides information on the contribution of Member States to EU recalculations in CO_2 from 2B Chemical industry for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 4.18 2B Chemical Industry: Contribution of MS to EU recalculations of CO_2 emissions for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-42	-7.2	-26	-4.1	As CO2 emissions from fertilizer production and nitric acid production are reported under the respective subcategories, they were sub-tracted from CO2 emissions reported under ammonia production. This subtraction resulted in lower CO2 emissions in the order of 20 to 40 Gg per year for the whole time series.
Belgium	2	0.4	334	17.2	Flanders: revision of the results of the survey of the chemical federation showed a missing emission of 1 of the companies of 328 kton CO2
Denmark	0	0.0	-1	-36.7	The process related CO2 emission from production of catalysts/fertilisers has recalculated for the years 2006-2012 by inclusion of available company reports to EU-ETS.
Finland	0	0.0	-6	-0.9	Correction of notationkey.
France	0	0.0	0	0.0	
Germany	0	0.0	4	0.0	Method is improved.
Greece	412	0.0	1	0.0	Error in files. Natural gas carbon content was updated.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-112	-7.1	Update of emission factor for carbon black.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	-31	-0.9	Improved activity data.
Portugal	0	0.0	-3	-2.4	AD revision based on IAPI.
Spain	0	0.0	1	0.2	Revision of CO2 emissions estimate as a result of the corresponding revision of carbon balance in one calcium carbide production plant.
Sweden	0	0.0	0	0.0	
UK	-212	-7.1	-219	-8.6	Removal of double count for incineration of waste chemical.
EU-15	**160**	**0.5**	**-58**	**-0.2**	

Table 4.19 provides information on the contribution of Member States to EU recalculations in N_2O from 2B Chemical Industry for 1990 and 2012 and main explanations for the largest recalculations in absolute terms.

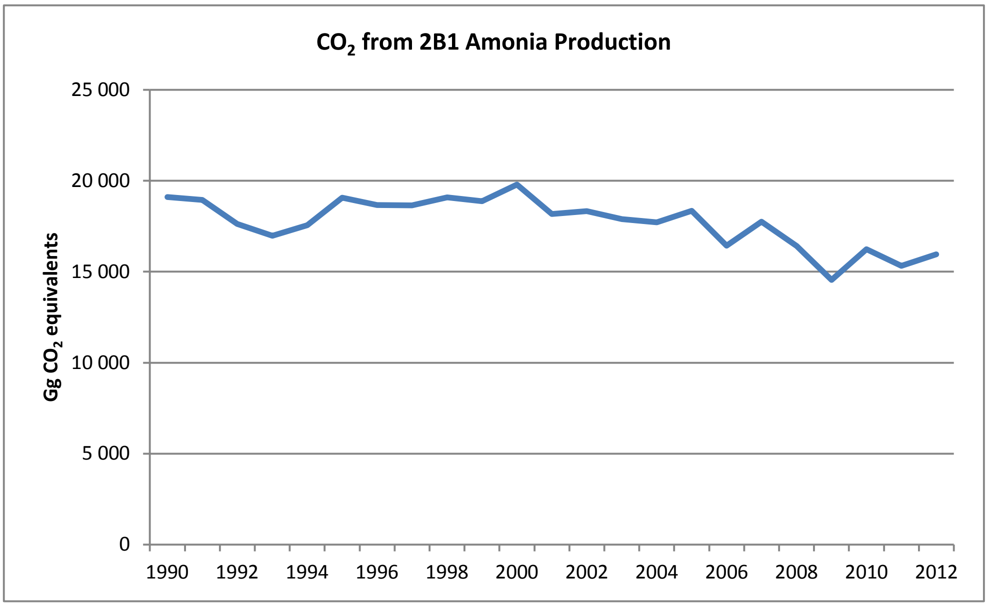
Table 4.19 2B Chemical Industry: Contribution of MS to EU recalculations of N_2O emissions for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	45	0.183	39	3.1	Taking into account new data: improving completeness.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	5	7.0	Correction of N2O emission factors based on revised monitoring data.
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**45**	**0.0**	**44**	**0.5**	

4.2.2.1 2B1 Ammonia Production

CO_2 emissions from 2B1 Ammonia Production account for 0.4 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from this source decreased by 16 % (Figure 4.6). Germany is responsible for nearly half of these emissions (47.8 %). The next largest contributors, Netherlands and France contribute 16 % and 8 % respectively. Italy, Ireland and France had large reductions in absolute terms between 1990 and 2012. The reasons for these reductions were a change to low emitting technology in France and production decreases in the other two countries and the cessation of production in Ireland. The largest growth in emissions between 1990 and 2012 was in Germany and Belgium.

Figure 4.6 2B1 Ammonia Production: EU-15 CO_2 emissions



The 10 % increase between 1993 and 1995 was dominated by growth in emissions in Belgium, Germany, Portugal and the Netherlands, whereas Italy showed a reverse trend in CO_2 emissions. Emissions in Belgium increased noticeably from 1993 to 1994 because new production installations started in the Flemish region. For Germany, production decreased during 1991-1993 due to closure of production sites in Eastern Germany, whereas in 1995 the market had stabilized again.

The abrupt decline from 2005 reflects declines for Germany, France, UK and Portugal, with changes from 2008 due to the economic crisis. The 4 % increase seen in EU-15 CO_2 emissions between 2011 and 2012 is mainly attributable to UK, Germany France and Italy.

Table 4.20 2B1 Ammonia Production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	472	530	511	3%	-19	-4%	39	8%	CS	CS,PS
Belgium	423	1 109	1 134	7%	25	2%	711	168%	T3	D,PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	44	NO	NO	-	-	-	-44	-100%	NA	NA
France	2 205	1 083	1 258	8%	175	16%	-947	-43%	T2	PS
Germany	5 745	7 450	7 631	48%	181	2%	1 886	33%	T3	PS
Greece	652	263	179	1%	-84	-32%	-473	-	T1a	CS
Ireland	990	NO	NO	-	-	-	-990	-100%	NA	NA
Italy	2 765	868	1 013	6%	144	17%	-1 752	-63%	T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3 096	2 681	2 578	16%	-103	-4%	-518	-17%	T1b	CS
Portugal	569	NO	NO	-	0	-	-569	-100%	NA	NA
Spain	709	697	701	4%	5	1%	-7	-1%	D	PS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	1 431	643	948	6%	306	48%	-483	-34%	T1	CS
EU-15	**19 101**	**15 322**	**15 952**	**100%**	**630**	**4%**	**-3 149**	**-16%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.21 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2B1 Ammonia Production for 1990 to 2012. The table shows that all MS (except for Ireland and the UK) use Ammonia Production as activity data for this emissions category. As 84% of EU-15 emissions are reported from 8 MS using comparable types of activity data it was possible to calculate an IEF based on the activity and emissions of these MS. Excluding the UK, the implied emission factors per tonne of ammonia produced for 2012 vary between 1.1 t CO_2/t ammonia for Austria and 2.4 t CO_2/t ammonia for Germany. In 2012 the EU-15 IEF (excluding the UK) was 1.71 t CO_2/t of ammonia produced. The table also shows that about 70 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.21 2B1 Ammonia Production: Information on methods applied, activity data, emission factors for CO_2 emissions

			1990				2012			
Member State	Method applied	Emission factor	Activity data		Implied emission factor	CO_2 emissions	Activity data		Implied emission factor	CO_2 emissions
			Description	(kt)	(t/t)	(Gg)	Description	(kt)	(t/t)	(Gg)
Austria	CS	CS,PS	Ammonia Production	461	1.02	472	Ammonia Production	479	1.07	511
Belgium	T3	D,PS	Ammonia Production	360	1.17	423	Ammonia Production	965	1.17	1134
Finland	NA	NA	Ammonia Production	28	1.55	44	Ammonia Production	NO	NO	NO
France	T2	PS	Ammonia Production	1928	1.14	2205	Ammonia Production	997	1.26	1258
Germany	T3	PS	Ammonia Production	2705	2.12	5745	Ammonia Production	3125	2.44	7631
Greece	T1a	CS	Ammonia Production	313	2.08	652	Ammonia Production	107	1.68	179
Ireland	NA	NA	Natural Gas Feedstocks	430	2.30	990	Natural Gas Feedstocks	NO	NO	NO
Italy	T2	PS	Ammonia Production	1455	1.90	2765	Ammonia Production	576	1.76	1013
Netherlands	T1b	CS	Ammonia Production	C	C	3096	Ammonia Production	C	C	2578
Portugal	NA	NA	Ammonia Production	C	C	569	Ammonia Production	C	NO	NO
Spain	D	PS	Ammonia Production	573	1.24	709	Ammonia Production	547	1.28	701
UK	T1	CS	Total Ammonia Produced	1328	1.08	1431	Total Ammonia Produced	1017	0.93	948
EU15			**EU15 w/o IE, NL, PT and UK (69%)**	**7823**	**1.66**	**13014**	**EU15**	**9 319**	**1.71**	**15 952**

Note: NL activity data and IEF are confidential. In order to improve comparability the EU AD value for the year 2012 is provided on the basis of the weighted average EF of the 8 MS with comparible activity data.

Abbreviations explained in the Chapter 'Units and abbreviations'.

The implied emission factor for 2012 was lower than in 1990 for Italy, Greece and the United Kingdom. However the average EU-15 implied emission factor increased by 3 % between 1990 and 2012 reflecting the increased IEFs in France and Germany. Explanations for the recent development of the implied emission factors and for outliers in IEFs are given in the following overview:

Implied Emission Factor Ammonia Production, Austria

Activity data (ammonia production) and natural gas input represent plant specific data. The composition of the synthesis gas is measured regularly. CO_2 emissions are calculated from the natural gas input – Tier 2 method of the IPCC guidelines with a standard emission factor (55.4 t/TJ) minus reported fugitive CH_4 emissions during start-ups of the ammonia production, minus reported CO_2 and CH_4 emissions from urea production that both derive directly from ammonia minus carbon stored in melamine.

Implied Emission Factor Ammonia Production, France

One plant stopped production in 2009. The sites reduced their specific emissions since 1990 due to improved efficiencies of catalysts. This was in particular the case for one site with 40% of the production for which the EF decreased from 2 kg CO_2 /t NH_3 produced to 1.5 kg CO_2/ t NH_3 in 2010. Deviating values occur for specific years, such as for 2009 when the IEF increased by 14% during 2008 and 2009 due to a non-optimal process in one plant due to lower process efficiency. In 2010, this site recovered its efficiency and that`s why the IEF decreased by 17 % and is around the 2008 IEF.

Implied Emission Factor Ammonia Production, Germany

The growth of German IEF during 1992 and 1993 of 14% contributed most to the overall increase of the IEF during 1990 and 2009 (17%). The underlying reason is a gap in the emissions reported to the UBA from 1990 to 1992. Since the resubmission in 2010 in line with recommendations from the In Country Review in 2010, Germany adds the CO_2 captured for other uses to total CO_2 emissions from 2B1. The IEF is higher than that of other countries, because Germany uses heavy fuel oil as a feedstock in addition to natural gas. The use of heavy fuel oil results significantly higher CO_2 emissions than natural gas, therefore fluctuations in the ratio of heavy fuel oil to natural gas is directly reflected in the IEF.

Implied Emission Factor Ammonia Production, Greece

The Greek IEF increased especially during the years 1990-1993 and 1998-2001 which is due to the different fuels used in the two plants operating in Greece. The first plant has been operating since 1990, with an interruption between 1994-1997 using natural gas provided by the Public Gas Company SA (DEPA) since 1998. During 1990-1993 natural gas has been provided by the Kavala Oil Corporation. Imported natural gas was introduced to the Greek energy system by DEPA in 1996. Until 1996 natural gas consumption in Greece corresponded to small amounts of domestic natural gas explored by the company Kavala Oil. The second plant has been operating since 1990 up to 1999 with intervals. This plant used lignite as feedstock until 1991, and liquid fuels until its closure. CO_2 emissions from lignite used during years 1990-1991 have been reallocated from the Energy Sector (1A2c) into the Industrial Processes Sector. The decrease of the CO_2 implied emission factor from 2011 is due to a lower carbon content of imported natural gas.

Implied Emission Factor Ammonia Production, UK

The lower than average IEF of the UK is not comparable with other IEFs, because one UK production site used hydrogen as feedstock. Also, the emissions calculation for the whole sector are based on natural gas consumption and not on ammonia production as is the case for other MS. Fluctuations in the IEF therefore represent changes in the carbon content of the natural gas. At the production site in Hull, ammonia is produced with hydrogen supplied as a by-product from another chemical process operated on a neighbouring site; hence the CO_2 emissions associated with that hydrogen production are not attributed to ammonia production.

Implied Emission Factor Ammonia Production, Italy

The CO_2 emission factor has been calculated on the basis of information reported by the production plants for 2002 and 2003 in the framework of the national EPER/E-PRTR registry and considering also the amounts of CO_2 recovered since the beginning of the recovery operations. CO_2 reported to the national EPER/E-PRTR registry has been used for the previous years in consideration that, as communicated by the operators, no modifications to the production plants have occurred along the period (YARA, 2007). Since 2002, the average emission factors result also from data reported by the plants in the national EPER/E-PRTR and they account for the recovered CO_2.

Table 4.22 provides a more detailed overview of the methodologies and data sources used by Member States for this source category as reported in the NIR 2014.

Table 4.22 2B1 Ammonia Production: Summary of methodological information provided by Member States

Ammonia Production	
Member State	**Methodology comment**
Austria	AD since 1990 and CH_4 emission data from 1994 onwards were reported directly by the only ammonia producer in Austria and thus represent plant specific data. The composition of the synthesis gas is measured regularly at the only ammonia producer in Austria. CO_2 emissions are calculated from the natural gas input with a standard emission factor (55.4 t/TJ). CH_4 emissions are calculated from the measured synthesis gas composition and the number and duration of start-ups. The implied emission factor for CH_4 that was calculated from activity and emission data from 1994 was applied to calculate emissions of the years 1990 to 1993 as no emission data was available for these years. CH_4 emission factors of ammonia plants depend largely on the number of shutdowns and start-ups during the year. Especially a start up after a turn around with exchange of catalyst in some of the reactors of the plant needs a prolonged start up procedure resulting in an increase of the IEF. CO_2 emissions are calculated from the natural gas input – Tier 2 method of the IPCC guidelines – with a standard emission factor (55.4 t/TJ) minus reported fugitive CH_4 emissions during start-ups of the ammonia production, minus reported CO_2 and CH_4 emissions from urea production that both derive directly from ammonia and minus carbon stored in melamine. [NIR 2014]
Belgium	In Flanders the emissions of CO_2 originating from the production of ammonia are obtained as a result of the yearly surveys carried out by the chemical federation in cooperation with the Vito. This information (activity data and emissions) comes directly from the plant via their annual integrated environmental reporting obligation. The estimation of the emissions is based on the consumption of natural gas. The consumption is multiplied with the default IPCC emission factor for CO_2 for natural gas (55.8 kton CO_2/PJ) and the caloric value (variable per month). A part of the CO_2 (recovery part) is transported internally to the nitro-phosphor-installation and effectively measured by flow measurements. This amount of measured CO_2 is obviously subtracted from the overall CO_2 emissions from ammonia production. This part of CO_2 is afterwards sold as lime product. In the Walloon region, the same methodology is used. The amount of natural gas used in the process is given directly by the plant. There is a flow meter on the duct. The CO_2 process emissions are calculated based on this amount of natural gas. 100% per cent of the carbon content of the natural gas is presumed to be emitted and the default IPCC emission factor for CO_2 for natural gas (55,8 kton CO_2/PJ) is used. A part of the process CO_2 emissions is used by two other plants for Ammonium carbonate production as intermediate, inert agent and food production. All the CO_2 emissions are allocated to the ammonia plant as it is assumed that all carbon will be emitted to the atmosphere in Belgium. [NIR 2014]

Ammonia Production	
Member State	**Methodology comment**
Denmark	Not occurring. [NIR 2014]
Finland	The tier 1 IPCC methodology was applied. CO_2 emissions from ammonia production are calculated by multiplying the amount of produced ammonia with the emission factor. Activity data have been received directly from the company and the emission factor is the default factor from the IPCC. All ammonia currently used in Finland is imported. In 1990-1992 small amounts (4 - 30 Gg per year) were produced using mainly peat and heavy oil as feedstock for the needed hydrogen. From 1993 on there has been no ammonia production in Finland [NIR 2014]
France	There are currently four ammonia producing plants in France. Emissions, activity data (natural gas consumption) and EFs are obtained directly from plants, CS EF calculated on this basis. [NIR 2014]
Germany	As of the 2010 report, emissions data for this source category are being collected and reported in accordance with the Tier 3 standard. Companies report all information to Industrieverband Agrar (IVA) where data is aggregated and forwarded to UBA. [NIR 2014]
Greece	Activity data concerning fuel consumption for the years 1998-2009 have been provided by the plant using natural gas and by DEPA. Data for 2010 – 2012 are plant specific. National production for the whole time-series has been provided by the El.Stat. and for the years 1998-2012 by the one plant still operating in Greece. The country specific carbon content of natural gas for the years 1990-1993 is 16.20 t C/TJ (the mean value of CC of NG from the different reservoirs that NG was extracted). The carbon content of imported NG is calculated basing on the chemical composition data of natural gas provided by DESFA (Hellenic Gas Transmission System Operator S.A.). [NIR 2014]
Ireland	Carbon dioxide emissions from ammonia production are estimated from the natural gas feedstocks to the plant as indicated in the national energy balance provided by SEI. In accordance with the 1996 IPCC guidelines, it is assumed that no feedstock carbon is sequestered in urea and the emission factor is 54.94 kg CO_2/TJ, the value for indigenous natural gas, which equates to 2.3 tonne CO_2/tonne natural gas. Ammonia production was closed in 2003. [NIR 2014]
Italy	Ammonia production data are published in the international industrial statistical yearbooks (UN, several years), national statistical yearbooks (ISTAT, several years) and from 2002 they have been checked with information reported in the national EPER/E-PRTR registry. Since 2009 only one facility has been producing ammonia in Italy and reporting data to the national PRTR. Recovered CO_2 has been investigated with the cooperation of the operators and the resulting information has been used to revise the whole CO_2 emission time series and the emission factors as reported in the last submissions. The analysis has allowed understanding that CO_2 emissions recovered from ammonia production are used to produce urea and technical gases. According to IPCC Guidelines this CO_2 recovered should be accounted for emission and included in the estimate. Differently from the previous submissions the resulting average CO_2 emission factors were found to be higher than the IPCC defaults. In particular, for the years 1990-2001, CO_2 emission factor has been calculated on the basis of information reported by the production plants for 2002 and 2003 in the framework of the national EPER/E-PRTR registry and considering also the amounts of CO_2 recovered since the beginning of the recovery operations. CO_2 reported to the national EPER/E-PRTR registry has been used for the previous years in consideration that, as communicated by the operators, no modifications to the

Ammonia Production	
Member State	**Methodology comment**
	production plants have occurred along the period (YARA, 2007). Since 2002, the average emission factors result also from data reported by the plants in the national EPER/E-PRTR and they account for the recovered CO_2. [NIR 2014]
Luxembourg	Not occurring. [NIR 2014]
Netherlands	A method equivalent to IPCC Tier 1b has been applied. The amount of natural gas used as feedstock and a country-specific emission factor are used to estimate CO_2 emissions. Activity data on use of natural gas are obtained from Statistics Netherlands (CBS). One of the ammonia/urea producers in the Netherlands operates also a melamine plant, where a part of the produced urea is used as input. For that reason the C stored in the melamine is subtracted from the CO_2 emissions from the Ammonia production. Until last year, an average storage factor, 17% of the total CO_2 emissions from the Ammonia production, have been used. From this year the Dutch inventory team has access to the produced urea data, used as input in the melamine plant. [NIR 2014]
Portugal	In 2008 only one fertilizer industrial plant manufactures ammonia in Portugal, using Vacuum Residual Fuel Oil (VRF) as source of hydrogen (feedstock). Total production of ammonia in Portugal is available from the only existing facility for the period 1990-2008. In 2009, this plant has stopped activity and the ammonia production has been relocated to India. The quantity of VRF that was used was set from data collected at the only industrial plant in Portugal for a limited number of years – 1990 till 1994 – and the linear relation between feedstock consumption and ammonia production was used to construct the full time series. [NIR 2014]
Spain	From 4 plants in 1990, only 2 plants still exist in 2012. In one plant that existed from 1990 to 1996, the production process was based on direct synthesis of ammonia in closed circuits with pure hydrogen and N which did not produce CO_2 emissions. Use of production data and country-specific EF from some plants and IPCC default factors and production statistics for the other plants. In 2009 only two plants were producing ammonia. Plant specific data (production of ammonia, consumption of natural gas and refinery gas, CO_2 produced, directly emitted, sold) is available. Emission factors are in the range 1.009-1.308 kg CO_2/tonne ammonia when using natural gas as input and in the range 1.420-1.430 kg CO_2/tonne ammonia when using naphtha / gas refinery as input. [NIR 2014]
Sweden	There is an annual production of about 5 Gg of ammonia in Sweden, according to United Nations statistics. This ammonia is however not intentionally produced, but is a by-product in one chemical industry producing various chelates and chelating agents. Emissions from this industry are included in CRF code 2B5. Ammonia production 2.B.1 is thus reported as NO. [NIR 2014]
United Kingdom	Emissions of CO_2 from feedstock use of natural gas are calculated by combining reported data on CO_2 produced, emitted and sold by the various ammonia processes. Where data are not available, they have been calculated from other data such as plant capacity or natural gas consumption. One ammonia plant uses hydrogen feedstock that is a by-product from chemicals manufacture and therefore has no process emissions of CO_2. [NIR 2014]

Source: NIR 2014

Table 4.23 summarizes the recommendations from the 2013 UNFCCC inventory review in relation to the category 2B1 Ammonia Production.

Table 4.23 2B1 Ammonia Production: Findings of the 2013 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2014 inventory submissions

Member State	Review findings and responses related to 2B1 Ammonia Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/AUT).	No follow-up necessary.
Belgium	The ERT recommends that Belgium provide a clear description of the amount of CO_2 recovered during ammonia production processes and of how the completeness of the reporting is ensured (FCCC/ARR/2012/BEL). The ERT reiterates the recommendation in previous review reports that the Party provide clearer information in the NIR on the methodology used, including justification for the oxidation factor applied. The ERT also reiterates the encouragement that Belgium develop plant-specific EFs (FCCC/ARR/2012/BEL). The ERT recommends provision of information on CH_4 analysis on the of ammonia scrubber (FCCC/ARR/2012/BEL). 2013 ARR not yet available.	The NIR methodology descriptions refer to CO_2 recovery flow measurement The NIR confirms that an oxidation factor is no longer used. The NIR provides information on ammonia scrubber CH_4 (NIR 2014: Section 4.3.2.1. Ammonia production).
Denmark	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/DNK). 2013 ARR not yet available.	No follow-up necessary.
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/FIN)	No follow-up necessary.
France	The ERT recommends that France revise the calculations and report transparently on these issues (FCCC/ARR/2012/FRA). 2013 ARR not yet available.	The NIR provides some details in section 2B1_ammonia de l'annexe 3.
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/DEU)	No follow-up necessary.
Greece	The ERT recommends that the Party complete the ongoing work to obtain more accurate data on the amount of liquid fuel used as feedstock and use the updated AD in the emission estimates in its next annual submission. (FCCC/ARR/2013/GRC)	To calculate the emissions for the missing years, communication with the one plant operating in Greece was performed to specify the liquid fuels used by the second plant. No recalculation has been completed , but it will be included in next submissions, when adequate data become available. NIR includes detailed plan of the ongoing improvement work.
Ireland	No recommendation for improvement of this	No follow-up necessary.

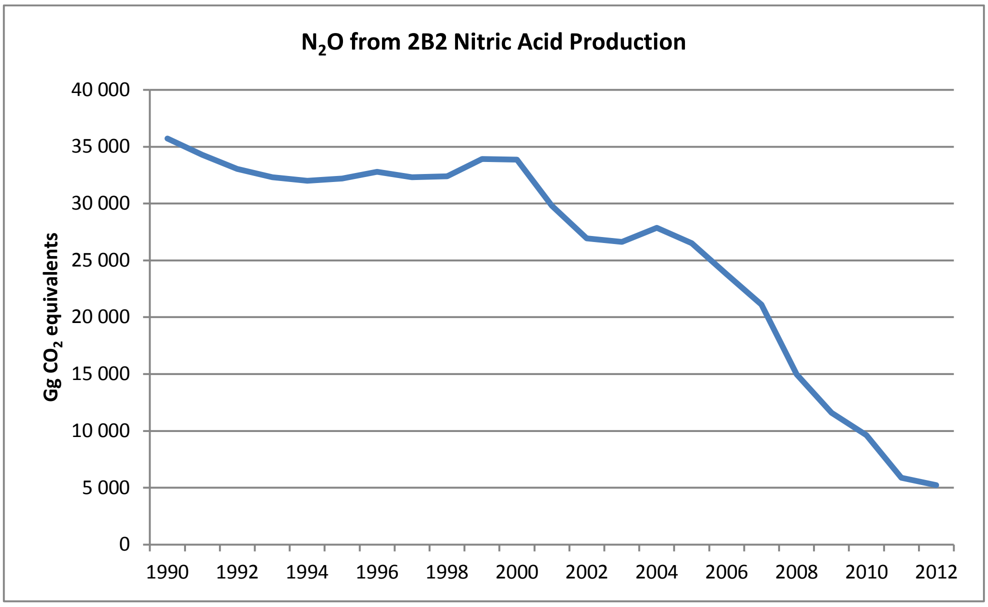
Member State	Review findings and responses related to 2B1 Ammonia Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
	source category in Annual Review Report (FCCC/ARR/2012/IRL). 2013 ARR not yet available.	
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/ITA)	No follow-up necessary.
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/LUX).	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/NLD)	No follow-up necessary.
Portugal	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/PRT). 2013 ARR not yet available.	No follow-up necessary.
Spain	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/ESP). 2013 ARR not yet available.	No follow-up necessary.
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/SWE).	No follow-up necessary.
UK	The ERT recommends that the United Kingdom report only the amount of natural gas used for ammonia production and provide clear explanations of the distribution of natural gas consumption for non-energy use by ammonia production plants (FCCC/ARR/2012/GBR). 2013 ARR not yet available.	NIR 2014 includes information on the feedstock use of natural gas, calculated by combining reported data on CO_2 produced, emitted and sold by the various ammonia processes. Where data are not available, they have been calculated from other data such as plant capacity or natural gas consumption.

Source: NIR 2014, UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php

4.2.2.2 2B2 Nitric Acid Production

N_2O emissions from 2B2 Nitric acid production account for 0.1 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source decreased by 85 % (Table 4.24). Germany (53%), France (10 %) and Belgium (13 %) accounted for 75 % of 2012 EU-15 emissions from this category. All Member States had reductions from this source between 1990 and 2012. The Netherlands and France had the greatest reductions in absolute terms, due to the implementation of technical measures at all Dutch nitric acid plants and due to the improvement of the process and catalyst efficiency in France. Production stopped in Denmark (middle of 2004) and ceased in Ireland in 2002 due to the insolvency of Irish Fertiliser Industries.

Figure 4.7 2B2 Nitric acid production: EU-15 N_2O emissions



The substantial decrease in N_2O emissions since 2006 is largely due to technical measures that have been implemented at all nitric acid plants. Special catalysts and improvement of the process efficiency led to a continuation of the trend in emissions. This trend of declining N_2O emissions continued between 2011 and 2012 with EU-15 emissions decreasing by 11 %. All Member States have seen decreases except for Austria, Belgium, Finland, Sweden and the Netherlands which all reported small emission increases in this period.

Table 4.24 2B2 Nitric acid production: Member States' contributions to N_2O emissions

Member State	N2O emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	912	48	53	1%	5	10%	-859	-94%	CS	PS
Belgium	3 562	625	681	13%	56	9%	-2 881	-81%	T3	PS
Denmark	1 043	NO	NO	-	-	-	-1 043	-100%	NA	NA
Finland	1 656	135	166	3%	31	23%	-1 489	-90%	T2	PS
France	6 570	670	500	10%	-170	-25%	-6 070	-92%	T2	PS
Germany	3 384	2 936	2 757	53%	-179	-6%	-627	-19%	T3	PS
Greece	1 109	475	307	6%	-168	-35%	-802	-72%	D	D
Ireland	1 035	NO	NO	-	-	-	-1 035	-100%	NA	NA
Italy	2 086	179	148	3%	-31	-17%	-1 938	-93%	T2	D,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	6 330	243	264	5%	21	9%	-6 066	-96%	T2	PS
Portugal	518	69	66	1%	-3	-5%	-452	-87%	D	PS
Spain	2 800	258	161	3%	-97	-38%	-2 639	-94%	T3	PS
Sweden	814	41	68	1%	27	65%	-746	-92%	T2	PS
United Kingdom	3 904	207	61	1%	-146	-71%	-3 843	-98%	CS	CS
EU-15	**35 723**	**5 886**	**5 231**	**100%**	**-655**	**-11%**	**-30 492**	**-85%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.25 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric Acid Production for 1990 to 2012. The table shows that all MS report Nitric Acid Production as activity data; for some MS this information is confidential (Netherlands and Portugal). The implied emission factors per tonne of nitric acid produced vary for 2012 between 0.0002 t N_2O/t of nitric acid produced for the UK and 0.0070 t N_2O/t of nitric acid produced for Greece. The EU-15 IEF (excluding Netherlands and Portugal) in 2012 is 0.0017 t N_2O/t of nitric acid produced. The decrease of the EU-15 IEF between 1990 and 2012 is mainly due to the implementation of improved abatement technologies in the different MS and the closure of some older plants. The table also shows that almost all EU-15 emissions are estimated with higher tier methods.

Table 4.25 2B2 Nitric Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

			1990				2012			
Member State	Method applied	Emission factor	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)
			Description	(kt)			Description	(kt)		
Austria	CS	PS	Nitric Acid Production	530	0.006	2.9	Nitric Acid Production	535	0.0003	0.2
Belgium	T3	PS	Nitric Acid Production	1436	0.008	11.5	Nitric Acid Production	1971	0.001	2
Denmark	NA	NA	Nitric Acid Production	450	0.007	3.4	Nitric Acid Production	NO	NO	NO
Finland	T2	PS	Nitric acid production medium pressure plants	549	0.01	5.3	Nitric acid production medium pressure plants	611	0.0009	0.5
France	T2	PS	Nitric Acid Production	3200	0.007	21.2	Nitric Acid Production	2178	0.0007	2
Germany	T3	PS	Nitric Acid Production	1698	0.006	10.9	Nitric Acid Production	2477	0.004	9
Greece	D	D	Nitric Acid Production	511	0.007	3.6	Nitric Acid Production	141	0.007	1
Ireland	NA	NA	Nitric Acid Production	339	0.01	3.3	Nitric Acid Production	NO	NO	NO
Italy	T2	D,PS	Nitric Acid Production	1037	0.006	6.7	Nitric Acid Production	431	0.001	0.5
Netherlands	T2	PS	Nitric Acid Production	C	C	20.4	Nitric Acid Production	C	C	0.9
Portugal	D	PS	Nitric Acid Production	C	C	1.7	Nitric Acid Production	C	C	0.2
Spain	T3	PS	Nitric Acid Production	1329	0.007	9.0	Nitric Acid Production	676	0.0008	0.5
Sweden	T2	PS	Nitric Acid Production	374	0.007	2.6	Nitric Acid Production	265	0.0008	0.2
UK	CS	CS	Nitric Acid Production	2408	0.005	12.6	Nitric Acid Production	1135	0.0002	0.2
EU15			**EU15 w/o NL and PT (81%)**	**13 861**	**0.0067**	**93**	**EU15 w/o NL and PT (95%)**	**10 420**	**0.002**	**16**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The implied emission factors for 2012 are significantly lower than in 1990 for all MS except for Greece. Explanations for the development of the implied emission factors are therefore given in the following overview. Besides implementing abatement measures, also the closure of older plants in Belgium, Denmark, Ireland, Italy and Sweden resulted in reduced emissions.

Implied Emission Factor, Belgium

The decrease in IEF was due to further introduction of catalysts in the different installations in the Flemish region. Since 2000 only one plant with 4 installations is still involved in this sector. From 2003 on lower emission factors in this plant are reported because of the gradually extension of the use of catalysts. This producer in the Flemish region has nowadays 4 installations involved and produces nitric acid via the dual pressure process (medium/high pressure) with SCR (emission of N_2O). In 2011 the lowest emission factor for the complete time series of 1.17 kg N_2O/ton HNO3 was registered in the Flemish region In the Walloon region, there is only one producer of nitric acid (one plant with 3 installations). Each year, this plant provides the N_2O emissions based on their production and on monitoring. The global emission factors used were 4.93 kg/t in 2008, 6.34 kg/t in 2009, 6.46 kg/t in 2010, 0.62 kg/t in 2011 and 0.68 kg/t in 2012. The drop of emissions from 2011 is explained by the placement of new catalysts on two installations at the end of 2010. The increase of the IEF in 2009 and 2010 is explained by an explosion in the plant in 2009 resulted in higher emissions in 2009 and 2010 as the control unit was out of order.

Implied Emission Factor, Austria

In Austria there is only one producer of nitric acid which operates two different dual pressure plants at one site. So called weak nitric acid is produced with a concentration of 59.6% HNO3 by oxidation of ammonia produced in the same location (Umweltbundesamt 2001(53)). There is no production of concentrated nitric acid in Austria. Nitric acid is mainly used for the production of fertilisers. The decrease of the IEF is due to the introduction of emission reduction measures: In 2001 a new catalyst was installed (IEF decreased from an average of 5.7 kg N_2O/t nitric acid, to about 5.0 kg N_2O/t nitric acid) and in 2004 a N_2O decomposition facility called Uhde process (EnviNO$_X$® process) was installed for the combined removal of N_2O and NO_X from the tail gas of nitric acid plants. (the IEF decreased from an average of 5.0 kg N_2O/t nitric acid, to about 1.6 kg N_2O/t nitric acid). In May 2009 a second catalyst in the nitric acid plant was installed, which fully operated from 2010. In 2011 saw further optimisation of the production process as well as slightly reduced activities. The increase of the IEF (increase of N_2O emissions despite lower activities) in 2012 can be attributed to a combination of various reasons with the last option being the predominant one: Reduced activity of the catalyst over time: Reduced activity of the catalyst at lower productivity, Emissions dependent on which of the two plants was in operation as their N_2O emissions differ. In 2012, N_2O emissions were 94% below the emissions in the base year. CO_2 emissions also varied over the period from 1990–2012, closely following the trend of nitric acid production until 1999. Specific emissions decreased since 2000 due to process optimisation.

Implied Emission Factor, France

IEF is calculated with activities and N_2O emissions reported under the E-PRTR. Between 2007 and 2008, reported N_2O emissions decreased due to improved processes and catalyst efficiency. In 2009 one older plant producing nitric acid was closed. Since 2002 the introduction of catalysts significantly reduced the IEF.

Implied Emission Factor, Finland

The decrease of the IEF after 2008 is due to the first joint implementation project in Finnish territory. This project aims on cutting down N_2O emissions of nitric acid plants and was started in 2009. A new N_2O abatement technology - a pelleted catalyst - was installed directly in the ammonia oxidation reactor underneath the ammonia oxidation catalyst (Pt-Rh) in all the three existing nitric acid plants which reduced emissions by 90 %.

Implied Emission Factor, Germany

A new plant started production that was built with the best available technology in 2002 and thus IEF significantly decreased from 2002 onwards. Further decreases of the IEF is due the use of reduction techniques from 2006 onwards. Up to 2006, production quantities correlated with the N_2O emissions. Subsequently, a decoupling of production quantities and N_2O emissions has become apparent that is due to use of emissions-reduction equipment.

Implied Emission Factor, Italy

In 2008 the implementation of catalyst N_2O abatement technology in one of the major production plants (i.e. in one unit of that plant) has led to a significant decrease in total N_2O emissions from nitric acid production, consequently a relevant reduction in the IEF can be observed too (YARA, several years) the implied emission factor for 2008 is in fact 2.29 kg N_2O/Mg nitric acid production (the abatement rate in one plant was 82% so far); in 2010 the implied emission factor is 1.21 kg N_2O/Mg nitric acid production; the relevant decrease is due to the installation of the abatement technology in the other unit of the same producing facility and to the technical improvements implemented in 2011. Sampling circumstances at the facility may affect the reported N_2O emission values: sampling in times very close to catalyst exhaustion generally leads to higher N_2O concentration in the processes flue gases, this seems to have occurred for N_2O emissions in 2011 according to the operator.

Implied Emission Factor, Spain

The emission reduction since 2010 is due to the installation of secondary reduction technologies in three of the four plants with medium pressure. The effective implementation of the technologies was in 2010 for two plants and in 2009, 2010 and 2011 for the third plant. With 2012 being the first year in which all three plants work at medium pressure with reduction techniques implemented permanently (note that the emission/production ratio decreases during the year in which the reduction techniques are implemented reaching the lowest ratio in 2012). The reduction technologies consist of additional catalysts that were installed in the reactors for ammonia oxidation which allows a catalytic destruction of N_2O.

Implied Emission Factor, Sweden

The IEF of Sweden decreased from 2006 to 2007, then emissions increased again until 2009 followed by a sharp decrease between 2010 and 2011. The higher N_2O implied emission factor in 2009 is due to that the N_2O reduction catalysts were not used during 2009. This was because 2009 was set as base year in a joint implementation project with the aim to reduce N_2O emissions. For some months in 2010 N_2O-reducing catalysts were used again, now in both production units at the facility. In one of the production units the catalyst was used from March and in the other unit from December. The fact that the catalysts were not used not during all months of the year is the reason for the higher implied emission factor in 2010 compared to 2007 and 2008. From 2011 and onwards the catalysts in both production units were used over the whole year with a significant decrease of N_2O emissions compared to earlier years.

Implied Emission Factor, United Kingdom

The larger of the two remaining UK plants was fitted control equipment to reduce N_2O emissions in early 2011, leading to the large decreases in the aggregate EFs for both pollutants in 2011 compared with the previous year.

Table 4.26 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from Nitric Acid Production.

Table 4.26 2B2 Nitric Acid Production: Summary of methodological information provided by Member States

Nitric Acid Production	
Member State	**Methodology comment**
Austria	Following the IPCC Guidelines and monitoring and reporting guidelines for the EU ETS, plant specific measurement data was collected. Activity and emission data of N_2O emissions was obtained directly from the plant operator. Since 1998, emissions are measured continuously. Based on the analysed emission data of 1998 and due to the fact that the production technology has not changed between 1990 and 1998 emission factors per ton of product were calculated for the used technologies. With these estimates of plant specific emission factors and the production volume of the individual plants the total emission of N_2O per year was calculated. [NIR 2014]
Belgium	N_2O emissions from the production of nitric acid are estimated in Flanders until 2002 by using an emission factor of 8 kg N_2O/ton HNO3 from CITEPA [2]. Nitric acid plants in Flanders agreed with this factor of 8 kg N_2O/ton HNO3 since 1990 and provide nitric acid production figures each year. From 2003 lower emission factors are reported because of increasing use of catalysts. Emissions have been monitored since 2003 and the Flemish region producer produces nitric acid via the dual pressure process (medium/high pressure) with SCR (emission of N_2O). After the closure of 2 plants in the Flemish region, in 1995 and in 2000 respectively, the production of nitric acid stabilized more or less after 2000, until 2008 and emissions of N_2O decreases over time due to abatement measures. 2009 was an exception due to the economic crisis and in the year 2010 an increase of 37% compared to 2009. In 2011 the lowest emission factor for the complete time series of 1.17 kg N_2O/ton HNO3 was registered in the Flemish region. In the Walloon region, there is only one producer of nitric acid (one plant with 3 installations). Each year, this plant provides the N_2O emissions based on their production and on monitoring. The global emission factor used was 4.93 kg/t in 2008, 6.34 kg/t in 2009, 6.46 kg/t in 2010, 0.62 kg/t in 2011 and 0.68 kg/t in 2012. This drop of the emissions in 2011 is explained by the placement of new catalysts on two installations at the end of 2010. The increase of the IEF in 2009 and 2010 is explained by an explosion in the plant in 2009 resulted in higher emissions in 2009 and 2010 as the control unit was out of order. No emission factors and N_2O emissions are presented by region as there is only one company. [NIR 2014]
Denmark	The N_2O emission from the production of nitric acid/fertiliser is based on measurement for 2002. For the previous years, the N_2O emission has been estimated from annual production statistics from the company and an emission factor of 7.5 kg N_2O/tonne nitric acid, based on the 2002 emission measured. The production of nitric acid ceased in mid-2004. [NIR 2014]
Finland	Statistics Finland co-operates with the nitric acid manufacturers to produce the annual emission estimates. For emissions in 1990–2004 the procedure was as follows: the manufacturers provided the activity data and emission factors, and Statistics Finland carried out the calculations using an agreed methodology that corresponds to the IPCC Good Practice Guidance equation 3.9. Starting from the inventory year 2005 both emissions and activity data have been received from the Vahti system. Currently it is the specific emission factors rather than emissions that are calculated by the inventory unit. Since 2009 all existing nitric acid plants have been equipped with automatic systems according to EU standards to measure the project key parameters. The plant-specific project emission factor representing the average N_2O emissions per tonne of nitric acid over the respective verification period is derived by dividing the total mass of N_2O emissions by the total output of 100% concentrated nitric acid for that period. Before 2009, only one of the three plants was equipped with a continuous N_2O emission measurement unit. From 2005 the

Nitric Acid Production	
Member State	**Methodology comment**
	company used also a portable measurement device at the other two plants. A consultant made periodically measurements at the plants in 1999–2004. No measurements are available prior to 1999. The annual nitric acid and fertiliser production figures have been obtained from the production plants or from the Vahti system [NIR 2014]
France	L'UNIFA reported emissions for each plant for the years 1990, 1998 , and 2001. For the intermediate years, only a global balance for all plants was provided. These data were compared with data reported in environmental declarations of industry. Since 2002 annual plant-specific data is available and good practice guidance for the estimation was adopted by AFNOR. The emissions are based on measurements and are annually verified by competent authorities. [NIR 2014]
Germany	As of the 2010 reporting round, and in keeping with the IPCC Guidelines, nitric-acid production is now reported plant-specifically, in accordance with the Tier 3 standard. This is being carried out on the basis of a co-operation agreement with the relevant plant operators for delivery of plant-specific data. [NIR 2014]
Greece	Estimation is based on IPCC default methodology. Estimates are based on activity data from El.Stat and the individual industrial units for 1990-2012 and average IPCC default EF (IPCC GPG 2000). Since 2006 there is only one unit producing nitric acid in Greece therefore, data are sent directly to the inventory team by the unit. No N_2O abatement technologies are used. [NIR 2014]
Ireland	Nitric acid production ceased in 2002 with the liquidation of Irish Fertilizer Industries. For the years 1990-1995, the inventory agency received direct correspondence from the plant operator specifying the quantities of nitric acid produced and the company's estimates of N_2O emitted during the production process. The emissions were estimated from nitrogen loading and the type of catalyst used in the process. [NIR 2014]
Italy	Nitric acid production (2B2), production figures at national level are published in the national statistical yearbooks (ISTAT, several years), while at plant level they have been collected from industry (Norsk Hydro, several years; YARA, several years; Radici Chimica, several years). In 1990 there were seven production plants in Italy; three of them closed between 1992 and 1995, and another one closed in 2004, one more closedown in 2008 has left two plants still operating. The N_2O average emission factors are calculated from 1990 on the basis of the emission factors provided by the existing production plants in the national EPER/E-PRTR registry, applied for the whole time series, and default IPCC emission factors for low and medium pressure plants attributed to the plants, now closed, where it was not possible to collect detailed information. Thus, N_2O emissions are estimated at plant level also considering the operating unit level, if necessary. Activity data have been collected at plant level for the whole time series. Unit specific default IPCC EFs have been used for plants closed in the nineties because it was not possible to collect more detailed information. For the other plants, data supplied in the framework of the EPER/EPRTR registry have been used from 2001 onwards, while for the years 1990-2000 EFs at unit level have been calculated as an average of 2001-2004 data provided by operators in the EPER/EPRTR register. The implied emission factor varies year by year depending on the production levels of the different plants and it was equal to 6.49 and 7.07 kg N_2O/Mg nitric acid production, in 1990 and in 2007 respectively. Catalyst N_2O abatement technology in one of the major production plants(i.e. in one unit of that plant) has led to a significant decrease in total N_2O emissions from nitric acid production, and a reduction in the IEF (YARA,

Nitric Acid Production	
Member State	**Methodology comment**
	several years). The implied emission factor for 2008 is 2.29 kg N_2O/Mg nitric acid production (the abatement rate in one plant was 82%). In 2010 the implied emission factor is 1.21 kg N_2O/Mg nitric acid production; the relevant decrease is due to the installation of the abatement technology in the other unit of the same producing facility (Radici Chimica, 2013) and to the technical improvements implemented in 2011 (Radici Chimica, 2014). [NIR 2014]
Luxembourg	Not occurring. [NIR 2014]
Netherlands	Activity data are confidential. An IPCC Tier 2 method is used to estimate N_2O emissions. The emission factors are based on plant-specific measured data which are confidential. The emissions are based on data reported by the nitric acid manufacturing industry and are included in the emission reports under EU ETS and the national Pollutant Release and Transfer Register (PRTR). [NIR 2014]
Portugal	Only three industrial plants produced nitric acid in Portugal between 1990 and 2011. All produce weak nitric acid (60 percent) from ammonia, using catalytic (Platinum-rhodium alloy catalysts) oxidation of ammonia with air to NO2 at medium pressure, and subsequent absorption with water to form nitric acid in a dual stage process. EFs were estimated based on monitoring data from the facilities and are confidential. Activity Data is obtained directly from the facilities. One of the plants was replaced by a new facility in 2010.[NIR 2014]
Spain	The nitric acid production figures used as the activity variable for emissions estimates have been obtained from data furnished by the manufacturing plants themselves for 1990 and 2008-2012, and from information contributed by the FEIQUE (the Business Federation of the Chemical Industry in Spain) and by the Ministry of Industry, Energy and Tourism (MINETUR) for the rest of the years in the period inventoried, broken down by plant and type of manufacturing process. AD differentiates data per plant, production types and processes. CS EF from plant-specific questionnaires are used taking into account technologies installed. Plant specific measurements are used for the N_2O emissions since 2008 which are gathered via questionnaires from the plants. Before 2008 plant-specific EFs for each plant are used. For the plants that closed an EF of 7 kg N_2O/t nitric acid was used based on information from the association from 1998. N_2O emission reduction technologies were implemented in the remaining plants in 2009, 2010 and 2011. [NIR 2014]
Sweden	Activity data, such as the produced amount of nitric acid, has been obtained from the facilities and from official statistics. Emission estimates of N_2O have been reported in the companies' environmental reports or have been provided by the facilities directly. Emission data are not available for all facilities for 1991-1993. Since two plants have been shut down, it is no longer possible to acquire this information. Calculations have therefore been made based on production statistics and an assumed emission factor. In 2012 the remaining facility completed a joint implementation project for catalytic reduction of nitrous oxide emissions from the nitric acid production. The project activity involved installation of a new N_2O abatement technology. This new abatement methodology is a combination of precious metal primary catalyst and secondary catalysts which are installed inside all of the Ammonia Oxidation Reactors, underneath the precious metal primary catalyst gauzes. The N_2O emissions are monitored using an automated system based on EU standards. [NIR 2014]

Nitric Acid Production	
Member State	**Methodology comment**
United Kingdom	Across the 1990-2012 time-series, the availability of emissions and production data for UK Nitric Acid (NA) plant is inconsistent, and hence a range of methodologies have had to be used to provide estimates and derive emission factors for this sector. Where possible, emission estimates are based on site-specific data provided by process operators. There have been nitric acid plants operating in England, Northern Ireland, and Scotland, although all production in Scotland ceased in the early 1990s. For plant in England, emissions data from plant operators are available for all sites from 1998 onwards from the EA's Pollution Inventory. For the single plant (now closed) in Northern Ireland, emissions data from plant operators became available from 2001. There is no site-specific data for any Scottish plants. Site-specific production estimates are largely based on production capacity reported directly by the plant operators. This approach may overestimate actual production. No data are available for three sites operating between 1990 and 1993, and production at these sites is calculated based on the difference between estimates of total production and the sum of production at the other sites. Emission estimates for N_2O are derived for each NA site using: a) Emissions data provided by the process operators directly or via the Pollution Inventory (1998 onwards for plant in England, 2001 onwards for plant in N Ireland); b) Site-specific emission factors derived from reported emissions data for the same site for another year (1990-1997 for some plant in England, 1994-1997 for other plant in England, 1990-2000 for plant in N Ireland); and c) A default emission factor of 6 kt N_2O /Mt 100% acid produced in cases where no emissions data are available for the site (some sites in England, Scotland, 1990-1993). This default factor is the average of the range quoted in IPCC Guidelines (IPCC, 1997) for medium pressure plant. At the end of 2012 nitric acid was being manufactured at 2 UK sites with a total of 4 production plants. At one site, the nitric acid production plant has had NO_X/N_2O abatement fitted to all units since commissioning (pre-1990), whilst at the other UK production site, all three production lines have had nitrous oxide abatement retrospectively fitted during 2011. This has led to a notable reduction in the UK IEF for nitrous oxide emissions from nitric acid production in the UK between 2010 and 2011. [NIR 2014]

Source: NIR 2014.

Table 4.27 summarizes the recommendations from the 2011 and 2012 UNFCCC inventory reviews in relation to the category 2B2 Nitric Acid Production.

Table 4.27 2B2 Nitric Acid Production: Findings of the 2013 UNFCCC inventory reviews in relation to N_2O emissions and responses in 2014 inventory submissions

Member State	Review findings and responses related to 2B2 Nitric acid Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/AUT).	No follow-up necessary.
Belgium	Belgium reported in the NIR that the AD and emissions for this category are measured and that the global EF of 6.34 kg/t is used. However, it is not clear whether the emissions are measured or calculated on the basis of the global EF. In response to a question raised by the ERT during the review, the Party informed the ERT that the AD and emissions are measured by the plants themselves. The data are then submitted to the inventory agency for use in the preparation of the national inventory. The ERT recommends that Belgium provide transparent documentation on the method used to obtain the AD in the NIR of its next annual submission (FCCC/ARR/2012/BEL). 2013 ARR not yet available.	NIR Section 4.3.2.2. provides this information.
Denmark	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/DNK). 2013 ARR not yet available.	No follow-up necessary.
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/FIN)	No follow-up necessary.
France	The ERT recommends that the Party transparently report specific information on data collection from two plants, with respect to verified measured emissions and those calculated using the IEF (FCCC/ARR/2012/FRA). 2013 ARR not yet available.	The NIR provides some details in the annex: section OMINEA_2B2_nitric acid.
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/DEU)	No follow-up necessary.
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/GRC)	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/IRL). 2013 ARR not yet available.	No follow-up necessary.

Member State	Review findings and responses related to 2B2 Nitric acid Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/ITA)	No follow-up necessary.
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/LUX)	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/NDL)	No follow-up necessary.
Portugal	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/PRT). 2013 ARR not yet available.	No follow-up necessary.
Spain	The ERT recommends improving the transparency of the information provided in the next annual submission by finding alternative ways of reporting the necessary information without violating the existing rules on confidentiality (FCCC/ARR/2012/ESP). 2013 ARR not yet available.	Not yet addressed.
Sweden	According to the information provided by Sweden during the review, nitric acid is currently produced in atmospheric pressure and medium/high pressure plants. The emission estimates are based on a tier 3 method from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the 2006 IPCC Guidelines), using direct measurement data. The technology applied for abatement is a combination of precious-metal primary catalysts and secondary catalysts, with the N_2O emission levels monitored by an automated monitoring system that follows the guidance of the European Norm EN14181 (2004).6 The ERT recommends that Sweden elaborate on the above information in the NIR of its next annual submission, to the extent possible, while taking into account confidentiality restrictions, in order to more transparently explain the strong decreasing trends in the N_2O. (FCCC/ARR/2013/SWE)	Documentation has been received from the facility concerning production data, production capacity and abatement measures, used emission factors and the method used for estimating emissions as well as uncertainty in emission estimates. However, this information is confidential. The facility has in 2012 completed a joint implementation project for catalytic reduction of nitrous oxide emissions from the nitric acid production. The project activity involved installation of a new N_2O abatement technology. This new abatement methodology is a combination of precious metal primary catalyst and secondary catalysts which are installed inside all of the Ammonia Oxidation Reactors, underneath the precious metal primary catalyst gauzes. The N_2O emissions are monitored using an automated system based on EU standards.
UK	The ERT recommends that the United	NIR 2014 tables information on the

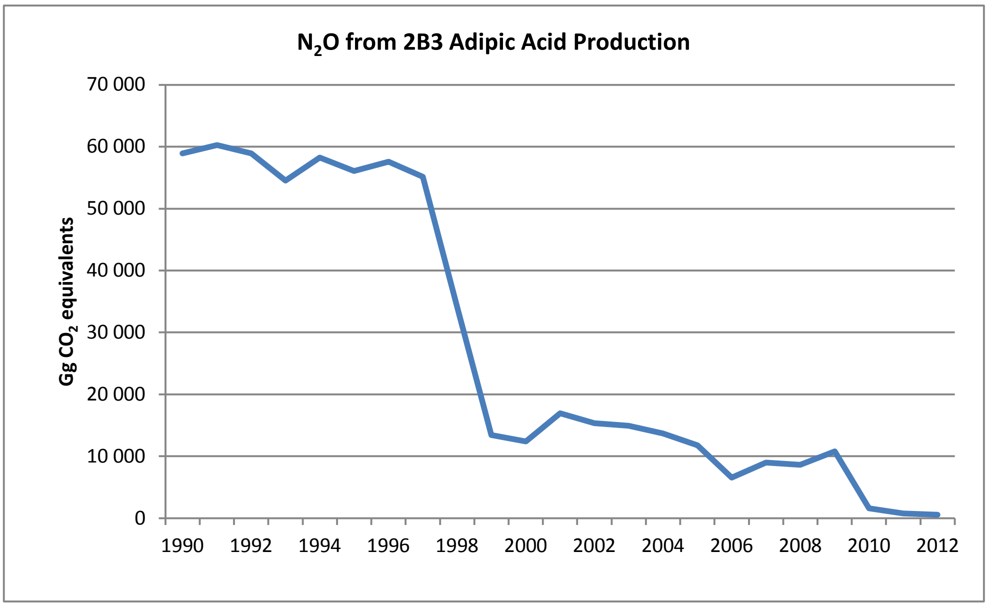
Member State	Review findings and responses related to 2B2 Nitric acid Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
	Kingdom improve the transparency of the NIR in its next annual submission by, for example, reporting the years when the plants closed and providing a table containing the AD and EFs to clearly show the impacts on the N_2O emission estimates. The ERT also recommends that the United Kingdom collect information on the methods used by the plant operators to estimate the N_2O emissions and ensure the consistency of the data reported across the entire time series (FCCC/ARR/2012/GBR). 2013 ARR not yet available.	number of plants and a summary of the approaches used across the time series to estimate production and N_2O emissions along with AD and EFs.

Source: NIR 2014, UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php

4.2.2.3 2B3 Adipic Acid Production

N_2O emissions from 2B3 Adipic Acid Production account for 0.01 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source decreased by 99 % (Figure 4.8). Only France, Germany and Italy produce adipic acid and all three countries were able to decrease emissions from this source category significantly due to the retrofitting of installations with abatement technologies (the UK produced adipic acid until 2009).

Figure 4.8 2B3 Adipic Acid Production: EU-15 N_2O emissions



During 1997 and 1999, N_2O emissions for EU-15 decreased significantly by 76 %. The countries' share in this change of emission trend was 43 % for Germany, 31 % for France and 28 % for the UK, whereas Italy increased its emissions during that time period and reduced its emissions significantly during 2005 and 2006 (-77%).

In Germany decomposition takes place nearly completely. At the end of 1997, both producers have put a catalytic reactor system into operation that, in constant operation, achieves an N_2O-

decomposition rate of 96-98 %. A N_2O abatement system was fitted to the single plant that produces adipic acid in 1998. The abatement system is a thermal oxidation unit and is reported by the operators to be 99.99 % efficient at N_2O destruction.

The only plant that produces adipic acid in France installed an abatement technique in 1998. A strong reduction was observed between 2003 and 2004 (more than 70 %) when a new treatment system was installed. Changes in the IEF after this period are due to the halt of the treatment system for maintenance or when it is out of order.

The decrease of N_2O emissions in Italy between 2005 and 2006 is the result of the application of the best available technique to reduce emission in the only existing adipic acid production plant. In 2004, the N_2O catalytic decomposition abatement technology has been tested so that the value of emission factor has been reduced taking into account the efficiency and the time, one month, that the technology operated. From the end of 2005 the abatement technology is fully operational; the average emission factor in 2006 is equal to 0.05 kg N_2O/kg adipic acid produced and the abatement system had been operating continuously for 9 months; since 2007 the average emission factor has been 0.03 kg N_2O/kg adipic acid produced and the operating time of the abatement system has been 11 months. Technical improvements in operating the production process and the abatement system have allowed achieving significant reduction in N_2O emissions since 2009 (Radici Chimica, 2013): in 2010 the average emission factor was 0.019 kg N_2O/kg adipic acid produced while in 2011 the average EF is 0.005 kg N_2O/kg adipic acid produced with the abatement rate exceeding 98%. (Table 4.28).

The increase of N_2O emissions between 2000 and 2001 and between 2006 and 2007 was dominated by the raise of emissions in Germany due to damaged abatement systems. During 2008 and 2009 German N_2O emissions from this source increased by 56 % because the exhaust air cleaning system of one producer in Germany was not working for a longer period of time. In 2008-2009, the largest reduction of emissions could be found for the UK. The UK's only remaining adipic acid plant closed in early 2009, and emissions have been zero since 2010.

Table 4.28 2B3 Adipic Acid Production: Member States' contributions to N_2O emissions

Member State	N2O emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	14 806	126	72	14%	-53	-42%	-14 733	-100%	T2	PS
Germany	18 805	522	371	70%	-151	-29%	-18 434	-98%	T3	PS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	4 579	116	86	16%	-30	-26%	-4 493	-98%	T2	D,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	20 737	NO	NO	-	-	-	-20 737	-100%	NA	NA
EU-15	**58 927**	**764**	**529**	**100%**	**-234**	**-31%**	**-58 397**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.29 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic Acid Production for 1990 to 2012. The table shows that in 2012 adipic acid was produced in only three MS. Adipic acid production is used as activity data but the information is confidential in France, Germany and the UK. The implied emission factors per tonne of adipic acid produced is only provided by Italy with 0.3 t/t for 1990 and 0.004 t/t for 2012. The table shows that in 2012 100 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.29 2B3 Adipic Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

			1990				2012			
Member State	Method applied	Emission factor	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)
			Description	(kt)			Description	(kt)		
France	T2	PS	Adipic acid production	C	C	48	Adipic acid production	C	C	0.2
Germany	T3	PS	Adipic acid production	C	C	61	Adipic acid production	C	C	1.2
Italy	T2	D,PS	Adipic acid production	49	0.30	15	Adipic acid production	79	0.00	0.3
UK	NA	NA	Adipic acid production	C	C	67	Adipic acid production	NO	C	NO
EU15			**EU15**			**190**	**EU15**			**1.7**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.30 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from adipic acid production.

Table 4.30 2B3 Adipic Acid Production: Summary of methodological information provided by Member States

Adipic Acid Production	
Member State	**Methodology comment**
France	There is only one production site in France. Emissions are based on plant-specific data. Good practice guidance for the emissions measurement and estimation at plant level have been developed and approved by AFNOR. Since 1998 an abatement system is installed that destroys N_2O using absorption which is synthesizing nitric acid. The plant is equipped with a catalytic treatment of NO_X before the exhaust is emitted in the atmosphere. In regular situations emissions are continuously measured, in irregular situations, emissions are estimated based on a material balance [NIR 2014]
Germany	"Until around the mid-1990s, producers provided data only on amounts produced. The IPCC default emission factors have been used to calculate nitrous oxide emissions for that period. For the subsequent period, in addition to reporting their production figures, producers also confidentially reported their N_2O emissions, along with necessary background information. This fact is highly significant with regard to the precision of the reported data; without data on technically unavoidable N_2O production, and – especially – without information as to the operating period of the relevant decomposition facilities, estimates of the reduction in nitrous oxide emissions would have been so imprecise that it would have been necessary to continue using the default EF. [NIR 2014]
Italy	Italian production figures and emission estimates for adipic acid have been provided by the process operator (Radici Chimica, several years) for the whole time series. Emissions estimates provided by the operator are based on the IPCC default EF. More specifically, N_2O emissions from adipic acid production (category 2B3) have been estimated using the default IPCC emission factor equal to 0.30 kg N_2O/kg adipic acid produced, from 1990 to 2003. Since 2004 the operator has started to study how to introduce an abatement system; although emission estimates provided by the operator have still been based on the IPCC default emission factor (0.30 kgN_2O/kg adipic acid produced), the operating hours of the abatement system and the abatement rates have also been included in the estimation process. The abatement system is generally run together with the adipic acid production process. In 2004, the N_2O catalytic decomposition abatement technology has been tested so that the value of emission factor has been reduced taking into account the efficiency and the time, one month, that the technology operated. From the end of 2005 the abatement technology is fully operational; the average emission factor in 2006 is equal to 0.05 kg N_2O/kg adipic acid produced and the abatement system had been operating continuously for 9 months; since 2007 the average emission factor has been 0.03 kg N_2O/kg adipic acid produced and the operating time of the abatement system has been 11 months. Technical improvements in operating the production process and the abatement system have allowed achieving significant reduction in N_2O emissions since 2009 (Radici Chimica, 2013): in 2010 the average emission factor was 0.019 kg N_2O/kg adipic acid produced while in 2011 the average EF is 0.005 kg N_2O/kg adipic acid produced with the abatement rate exceeding 98%. Thus, both for the period 1990-2005 and from 2006 onwards the estimates are provided according to the GPG (default EF has been used when no abatement system was operational; abatement rates have been considered in estimating emission values since 2006). The operator reports also under EPER/E-PRTR both adipic acid production and the N_2O emissions related to this production; adipic production and N_2O emissions have been also reported by the operator to the national competent authority for the ETS (because the facility will join the ETS system in 2013) together with additional information such as abatement rates and operating times. Based on information from the national PRTR EFs are calculated for the plant, the resulting value is checked and verified by the formula included in the following box

Adipic Acid Production	
Member State	**Methodology comment**
	(based on the IPCC default EFs for adipic acid production, abatement rate and operating time of the abatement technology at the facility). In the formula the average emission factor is calculated subtracting from the default EF (0.300 kgN_2O /kg adipic acid produced) the default EF multiplied by the abatement technology rate and by the operating time factor, parameters and resulting EF values are indicated for the years 2005 to 2012. The EFs submitted for the adipic acid production in the CRF and the EFs calculated for the plant in the following box are practically the same. [NIR 2014]
United Kingdom	There was only one company manufacturing adipic acid in the UK, but this closed in early 2009. Production data and emission estimates have been estimated based on data provided by the process operator (Invista, 2010). The emission estimates are based on the use of plant-specific emission factors for unabated flue gases, which were determined through a series of measurements on the plant, combined with plant production data and data on the proportion of flue gases that are unabated. In 1998 an N_2O abatement system was fitted to the plant. The abatement system was a thermal oxidation unit and was reported by the operators to be 99.99% efficient at N_2O destruction. The abatement unit was not available 100% of the time, and typically achieved 90-95% availability during adipic acid production. A small nitric acid plant was associated with the adipic acid plant, and this also emitted N_2O. From 1994 until the plant's closure in 2009, the emission from the nitric acid production is reported under 2B2, but prior to 1994 it is included under adipic acid production because separate emissions data for the different processes on that site were not available for those years. This discrepancy in reporting will cause a variation in the reported effective emission factor for these years for 2B2 and 2B3 but overall emission estimates are not affected. [NIR 2014]

Source: NIR 2014

Table 4.31 summarizes the recommendations from the 2013 UNFCCC inventory reviews in relation to the category 2B3 Adipic Acid Production.

Table 4.31 2B3 Adipic Acid Production: Findings of the 2013 UNFCCC inventory reviews in relation to N_2O emissions and responses in 2014 inventory submissions

Member State	Review findings and responses related to 2B3 Adipic Acid Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	**Status in 2014 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/AUT).	No follow-up necessary.
Belgium	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/BEL). 2013 ARR not yet available.	No follow-up necessary.
Denmark	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/DNK). 2013 ARR not yet available.	No follow-up necessary.
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/FIN)	No follow-up necessary.
France	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/FRA). 2013 ARR not yet available.	No follow-up necessary.

Member State	Review findings and responses related to 2B3 Adipic Acid Production	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
Germany	The emissions from adipic acid production included in the inventory for 1990 until the mid-1990s are based on IPCC default EFs and the amount of adipic acid produced, obtained from the producers. Thereafter, the emission estimates reported are based upon emission data reported by the plants. Production data and IEFs are reported as confidential. In response to a question raised by the ERT during the previous review, Germany provided the confidential production data and the time series for the calculated IEFs based on reported total emissions and production for the category. The three facilities producing adipic acid have installed abatement technologies. The ERT reiterates the recommendation made in the previous review report that Germany improve the description of the methodological issues for the calculation of the N_2O emissions (e.g. precisely for which years the IPCC default EF is used, and the methods used to calculate N_2O emissions at each plant) in its NIR, to improve transparency. (FCCC/ARR/2013/DEU).	No follow-up necessary.
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/GRC)	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/IRL). 2013 ARR not yet available.	No follow-up necessary.
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2012/ITA)	No follow-up necessary.
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/LUX)	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/NDL)	No follow-up necessary.
Portugal	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/PRT). 2013 ARR not yet available.	No follow-up necessary.
Spain	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/ESP). 2013 ARR not yet available.	No follow-up necessary.
Sweden	No recommendation for improvement of this source category in Annual Review Report. (FCCC/ARR/2013/SWE)	No follow-up necessary.
UK	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/GBR). 2013 ARR not yet available.	No follow-up necessary.

Source: NIR 2014, UNFCCC inventory review reports, as published at UNFCCC:

http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php

4.2.2.4 2B5 Other Chemical Industry

CO_2 emissions from 2B5 Other account for 0.41 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from this source increased by 40 % (Figure 4.8). Germany is responsible for 61.3 % of these emissions in the EU-15, followed by the UK (11.4 %), Belgium (6.4 %), France (5.0 %),Finland (5.0 %) the Netherlands (4.0%) and Italy (3.3 %). Between 1990 and 2012 Germany had the largest growth of emissions in absolute terms due to the increased production of methanol and a new producer for carbon black, although there has been a small decrease since 2011. Between 2011 and 2012, CO_2 emissions from this source decreased by 3 % with Belgium and Italy contributing the largest decreases.

Figure 4.8 2B5 Other: EU-15 CO_2 emissions

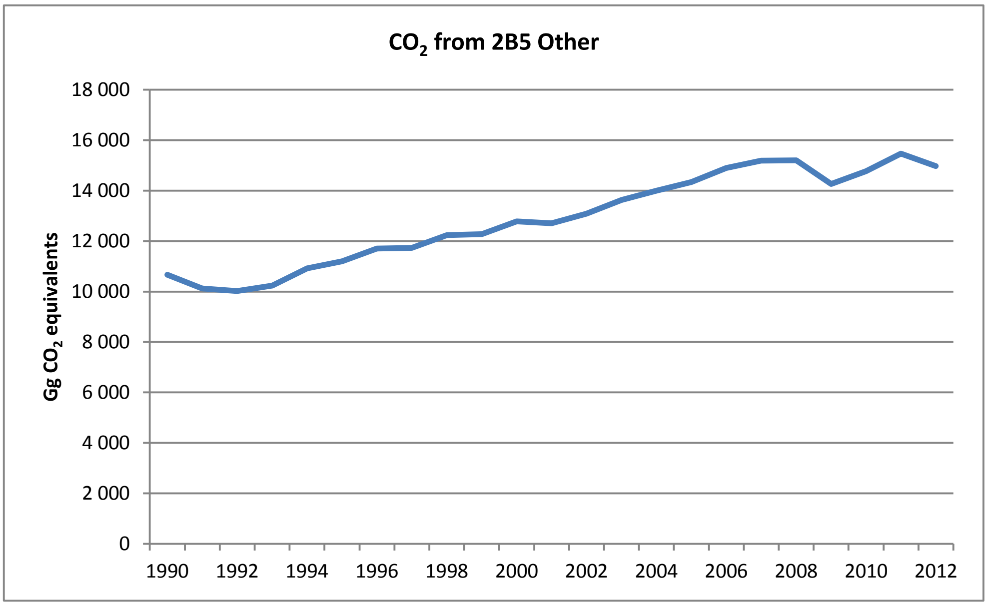


Table 4.32 2B5 Other: EU-15 CO_2 emissions – emission trends between 1990 and 2012 and MS contribution

Member State	2.B.5 Other	CO_2 emissions [Gg]	CO_2 emissions [Gg]	CH_4 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	N_2O emissions [Gg]
		1990	2012	1990	2012	1990	2012
AT	5. Other (please specify)	31	28	1	1	NA,NO	NA,NO
	CO2 from nitric acid production	0	0	NO	NO	NO	NO
	Other Chemical Industry	30.5	27.8	0	0	NA	NA
BE	Other non-specified	224.19	953.13	NA	0.20	0.03	0.06
DK	5. Other (please specify)	1	1	NA,NO	NA,NO	NA,NO	NA,NO
	Catalysts/Fertilizers	0.80	1.41	NA	NA	NA	NA
FI	5. Other (please specify)	107	726	NA,NO	NA,NO	NA,NO	NA,NO
	chemicals production	24.4	7.5	NO	NO	NO	NO
	Hydrogen	57.9	676.5	NO	NO	NO	NO
	Phosphoric Acid Production	24.5	42.4	NO	NO	NO	NO
FR	5. Other (please specify)	805	743	4	2	10	1
	Ethylene	IE	IE	2.18	1.24	NA	NA
	2.B.5.6 Glyoxylic Acid Production	NA	NA	NA	NA	8.64	0.83
	2.B.5.7 Anhydrid Phtalic Production	30.08	28.62	NA	NA	NA	NA
	2.B.5.8 Other non-specified	775.32	714.72	1.49	0.76	1.75	0.25
DE	Calcium Carbide	443	10	NO	NO	0	0
	5. Other (please specify)	6888	9185	0	0	1	C,IE,NA,NO
	Carbon Black	786.68	1809.10	0.01	0.03	0.00	0.00
	Methanol	848.38	648.20	NO	NO	0.00	0.00
	Caprolactam	NA	NA	NA	NA	0.74	NO
	Catalytic Burning	2553.11	2952.25	NA	NA	NA	NA
	Conversion loss	2700.00	3775.71	NO	NO	NO	NO
GR	5. Other (please specify)	NA,NE,NO	323	0	NA,NO	NA,NO	NA,NO
	Hydrogen Production	NA	323.290	NA	NA	NA	NA
	Organic chemicals production	NE	NE	0.025	NO	NA	NA
IE	5. Other (please specify)	NO	NO	NO	NO	NO	NO
IT	5. Other (please specify)	474.85	492.89	2.45	0.26	0.04	NA,NO
	Carbon Black	422.05	440.06	1.84	0.10	0.00	0.00
	Propylene	NA	NA	0.07	0.06	NA	NA
	Titanium Dioxide Production	53	53	NA	NA	NA	NA
LU	Carbon Black	0	0	NO	NO	0	0
NL	Calcium Carbide	NO	NO	NO	NO	0	0
	5. Other (please specify)	649	631	11	11	2	3
	Carbon Black	0.0	0.0	1.5	0.7	0.0	0.0
	Ethylene	IE	IE	2.9	4.6	NO	NO
	Styrene	0.0	0.0	5.3	5.3	0.0	0.0
	Methanol	0.0	0.0	1.7	0.7	0.0	0.0
	Carbon electrodes	54.6	75.0	NO	NO	NO	NO
	Ethene oxide production	127.7	178.0	NO	NO	NO	NO
	Graphite	33.0	20.6	NO	NO	NO	NO
	Other Chemical Industry	433.2	357.5	NO	NO	NO	NO
PT	Carbon Black	50.6	64.1	0.2	0.2	0.0	0.0
	Ethylene	7.2	8.4	0.2	0.2	NO	NO
	Ammonium sulphate	0.1	0.0	NO	NO	NO	NO
	Monomer and polymer production	2.0	2.1	NO	NO	NO	NO
	Production of Explosives	3.6	NO	NO	NO	NO	NO
ES	Silicon Carbide	41	43	0	0	0	0
	Calcium Carbide	35	21	NA	NA	0	0
	5. Other (please specify)	NA	NA	2	2	NA	NA
	Carbon Black	0	0	1	1	0	0
	Ethylene	NA	NA	1	1	NA	NA
	5. Other (please specify)	NA	NA	2	2	NA	NA
	Carbon Black	0.00	0.00	0.71	0.59	0.00	0.00
	Ethylene	NA	NA	1.03	1.13	NA	NA
	Dichloroethylene	0.00	0.00	NA	NA	0.00	0.00
SE	4. Carbide Production	54	24	NA,NO	NA,NO		
	Calcium Carbide	54	24	NA	NA	0	0
	5. Other (please specify)	72	107	0	0	0	0
	Base chemicals for plastic industry	NA	NA	NE	NE	0	0.00003
	Other inorganic chemical prod	34	60	0.34	0.32	0.01	0.00
	Other non-specified	NA	NA	NE	NE	NE	NE
	Other organic chemical prod	38	47	0.025	0.031	NA	NA
	Pharmaceutical industry	NA	NA	NE	NE	0.050	0.018
GB	Calcium Carbide	NO	NO	NO	NO	0	0
	5. Other (please specify)	1350	1709	8	4	NA,NO	NA,NO
	Ethylene	IE	IE	0.612	1.570	NO	NO
	Methanol	0.000	0.000	0.030	NO	0.000	0.000
	Carbon from NEU products	1350.493	1709.264	NA	NA	NA	NA
	Chemical Industry (Other)	NA	NA	7.426	2.350	NA	NA

For an overview of sources and MS trend developments at disaggregate level for source 2B5 see Table 4.32. Due to the heterogeneity of emission sources in this category, it is difficult to interpret the EU-15 trend in a meaningful way.

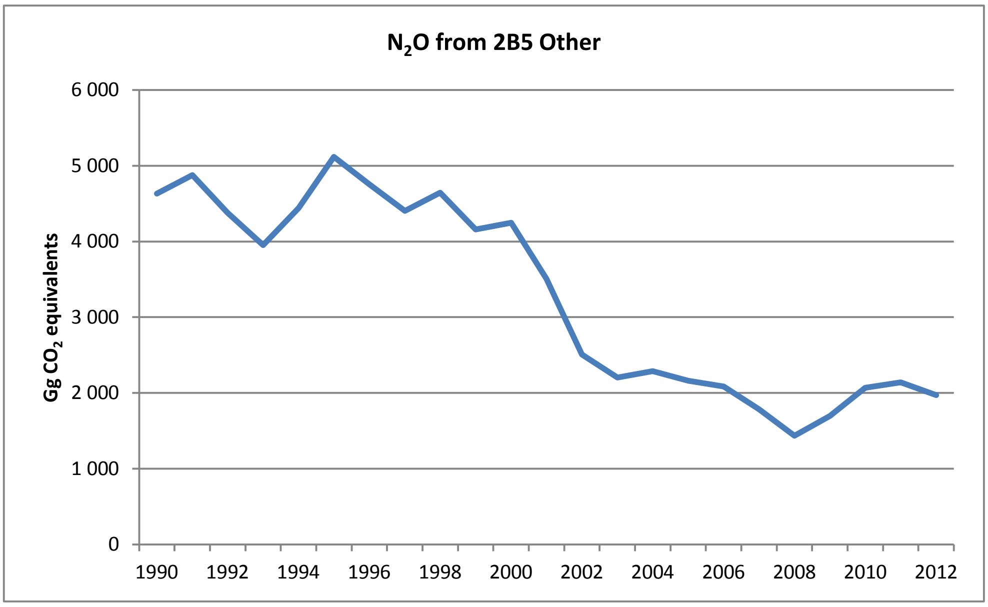
Table 4.33 2B5 Other: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	31	26	28	0.2%	2	7%	-3	-9%	CS,T3	CS,PS
Belgium	224	1 169	953	6.4%	-216	-18%	729	325%	T3	PS
Denmark	1	1	1	0.01%	0.02	1%	1	76%	CS	D
Finland	107	706	726	4.9%	20	3%	620	580%	CS,T2	CS,PS
France	805	827	743	5.0%	-84	-10%	-62	-8%	T2	PS
Germany	6 888	9 212	9 185	61.3%	-27	-0.3%	2 297	33%	CS,T2	CS,D
Greece	NA,NE,NO	322	323	2.2%	1	0.4%	323	-	T1	CS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	475	603	493	3.3%	-110	-18%	18	4%	D,T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	649	696	631	4.0%	-65	-9%	-17	-3%	CS,T1	CS,D,PS
Portugal	63	106	75	0.5%	-32	-30%	11	18%	D	CS
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	72	104	107	0.7%	3	3%	35	49%	CS	PS
United Kingdom	1 350	1 698	1 709	11.4%	11	1%	359	27%	CS	CS,OTH
EU-15	**10 666**	**15 471**	**14 976**	**100.0%**	**-495**	**-3%**	**4 310**	**40%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B5 Other account for 0.05 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source decreased by 57 % (Table 4.34). The Netherlands, Belgium and France are responsible for almost all of these emissions in the EU-15. Between 2011 and 2012, N_2O emissions from this source decreased by 8 % with most of the decrease in France.

Figure 4.9 2B5 Other: EU-15 N_2O emissions



In the last two years N_2O emissions from this source from Belgium and the Netherlands have exceed those from France.

N_2O emissions in Belgium increased between 1990 and 2012, especially in 2007. Emissions of N_2O originate mainly from the production of caprolactam. Only one company is involved in Belgium in the Flemish region and since 1997 this company offers each year the results of the monitoring carried out. N_2O emissions increased again by 31% between 2009 and 2010 in the Flemish region due to strong increase of production of caprolactam in that period. There was a 6% change between 2010 and 2011 with very little change in 2012.

Table 4.34 2B5 Other: Member States' contributions to N_2O emissions

Member State	N2O emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	381	775	774	39%	-1	-0.1%	393	103%
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
France	3 220	488	334	17%	-154	-32%	-2 887	-90%
Germany	231	C,IE,NA,NO	C,IE,NA,NO	-	-	-	-231	-100%
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	11	NA,NO	NA,NO	-	-	-	-11	-100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	766	870	856	43%	-14	-2%	89	12%
Portugal	0.03	0.1	0.04	0.002%	-0.02	-33%	0.01	27%
Spain	NA	NA	NA	-	-	-	-	-
Sweden	22	8	6	0.3%	-1	-16%	-15	-70%
United Kingdom	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-15	**4 631**	**2 141**	**1 970**	**100%**	**-171**	**-8%**	**-2 661**	**-57%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.35 provides an overview of all sources reported under 2B5 Other Chemical Production by EU-15 Member States for the year 2012 and for all gases. The largest contributor to the total EU-15 emissions is Germany. A detailed overview of the estimated emission sources and the methodologies used is provided in Table 4.36.

Table 4.35 2B5 Other: Overview of sources reported under this source category for 2012

Member State	2.B.5 Other Chemical Industry	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	Ethylene, Other chemical industry, CO2 from nitric acid production	28	0.8	NA,NO	45	0.3%
Belgium	Caprolactam Production, Other chemical production	953	0.2	2	1 732	10%
Denmark	Catalysts/Fertilizers, Pesticides and Sulphuric acid	1	NA,NO	NA,NO	1	0.01%
Finland	Hydrogen, chemicals production	726	NA,NO	NA,NO	726	4%
France	Ethylene, Styrene, Glyoxylic acid production, Anhydrid Phtalic Production, Other chemical production	743	2	1	1 119	6%
Germany	Carbon Black, Methanol, Caprolactam, Catalytic Burning, Conversion loss, N-Dodecandiacid	9 185	0.03	C,IE,NA,NO	9 186	53%
Greece	Organic chemicals production	323	NA,NO	NA,NO	323	2%
Ireland		NO	NO	NO	-	0%
Italy	Carbon Black, Ethylene, Dichloroethylene, Styrene, Titanium Dioxide Production, Propylene, Caprolactam	493	0.3	NA,NO	498	3%
Luxembourg		NO	NO	NO	-	0%
Netherlands	Carbon Black, Ethylene, Styrene, Methanol, Graphite, Caprolactam, Other chemical industry, Carbon electrodes, Ethene oxide production	631	11	3	1 726	10%
Portugal	Carbon Black, Ethylene, Ammonium sulphate, Monomer and polymer production, Production of explosives	75	0.4	0.0	83	0.5%
Spain	Carbon Black, Ethylene, Styrene	NA	2	NA	36	0.2%
Sweden	Pharmaceutical industry, Other inorganic chemical production, Other organic chemical production, Base chemicals for plastic industry	107	0.3	0.0	121	0.7%
UK	Ethylene, Methanol, Chemical Industry (All), Carbon from NEU products	1 709	4	NA,NO	1 792	10%
EU-15 Total		**14 976**	**21**	**6**	**17 388**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In response to a recommendation by the ERT in its review report, the methodologies for the largest emission sources in this category are provided (FCCC/ARR/2008/EC, para 53). Table 4.36 gives an overview on the coverage of source categories and methodologies and data sources used by Member States for Other chemical production.

Table 4.36 2B5 Other Chemical Production: Summary of methodological information provided by Member States

Other Production	
Member State	**Methodology comment**
Austria	Production of Fertilizers and Urea: No IPCC methodology is available for these sources. Data for urea production were directly reported by the Austrian producer of urea and thus represent plant-specific data. The CH_4 emissions are calculated from the ammonia input in the urea production process and the methane content of the ammonia. CH_4 emissions from the production of urea were reported for the years 2002–2012. For earlier years, no data is available; therefore the implied emission factor for the year 2002 was used for all years. CO_2 emissions are reported by the operator since 1995. The IEF from this year was applied to calculate emissions from the previous years. Data for fertilizer production for 1990 to 1994 were taken from national statistics (STATISTIK AUSTRIA), for 1995 to 2012 production data were reported directly by the main producer of fertilizers in Austria. CH_4 emissions from the production of fertilizers were reported for the years 2002–2012; these data became available due to a measurement programme for CH_4 at the plant starting in 2002. Before no data is available; therefore the IEF for the year 2002 was used for all years. [NIR 2014]
	Ethylene Production: Emissions were estimated using the IPCC default methodology. Activity data are the capacity of the only ethylene producing plant in Austria and amount to 350 000 t Ethylene per year until 2005. In 2006 the capacity of the ethylene plant was expanded to 500 000 t. The IPCC default emission factor of 1 g CH_4/kg Ethylene production was used to calculate the emissions that amount to 350 tonnes CH_4 until 2005 and 500 tonnes CH_4 from 2006 onwards.[NIR 2014]
Belgium	The emissions of N_2O originate mainly from the production of caprolactam. Only one company is involved in Belgium in the Flemish region and since 1997 this company offers each year the results of the monitoring carried out (monthly measurements-gas analysing by using the gas chromatography - ECD method to determine the concentration of N_2O in the gas and estimate the emissions of N_2O.). This company estimated the emissions of the previous years from 1990 on as accurate as possible. There is a strong increase of emissions of N_2O between 2009 and 2010 due to strong increase of production of caprolactam in that period (+20%). [NIR 2014]
	Other process CO_2 emissions are reported by the chemical industry in Flanders (for example production of ethylene oxide, production of acrylic acid from propene, production of cyclohexanone from cyclo-hexane, production of paraxylene/meta-xylene production of carbon black etc.). These CO_2 emissions result from surveys in the chemical sector in Flanders. The emissions of this category are reported by the companies to the chemical federation (about 15 to 20 companies involved). The data fluctuate, since the processes included can fluctuate. The data are reported in an aggregated way by the chemical federation and need to be treated confidential; Since there is only one producer of carbon black in Belgium (Flemish region), emitting below the threshold value of 100 kton CO_2 and not (yet) obliged to report under the ETS-directive, no individual emissions of this plant are reported because of confidentiality. These emissions are consequently integrated in the category 2B5/other. [NIR 2014]
	The emissions of CO_2 originate from the production of 1,2 dichloromethane and vinyl chloride in the Walloon region. The CO_2 emissions decreases between 2008 and 2010 as the production of anhydride maleic and phtalic was stopped in 2009 in the Walloon region. The emissions are estimated by the chemical industry. [NIR 2014]

Other Production	
Member State	**Methodology comment**
	Some small process emissions of N_2O (maximum 25 kton CO_2 eq) and CH_4 (maximum of 11 kton CO_2 eq) mainly in the chemical industry in the Flemish region. These emissions are reported by the industry via their annual environmental emission reporting obligations and are small process emissions from 1) for N_2O: a naphtha cracker, emissions from waste gas combustion (containing NH_3 from the production process), emissions from purging of bottles and purifying of bulk product N_2O, and from 2) for CH_4: emissions from an adsorption system of an oxidation unit, process emissions of naphtha cracker and leak losses from a relax station of natural gas. [NIR 2014]
Denmark	The CO_2 emission from the production of catalysts/fertilisers is based on information in an environmental report from the company, combined with personal communication. In the environmental report, the company has estimated the amount of CO_2 from the process and the amount from energy conversion. Based on information from the company, the emission of CO_2 has been calculated from the composition of raw materials used in the production (for the years 1990 and 1996-2004). For 2005 the EF is assumed to be the same as in 2004 based on the same activity (produced amount). For the years 1991-1995, the production, as well as the CO_2 emission, has been assumed to remain the same as in 1990. The producer of catalysts/fertilisers is obliged to report energy related CO_2 emissions to EU-ETS but no the process related emissions. For the years 2006-2012 the process related emissions have been estimates as the difference between the total CO_2 emission reported by the company in yearly environmental reports and energy related CO_2 emissions reported by the company to EU-ETS. [NIR 2014]
Finland	Hydrogen Production: Emissions from hydrogen production are calculated by multiplying activity data with emission factors. Activity or emission data have been received directly from companies, a minor part of earlier years' data having been estimated. There are no default emission factors for hydrogen production in the 1996 IPCC GL, for which reason the stoichiometric ratio of chemical reactions is used. One company has a system to capture formed carbon dioxide for recovery and use. The transferred CO_2 is bottled and according to present knowledge is used in applications from which it is released to the atmosphere immediately or within a timeframe of some years after the transfer and therefore the transferred CO_2 is not deducted from the total emissions of this sub-category. The emission factor for calculating emissions from hydrogen production is based on the stoichiometric ratios of chemical reactions. The consumption of hydrocarbons is used as activity data in calculating emissions from hydrogen production. The feedstocks used are natural gas, naphtha and propane. Activity data are collected directly from individual companies. [NIR 2014]
	Phosphoric acid production: The total amount of CO_2 released from phosphoric acid plant has been calculated multiplying the use of apatite and calcite with CO_2 content of defined yearly average of daily samples. Emission factors, used amount of apatite and calcite and calculated CO_2 emissions were received from the phosphoric acid producing company. Emission factors for apatite and calcite have been defined as a yearly average of daily samples. Emission factors are received directly from the phosphoric acid producing company. The activity data are the used amount of apatite and calcite. The amounts of them are received from the company. [NIR 2014]

Other Production	
Member State	**Methodology comment**
	Indirect CO_2 emissions from NMVOC emissions from chemical industry: NMVOC emissions from chemical industry are estimated by the Finnish Environment Institute based on emission data from the VAHTI system. Documentation of the calculation is presented in the Finnish IIR 2013. Indirect CO_2 emission was calculated using the equation below. It was assumed that the average carbon content is 80% by mass for years 1990-2012 for all categories under the sector Industrial Processes based on 2006 IPCC Guidelines. The fraction of fossil carbon in the NMVOCs is based on the NMVOC speciation profile provided in the EMEP/EEA Emission Inventory Guidebook under NFR Sector 2A5 Asphalt Roofing. [NIR 2014]
France	N_2O from Glyoxylic Acid Production: Emissions are taken from annual declarations of the two plants. Catalytic treatment was installed in 1998 which reduced emissions. Emissions are continuously measured and in times when measurement units do not function properly they are calculated with a mass balance approach based on measured data for glyoxylic acid (an average this occurs during 6 days per year) [NIR 2014]
	Medical N_2O: AD and emissions are delivered directly from one production plant [NIR 2014]
	Uranium tetrafluoride: N_2O emissions data is taken directly from annual statements of pollutant emissions since 1990 and emissions are derived from continuous measurements since the 2012 submission. [NIR 2014]
	Titanium tetrachloride CO_2 emissions come directly from the annual statements of emissions. For years without information, reports or linear interpolations are performed. [NIR 2014]
	Carbon Black: Domestic production of carbon black is available from national statistics. Since 2001, emissions of CO_2 and CH_4 are determined based on an assessment by the production site. For earlier years, the 2001 factor is applied. The CH_4 emission factor has been reduced by over 90% between 1990 and 2012 mainly due to the systematic recovery of process gases and their treatment (flares) or recovery as fuel in the boiler. [NIR 2014]
	Ethylene-Propylene: The national production is reported by the association for the years 1990 to 2003, in national statistics from 2004-2005 and in the publication "Pétrole" from CPDP since 2006. The CH_4 EF is taken from IPCC guidelines. [NIR 2014]
	Hydrogen: Natural gas consumption is provided by the plants and the EF for natural gas of 57 $kgCO_2/GJ$ is used [NIR 2014]
Germany	Carbon Black: Estimation of CO_2 emissions is based on IPCC default CO_2-EFs from IPCC-Guidelines 2006 and AD, which were provided by the Federal Statistical Office. The three German producers of carbon black report an emission factor of 0.027 kg methane per tonne of carbon black. Since relevant technology has been in service since the 1970s, this EF is rounded off to 0.03 kg/t and applied to the entire time series.[NIR 2014]
	Coke burn-off for catalyst regeneration in refineries: With regard to refineries, only catalyst regeneration is taken into account. Reviews to date indicate that other emissions sources from refineries (heavy-oil gasification, calcination and hydrogen production) are already covered as part of refineries' own consumption .[NIR 2014]

Other Production	
Member State	**Methodology comment**
Greece	CH_4 and NMVOC emissions from the production of ethylene and 1,2 dichloro-ethane, as well as NMVOC emissions from the production of polyvinylchloride and polystyrene are included in this category. CO_2 emissions from Hydrogen production are also included in this category. In 2011 submissions these emissions were included in the Energy Sector, but in 2012 they have been reallocated in the IP sector, in line with the ERT recommendations. Hydrogen production: CO_2 emissions for H2 production are estimated on the basis of the natural gas consumed for the process. Hydrogen production emissions refer to years after 1997, as natural gas consumption refers to the imported Natural Gas that was introduced in1996 to the Greek energy system. For years where data from both Public Gas Company (DEPA) and the EU ETS are available (2005-2012), the quantities of natural gas are cross-checked. CH_4 emissions from the production of ethylene and 1,2 dichloro-ethane are estimated according to the equation: (Emissions) = (Production) * (Emission factor). Default emission factors (IPCC Guidelines) are used. Activity data (production of ethylene and 1,2 dichloro-ethane) are confidential and provided by the ElStat. The available data cover the period 1990 – 2007, whereas the ethylene and 1,2 dichloro-ethane production has ceased in 1998 and 2000 respectively. [NIR 2014]
Italy	Caprolactam: N_2O emissions from caprolactam have been estimated on the basis of information supplied by the only plant present in Italy, production activity data published by ISTAT (ISTAT, several years), and production and emission data reported in the national EPER/E-PRTR registry. The average emission factor is equal to 0.3 kg N_2O/Mg caprolactam production. The plant closed in 2003. [NIR 2014]
	Carbon Black: CO_2 and CH_4 emissions from carbon black production process have been estimated on the basis of information supplied by the Italian production plants in the framework of the national EPER/EPRTR registry and the European emissions trading scheme. In 1996 a change in the production technology in the existing plants caused a reduction of CH_4, NMVOC, NO_X, SOx and PM10 emissions. In the present submission update values for the emission factors for this source category have been considered for the years 2010 and 2011 due to the performance of additional QA/QC procedures. In 2010 the IEF is 2.48 t CO_2/t carbon black production, in 2011 2.45 t CO_2/t carbon black and in 2016 2.46 t CO_2/t carbon black. [NIR 2014]
	Calcium Carbide: CO_2 emissions from calcium carbide production process have been estimated on the basis of the activity data provided by the sole Italian producer and referred to the years from 1990 to 1995 when the production stopped. The default IPCC CO_2 emission factor (IPCC, 2006) has been used to estimate the emissions. [NIR 2014]
Netherlands	Caprolactam production: Plant-specific N_2O emission factors are used for Caprolactam production (confidential). [NIR 2014]
	Industrial gases: CO_2 emissions are estimated based on use of fuels (mainly natural gas) as chemical feedstock. An oxidation fraction of 20% is assumed, based on reported data in environmental reports from the relevant facilities. [NIR 2014]
	Carbon electrodes: CO_2 emissions are estimated based on fuel use (mainly petroleum coke and coke). A small oxidation fraction – 5% – is assumed, based on reported data in the environmental reports.[NIR 2014]

Other Production	
Member State	**Methodology comment**
	Activated carbon: CO_2 emissions are estimated on the basis of the production data for Norit and by applying an emission factor of 1 t/t Norit. The emission factor is derived from the carbon losses from peat uses reported in the environmental reports. As peat consumption is not included in the national energy statistics, the production data since 1990 have been estimated based on an extrapolation of production level of 33 Tg reported in 2002. This is considered to be justified because this source contributes relatively little to the national inventory of greenhouse gases. [NIR 2014]
	Ethylene oxide: CO_2 emissions are estimated based on capacity data by using a default capacity utilisation rate of 86% and applying an emission factor of 0.45 t/t ethylene oxide. [NIR 2014]
Portugal	The major organic chemical plant in Portugal is BOREALIS unit, a petrochemical unit. The basic process in this unit is Ethylene production by Thermal Steam Cracking of petroleum feedstock. A specific and detailed inventory survey was made for BOREALIS Petrochemical Plant in Sines unit in 1993-1994. Emissions estimated for this period where used to determine plant-specific process emission factors that were used to estimate emissions for all time series from 1990 to 2001 and using ethylene production as activity rate indicator. For BOREALIS Petrochemical Plant in Sines - produced quantities are available from 1990 to 1997 and were forecasted thereafter. [NIR 2014]
	The second chemical industry LPS is the sole Carbon Black plant in Portugal. In the case of carbon black, where CO_2 emissions result from liberation of carbon in tail gas to atmosphere, emissions were estimated using a simple mass balance. Production of carbon black and explosives is available from since 1990 from INE Statistical Database (IAIT and IAPI surveys). Emissions from flares and flue gas combustor where included in the emission factors. Statistical information for all emissions sources other than Sines industrial Plants were obtained from the National Statistical Institute (INE). In the case of carbon black, where CO_2 emissions result from liberation of carbon in tail gas to atmosphere, emissions were estimated using a simple mass balance [NIR 2014]
	Finally the last individualized unit (LPS) is an industrial plant located in Lisbon producing Phthalic Anhydride from aromatic compounds. Apart from those individualized industrial plants other chemical industrial activities were included as area sources in this sub-source sector: Vinyl Chloride Monomer (VCM); - Low Density Poly-ethylene (LDPE); Poly Vinyl Chloride (PVC); Poly propylene (PP); Poly styrene (PS); Formaldehyde; Explosives. Emission factors for the Phthalic Anhydride Plant are from US-EPA (1983) [NIR 2014]"
Spain	Methodologies for 2B5 not explained in the NIR while small amounts of CH_4 emissions are reported in the CRF [NIR 2014]

Other Production	
Member State	**Methodology comment**
Sweden	This sub-category includes various chemical industries, such as sulphuric acid production, the pharmaceutical industry, production of base chemicals for plastic industry, various organic and inorganic chemical productions and other non-specified chemical production, which are not covered elsewhere. The primary information on emissions of CO_2, CH_4, N_2O, NO_X, CO, NMVOC and SO_2 is as reported by the companies in their environmental reports. In the IPCC Guidelines, methods for estimating CH_4 emissions for several chemical products are presented and consequently the CRF Reporter is divided on those products (2B5.1-5). Since several plants in Sweden produce several chemicals products each but report emissions aggregated by plant, it is not possible to report emissions in accordance with the suggested split in the CRF Reporter. In Sweden there is one company producing carbon black. CH_4 emissions are included from 1990 and onwards based on production data from the company's environmental reports and IPCC Guidelines default EF (11 g CH_4/kg production). [NIR 2014]
United Kingdom	It is possible that other chemical processes also result in direct CO_2 emissions but none have been identified. Emissions of carbon from the following sources were included in the 2004 GHG inventory (2006 NIR) and subsequent NIRs: • Petroleum waxes; • Carbon emitted during energy recovery - chemical industry; • Carbon in products - soaps, shampoos, detergents etc.; and • Carbon in products – pesticides. A full time series of emissions is included in the inventory, and details of the methodology for these sectors are given. [NIR 2014]
	Methane emissions are reported separately for production of ethylene and production of methanol, these chemicals being suggested as sources by the IPCC Guidelines for National Greenhouse Gas Inventories. Ethylene was manufactured on four sites at the end of 2011 while the only methanol plant closed in 2001. The IPCC Guidelines also suggested that methane might be emitted from manufacture of carbon black, styrene and dichloroethylene, however no evidence of any emissions of methane from these processes in the UK has been found and no estimates have been made. However, methane is emitted from other UK chemical processes and these emissions are reported as third, general, source category (named 'chemical industry' in the inventory) . [NIR 2014]"

Source: NIR 2014

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.37 summarizes the recommendations from the 2013 UNFCCC inventory reviews in relation to the category 2B5 Other Chemical Production.

Table 4.37 2B5 Other Chemical Production: Findings of the 2013 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2014 inventory submissions

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
Austria	The ERT recommends that Austria subtract the emissions from fertilizers from its estimates of CO_2 emissions from NH_3 production. (FCCC/ARR/2013/AUT).	As CO_2 emissions from fertilizer production and nitric acid production are reported under the respective subcategories, they were subtracted from CO_2 emissions reported under ammonia production, in order to avoid double counting. This approach resulted in lower CO_2 emissions in the order of 20 to 40 Gg per year for the whole time series.
Belgium	Other (chemical industry) – CO_2 emissions are estimated by the companies producing the chemical products, but no information has been provided on the methods, AD and EFs used in the NIR, the ERT recommends that the Party provide more detailed information in the NIR of its next annual submission. The ERT recommends that the Party report information on carbon black in the NIR and clearly identify, in CRF table 2(I), the emissions from carbon black using the notation key for confidential (FCCC/ARR/2012/BEL). 2013 ARR not yet available.	The NIR descriptions include this information. NIR: Section 4.3.2.3. Other (category 2B5)), and the CRF Table 2(I) uses the notation key IE for carbon black and includes a cell comment about confidentiality.
Denmark	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/DNK). 2013 ARR not yet available.	No follow-up necessary.

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
Finland	Other (solvent and other product use) – CO_2. Non-methane volatile organic compound (NMVOC) emissions from other (fat, edible and non-edible oil extraction) are used to estimate indirect CO_2 emissions. The ERT noted that the NIR includes a detailed methodology description, including that NMVOC/CO_2 emissions from this category arise from biomass. The CRF tables do not facilitate distinguishing between CO_2 emissions from biomass and fossil components under the category total solvent and other product use. This approach slightly overestimates national total CO_2 emissions, as CO_2 emissions from biomass are accounted for under fossil CO_2 emissions. The ERT recommends that Finland develop a way of reporting indirect CO_2 emissions which will allow CO_2 emissions from biomass to be distinguished from those from the fossil component and use this in the CRF tables of its annual submission, and an appropriate methodology and process description in its NIR. (FCCC/ARR/2013/FIN).	Not yet addressed. As a part of updating of air emissions time series also the activity data of this category will be checked in 2015.
France	CO_2 emissions from phthalic anhydride production: The ERT reiterates the recommendation in the previous review report that France include a methodological description for this subcategory in its next annual submission (FCCC/ARR/2012/FRA). 2013 ARR not yet available.	Not yet addressed.

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
Germany	In 2011, CO_2 emissions from other (chemical industry) contributed 13.3 per cent of the total GHG emissions from the industrial processes sector. The main contributors to CO_2 emissions were: burn-off of coke as a catalyst at oil refineries; production of carbon black and methanol; and transformation processes. The methodology used to estimate emissions from coke burn-off in catalyst regeneration is not clearly described in the NIR. The ERT reiterates the recommendation made in the previous review report that Germany include a more detailed description of methodological issues in the NIR, including explanations of whether the emissions are the result of fuel use for the production of energy, to improve transparency. (FCCC/ARR/2013/DEU).	Not yet addressed.
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/GRC).	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/IRL). 2013 ARR not yet available.	No follow-up necessary.
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/ITA)	No follow-up necessary.
Luxembourg	Other (solvent and other product use) – N_2O. Emissions from anaesthesia have been estimated for the period 1990–2002 by combining emissions data from Germany with the relative population in Luxembourg… The ERT welcomes the efforts by Luxembourg and…ERT reiterates the recommendation made in the previous review report that the Party ensure time-series consistency either by using data-specific techniques from the IPCC good practice guidance or by collecting country-specific data for the entire time series.	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/NLD).	No follow-up necessary.

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2012 or 2013 submission	Status in 2014 submission
Portugal	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/PRT). 2013 ARR not yet available.	No follow-up necessary.
Spain	No recommendation for improvement of this source category in Annual Review Report (FCCC/ARR/2012/ESP). 2013 ARR not yet available.	No follow-up necessary.
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2013/SWE).	No follow-up necessary.
UK	Other (chemical industry (all)) – CH_4 The ERT recommends that the United Kingdom include additional information disaggregating chemical industry CH_4 emissions from industrial wastewater treatment plant CH_4 emissions (FCCC/ARR/2012/GBR). 2013 ARR not yet available.	Industrial wastewater estimates were included separately for the 2013 submission following the in country review.

Source: NIR 2014, UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php
Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.2.5 Non-key sources

2B4 Carbide Production

The ERT identified that the NIR does not include a section on 2B4 Carbide Production (FCCC/ARR/2008/EC, para 55). This is due to the fact that carbide production is not a key source in the sector 2 Industrial processes. An overview of Member States' methodologies, emission factors, quality estimates and emission trends is only provided in this report if identified with the key category analysis at EU-15 level.

In response to a recommendation raised during the EU Centralized Review in 2010, information on the trend of EU-15 CO_2 emissions from Carbide Production that was provided during the review is given in this NIR: The EU-15 CO_2 emissions trend from carbide production is mainly influenced by Germany and France. In Germany, emissions dropped by 79 % in 1991 compared to 1990. During the reunification period, calcium carbide production took place primarily in former East Germany. Shortly after reunification, production discontinued in former East Germany, while only one producer remained in former West Germany. In the period 1990 to 2008, this producer cut production by about half. In France, carbide production occurred in one plant up to 2003, after which carbide production ceased.

4.2.3 Metal production (CRF Source Category 2C) (EU-15)

This source category includes two key sources, namely CO_2 emissions from 2C1 Iron and Steel Production and PFC emissions from 2C3 Aluminium Production.

Table 4.38 summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2012, CO_2 emission from 2C Metal Production decreased by 29 %. The absolute decrease (in terms of Gg CO_2 equivalents) was largest in Germany, France and Italy.

Table 4.38 2C Metal Production: Member States' contributions to total GHG, CO_2, PFC and SF_6 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)	PFC emissions in 1990 (Gg CO2 equivalents)	PFC emissions in 2012 (Gg CO2 equivalents)	SF_6 emissions in 1990 (Gg CO2 equivalents)	SF6 emissions in 2012 (Gg CO2 equivalents)
Austria	4,972	5,479	3,725	5,474	994	NO	253	5
Belgium	2,022	459	2,022	444	NO	NO	NO	NO
Denmark	60	0	28	NA,NO	NO	NO	31	NO
Finland	1,941	2,287	1,936	2,278	NO	NO	NO	C,NO
France	8,376	3,311	4,524	3,021	3,032	116	819	172
Germany	26,863	16,645	24,153	16,475	2,489	75	189	37
Greece	1,104	1,102	940	1,052	163	50	NA,NO	NA,NO
Ireland	0	0	NO	NO	NO	NO	NO	NO
Italy	5,608	1,603	3,878	1,520	1,673	33	NA,NO	NA,NO
Luxembourg	985	100	985	100	NA,NO	NA,NO	NA,NO	NA,NO
Netherlands	4,907	1,443	2,661	1,404	2,246	38	NO	NO
Portugal	175	71	170	58	NE	NO	NE	NO
Spain	4,290	2,802	3,384	2,749	883	39	NA	NA
Sweden	3,625	2,648	3,208	2,557	377	65	24	26
United Kingdom	4,088	1,132	2,341	924	1,333	41	406	161
EU-15	**69,014**	**39,083**	**53,955**	**38,058**	**13,190**	**458**	**1,722**	**401**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.39 provides information on the contribution of Member States to EU recalculations of CO_2 emissions from 2C Metal Production for 1990 and 2011, including main explanations.

Table 4.39 2C Metal Production: Contribution of MS to EU recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-95.5	-1.65	Revised coke input data became available in the energy balance for the year 2011, leading to lower CO2 emissions (- 95 Gg) in that year.
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	-15	-0.6	Corrections in activity data.
France	0	0.0	16	0.4	New data: improved accuracy.
Germany	0	0.0	47	0.3	Updated statistical data.
Greece	0	0.0	-78	-6.9	Error in files concerning the ground coke quantity used for nikel production.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-22	-30.4	Correction of estimates error.
Spain	0	0.0	0	0.0	
Sweden	129	4.2	-319	-9.8	Updated activity data.
UK	31	1.4	-36	-2.6	Revision to carbon balance apprach to use AD and EFS from ISSB/Tata in preference to DUKES stats and historic EF defaults.
EU-15	**161**	**0.3**	**-502**	**-1.2**	

Table 4.40 provides information on the contribution of Member States to EU recalculations of PFC emissions from 2C Metal Production for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 4.40 2C Metal Production: Contribution of MS to EU recalculations in PFC for 1990 and 2010 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-57	-5.4	0	0.0	A transcription error in the calculation of C2F6 emissions was corrected, leading to lower emissions in the order of 2 to 6 tonnes of C2F6 in the years 1990-1992.
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	-1	-0.7	New data: improved accuracy.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**-57**	**-0.4**	**-1**	**-0.1**	

4.2.3.1 2C1 Iron and steel production

This source category includes emissions from the iron and steel industry. Crude iron is produced by the reduction of iron oxide ores mostly in blast furnaces, generally using the carbon in coke or charcoal (sometimes supplemented with coal or oil) as both the fuel and reducing agent. In most iron furnaces, the process is aided by the use of carbonate fluxes (limestone). Additional emissions occur as the limestone or dolomite flux gives off CO_2 during reduction of pig iron in the blast furnace, but this source category is generally covered as emissions from limestone use. Carbon plays the dual role of fuel and reducing agent. Member States use different methods for the allocation of emissions that are described in Table 4.43.

CO_2 emissions from 2C1 Iron and Steel Production amounted to approx. 1 % of total EU-15 GHG emissions (without LULUCF) in 2012. Germany accounts for 48 % of these emissions in the EU-15. Germany had the largest decrease in absolute terms between 1990 and 2012 while increases were encountered in Austria and Finland.

The overall emission trend between 1990 and 2012 roughly follows the trend of emissions from Germany that fluctuate due to varying production figures. Overall, between 1990 and 2012, CO_2 emissions from iron and steel production decreased by 29 % (Table 4.41). The past two years also showed declining emissions, with a 7 % reduction between 2011 and 2012.

Figure 4.10 2C1 Iron and Steel Production: EU-15 CO_2 emissions

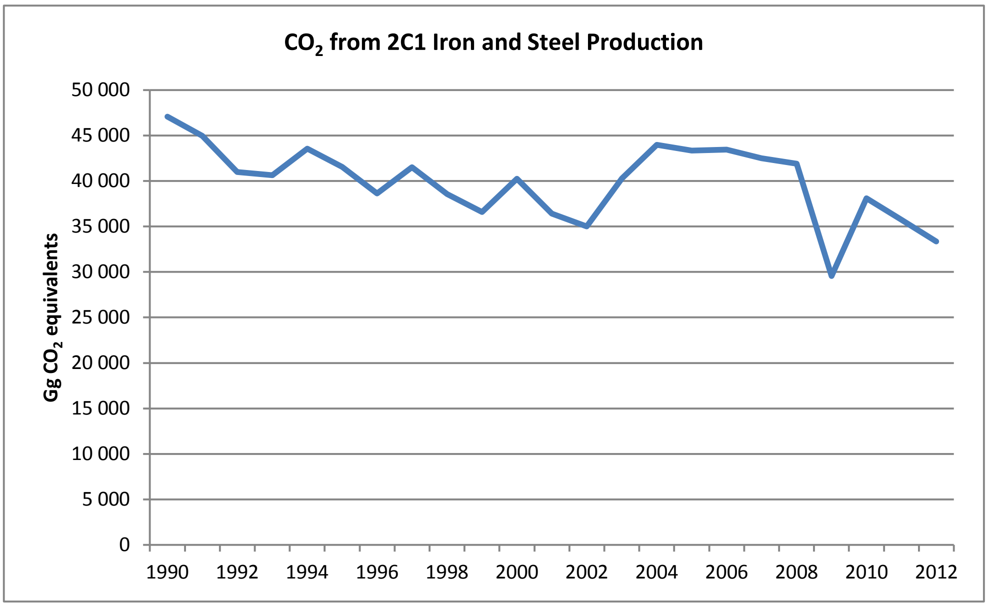


Table 4.41 2C1 Iron and Steel Production: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	3 546	5 674	5 454	16%	-219	-4%	1 909	54%	CS,T2	D,PS
Belgium	2 022	540	444	1%	-96	-18%	-1 579	-78%	CS,T3	PS
Denmark	28	NA,NO	NA,NO	-	-	-	-28	-100%	NA	NA
Finland	1 935	2 343	2 278	7%	-65	-3%	343	18%	CS,T1,T2,T3	CS,D
France	3 298	3 053	2 212	7%	-841	-28%	-1 086	-33%	T2	CS
Germany	22 712	16 397	15 908	48%	-489	-3%	-6 804	-30%	T2	CS
Greece	93	126	83	0%	-43	-34%	-10	-10%	CS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	3 124	1 297	1 291	4%	-6	0%	-1 833	-59%	T2	CR,CS,PS
Luxembourg	985	124	100	0.3%	-24	-19%	-885	-90%	CS,T2	CS
Netherlands	2 267	1 110	1 240	4%	130	12%	-1 026	-45%	T2	CS
Portugal	170	50	58	0.2%	8	16%	-112	-66%	T2	PS
Spain	2 428	1 539	1 375	4%	-164	-11%	-1 054	-43%	T2	CS,PS
Sweden	2 594	2 474	2 071	6%	-403	-16%	-523	-20%	CS,T2	PS
United Kingdom	1 890	1 019	831	2%	-188	-18%	-1 059	-56%	T2	CS
EU-15	**47 093**	**35 746**	**33 345**	**100%**	**-2 401**	**-7%**	**-13 748**	**-29%**		

Table 4.42 shows information on activity data and emission factors for CO_2 emissions from 2C1 Iron and Steel Production for 1990 and 2012. For this category, it is not useful to give an average IEF across the Member States because of their varying emission allocation (the split between process and combustion related emissions for pig iron production, which is the most important sub category). The table and the method descriptions included in Table 4.43 suggest that all Member States reporting CO_2 emissions in category 2C1 in 2012 use higher tier methods.

Table 4.42 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions

	1990				2012			
Member State	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)
Austria	**Iron and steel production**		**0.26**	**3546**	**Iron and steel production**	**0**	**0.31**	**5454**
	Steel Production	3921	0.12	484	Steel Production	6746	0.12	806
	Iron Production	3444	0.88	3043	Iron Production	5751	0.80	4602
	Sinter Production	4384	NA	NA	Sinter Production	3528	NA	NA
	Coke Production	1725	NA	NA	Coke Production	1308	NA	NA
	Other			20	Other			46
Belgium	**Iron and steel production**	**0**	**0.06**	**2022**	**Iron and steel production**	**0**	**0.03**	**444**
	Steel	11570	0.17	2022	Steel	6981	0.06	440
	Pig Iron	9415	IE	IE	Pig Iron	4078	IE	IE
	Sinter	13735	IE	IE	Sinter	5044	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			IE,NA	Other			4
Denmark	**Iron and steel production**	**0**	**0.05**	**28**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	Steel	614	0.05	28	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other			NA
Finland	**Iron and steel production**	**0**	**0.58**	**1935**	**Iron and steel production**	**0**	**0.49**	**2278**
	Produced steel	2861	0.68	1931	Produced steel	3759	0.61	2275
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Produced coke	487	0.001	1	Produced coke	881	0.001	1
	Other			3	Other			1
France	**Iron and steel production**	**0**	**0.10**	**3298**	**Iron and steel production**	**0**	**0.09**	**2212**
	Steel: kt Production	19073	0.09	1643	Steel: kt Production	15653	0.07	1091
	Pig Iron: kt Production	14088	0.09	1324	Pig Iron: kt Production	9456	0.09	896
	Sinter: kt Production	IE	IE	IE	Sinter: kt Production	IE	IE	IE
	Coke: kt Production	IE	IE	IE	Coke: kt Production	IE	IE	IE
	Other			331	Other			224
	2.C.1.5.1 Rolling mills, blast furnace charging	16848	0.02	331	2.C.1.5.1 Rolling mills, blast furnace charging	15653	0.01	224

	1990				2012			
Member State	**Activity data: Description**	**(kt)**	**Implied emission factor (t/t)**	**CO_2 emissions (Gg)**	**Activity data: Description**	**(kt)**	**Implied emission factor (t/t)**	**CO_2 emissions (Gg)**
Germany	**Iron and steel production**		**0.19**	**22712**	**Iron and steel production**	**0**	**0.23**	**15908**
	Steel	87878	0.26	22712	Steel	42661	0.37	15908
	Pig Iron	32263	IE	IE	Pig Iron	27048	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NO	Other			NO
Greece	**Iron and steel production**		**0.09**	**93**	**Iron and steel production**	**0**	**0.07**	**83**
	steel production in EAF	999	0.09	93	steel production in EAF	1247	0.07	83
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other			NO
Ireland	**Iron and steel production**		**NO**	**NO**	**Iron and steel production**	**0**	**NO**	**NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other			NO
Italy	**Iron and steel production**		**0.05**	**3124**	**Iron and steel production**	**0**	**0.03**	**1291**
	Steel: Production	25467	0.05	1346	Steel: Production	27257	0.02	627
	Pig Iron: Production	11852	0.15	1778	Pig Iron: Production	9424	0.07	663
	Sinter: Production	13577	NA	NA	Sinter: Production	10529	NA	NA
	Coke: Production	6356	NA	NA	Coke: Production	4184	NA	NA
	Other			NA	Other			NA
Luxembourg	**Iron and steel production**		**0.09**	**985**	**Iron and steel production**	**0**	**0.05**	**100**
	steel production	3506	0.12	404	steel production	2208	0.05	100
	pig iron production	2645	0.08	200	pig iron production	NO	NO	NO
	sinter production	4804	0.08	380	sinter production	NO	NO	NO
	coke production in non-integrated plants	NO	NO	NO	coke production in non-integrated plants	NO	NO	NO
	Other			NA	Other			NA

	1990				2012			
Member State	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Netherlands	**Iron and steel production**		**0.44**	**2267**	**Iron and steel production**	**0**	**0.18**	**1240**
	Crude steel production	5162	0.01	43	Crude steel production	6896	0.00	20
	Pig Iron	NO	IE	IE	Pig Iron	NO	IE	IE
	Sinter	NO	IE	IE	Sinter	NO	IE	IE
	See 1B1b	IE	IE	IE	See 1B1b	IE	IE	IE
	Other			2224	Other			1220
	Limestone equiv. use	IE	IE	IE	Limestone equiv. use	IE	IE	IE
	Carbon loss	12	190.21	2224	Carbon loss	NA	NA	1220
Portugal	**Iron and steel production**		**0.11**	**170**	**Iron and steel production**	**0**	**0.03**	**58**
	Steel	621	0.08	50	Steel	1959	0.03	58
	Pig Iron	308	0.00	0	Pig Iron	NO	NO	NO
	Sinter	338	0.24	80	Sinter	NO	NO	NO
	Coke	230	0.18	40	Coke	NO	NO	NO
	Other			NO	Other			NO
Spain	**Iron and steel production**		**0.18**	**2428**	**Iron and steel production**	**0**	**0.10**	**1375**
	Steel production	13163	0.07	979	Steel production	13628	0.05	625
	Pig iron production	C	C	246	Pig iron production	C	C	232
	Sinter production	C	C	538	Sinter production	C	C	167
	Coke production	IE	IE	IE	Coke production	IE	IE	IE
	Other			666	Other			350
Sweden	**Iron and steel production**		**0.17**	**2594**	**Iron and steel production**	**0**	**0.07**	**2071**
	Production of secondary steel	1755	0.09	156	Production of secondary steel	1644	0.10	170
	Production of primary iron	2845	0.78	2223	Production of primary iron	2908	0.65	1896
	Sinter	10977	0.02	215	Sinter	23813	0.00	5
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NA	Other			NA
UK	**Iron and steel production**		**0.09**	**1890**	**Iron and steel production**	**0**	**0.07**	**831**
	Electric Steel Production	4316	0.01	37	Electric Steel Production	1966	0.01	15
	Iron Production (blast furnace)	12463	IE	IE	Iron Production (blast furnace)	7183	IE	IE
	Sinter	NA	IE	IE	Sinter	NA	IE	IE
	Coke consumed in blast furnaces	5180	IE	IE	Coke consumed in blast furnaces	2964	IE	IE
	Other			1854	Other			816
	Blast furnace gas flared	2824	0.65	1837	Blast furnace gas flared	1269	0.64	808
	Basic Oxygen Steel Production	13169	0.00	17	Basic Oxygen Steel Production	7525	0.00	9

According to the IPCC methodology, processes including auto-producers (power and heat production facilities located in iron and steel plants) should be taken into account in sub-category 1A2a, while processes including consumption of carbonaceous reducing agents, oxidation of carbon contained in pig iron or scrap and the burning of carbonaceous electrodes should be reported in sub-category 2C1. Additionally, emissions originating from limestone and dolomite use in iron and steel plants should be included under 2A3 and emissions from heating of coke ovens should be reported under 1A1c.

However, some EU-15 Member States do not keep this boundary for various reasons (local circumstances, types of data available and in this context the aim to keep data series consistent). E. g. some Member States report emissions from blast furnace gas and from converter gas under 1A2a instead of 2C1 because they interpret them as emissions from energy supply.

Thus, for an overview of EU-15 total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for the EU-15 Member States in the combined category 1A2a + 2C1 are given in Table 4.43.

Table 4.43 CO_2 Emissions of EU-15 Member States from iron and steel production: 1A2a, 2C1 and combined (sum of both categories). The column "Share 2C1" denotes the ratio of emissions under 2C1 and combined emissions.

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Share 2C1
	1A2a	2C1	Combined		
Austria	5 859	5 454	11 313	8%	48%
Belgium	4 378	444	4 821	4%	9%
Denmark	55	NA,NO	55	0.04%	0%
Finland	2 252	2 278	4 530	3%	50%
France	13 335	2 212	15 547	12%	14%
Germany	33 054	15 908	48 962	37%	32%
Greece	197	83	280	0.2%	30%
Ireland	2	NO	2	0.002%	NA
Italy	15 420	1 291	16 711	13%	8%
Luxembourg	325	100	425	0.3%	24%
Netherlands	4 312	1 240	5 552	4%	22%
Portugal	140	58	198	0.1%	29%
Spain	6 122	1 375	7 497	6%	18%
Sweden	1 160	2 071	3 230	2%	64%
United Kingdom	13 415	831	14 246	11%	6%
EU-15	**100 026**	**33 345**	**133 371**	**100%**	**25%**

It can be seen that the ratio of emissions under 2C1 and combined emissions (see column "Share 2C1" in Table 4.43) varies across Member States. This indicates that the boundary between 1A2a and 2C1 is not uniformly interpreted by Member States. The seven Member States that are major CO_2 emitters from iron and steel production (accounting together for 90 % of EU-15 emissions) allocate their emissions in the following ways:

- **Germany**: Approx. 32 % of emissions are reported under 2C1. This category comprises process-related CO_2 emissions (including emissions from carbonate use). However, emissions from energy-related use of top gas and converter gas are reported under the respective sub-categories of sector 1.
- **Italy:** Major share of emissions (92 %) is reported under 1A2a. CO_2 emissions due to the consumption of coke, coal and other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector. In sector 2C1, emissions are reported from carbonates used in sinter plants and in basic oxygen furnaces to

remove impurities, emissions related to steel and pig iron scraps and emissions from graphite electrodes consumed in electric arc furnaces.

- **France:** Major share of emissions (86 %) is reported under 1A2a. In the CRF tables it is specified that all emissions from sinter production are reported under 1A2a and emissions from coke production are included in 1B1b.
- **United Kingdom:** Major share of emissions (92 %) is reported under 1A2a. Only emissions from flared blast furnace gas, basic oxygen furnace gas and emissions from electric steel production are reported under 2C1.
- **Austria:** 48 % of emissions are reported under 2C1. Process specific emissions are calculated applying a fixed percentage of total emissions; the remaining emissions are reported as emissions due to combustion in category 1A2a. Emissions from sinter and coke production are included in 1A2a. Process emissions also include electrode combustion in the electric steel production.
- **Spain:** Major share of emissions (82 %) is reported under 1A2a. Emissions from coke production are included in the energy sector.
- **Netherlands:** Major share of emissions (78 %) is reported under 1A2a. This includes emissions from energy use and from the use of blast furnace gas and oxygen furnace gas produced as by-products of the iron and steel industry.

Table 4.44 summarises information by Member State on methods used for estimating CO_2 emission from 2C1 Iron and Steel Production.

Table 4.44 CO_2 from 2C1 Iron and Steel Production: Summary of methodological information provided by Member States

Member States	Description of methods
Austria	Total CO_2 emissions from the two main integrated iron and steel production sites in Austria were reported directly by industry until 2002. They were calculated by applying a very detailed mass balance approach for carbon. For the years 2003 and 2004, total CO_2 emissions were not reported by industry, thus they were estimated using information from the national energy balance and from the years before. For 2005–2012, verified CO_2 emissions, reported under the ETS, were taken for the inventory, which constitutes a similar – slightly more detailed – approach as for the years before. The ETS data cover CO_2 emissions from pig iron, basic oxygen and electric arc furnace steel production. Process specific emissions were estimated according to the IPCC good practice guidance; these emissions were subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1.A.2.a. CO_2 emissions from blast furnace pig iron production were calculated following closely the IPCC GPG guidelines Tier 2 approach, applying the default emission factor of table 3.6 of the IPCC GPG. CO_2 emissions from steel production at the two integrated sites operating basic oxygen furnaces were calculated following the IPCC GPG guidelines Tier 2 approach. CO_2 and CH_4 emissions from electric arc furnace steel production were estimated using a country specific methodology. CO_2 emissions for the year 2003 have been reported by each electric steel site in Austria. The IEF calculated for this year (52 kg/t steel) was also used to calculate emissions for earlier years and for 2004. For 2005–2012, verified CO_2 emissions, reported under the ETS, were used for the inventory.
Belgium	The category 2C1 includes the emissions of CH_4 from sinter production (Flemish region) and the process emissions of CO_2 from the iron and steel sector (Flemish and Walloon regions). The emissions from the use of limestone in the sinter factory are allocated in the category 2A3. Other emissions from the iron and steel sector are allocated to the category 1A2a (energy emissions) and category 1A1c (emissions of production of coke). All activity data recorded in this sector (fluid steel, pig iron, sinter and cokes) originate directly from the companies involved. For electric arc furnaces, methodologies consistent with the ETS-reporting data are used. They take into account emissions from the consumption of raw materials and carbon storage in the steel produced.
Denmark	The CO_2 emission from the consumption of metallurgical coke at steelworks has been estimated from the annual production of steel sheets and steel bars combined with the consumption of metallurgical coke per produced amount. The carbon source is assumed to be coke and all the carbon is assumed to be converted to CO_2 as the carbon content in the products is assumed to be the same as in the iron scrap. The emission factor (3.6 tonnes CO_2 per tonne metallurgical coke) is based on values in the IPCC-guidelines. The CO_2 emission has been calculated from amounts of final products but related to amount of steel scrap handled at the electro steelwork. Emissions of CO_2 for 1990-1991 and for 1993 have been determined with extrapolation and interpolation, respectively. The electro-steelwork was in operation between 1990 and 2001. It reopened and closed down again in 2005.

Member States	Description of methods
Finland	The calculation method of CO_2 emissions from the iron and steel industry is a country-specific bottom-up methodology. Both fuel-based emissions and process emissions are calculated in connection with the ILMARI calculation system using plant/process level data. The methodology is slightly plant-specific, because all plants differ from each other. The main common feature for all plants is that fuel-based emissions for each installation are calculated in the ILMARI system from the use of fuels, excluding coke and heavy bottom oil used in blast furnaces, and subtracted from total CO_2 emissions. Fuel-based emissions are allocated to CRF 1.A 2a and CRF1.A 1c (coke ovens). Total CO_2 emissions for each installation in each plant are taken from the VAHTI system until 2004. These emissions are basically calculated by plant operators using carbon inputs (fuel inputs and reducing materials) and they are reported by installations separately. From 2005 on, all four iron and steel plants in Finland report to the EU ETS. Starting from 2007 submission (2005 data), the total CO_2 emissions for GHG inventory have been taken from the ETS data, although the split between process and fuel-based emissions has been done in the same way as in the previous years' calculation.
France	Category 2C1 includes blast furnace charging, basic oxygen furnaces, electric steel plants and rolling mills. Limestone use is reported under 2A3. There are currently two integrated sites in operation. However, some additional sites retain one or more specific activities (e.g. furnaces). There are 24 electrical steel sites in France, several of which closed down in recent years. For pig iron, the emission factor for CO_2 is based on the carbon balance. Carbon entering at different levels (fuel, coke) is compared to the carbon leaving the system (blast furnace gas, cast iron). Data are obtained from the French Steel Federation. For basic oxygen furnaces, the same method as for blast furnaces is applied. For electric steel plants, the CO_2 emission factor is based on the consumption of iron, consumption of fuel, the carbon content of the electrodes and the consumption of these electrodes.
Germany	Process-related CO_2 emissions from primary steel production in integrated smelters result primarily from use of reducing agents in blast furnaces. CO_2 emissions from limestone inputs in sinter plants and in pig-iron production, and CO_2 emissions from electrode consumption in electric steel production, are added to process-related emissions in sector 2.C.1. Only part of all energy-related use of top gas and converter gas is found in source category 2.C.1. Such gas is used for other process combustion in the iron and steel industry (1.A.2.a); in coking plants, for bottom heating of coking furnaces (1.A.1.c); and for electricity generation in public power stations (1.A.1.a) and industrial power stations (1.A.2.f). Consequently, the CO_2 emissions resulting from reducing-agent inputs for primary steel production are divided among all source categories in which top gas and converter gas are burned and, thus, CO_2 is actually emitted. In electric steel production, CO_2 emissions occur directly via consumption of graphite electrodes. These emissions must also be allocated to process-related CO_2 emissions for steel production. They are calculated from the quantity of produced electric steel, via an emission factor that is based on the specific electrode consumption per tonne of electric steel. its carbon content and the relevant stoichiometric factor.
Greece	Steel production in Greece is based on the use of electric arc furnaces (EAF). There are no integrated iron and steel plants for primary production as no units for primary production of iron exist, but there are several iron and steel foundries. The methodology used for the estimation of emissions is based on tracked carbon oxidation throughout the production processes in electric arc furnace operation. Activity data for 2005-2012 are plant specific and are based on the verified reports under the EU ETS context. For the period 1990-2004, information has been collected through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC from all individual plants in Greece, in the framework of the formulation of the NAP, according to the EU Directive 2003/87/EC.
Ireland	NO – There is no iron and steel production in Ireland
Italy	The main processes involved in iron and steel production are those related to sinter and blast furnace plants, to basic oxygen and electric furnaces. CO_2 and CH_4 emissions from the sector have been estimated on the basis of activity data published in the national statistical yearbooks, data reported in the framework of the national EPER/E-PRTR registry and the European Emissions Trading Scheme, and supplied by industry. Concerning the electric arc furnaces, additional information on the consumption of scraps, pig iron, graphite and electrodes and their average carbon content has been supplied together with the steel production by industry for a typical plant in 2004 and checked with other sectoral study. On the basis of these figures an average emission factor has been calculated. CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector, including fuel consumption of derived gases; in Annex 3, the energy and carbon balance in the iron and steel sector, with detailed explanation, is reported. A balance is made between the coal used for coke production and the quantities of derived fuels used in various sectors. The iron and steel sector gets the resulting quantities of energy and carbon after subtraction of what is used for electricity generation, non energy purposes and other industrial sectors. The amount of carbon stored in steel produced in integrated plants has been considered and subtracted from the carbon balance. The amount of carbon contained in steel has been estimated on the basis of EN standard and, from 2005, with emission trading data.

Member States	Description of methods
Luxembourg	Sinter Plant: The emissions in 1990 are calculated from the mass of carbon in the ore. It is therefore a country specific methodology. The data were collected directly from the operator. Blast furnace and basic oxygen furnace steel production: The 2000 IPCC-GPG Tier 2 methodology is applied for calculating the emissions in 1990. The emissions from iron production in blast furnace and from steel production in basic oxygen furnace are calculated separately based on a carbon balance over the production processes. Electric arc furnace steel production: The mass balance approach according to 2007 ETS guidelines is applied for calculating the emissions for the years 2004 to 2012.
Netherlands	CO_2 emissions are estimated using a Tier 2 IPCC method and country-specific value for the carbon content of the fuels. Carbon losses are calculated from coke and coal input used as reducing agents in the blast and oxygen furnaces, including other carbon sources such as the carbon contents in the iron ore (corrected for the fraction that ultimately remains in the steel produced). Only the carbon losses are reported in category 2C1. The carbon contained in the blast furnace gas and oxygen furnace gas produced as by-products and subsequently used as fuel for energy purposes is subtracted from the carbon balance and included in the Energy sector (1A1a and 1A2a).
Portugal	Emissions are calculated from multiplication of activity levels by a suitable emission factor. To avoid double counting, carbon dioxide emissions in cokerie and blast furnace, from oxidation of the carbon that was used as a reducing agent were not estimated from steel or coke production data but simply from use of coke derivative fuels (coke gas and blast furnace gas) in all combustion equipment. Emissions from combustion of coke gas and blast furnace gas are included in source sector 1A.2 and 1A.1.c.1. From 2001 onwards, there is only secondary steel production in Portugal. The CO_2 emission factors for Electric Arc Furnace that were used for each one of the two plants that are included in the European Union Emission Trading Scheme (EU-ETS) were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke from 2002 onwards.
Spain	The estimation of CO_2 emissions in the manufacturing processes of sinter, pig iron and steel has been performed using the Tier 2 IPCC approach, taking stock of carbon through the production process, thus avoiding the double-counting of emissions. This method makes use of a carbon mass balance of inputs and outputs for each of the processes within this category.
Sweden	Process emissions arising from reducing agents in the primary steel works and secondary iron and steel works are reported in CRF 2.C.1. The plants also generate emissions from fuel combustion (CRF 1.A.1c and CRF 1.A.2.a) and fugitive emissions (CRF 1.B.1.c). Secondary steel production: In most cases, data from the Swedish enquiry for the Swedish national allocation plan (NAP) for the EU ETS could be used for the years 1998-2002. Data for 1990-1997 and 2003-2004 has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, from the facilities environmental reports and through contacts with the companies. Primary iron and steel production: The emissions of $CO_2$are calculated using the Good Practice Guidance method Tier 2. Plant-specific data on emissions from carbon-containing input materials such as coke and anthracite and also specific carbon-contents of output iron and by-products are used for all years. From 2005, ETS data is used and 1990-2004, information has been acquired from the plant. The emissions are verified using national statistics from Statistics Sweden on amounts of coke, anthracite and output material. CO_2emissions from natural gas used for production of reduction gas used in the process are considered to be process-related and thus reported in 2.C.1.2. The remaining amounts of natural gas used by the facility are considered as energy-related and the corresponding emissions are reported in the Energy sector (CRF 1.A.2.a). To be consistent with calculations of emissions from production of pig iron, limestone used in the production is included in the emissions from the production of iron powder in CRF 2.C.1.2. Sweden uses the recommended Tier 2 method according to the IPCC Guidelines, to base the calculations of CO_2 emissions on carbon mass-balances in order to reduce the risk of double counting or omitting CO_2 emissions. The carbon contents of external input materials such as coking coal, coke, injection coal, limestone, etc., are balanced against final output materials; coke, pig iron, steel, tar, sludge, slag, etc. The remaining carbon contents are accounted for as CO_2 emissions.
United Kingdom	The methodology for the prediction of carbon dioxide emissions from fuel combustion, fuel transformation, and processes at integrated steelworks is based on a detailed carbon balance. Carbon emissions from integrated steelwork are reported under 1A1c, 1B1b, 1A2a, 2A3 and 2C1, depending upon the emission source. Only carbon emissions from flared blast furnace gas and basic oxygen furnace gas are reported under 2C1. Carbon emissions from electric arc furnaces and ladle arc furnaces are calculated using UK-specific emission factors. Energy related emissions from foundries are included in category 1A2a but any process emissions from foundries of direct GHGs are likely to be very small and are not estimated.

Source: NIR 2014

Table 4.45 summarizes the recommendations from the latest UNFCCC review of the inventory reports in relation to the category 2C1 Iron and Steel Production.

Table 4.45 2C1 Iron and Steel Production: Findings of the latest UNFCCC review of the inventory report in relation to CO_2 emissions and responses in 2014 inventory submissions

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
Austria	ARR 2013: No recommendations for this category	
Belgium	ARR 2012: Clearly and transparently explain in the NIR that the emissions from coke consumption are reported under the energy sector and explain why the emissions are reported under the energy sector. Improve the transparency of the reporting by providing information on the allocation of CO_2 emissions from this category in the NIR ARR 2012: Report the CO_2 emissions from limestone and dolomite used as flux in blast furnaces in iron and steel production under limestone and dolomite use	The NIR explains which coke and coal inputs are considered in sector 2 and which inputs are considered in sector 1. As a result of the review, process emissions originating from limestone use were re-allocated to the category 2A3.
Denmark	ARR 2012: No recommendations for this category	
Finland	ARR 2013: No recommendations for this category	
France	ARR 2012: No recommendations for this category	
Germany	ARR 2013: No recommendations for this category	
Greece	ARR 2013: No recommendations for this category	
Ireland	ARR 2012: No recommendations for this category	
Italy	ARR 2013: Include in the NIR details of the industry survey on the availability of data on process-related emissions from coke	It is explained in the NIR that as a result of the survey there is no accurate information by which to disaggregate the emissions between energy and process.
Luxembourg	ARR 2013: Include an explanation of the variations of the IEF for steel production over the time series, include more information on the country-specific methodologies and how the timeseries consistency is maintained.	Information on the country-specific methodologies is provided. An explanation of the variations of the IEF has not yet been included in the current version of the NIR.
Netherlands	ARR 2013: No recommendations for this category	
Portugal	ARR 2012: No recommendations for this category	
Spain	ARR 2012: Continue to explore channels that could allow access to necessary background data.	It is clarified in the NIR that it is not possible to further break down the information on steel production due to confidentiality reasons because basic oxygen steel is produced by one company only.
Sweden	Provide detailed energy and carbon mass balances for the two integrated iron and steel production plants and corresponding explanations with a clear indication of where in the CRF tables the associated emissions are reported.	A detailed mass balance for the two integrated primary iron and steel plants, including references to the CRF tables, was provided as an annex to the NIR.
UK	ARR 2012: No recommendations for this category	

Sources: Review Reports 2013 unless stated otherwise; NIR 2014 unless stated otherwise

4.2.3.2 2C3 Aluminium production and magnesium foundries

This category includes PFC and SF_6 emissions from aluminium production and magnesium foundries. Two PFCs, tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6), are known to be emitted from the process of primary aluminium smelting. These PFCs are formed during the phenomenon known as the anode effect, when the aluminium oxide concentration in the reduction cell electrolyte is low. In the magnesium industry, SF_6 is used as a cover gas in foundries to prevent oxidation of molten magnesium. It is assumed that all SF_6 used as cover gas is emitted to the atmosphere.

Table 4.46 summarizes information by Member State on emission trends for the key source PFCs from 2C3 Aluminium Production. PFC emissions from 2C3 Aluminium production account for 0.01 % of total EU-15 GHG emissions (without LULUCF) in 2012. Between 1990 and 2012, PFC emissions from this source decreased by 97 %. In 2012, France contributed the highest share among the EU-15, amounting to 25 % of overall emissions.

All Member States reduced their emissions from this source between 1990 and 2012. France, Germany, the Netherlands and Italy had the largest decreases in absolute terms; in Austria, aluminium production ended in 1992. The decreasing trend of PFC emissions from this key source between 1990 and 2012 is due to production stop (AT) or decline (DE, ES) and due to process improvements (FR, DE, ES, NL). The emission peak in 2002 (see Figure 4.11) can be explained by technological changes and sub-optimal conditions of operation (NL, FR).

Figure 4.11. 2C3 Aluminium Production: EU-15 PFC emissions

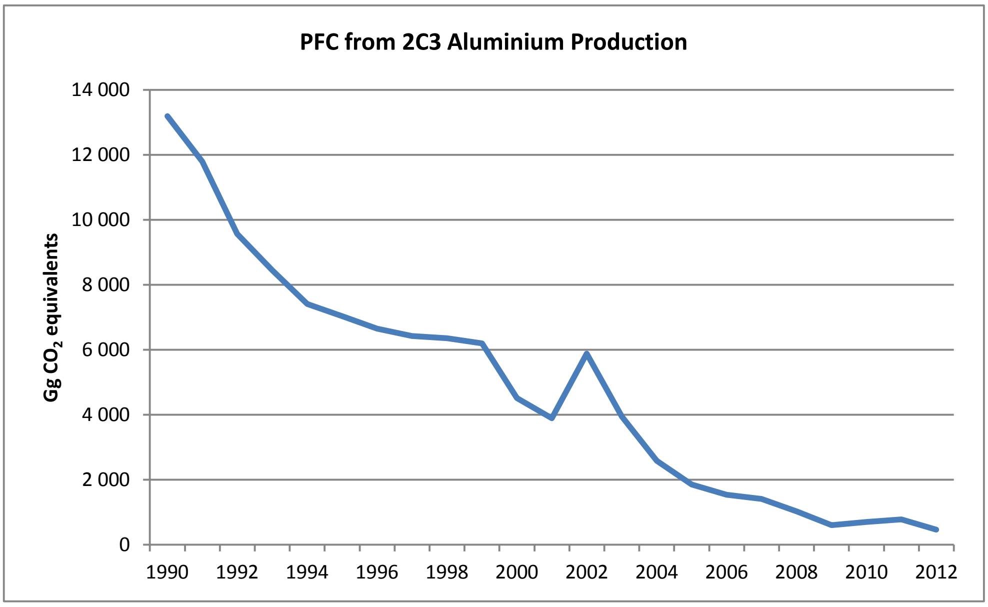


Table 4.46 2C3 Aluminium Production: Member States' contributions to PFC emissions and information on method applied, activity data and emission factor

Member State	PFC emissions (Gg CO2 equiv.)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	994	NO	NO	-	-	-	-994	-100%	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	3 032	85	116	25%	30	36%	-2 916	-96%	CR	PS
Germany	2 489	82	75	16%	-7	-8%	-2 414	-97%	T3	CS
Greece	163	39	50	11%	11	28%	-113	-69%	T3	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	1 673	81	33	7%	-48	-59%	-1 640	-98%	T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	2 246	82	38	8%	-44	-54%	-2 208	-98%	T2	PS
Portugal	NE	NO	NO	-	-	-	-	-	NA	NA
Spain	883	62	39	8%	-24	-38%	-844	-96%	T2	PS
Sweden	377	180	65	14%	-115	-64%	-312	-83%	T2	D
United Kingdom	1 333	162	41	9%	-121	-74%	-1 291	-97%	CS	CS,PS
EU-15	**13 190**	**775**	**458**	**100%**	**-317**	**-41%**	**-12 732**	**-97%**		

Table 4.47 shows information on activity data and emission factors for PFC emissions from 2C Metal Production for 1990 to 2012. The implied emission factors for CF_4 per tonne of aluminium produced vary between 0.02 kg/t for Germany and 0.09 kg/t for the United Kingdom in 2012. The overall implied emission factor is 0.04 kg/t. The implied emission factors for C_2F_6 per tonne of aluminium produced

vary between 0.003 kg/t and 0.012 kg/t in 2012. The overall implied emission factor is 0.005 kg/t. The table suggests that for 2012 all reported emissions are estimated using higher tier methods (based on plant specific data).

Table 4.47 2C Metal Production: Information on methods, activity data and implied emission factors for PFC emissions.

Member State	Method applied (2012)	Emission factor (2012)	Gas	1990				2012			
				Activity data		Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
				Description	(kt)			Description	(kt)		
Austria	NA	NA	CF_4	Aluminium production	88	1.56	137	Aluminium production	NO	NO	NO
			C_2F_6	Aluminium production	88	0.12	11	Aluminium production	NO	NO	NO
France	CR	PS	CF_4	Aluminium production	326	1.13	369	Aluminium production	350	0.05	16.2
			C_2F_6	Aluminium production	326	0.21	69	Aluminium production	350	0.003	1.1
Germany	T3	CS	CF_4	Aluminium production	740	0.45	336	Aluminium production	410	0.02	9.8
			C_2F_6	Aluminium production	740	0.05	34	Aluminium production	410	0.003	1.2
Greece	T3	PS	CF_4	Aluminium production	150	0.14	21	Aluminium production	165	0.04	6.6
			C_2F_6	Aluminium production	150	0.02	3	Aluminium production	165	0.005	0.8
Italy	T2	PS	CF_4	Aluminium production	232	0.86	198	Aluminium production	99	0.04	4.4
			C_2F_6	Aluminium production	232	0.18	42	Aluminium production	99	0.005	0.5
Netherlands	T2	PS	CF_4	Aluminium production	272	1.02	277	Aluminium production	114	0.04	5.1
			C_2F_6	Aluminium production	272	0.18	48	Aluminium production	114	0.005	0.6
Spain	T2	PS	CF_4	Aluminium production	C	C	122	Aluminium production	C	C	5.3
			C_2F_6	Aluminium production	C	C	10	Aluminium production	C	C	0.4
Sweden	T2	D	CF_4	Aluminium production	96	0.56	54	Aluminium production	131	0.06	8.5
			C_2F_6	Aluminium production	96	0.03	3	Aluminium production	131	0.008	1.1
UK	CS	CS,PS	CF_4	Aluminium production	290	0.60	174	Aluminium production	60	0.09	5.4
			C_2F_6	Aluminium production	290	0.08	22	Aluminium production	60	0.012	0.7
Total for Member States reporting aluminium production			**CF_4**	**Aluminium prod.**	**2194**	**0.71**	**1566**	**Aluminium prod.**	**1329**	**0.04**	**56**
			C_2F_6	**Aluminium prod.**	**2194**	**0.11**	**231**	**Aluminium prod.**	**1329**	**0.005**	**6**

Note: Totals are calculated for Member States reporting aluminium production. The emissions reported by Spain are not included in the total and are not used for calculating overall implied emission factors because Spain reports its activity data as confidential.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.48 provides key information on methods used for 2C3 Aluminium Production by the EU-15 Member States.

Table 4.48 2C3 Aluminium Production: Description of national methods used for estimating PFC emissions

Member States	Description of methods
Austria	PFC emissions were estimated using the IPCC Tier 3b methodology. The specific CF_4 emissions (and C_2F_6 emissions respectively) of the anode effect were calculated based on the frequency of occurrence of the anode effect, the effective production capacity per year, anode effect duration and current efficiency. For the aluminium production in Austria the rate of C_2F_6 is about 8% and the current efficiency about 85%. Activity data were taken from national statistics. Primary aluminium production in Austria was terminated in 1992.
Belgium	NO – there is no aluminium production in Belgium
Denmark	NO – there is no aluminium production in Denmark
Finland	NO – there is no aluminium production in Finland
France	Two types of technologies are used: Side worked prebaked (referred to as SWPB) and centre worked prebaked (referred to as PFPB). The method applied for estimating emissions is Tier 2. Aluminum production by electrolysis causes emissions of PFCs (CF_4 and C_2F_6) by anode effect. From 1990 to 2003, emissions of PFCs are provided by operators as part of a voluntary agreement. From 2004 onwards, emission data are obtained from the annual reports of the various sites. Emissions are determined using specific data and emission factors.
Germany	Emissions data are available for PFC emissions from primary aluminium smelters, thanks to a voluntary commitment on the part of the aluminium industry. The measurements conducted in all German smelters in the years 1996 and 2001 form the basis for calculation of CF_4 emissions. In this context, specific CF_4 emission figures per anode effect were calculated, in keeping with the technologies used. The number of anode effects is recorded and documented in the foundries. The total CF_4 emissions were calculated by multiplying the total anode effects for the year by the specific CF_4 emissions per anode effect determined in 2001. C_2F_6 and CF_4 occur in a constant ratio of about

Member States	Description of methods
	1:10.
Greece	PFC emissions estimates are based on anode effect performance by calculating the anode effect overvoltage statistic (Overvoltage method). This methodology concerns measurements and recordings that are being performed concerning the parameters of the equation used for the CF_4 emission's calculation, namely the overvoltage and the aluminium production process current efficiency.
Ireland	NO – there is no aluminium production in Ireland
Italy	PFC emissions from aluminium production have been estimated using both Tier 1 and Tier 2 IPCC methodologies. The Tier 1 has been used to calculate PFC emissions from 1990 to 1999, while Tier 2 has been used since 2000; the use of different methods along the period is due to the lack of detailed data for the years previous to 2000. PFC emissions, specifically CF_4 and C_2F_6, have been calculated on the basis of information provided by national and the national primary aluminium producer, with reference to the documents drawn up by the International Aluminium Institute and the IPCC Good Practice Guidance. PFC emissions for the period from the year 2000 are estimated by the IPCC Tier 2 method, based on default technology specific slope factors and facility specific anode effect minutes. Site-specific values (CF_4 and C_2F_6 emissions) and default coefficients (slope coefficients for CF_4 and C_2F_6) were provided by the main national producer. Moreover, from 2005 certificated emission values and parameters, including anode effects, have been communicated under EU-ETS.
Luxembourg	NO – there is no aluminium production in Luxembourg
Netherlands	PFC emissions from primary aluminium production reported by the two facilities are based on the IPCC Tier 2 method for the complete period 1990-2012. Emission factors are plant specific and are based on measured data.
Portugal	NO – there is no aluminium production in Portugal
Spain	Two plants use Söderberg anode systems with vertical studs, while the third uses prebaked anode systems (both centre-worked and side-worked). For the calculation of PFC emissions, the Tier 2 method of the 2000 IPPC Good Practice Guidance is used. In applying the formula from the Good Practice Guidance, the default value was used for the slope variable. Information on the number of anode effects per cell-day and the anode effect duration was provided by the producing plants using a specific questionnaire designed for this purpose, distinguishing between plants and production methods.
Sweden	The two different processes for aluminium production, prebaked (CWPB) and Söderberg (VSS), have substantially different emission factors for PFCs. Estimates of emissions are based on the number of ovens and the number and duration of anode effects. Activity data used for the PFC emission calculations, anode effects in min/oven day and production statistics, were provided by the company, and specified for the prebaked and Söderberg processes.
United Kingdom	The estimates were based on estimates of emissions provided by the plant operators. These estimates were derived from records of the number and duration of anode effects. Both operators use a Tier 2 methodology smelter-specific relationship between emissions and operating parameters based on default technology-based slope and over-voltage coefficients, using the default factors for the CWPB (Centre Worked Prebaked) plant for three of the plants, and for VSS (Vertical Stud Soderberg) for the plant which closed in 2000.

Source: NIR 2014

Table 4.49 summarizes the recommendations from the latest UNFCCC reviews of the inventory report in relation to the category 2C3 Aluminium Production.

Table 4.49 2C3 Aluminium Production: Findings of the latest UNFCCC review of the inventory report in relation to PFC emissions and responses in 2014 inventory submissions

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
Austria	Not relevant as there is no Aluminium production in Austria	No follow-up necessary
Belgium	Not relevant as there is no Aluminium production in Belgium	No follow-up necessary

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
Denmark	Not relevant as there is no Aluminium production in Denmark	No follow-up necessary
Finland	Not relevant as there is no Aluminium production in Finland	No follow-up necessary
France	ARR 2012: No recommendations for this category	
Germany	ARR 2013: No recommendations for this category	
Greece	ARR 2013: Obtain information on the abatement technologies used in aluminium production and nitric acid production and incorporate that information in the reporting of emissions.	Greece reported in the NIR that the relevant data are obtained directly from the plants and are considered to be confidential. As soon as abatement technologies are installed by the plants the NIR will be updated.
Ireland	Not relevant as there is no Aluminium production in Ireland	No follow-up necessary
Italy	ARR 2013: No recommendations for this category	
Luxembourg	Not relevant as there is no Aluminium production in Luxembourg	No follow-up necessary
Netherlands	ARR 2013: No recommendations for this category	
Portugal	Not relevant as there is no Aluminium production in Portugal	No follow- up necessary
Spain	ARR 2012: Include information related to the specific use of technologies.	Information on process parameters is not presented in the NIR due to confidentiality, as all installations are owned by the same company.
Sweden	ARR 2013: No recommendations for this category	
UK	ARR 2012: No recommendations for this category	

Sources: Review Reports 2013 unless stated otherwise; NIR 2014 unless stated otherwise

Table 4.50 summarises information by Member State on emission trends and methodologies for the source category SF_6 from 2C Metal Production.

Table 4.50 2C (Aluminium and Magnesium Foundries): Description of national methods used for estimating SF_6 emissions

Member states	Description of methods
Austria	Emissions were estimated following the IPCC methodology using annual consumption data of SF_6. Information about the amount of SF_6 used was obtained directly from the aluminium and magnesium producers in Austria and thus represents plant-specific data (for verification, data was checked against data from SF_6 suppliers). Actual emissions of SF_6 correspond to the annual consumption of SF_6 for magnesium casting. SF_6 has been used to quench fires of molten magnesium until 2006. For aluminium casting the same method was applied until 1999, when it was not further used by companies. Of the six secondary aluminium smelters only one started the use of SF_6 as cleaning gas again from 2006 onwards.
Belgium	NO – there are no aluminium/magnesium foundries in Belgium
Denmark	The emission of SF_6 has been decreasing in recent years due to the fact that activities under Magnesium Foundry no longer exist.
Finland	For Magnesium die-casting, a direct reporting method, Tier 1a, is used. Tier 1b is not applicable to this category because all SF_6 used is imported in bulk. Emissions from this source are not reported separately due to confidentiality (they are included in 2 F).
France	SF_6 emissions are determined from a mass balance using the estimated annual consumption of this gas and information provided by manufacturers. It is assumed that the total amount consumed is emitted into the atmosphere.
Germany	Use of SF_6 as a purification and protective gas in magnesium production is an open use, i.e. all of the SF_6 used in the process is emitted into the atmosphere. The practice of assuming the equivalence between consumption (AD) and emissions conforms to the method in the IPCC Guidelines (IPCC, 1996a: page 2.34). For aluminium foundries, the relevant emission factor has been established more reliably, via plant-

Member states	Description of methods
	specific measurements carried out in 2010. On the basis of confidential measurement records certified by the pertinent permit authority, the emission factor for the period 1999 through 2008 has been reduced to 3 %. Via structural conversions, the emission factor has been further reduced, to 1.5 %, as of 2009. Since the 2007 reporting year, the data have been obtained by the Federal Statistical Office via surveys of gas sellers with regard to SF_6-sales figures.
Greece	NO – there are no aluminium/magnesium foundries in Greece
Ireland	NO – there are no aluminium/magnesium foundries in Ireland
Italy	For SF_6 used in magnesium foundries, according to the IPCC Guidelines (1997), emissions are estimated from consumption data made available by the company, assuming that all SF_6 used is emitted. In 2007, SF_6 has been used partially, replaced in November by HFC 125, due to the enforcement of fluorinated gases regulation. SF_6 was still reported together with HFC 125 emissions for the years 2008, 2009 while for 2010 only HFC125 was reported. Since 2011 HFC134a has replaced HFC125. HFC 125 emissions, as well as HFC134a, have been reported in the CRF category 2G Other.
Luxembourg	NO – there are no aluminium/magnesium foundries in Luxembourg
Netherlands	NO – there are no aluminium/magnesium foundries in the Netherlands
Portugal	NO – there are no aluminium/magnesium foundries in Portugal
Spain	NO – there are no aluminium/magnesium foundries in Spain
Sweden	The total annual amount of SF_6 used in the magnesium foundries is reported as emissions, according to the IPCC Guidelines and Good Practice Guidance. Data is obtained from companies using SF_6. In Sweden, four magnesium foundries use SF_6 as a cover gas. No SF_6 is used in aluminium foundries.
United Kingdom	For Magnesium alloy production, an IPCC Tier 2 methodology is used to estimate emissions. It is estimated that 95% of SF_6 consumption is emitted. No emissions of SF_6 are currently reported by any of the aluminium foundries in the Pollution Inventory. Emissions from the use of SF_6 in the UK are therefore reported as Not Occurring.

4.2.3.3 Other metal production

Table 4.51 provides an overview of all sources reported under 2C5 Other Metal Production by EU-15 Member States for the year 2012. In that year, two Member States report CO_2 emissions from non-ferrous metal production. In addition, one Member State each reports CO_2 emissions from Silicium production, HFC emissions from magnesium production and SF_6 emissions from non-ferrous metal production.

Table 4.51 2C5 Other: Overview of sources reported under this source category for 2012

Member State	Type of source	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	NA, NO	NA	NA	NA	NA,NO	NA,NO	NO	-	0%
Belgium	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Denmark	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Finland	Non-ferrous metals	0.3	NO	NO	NA,NO	NA,NO	NO	0.3	0.06%
France	NA	NA	NA	NA	NA	NA	NA	-	0%
Germany	Magnesium production	NA,NO	NA,NO	NA,NO	39	NA,NO	IE,NA,NO	39	7%
Greece	NA, NO	NO	NO	NA	NA,NO	NA,NO	NA	-	0%
Ireland	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Italy	NA	NA	NA	NA	NA	NA	NA	-	0%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0%
Netherlands	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Portugal	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Spain	Silicium production	152	NA	NA	NA	NA	NA	152	28%
Sweden	Non-ferrous metals	186	NE,NO	NA,NO	NA,NO	NA,NO	NA,NO	186	34%
UK	Non-ferrous metals	NO	NO	NO	2	NA,NO	0.007	163	30%
EU-15 Total		**338**	**0**	**0**	**41**	**0**	**0.007**	**540**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-15)

Emissions related to the production of halocarbons as well as SF_6 are reported under this source category. This includes chemical by-products of processes related to the production of these substances that may be released into the atmosphere as well as fugitive emissions of the chemicals that occur during the production and distribution of the chemical.

Table 4.52 summarises information by Member States on emission trends for the key source HFCs from 2E Production of Halocarbons and SF_6.

Table 4.52 2E Production of Halocarbons and SF_6: Member States' contributions to total GHG and HFC emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2012 (Gg CO_2 equivalents)
Austria	NA, NO	NA,NO	NA,NO	NA,NO
Belgium	3 313	212	NO	NA,NO
Denmark	0	0	NO	NA,NO
Finland	0	0	NA,NO	NA,NO
France	4 691	118	3 635	115
Germany	4 529	147	4 409	34
Greece	935	0	935	NA,NO
Ireland	NA, NO	NA, NO	NO	NA,NO
Italy	1 284	1 184	351	1
Luxembourg	0	0	NA,NO	NA,NO
Netherlands	4 432	181	4 432	181
Portugal	NE, NO	NE, NO	NE,NO	NA,NO
Spain	2 403	290	2 403	290
Sweden	0	0	NO	NA,NO
United Kingdom	11 385	142	11 374	54
EU-15	**32 971**	**2 273**	**27 539**	**675**

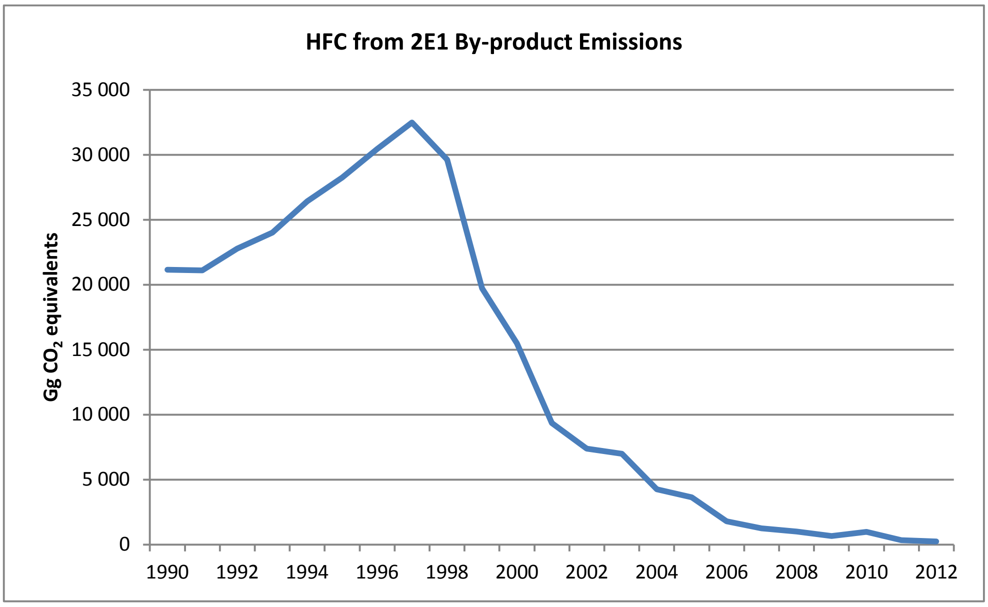
Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2014 two recalculations have been performed for HFCs in source category 2E. Spain revised the HFC-23 by-product emissions from the production of HCFC-22 (2.E.1) for the year 2011, resulting in a reduction of the emissions by 4 Gg CO_2 equiv. As a result of the In-Country-Review (ICR) 2014, Italy presented for the first time a 1997-2012 time series of the residual HFC-23 by product emissions after the 1996 installation of an abatement system. The emissions had been estimated zero before and are now estimated ~ 1 Gg CO_2 eqiv. per year.

HFC by-product emissions from 2E1 (HFC-23 from HCFC-22 production and HFC by-product emissions from F-gas production) account for 0.01 % of total EU-15 GHG emissions (w/o LULUCF). In 2012, most by-product emissions consisted of HFC-23 arising from the production of HCFC-22, which takes place in four Member States, by 2012. The Netherlands and France, account for about 97 % of these HFC-23 by-product emissions, in the EU-15. Italy and Germany report only very small emissions due to special conditions of HFC-23 abatement in their countries.

Between 1990 and 2012, HFC emissions from the source HCFC-22 decreased by 99 % (Table 4.53). The initial increase in emissions from 1990 to 1997 by 54 % is due to increased production in UK, Spain, Greece and the Netherlands. Since 1997 emissions decreased in nearly all Member States strongly; in UK and Italy due to the installation of thermal oxidising abatement equipment; in the Netherlands due to the installation of a thermal afterburner; in Spain due to the installation of condensation equipment; and in Greece due to production stop in 2006. By 2008 and 2009, production of HCFC-22 discontinued also in UK and by 2010 in Germany (one plant). The last HCFC-22 plant in Spain ceased production in 2011.

Figure 4.12. 2E1 By-Product Emissions: EU-15 HFC emissions



The Table 4.53 on by-product emissions includes not only HFC-23 from HCFC-22 production but also "other" by-products such as HFC-143a or HFC-125 from HFC-134a production. This is the reason why UK, where HCFC-22 is no longer manufactured, is represented with emissions in the table. It should however be noted that by-product emissions (substances other than the target product) and fugitive emissions (parts of the target product itself) are not always clearly distinghished in the CRF tables by the Member States.

Table 4.53 2E1 By-Product Emissions: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC ((Gg CO2 equiv.))			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Belgium	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Finland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
France	1 663	55	67	27%	12	22%	-1 595	-96%	T2	PS
Germany	C,NA	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Greece	935	NA,NO	NA,NO	-	-	-	-935	-100%	NA	NA
Ireland	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Italy	351	1	1	0.3%	-0.1	-7%	-350	-100%	CS	PS
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	4 432	166	125	51%	-41	-25%	-4 307	-97%	T2	PS
Portugal	NE,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Spain	2 403	50	NA,NO	-	-50	-100%	-2 403	-100%	NA	NA
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
United Kingdom	11 374	73	54	22%	-18	-25%	-11 319	-100%	T2	PS
EU-15	**21 158**	**345**	**248**	**100%**	**-97**	**-28%**	**-20 910**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.54 shows information on methods used for HFC emissions from both 2E1 by-product emissions and 2E2 fugitive emissions for the years between 1990 and 2012. For 2E1 By-Product Emissions it is not possible to give an average IEF for the EU-15 because for most countries activity data is confidential. Except for Greece, all reported emissions are estimated with higher Tier methods. This means that for the latest inventory year (2012) all reported emissions are estimated using higher tier methods (based on plant specific data).

Table 4.54 2E1 By-Product Emissions: Description of national methods used for estimating HFC emissions and abatements applied

Member States	Description of methods
Austria	NO – there is no production of Halocarbons and SF_6 in Austria
Belgium	In Belgium only PFC emissions arise, which are mentioned here for additional information only. The emissions are produced by a single chemical plant and are almost all fugitive emissions. The emissions of category 2E (Production of halocarbons) are those of an electrochemical synthesis (electro-fluorination) plant, which emits, or has emitted SF_6, CF4, C2F6, C3F8, C4F10, C5F12 and C6F14 as well as fluorinated greenhouse gases not covered by the Kyoto Protocol (among which CF3SF5, C7F16, C8F18 and C8F16). This plant produces a broad range of fluorochemical products, which are used as basic chemicals as well as end products and mainly in the electronic industry. A gas incinerator with HF-recovery has been installed in 1997. This has resulted in a drastic reduction of the fugitive emissions, which are estimated for 2012 at about 211 kt CO_2 equivalents (for the gases covered by the Kyoto Protocol), down from 4.4 Mt CO_2 equivalents in 1995. The process used in this electro-fluorinated plant is unique in the EU (there are however some similar plants in the US). This means that there is no readily available documentation on the process used, neither on the reported emission factors. The emissions have been calculated by using mass balances in combination with measurements. These measurements are based on EPA Method 320 using FTIR (Fourier Transform Infra Red spectroscopy) and GC/MS (gas chromatography combined with mass spectrometry). The emission estimates are complicated due to the fact that all emissions come from batch processes and that there are many reactors and process steps. For each process step (around 60 steps for the greenhouse gas emissions) an emission factor is reported. The emission factors are combined with detailed specific production data. Due to the complexity and for reasons of confidentiality, the detailed emission calculations are not made public.
Denmark	NO – there is no production of Halocarbons and SF_6 in Denmark
Finland	NO – there is no production of Halocarbons and SF_6 in Finland
France	*In France there arise both by product emissions (from the production of HCFC-22 and of trifluoroacetic acid), and fugitive emissions, from the deliberate production of HFCs such as HFC-32, HFC-134a, HFC-125, HFC-152a, HFC-143a, and HFC-365mfc. For both source categories"By-product emissions" and "Fugitive emissions", the IPCC Tier 2 method is used. The emissions estimates follow a bottom-up approach, based on direct annual communication from the industrial plants.* La méthode appliquée est de rang GIEC 2. Toutes les émissions sont déterminées à partir d'une approche bottom-up à partir des données communiquées directement par les sites industriels conformément aux déclarations annuelles faites aux DREAL. Pour les émissions de HFC et de PFC, les sites industriels distinguent les émissions dues aux sous-produits (HFC-23, HFC-125 et CF_4) des émissions fugitives (HFC-32, HFC-125, HFC-134a, HFC-143a, HFC-152a, HFC-365mfc, PFC-116 et C4F8). *Sous produits (2E1)* Suite aux réductions d'émissions de HFC-23 particulièrement, ce sous-secteur contribue globalement comme catégorie clé pour l'évolution des émissions au 28ème rang en 2012 (0.8%). *Production du HCFC-22* Il existe un site en France, producteur de HCFC-22, émetteur du sous-produit HFC-23. Les émissions ont été réduites de façon importante depuis 1994 après la mise en place d'une unité de traitement des produits fluorés par oxydation thermique. Les productions sont confidentielles. De 1990 à 2012, les émissions ont chuté de près de 96%. *Production d'acide trifluoroacétique* Ce produit est fabriqué sur un site. Le procédé engendre des sous-produits fluorés dont le HFC-125 et le CF4. La production depuis 1990 a été multipliée par six entrainant une hausse des émissions sur la période mais les facteurs d'émission diminuent grâce à la mise en place d'un nouveau réacteur en 2003 et d'un oxydateur thermique fin 2008. La mise en place de ce dernier explique les très faibles émissions à partir de 2009. *Émissions fugitives (2E2)* Cette catégorie est la 25ème catégorie clé (0.9%) en termes de contribution à l'évolution des émissions pour les HFC. Sur l'un des deux sites de production, les émissions ont été réduites de façon importante depuis 1992, pour le HFC-143a en particulier, suite au renouvellement de l'atelier de production et, depuis 1994-1995, pour l'ensemble des gaz après l'introduction d'un incinérateur et la suppression progressive des sources diffuses. Le second site de production était déjà équipé d'un tel dispositif depuis une date antérieure à 1990. Depuis 2003, il n'y a plus d'émissions de PFC.
Germany	2.E.1: Since 1995, HFC-23 by-product emissions have been calculated (via mass balance) on the basis of the amount of HCFC-22 produced, of annual measurements of HFC-23 concentrations in the facility's waste gas, of amounts of HFC-23 sold and of the amounts of HFC-23 delivered to the cracking facility; for the 1995 report year, emissions reduction measures (cracking facility) have been taken into account, as of the middle of the year, for the first production facility. Since produced quantities of HCFC-22 have not been reported, no emission factor could be determined. The producers reported only emissions of HFC-23. These were reported in aggregated form, together with emissions from the CRF sub-source category 2.E.2, since they were confidential.

Member States	Description of methods
	In 1995, in Frankfurt, a CFC cracking plant went into operation that cracks, at high temperature, excess HFC-23 produced during production of HCFC-22 and that recovers hydrofluoric acid. The first German HCFC-22 facility is linked via pipes to the adjacent cracking plant so that no significant HFC-23 emissions arise, and are not reported. HFC-23 by-product at the second German production facility has been captured in large amounts at the production system itself and was transported to the Frankfurt cracking plant; parts of the substance was sold as a refrigerant or – following further distillative purification – as an etching gas for the semiconductor industry. The HCFC-22 production at this plant was terminated in mid-2010. From 2011 emissions from HFC-23 are longer reported. 2.E.2: Fugitive emissions arise from the production of HFC-134a, HFC-227ea, and SF_6. All plants are operated by one producer (Solvay Fluor) who annually reports the emissions in aggregated form, for confidentiality reasons.
Greece	According to the IPCC Good Practice Guidance, the analytical methodology (Tier 2) was applied for the calculation of HFC-23 emissions from HCFC-22 production, as it constituted a key source. This methodology is based on the collection and elaboration of on-site measurement data. However, due to the lack of such data, calculation of emissions was based on production statistics and a reference emission factor. It should be noticed that data on the production of HCFC-22 were confidential and therefore are not presented in the current report. The reference emission factor used is suggested by the IPCC GPG. HFC-23 emissions from HCFC-22 manufacture do not occur since 2006, since the plant manufacturing HCFC-22 has stopped operating since.
Ireland	NO – there is no production of Halocarbons and SF_6 in Ireland
Italy	For both source categories ”By-product emissions” and “Fugitive emissions”, the IPCC Tier 2 method is used, based on plant-level data. The data are provided annually by the only national producer, and include production, emissions, import and export data for each gas (Solvay, several years). By 2012, within by-product emissions, HFC-23 emissions are released from HCFC-22 manufacture, and CF4 emissions are released from HCFC22/TFM productions. HFC-23 emissions from HCFC-22 had been drastically reduced since 1996 due to the installation of a second thermal oxidation system in the facility located in Spinetta Marengo (the only facility currently producing HCFC-22 in Italy). Since 1989 the abatement system has allowed to reduce HFC-23 released to air, up to 1996 HFC-23 emissions had been about 30 t/y. In 1996 the abatement system was improved with a second operating unit, since 1996 the abatement rate has been 99.99% thus reducing drastically HFC-23 emissions close to zero. The operator communicated that for a HCFC-22 production of 30 000 tons, HFC-23 residual emissions are less than 100 kg; a monitoring analysis has measured about 10 kg of HFC-23 in one year (Spinetta Marengo, 2011). HFC-23 emissions have been estimated, in response to the problem identified by the EU during the European Union 2013 GHG inventory check review and included in the estimates under CRF category 2E1 (By-product emissions; Solvay Solexis, 2011). For the current NIR the time series of the residual HFC-23 emissions has been recalculated. The emissions which so far had been estimated zero from 1997 onwards are now accounted for by an annual quantity from 0.8 to 1.0 Gg CO_2 equiv. (70-90 kg). (E.F. 3.3 g of HFC-23/t of HCFC-22). CF4 by-product emissions which are mentioned here additionally, in HCFC-22 production process had been fully investigated in 2013; information had been supplied by the operator, and has allowed estimating emissions for the whole time series from 1990 onwards. Recalculation was carried out in 2013, and is documented in the 2013 NIR. Regarding fugitive emissions, emissions of HFC-125 and HFC-134a have been cut in 1999 thanks to a rationalisation in the new production facility located in Porto Marghera, whereas HFC-143a released as byproduct from the production of HFC-134a has been recovered and commercialized. The relevant productions in Italy which originate these fugitive emissions stopped in the first quarter of 2008.
Luxembourg*	NO – there is no production of Halocarbons and SF_6 in Luxembourg
Netherlands	HFC-23 by-product emissions from the production of HCFC-22 (2E1): To comply with the IPCC Good Practice Guidance (IPCC, 2001) an IPCC Tier 2 method is used to estimate emission of this source category. HFC-23 emissions are calculated using both (measured) data on the mass flow of HFC-23 produced in the process and a destruction factor to estimate the reduction of this HFC-23 flow by the thermal afterburner. Handling activities (HFCs) (2E3): Tier 1 country-specific methodologies are used to estimate the handling emissions of HFCs. The estimations are based on emissions data reported by the manufacturing and sales companies.
Portugal	NO – there is no production of Halocarbons and SF_6 in Portugal
Spain	*2.E.1: The information on HFC-23 emissions is based on the estimates made by the manufacturers themselves, complemented for the years 1990-1998 by a default emission factor. Therefore, the estimation methodology applied in this case is a combination of Tier 1 and Tier 2 in the IPCC’s terminology. HFC-23 by-product from one of the two HCFC-22 plants had been captured and transported to a destruction plant in Germany. The production of this plant discontinued in 2008. The second HCFC-22 plant was closed in 2011.* No se presenta aquí la información sobre variables de actividad y parámetros de proceso por ser de carácter confidencial, al corresponder actualmente la propiedad de las plantas únicamente a dos empresas. Cabe asimismo mencionar que en una de las plantas existe un descenso de la emisión a partir del año 2001 debido a la construcción y puesta en servicio de una instalación para disminuir la emisión de HFC-23 mediante su compresión, condensación, licuación y almacenamiento. El HFC-23 licuado se carga en cisternas y se envía a un gestor exterior para su tratamiento. Por último, el

Member States	Description of methods
	descenso que se observa en las emisiones en el año 2011 tiene su origen en el correspondiente descenso de la producción de HCFC-22 en la única planta de fabricación existente en este año, mientras que en 2012 no ha habido producción de HCFC-22. HFC-23 by-product emissions from the production of HFC-32 (from 2002 onwards) has never been reported explicitly
Sweden	NO – there is no production of halocarbons and SF_6 in Sweden
United Kingdom	Emissions arise from the UK manufacture of HFCs, PFCs and HCFC-22. HFC-23 is a by-product of HCFC-22 manufacture and of the production of an HFC species. There are two single manufacturers of HFCs and PFCs respectively in the UK, and two companies were operating HCFC-22 plants, one of which closed in 2008, and the second closed at the end of 2009. A full description of the emission model and associated methodology used for this sector is contained in AEA (2008). Within the model, manufacturing emissions from UK production of HFCs, PFCs and HFC-23 (by-product of HCFC-22 manufacture) are estimated from reported data from the respective manufacturers. Manufacturers have reported both production and emissions data, but only for certain years, and for a different range of years for different manufacturers. Therefore the emissions model is based on implied emission factors, and production estimates are used to calculate emissions in those years for which reported data are not available. Two of the three manufacturers were members of the UK greenhouse gas Emissions Trading Scheme. As a requirement of participation in the scheme, their reported emissions were verified annually via external and independent auditors. For PFC production, emissions are now reported to the Environment Agency's Pollution Inventory, and these emissions are directly used within the GHG inventory. The operator of the HFC and (now closed) HCFC-22 plant provides speciated emissions data directly to the inventory agency, based on vent analysis and flow meter readings, or on weighbridge differences. The other HCFC-22 plant, which closed in 2008, also reported to the Pollution Inventory and these emissions were used within the GHG inventory. All emissions from the production of HFCs, PFCs and HCFC-22 are reported in CRF category 2.E.2. The categories are aggregated at the request of the operators and activity data are not reported, to protect commercially confidential information.

Source: NIR 2014 unless stated otherwise

Table 4.55 provides an overview of Member States' contributions to HFC emissions from sector 2E2, Fugitive Emissions (HFCs only). Three Member States report emissions from this sector specifically. Spain accounts for 78 % of all emissions, France for 13 % and Germany for 9 %. Fugitive emissions from UK are not included in this table.

Table 4.55 2E2 Fugitive Emissions: Member States' contributions to HFC emission

Member State	HFC (Gg CO2 equiv.)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Finland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
France	1 972	46	47	13%	2	4%	-1 924	-98%	T2	PS
Germany	4 409	41	34	9%	-7	-17%	-4 375	-99%	T3	PS
Greece	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Ireland	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Italy	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Portugal	NE	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Spain	NA	343	290	78%	-54	-16%	290	-	T2	PS
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
United Kingdom	NA	NA	NA	-	-	-	-	-	NA	NA
EU-15	**6 381**	**430**	**371**	**100%**	**-59**	**-14%**	**-6 010**	**-94%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.56 shows that only one Member State reports GHG emissions under 2E3 Other for the year 2011. The Netherlands include HFC emissions from handling activities, like repackage HFCs from large units (e.g. containers) into smaller units (e.g. cylinders).

Table 4.56 2E3 Other: Overview of sources reported under this source category for 2012

Member State	2.E.3 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total	Information from NIR-2008
Austria	NA	NA	NA	NA	-	0%	
Belgium	Other non-specified	NA,NO	NA,NO	NO	-	0%	
Denmark	Other non-specified	NA,NO	NA,NO	NO	-	0%	
Finland	Other non-specified	NA,NO	NA,NO	NO	-	0%	
France	Other non-specified	NA,NO	NA,NO	NO	-	0%	
Germany	Other non-specified	NA,NO	NA,NO	NO	-	0%	Includes confidential HFC emissions from 2E1 and 2E2
Greece	Other non-specified	NA,NO	NA,NO	NO	-	0%	
Ireland	Other non-specified	NA,NO	NA,NO	NO	-	0%	
Italy	NA	NA	NA	NA	-	0%	
Luxembourg	NA	NA	NA	NA	-	0%	
Netherlands	Not specific attributable due to Confidential Bussiness Information	55.4	NA,NO	NO	55.4	100%	2E3 Handling activities: emissions of HFCs. There is one company in the Netherlands that repackage HFCs from large units (e.g. containers) into smaller units (e.g. Cylinders) and in addition trading with HFCs. Besides this company there are a lot of companies in the Netherlands which are importing small units with FCs and sell them in the trading areas.
Portugal	Other non-specified	NA,NO	NA,NO	NO	-	0%	
Spain	NA	NA	NA	NA	-	0%	
Sweden	Other non-specified	NA,NO	NA,NO	NO	-	0%	
UK	Other non-specified	NA	NA	NA	-	0%	
EU-15 Total		**55**	**0**	-	**55**	**100%**	

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.57 summarizes the recommendations from the latest UNFCCC reviews of the inventory report in relation to the category 2E Production of Halocarbons.

Table 4.57 2E Production of Halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2012 inventory submissions

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2013 submission**
Austria	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Belgium	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Denmark	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Finland	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
France	No 2013 review report available: 04.04.14	Follow – up necessary
Germany	The ERT noted that in the CRF tables, Germany reported AD as "NE" (not estimated) and emissions as "C" (confidential). In response to a question raised by the ERT during the review, the Party explained that the correct notation key is "NO". The ERT recommends that the Party correct the use of notation keys.	Resolved in NIR 2014
Greece	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2013 submission
Ireland	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Italy	ARR 2013: No recommendations for this sector	No follow – up necessary
Luxembourg	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Netherlands	The ERT reiterates the recommendation made in the previous review report that the Netherlands enhance the category-specific QA/QC procedures to verify the plant-specific information provided by the companies, document these procedures and include this information in the NIR in accordance with the IPCC good practice guidance.	Resolved The confidential information is checked and verified as follows: As mentioned in the protocol, the confidential information ("HFC 23 load in the untreated flow" and "the removal efficiency of the TC") can be viewed at the company's premises. During the annual verification of the AER , the competent authorities checks the reliability of the information at the company. Furthermore the industrial expert of the Dutch emission inventory team checks the confidential information at the company.
Portugal	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
Spain	No 2013 review report available: 04.04.14	Follow – up necessary
Sweden	Not applicable as there is no production of Halocarbons and SF_6	No follow-up necessary
UK	No 2013 review report available: 04.04.14	Follow – up necessary

Sources: Review Reports 2012 and 2013 unless stated otherwise; NIR 2014 unless stated otherwise

4.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-15)

Emissions related to the consumption of Halocarbons (HFCs, PFCs) and Sulphur Hexafluoride (SF_6) are reported under this source category. HFCs are predominantly serving as alternatives to ozone depleting substances (ODS) that are being phased out under the Montreal Protocol, and have been introduced to the EU market first at the end of 1990. The main applications of halocarbons include refrigeration and air conditioning, foam blowing, fire protection, aerosols, solvent cleaning, as well as some other applications. Primary uses of SF_6 include gas insulated switch gear for transportation and distribution of electric power, and several other applications. Like SF_6, PFCs had been used already before 1990, especially in semiconductor manufacture.

Table 4.58 summarises for 2F Consumption of Halocarbons and SF_6 information by Member States on emission trends of total GHG emissions as well as of HFCs, PFCs and SF_6 individually.

Table 4.58 2F Consumption of Halocarbons and SF_6: Member States' and EU-15 total GHG, HFC, PFC and SF_6 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 1995 (Gg CO_2 equivalents)	HFC emissions in 2012 (Gg CO_2 equivalents)	PFC emissions in 1990 (Gg CO2 equivalents)	PFC emissions in 2012 (Gg CO2 equivalents)	SF_6 emissions in 1990 (Gg CO_2 equivalents)	SF6 emissions in 2012 (Gg CO_2 equivalents)
Austria	292	1 793	23	340	1 431	29	40	240	321
Belgium	91	2 265	NO	449	2 140	NE,NO	8	91	117
Denmark	13	784	NA,NO	218	657	NA,NO	9	13	118
Finland	115	964	0	29	926	0	2	115	37
France	1 692	17 564	23	1 193	16 785	342	281	1 327	498
Germany	4 513	12 425	40	2 347	9 134	140	134	4 333	3 157
Greece	3	3 954	NA,NO	37	3 889	NA,NO	60	3	5
Ireland	37	1 029	0	37	982	0	8	36	39
Italy	213	9 695	NO	239	9 241	NO	98	213	356
Luxembourg	13	76	12	16	67	NO	0	1	8
Netherlands	237	2 183	NO	248	1 874	18	113	218	196
Portugal	0	1 713	NE	27	1 667	NE	NA,NO	NE	45
Spain	67	7 507	38	242	7 285	NA	2	67	220
Sweden	88	808	4	132	775	NO	4	84	29
United Kingdom	650	14 289	10	1 336	13 829	58	79	582	381
EU-15	**8 024**	**77 049**	**150**	**6 890**	**70 682**	**588**	**838**	**7 324**	**5 528**

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2F Consumption of Halocarbons and SF_6 account for about 2 % of total EU-15 GHG emissions (w/o LULUCF) in 2012. HFC emissions in 2012 were 10 times higher than in 1995. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production, fire protection, and as aerosol propellants). France, Italy, UK, Spain and Germany had the most significant absolute increases from this source between 1995 and 2012.

SF_6 emissions from 2F Consumption of Halocarbons and SF_6 account for 0.2 % of total EU-15 GHG emissions (w/o LULUCF) in 2012. Between 1990 and 2012, SF_6 emissions from this source decreased by 25 %. Germany, France, Italy, UK, Austria and Spain are responsible for about 89 % of total EU-15 emissions (w/o LULUCF) from this source, Germany alone for 57%. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2012.

Table 4.59 provides information on the contribution of Member States to EU recalculations in HFC from 2F Consumption of Halocarbons for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 4.59 2F Consumption of halocarbons: Contribution of MS to EU recalculations in HFC for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	80	4.0	Addition for Room air conditioners. Reallocation (previously in Commercial refrigeration). Revision of activity data (consumption).
Denmark	0	0.0	0	0.0	
Finland	0	0.0	6	0.6	Addition of a one new discovered emissions source
France	-85	-79.1	902	5.7	2F1 + 2F9: New data considered: improving comprehensiveness. Updated data : improved accuracy. 2F2: Consolidation of data : improved accuracy (data from the previous edition are provisional data) . 2F3: Correction: improving accuracy. 2F4: Updated data and refinement of the allocation method : improved accuracy. 2F7: New data considered: improving comprehensiveness.
Germany	0	0.0	-28	-0.3	AD was changed because of new informations. Correction of a mistake.
Greece	0	0.0	-97	-2.8	Updated data. Error in file, in exports value which affect the whole timeseries.
Ireland	-1	-64.2	454	84.2	Recalculations due to new methodology (new study on F-gases carried out in 2013)
Italy	0	0.0	-503	-5.4	Leakage rates in manufacturing and in use have been revised for the whole time series
Luxembourg	0	0.0	0.0	0.0	
Netherlands	0	0.0	-1	0.0	Improved activity data.
Portugal	0	0.0	1	0.1	AD provisional data revision.
Spain	38	0.0	-485	-6.2	New baseline information on exports of novelty aerosols for year 2011.
Sweden	0	0.7	7	0.8	Import and export statistics from the Swedish Chemicals Agency for 2011 has been updated due to the one year time lag in data production.
UK	-2	-13.2	-769	-5.3	Updated activity data.
EU-15	**-50**	**-24.9**	**-433**	**-0.6**	

Table 4.60 provides information on the contribution of Member States to EU recalculations in SF_6 from 2F Consumption of Halocarbons for 1990 and 2011 and main explanations for the largest recalculations in absolute terms.

Table 4.60 2F Consumption of halocarbons and SF_6: Contribution of MS to EU recalculations in SF_6 for 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	-12	-11.4	0	0.0	The SF6 emissions from stock of the electricity transport sector in 1995 were revised in two ways: a reduction of the emission factor from 2% to 1%, based on new data obtained from the transport grid operator Elia, and a reassessment of the stock, taking into account that it had been rising, while previously it had been considered constant over the period 1995-2000, equal to its value in 2000. And NIR mentions: `No systematic emission inventories of fluorinated greenhouse gases were made for the years 1990-1994, because it is very difficult to obtain reliable information for this period. However Belgium did try to estimate the F-gas emissions for these years as accurately as possible (see CRF-tables): the emissions of the chemical process industry, which represent 89% of the total fluorinated GHG emissions in 1995, are known for the complete time series. For the years 1990-1994, the emissions of the remaining sources (11% in 1995) were assumed constant and equal to their level of 1995, except for the years in which the corresponding gas is known not to have been available, in which case the emissions have been put to zero. As a result, the Belgian emission inventory of fluorinated gases from 1995 to 2012 can be considered as time consistent for the complete time series.`
Denmark	0	0.0	0.0	0.0	
Finland	0	0.0	0	0.0	
France	257	24.0	165	48.4	2F1 + 2F9: New data considered: improving comprehensiveness. Updated data : improved accuracy. 2F2: Consolidation of data : improved accuracy (data from the previous edition are provisional data) . 2F3: Correction: improving accuracy. 2F4: Updated data and refinement of the allocation method : improved accuracy. 2F7: New data considered: improving comprehensiveness.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	-1	-1.3	Recalculations due to new methodology (new study on F-gases carried out in 2013).
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	1	1.8	AD provisional data revision.
Spain	0	0.0	-148	-37.4	The activity data series estimation has been updated based on new information information (provided in the framework of the Voluntary Agreement for limiting SF6 emissions in electrical equipment).
Sweden	0	0.0	0	-0.5	Updated activity data. Import and export statistics from the Swedish Chemicals Agency for 2011 has been updated due to the one year time lag in data production.
UK	-22	-3.7	-135	-25.3	A review of the data sources and methodology used to estimate emissions from electrical switchgear has been carried out in 2013.
EU-15	**223**	**3.1**	**-117**	**-2.1**	

Table 4.61 shows the sub-categories of HFC emissions from 2F Consumption of Halocarbons and SF_6 by Member State. It shows that 2F1 Refrigeration and Air Conditioning Equipment is by far the largest sub-category accounting for 86 % of HFC emissions in this source category; 2F4 Aerosols/Metered Dose Inhalers and 2F3 Fire Extinguishers account for 7% and 3 % respectively.

Table 4.61 2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2012 (Gg CO_2 equivalents)

Member State	Consumption of Halocarbons and SF_6	Refrigeration and Air Conditioning Equipment	Foam Blowing	Fire Extinguishers	Aerosols/ Metered Dose Inhalers	Solvents	Other applications using ODS substitutes	Semiconductor Manufacture	Electrical Equipment	Other (please specify)
Austria	**1 431**	1 389	12	10	19	NO	NO	2	NO	NA,NO
Belgium	**2 140**	1 975	86	10	67	NO	NO	2	NO	NO
Denmark	**657**	574	66	NO	16	NO	NO	NO	NO	1
Finland	**926**	861	13	C,NO	48	NO	NO	C,NA,NO	NO	3
France	**16 785**	13 726	570	140	1 962	379	NO	8	NO	NA,NO
Germany	**9 134**	8 006	579	31	506	C,NO	NO	11	NO	0
Greece	**3 889**	3 777	33	38	41	NA,NO	NO	NO	NO	NA,NO
Ireland	**982**	837	NO	31	111	NO	NO	3	NO	NA,NO
Italy	**9 241**	8 166	529	187	354	NO	NO	5	NO	NA,NO
Luxembourg	**67**	63	2	NO	3	NO	NO	NO	NA	NA,NO
Netherlands	**1 874**	1 598	IE	IE,NO	IE	IE,NO	NO	NO	NO	275
Portugal	**1 667**	1 610	46	6	6	NO	NO	NO	NO	NA,NO
Spain	**7 285**	6 079	75	1 100	30	NA	NA	NA	NA	NA
Sweden	**775**	706	35	6	28	NO	NO	NO	NO	NA,NO
UK	**13 829**	11 234	322	208	1 959	107	NA	IE	IE	NA,NO
EU-15	**70 682**	**60 601**	**2 368**	**1 767**	**5 149**	**486**	**0**	**31**	**0**	**280**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.62 to Table 4.65 show MS contribution to EU-15 HFC emissions from the most important sub-sources 2F1, 2F2, 2F3 and 2F4 respectively.

Table 4.62 2F1 Refrigeration and Air conditioning: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)				Share in EU15 emissions in 2012	Change 2011-2012		Change 1995-2012		Method applied	Emission factor
	1990	1995	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NO	33	1 304	1 389	2%	84	6%	1 356	4144%	CS	CS
Belgium	NO	85	1 901	1 975	3%	74	4%	1 891	2233%	T2	CS,D,PS
Denmark	NO	35	661	574	1%	-87	-13%	539	1532%	CS	CS
Finland	0	25	977	861	1%	-116	-12%	836	3380%	T2	D
France	NO	532	13 440	13 726	23%	286	2%	13 195	2481%	M	CS
Germany	NA,NO	495	7 683	8 006	13%	323	4%	7 511	1517%	T2	CS,D
Greece	NO	37	3 292	3 777	6%	485	15%	3 740	10023%	T2	D
Ireland	IE,NO	11	840	837	1%	-3	-0.4%	826	7776%	T1,T3	CS
Italy	NO	239	7 715	8 166	13%	451	6%	7 927	3317%	T2	CS
Luxembourg	0.003	2	63	63	0.1%	0.1	0.1%	61	2918%	CS	CS
Netherlands	NO	61	1 565	1 598	3%	33	2%	1 538	2529%	T2	CS
Portugal	NE	10	1 433	1 610	3%	176	12%	1 599	15475%		
Spain	38	238	6 182	6 079	10%	-103	-2%	5 841	-	T1	OTH
Sweden	3	125	749	706	1%	-43	-6%	581	465%	CS,T2	CS,D
UK	NO	766	11 087	11 234	19%	146	1%	10 468	1367%	T3	CS
EU-15	**41**	**2 693**	**58 894**	**60 601**	**100%**	**1 707**	**3%**	**57 908**	2151%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2012, HFC emissions from 2F1 were about 24 times higher than in 1995 (Figure 4.13). France, Germany, Italy and the UK are responsible for 68% of total EU-15 emissions from this source. Between 2011 and 2012 EU-15 emissions increased by 3 %. The largest increase of HFC emissions from 2F1 between these years was in Greece. Denmark, Finland, Ireland and Sweden reported in 2012 decreasing emissions compared to the previous year.

Figure 4.13 2F1 Refrigeration and Air conditioning: EU-15 HFC emissions

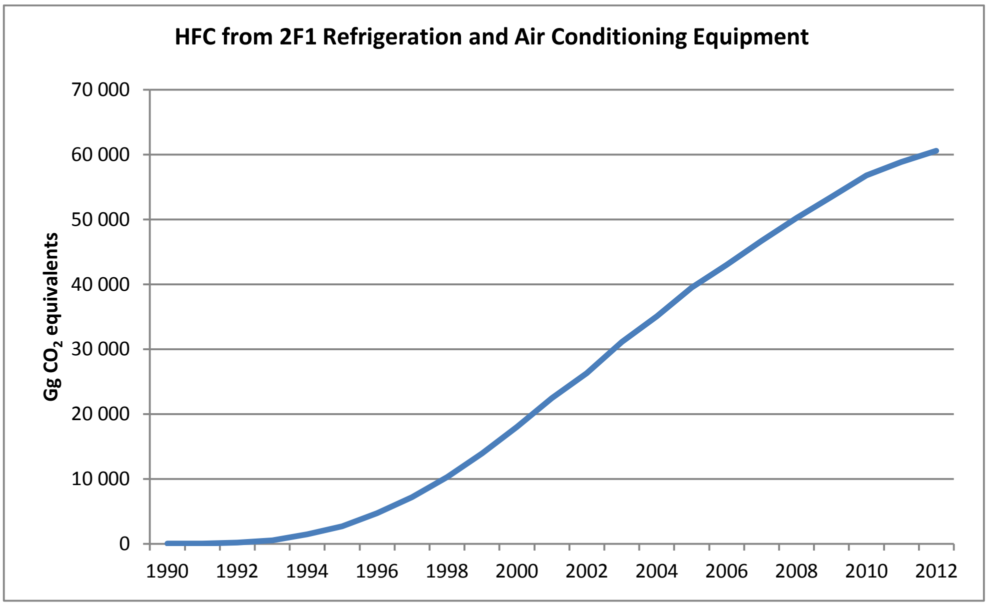


Table 4.63 2F2 Foam Blowing: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)				Share in EU15 emissions in 2012	Change 2011-2012		Change 1995-2012		Method applied	Emission factor
	1990	1995	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NO	275	12	12	1%	-0.1	-1%	-263	-96%	CS	CS
Belgium	NO	324	96	86	4%	-11	-11%	-239	-74%	T2	CS,D,PS
Denmark	NO	183	78	66	3%	-11	-15%	-116	-64%	CS	CS
Finland	NO	2	13	13	1%	0.003	0.02%	11	438%	T2	D
France	NO	NO	546	570	24%	24	4%	570	-	CR,T2	CS,PS
Germany	C,NO	1 534	694	579	24%	-115	-17%	-955	-62%	T2	CS,D
Greece	NO	NO	31	33	1%	1	4%	33	-	T2	D
Ireland	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NO	NO	513	529	22%	16	3%	529	-	T2	D
Luxembourg	12	12	2	2	0%	0.03	2%	-10	-85%	CS	CS
Netherlands	NO	IE	IE	IE	-	-	-	-	-	NA	NA
Portugal	NE	1	47	46	2%	-2	-3%	45	5264%	NA	NA
Spain	NA	NA	64	75	3%	11	17%	75	-	T2	D
Sweden	NO	NO	37	35	1%	-2	-5%	35	-	T2	PS
UK	NO	NO	310	322	14%	12	4%	322	-	T3	CS
EU-15	**12**	**2 332**	**2 444**	**2 368**	100%	**-76**	**-3%**	**36**	**2%**		

In 2012, HFC emissions from 2F2 (Table 4.63) decreased by 3% compared to 2011 – and slightly increased by 2% compared to 1995. The biggest contributors to this sector are Germany (24%), France (24%), Italy (22%) and UK (14%), those three countries account for 60% of the share in EU15 emissions in this sector. All countries but France, Finland, Greece, Italy, Luxembourg, Spain and the UK reported a decrease in emissions compared to 2011.

Table 4.64 2F3 Fire extinguishers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)				Share in EU15 emissions in 2012	Change 2011-2012		Change 1995-2012		Method applied	Emission factor
	1990	1995	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	0.00005	0.02	12	10	1%	-2	-18%	10	52382%	CS	CS
Belgium	NO	1	10	10	1%	-0.1	-1%	10	1825%	T2	CS
Denmark	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	C,NO	C,NO	C,NO	-	-	-	-	-	NA	NA
France	NO	4	136	140	8%	4	3%	136	3411%		
Germany	NO	NO	30	31	2%	1	3%	31	-	CS	CS,D
Greece	NA,NO	NA,NO	43	38	2%	-4	-10%	38	-	CS	D
Ireland	NO	NO	31	31	2%	0	0%	31	-	T3	CS
Italy	NO	NO	174	187	11%	13	7%	187	-	T2	CS
Luxembourg	NO	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Portugal	NE	NO	6	6	0.3%	-0.2	-3%	6	-		
Spain	NA	3	1 098	1 100	62%	2	0%	1 098	39604%	T1,T2	D
Sweden	NO	NO	6	6	0.3%	0	0%	6	-	CS,T2	CS
UK	NO	3	206	208	12%	2	1%	205	6557%	T2	CS
EU-15	**0**	**10**	**1 752**	**1 767**	**100%**	**15**	**1%**	**1 757**	**16844%**		

In 2012, HFC emissions from 2F3 (Table 4.64) increased by 1% compared to 2011 – and by 16 844 % compared to 1995. The biggest contributors to this sector are Spain (62%), UK (12%), and Italy (11%), those three countries account for 85% of the share in EU15 emissions in this sector. Austria, Greece, Portugal and Belgium reported a decrease in emissions (-18%, -10%, -3% and -1% respectively) compared to 2011.

Table 4.65 2F4 Aerosols/ Metered Dose Inhalers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)				Share in EU15 emissions in 2012	Change 2011-2012		Change 1995-2012		Method applied	Emission factor
	1990	1995	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	20	22	18	19	0.4%	0.2	1%	-3	-15%	CS	CS
Belgium	NO	39	67	67	1%	0.0	0%	28	71%	T1,T2	D
Denmark	NA,NO	NA,NO	16	16	0.3%	-0.4	-3%	16	-	CS	CS
Finland	NA,NO	2	38	48	1%	10	26%	46	2168%	T2	D
France	IE,NO	591	2 088	1 962	38%	-127	-6%	1 371	232%	CR,T2	CS
Germany	C,NO	304	525	506	10%	-18	-3%	202	66%	CS,T2	CS,D
Greece	NO	0	44	41	1%	-3	-8%	41	139873%	T2	D
Ireland	NO	25	119	111	2%	-7	-6%	87	352%	T1,T2	CS
Italy	NO	NO	389	354	7%	-35	-9%	354	-	T2	CS
Luxembourg	NA,NO	1	2	3	0.1%	0.2	7%	1	74%	CS	CS
Netherlands	NO	IE	IE	IE	-	-	-	-	-	NA	NA
Portugal	NE	15	7	6	0.1%	-0.2	-3%	-9	-59%	T1, T2	D, CS
Spain	NA	2	53	30	1%	-23	-43%	28	1273%	D	D
Sweden	1	7	29	28	1%	-1	-3%	21	317%	CS,T2	D
UK	10	400	1 936	1 959	38%	22	1%	1 559	389%	T2	CS
EU-15	**32**	**1 409**	**5 332**	**5 149**	**100%**	**-182**	**-3%**	**3 740**	**265%**		

In 2012, HFC emissions from 2F4 were 3.7 times higher than in 1995 (Figure 4.14). France and UK are responsible for 76 % of total EU-15 emissions from this source. Between 2011 and 2012 EU-15 emissions decreased by 3 %. The relative decrease between these years was largest in Spain; the biggest increase was reported in Finland (Table 4.65).

Figure 4.14 2F4 Aerosols/Metered Dose Inhalers: EU-15 HFC emissions

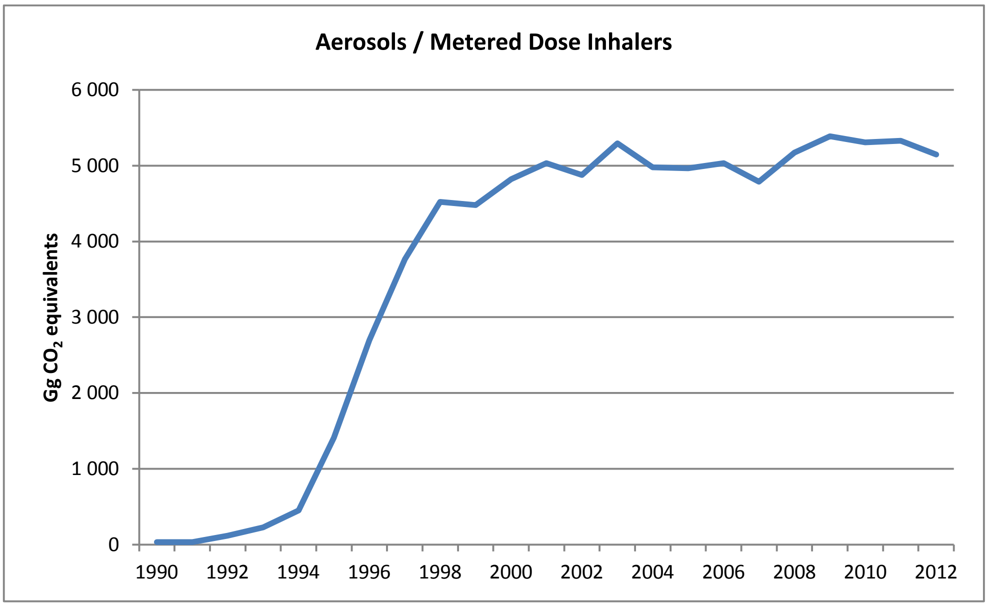


Table 4.66 provides descriptions on methods used for estimating HFC, PFC and SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.66 2F Consumption of halocarbons and SF_6: General description of national methods used for estimating emissions

Member States	**Description of methods**
Austria	Methodologies have been developed in general in several studies contracted by the Umweltbundesamt: • (Umweltbundesamt 2001b) – 1990-2000 total sector • (Obernosterer et al 2004) – re-evaluation of sub category foam blowing • Austrian estimates of emissions from the sources *2.F.4* Aerosols and *2.F.5* Solvents, based on a European evaluation of emissions from this sector (HARNISCH & SCHWARZ (2003), disaggregated to provide a top-down estimate for Austria. • (Leisewitz & Schwarz 2010/2011) – All sub categories of Category 2.F for the years 2000 to 2007; some sub categories for 2008 as well. • Leisewitz (2012): Category 2.F.1 for the year 2010. For the years 2008 to 2012, additional data updates were obtained from importers and companies using fluorinated gases, based on the same contacts and data sources as in LEISEWITZ & SCHWARZ (2010). Emissions for all subcategories were estimated using a country specific methodology, emission factors are based on information of experts from the respective industries. For most sources emissions are calculated from annual stocks using emission factors. Data about consumption of HFC, PFC and SF_6 were determined from the following sources: data from national statistics data from associations of industry direct information from importers and end users Since 2004 there is also a reporting obligation under the Austrian FC-regulation for users of FCs in the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols.
Belgium	For estimating the emissions of the F-gases described in Annex A to the Kyoto Protocol (hydrofluorocarbons HFCs, perfluorocarbons PFCs, sulphur hexafluoride SF_6), a country-specific methodology was developed by 2 consultancies (ECONOTEC and ECOLAS) in 1999 based on the IPCC Guidelines and updated every year and further optimised by ECONOTEC in collaboration with the VITO. Emissions of fluorinated greenhouse gases are mainly estimated on the basis of: the consumption of the different substances for each application, the consumption of products containing such substances, figures on external trade in substances or products containing substances, as well as on

Member States	Description of methods
	emission modelling by application and assumptions on leakage rates.
Denmark	The data for emissions of HFCs, PFCs, and SF_6 have been obtained in con-tinuation on work on inventories for previous years. The determination in-cludes the quantification and determination of any import and export of HFCs, PFCs, and SF_6 contained in products and substances in stock form. This is in accordance with the IPCC guidelines (IPCC (1997), vol. 3, p. 2.43ff), as well as the relevant decision trees from the IPCC Good Practice Guidance (IPCC, 2000) p. 3.53ff). For the Danish inventories of f-gases, a Tier 2 bottom-up approach is basically used. As for verification using import/export data, a Tier 2 top-down approach is applied. In an annex to the f-gas inventory report 2011 (Poulsen & Musaeus, 2014)), there is a specification of the approach applied for each sub-source category. The following sources of information have been used: - Importers, agency enterprises, wholesalers and suppliers. - Consuming enterprises, and trade and industry associations. - Recycling enterprises and chemical waste recycling plants. - Statistics Denmark. - Danish Refrigeration Installers' Environmental Scheme (KMO). - Previous evaluations of HFCs, PFCs and SF_6. Suppliers and/or producers provide consumption data of f-gases. Emission factors are primarily defaults from the GPG, which are assessed to be applicable in a national context. In case of commercial refrigerants and Mobile Air Condition (MAC), information from Danish suppliers has been used. The actual amount of f-gas used for refilling is used as an estimate on the actual emission. Import/export data for sub-source categories where import/export is relevant (MAC, fridge/freezers for household) are quantified on estimates from import/export statistics of products + default values of the amount of gas in the product. The estimates are transparent and described in the annex to the report referred to above.
Finland	Emissions from each category are quantified using two or three different methods given in the GPG 2000. Finland reports both actual and potential emissions of F-gases in accordance with the UNFCCC reporting guidelines (FCCC/SBSTA/2004/8). There are two tiers for the estimation of potential emissions that describe gas consumption within a country (Tier 1a and 1b). The difference between the two is whether gases imported and exported in products are accounted for.
France	*IPCC Tier 2 methodology is applied to all subsectors.* *Methodological changes (2014 Submission) in 2.F.1: Inclusion of "drive" markets into commercial and industrial refrigeration. Correction of several emission factors and of the share of R-134a in commercial and industrial refrigeration, and of the refrigerant split in heat pumps.* *Methodological changes (2014 submission) 2.F.2:* *General application of Tier 2 to F-gas blowing agents for insulation foam.* *Methodological changes in 2.F.4 Aerosols (2014 submission:* *Changed split between HFC-134a and HFC-227 in MDIs.* *Methodological changes in Semiconductor manufacture 2.F.7 (2013 submission):* *Taking into account fo CF4 emissions from the production of photovoltaic cells (1 pant).* Prise en compte dans l'inventaire de deux nouveaux sous-secteurs : les magasins « drive » dans le froid commercial et l'industrie des plats cuisinés dans l'agroalimentaire. Mise à jour annuelle de l'inventaire des fluides frigorigènes par Armines ParisTech (correction de certains taux d'émissions en froid commercial, correction de certaines erreurs aperçues dans le froid commercial et industriel (notamment pour la période 1990 - 1992 où le R-134a n'était pas encore présent), correction de la répartition des fluides utilisés sur certaines pompes à chaleur, etc.). L'inventaire des émissions de gaz fluorés dans le secteur d'activité des mousses d'isolation a été réalisé par EReIE selon la méthode de rang 2 du GIEC. Il est à noter l'utilisation dans ce secteur du HFC-245fa dont les émissions n'étaient pas encore estimées dans les éditions précédentes de l'inventaire. Mise à jour pour l'année 2011 des quantités de HFC vendus en France dans la catégorie des aérosols techniques (HFC-152a et HFC-134a) et de la modification du taux de répartition du type de HFC (HFC-134a vs HFC-227ea) présent dans les ventes d'aérosols pharmaceutiques en France. L'ancienne méthode de répartition du type de HFC contenu dans les ventes d'aérosols pharmaceutiques en France était basée sur des données d'expert datant de plusieurs années. Cette répartition était constante sur toute la période 2005 - 2011 et prise égale à 10% de HFC-227ea contre 90% de HFC-134a. Dans la nouvelle méthodologie, cette répartition varie en fonction de la production française ce qui améliore notablement la justesse de l'inventaire car ces données sont spécifiques de la France. Prise en compte des émissions de CF4 dans la production de cellules photovoltaïques (1 site). La méthodologie utilisée dans les calculs d'émissions de CF4 dans la production de cellules photovoltaïques est basée sur la méthode Tier 1 de l'IPCC 2000.
Germany	There is a variety of Tiers applied to the 2.F emission source categories: Tier 2a is applied to all sub-sources of 2.F1, to 2.F.2 (foam) and 2.F.7 (semiconductor manufacture). Tier 2 is used for 2F.4b/c (other aerosols and novelties) and 2.F.5 (solvents). CS approaches are applied to 2.F.3 (fire protection), 2.F.4a (MDI), and 2.9 (other SF_6 and HFCs applications). Tier 3a is applied to emission estimates from 2.F.8 (electrical switchgear).
Greece	In order to obtain a reliable estimation of f-gases emissions, the collection of detailed data for all the activities mentioned above (e.g. number of refrigerators, type and amount of refrigerant used by each market label, substitutions of refrigerants that took place the late years etc.) is required. The availability of official data in Greece is limited and, therefore, in some cases the estimations presented hereafter involve the application of country specific methodologies.

Member States	Description of methods
	In order to resolve any remaining completeness issues, and given the fact that there has not been any opposite indication for the use of the PFCs in Fire Extinguishers and f-gases in Solvent Uses up to now, in September 2010 Greece has decided to use information from inventories of neighboring countries. In specific for Solvent uses the inventory of Italy has been used while for Fire Extinguishers the inventories of Italy, Spain and Portugal have been used, on the grounds that the climatic and socio-economic conditions between Greece and these Countries are quite similar.
Ireland	Where data allowed, emission estimates were calculated following the guidance for individual sub-categories provided by IPCC good practice guidance. The approach developed by Adams *et* al. (2005) was used for the submissions until 2013 (for 1990-2011 data). A review of existing approach and new study on F-gases was carried out as a project commenced in 2013. The time series 1990-2011 was reviewed and emission estimates for 2012 were compiled along with the revised estimates. Information obtained from stakeholders was used to update the current inventory using best practice and methodologies as outlined in the Revised 1996 Guidelines and IPCC GPG. A comparison of emissions with other European countries was carried out. Further information on the recalculations of each sector in the F-Gases inventory can be found in each relevant sub-section. The approach used for the new estimates (in 2013 study) still requires further review and additional data collection from industry.
Italy	The sub-sector consumption of halocarbons and SF_6 consists of three sources, “HFC, PFC emissions from ODS substitutes”, key category at level and trend assessment, both Tier 1 and 2 approaches, “PFC, HFC, SF_6 emissions from semiconductor manufacturing”, “SF_6 emissions from electrical equipment”, that are non-key categories. Potential emissions are also reported in this section. General methodology used for the sub-sources of 2.F is IPCC Tier 2a, except for SF_6 emissions from electrical equipment (2F7), where it is IPCC Tier 3b. The IPCC Tier 1a method has been used to calculate potential emissions, using production, import, export and destruction data provided by the national producers (Solvay, several years; ST Microelectronics, several years; MICRON, several years). As regard PFC potential emissions, since no production occurs in Italy, export has been reasonably assumed negligible, whereas import corresponds to consumption of PFCs by semiconductor manufacturers that use these substances. Regarding HFCs there was an update in 2011 of import export data reported by operators.
Luxembourg*	A re-evaluation of the emission sources and the emissions of HFCs, PFCs and SF_6, taking into account the 2000 IPCC-GPG Guidelines as well as country specific considerations has been done in the previous submission.
Netherlands	In the Netherlands, many processes related to the use of HFCs and SF_6 take place in only one or two companies. Because of the sensitivity of data from these companies, only the sum of the HFC emissions of 2F2–5 (included in 2F9) and of the SF_6 emissions of 2F7 and 2F8 is reported (included in 2F9). In past submissions only a table with the potential emissions from Stationary refrigeration and air-conditioning (2F1) was included. From this submission onwards the potential emissions for the period 1990–2012 are included in the CRF. These emissions are determined according to the Tier 1a method (Revised Reference Manual 1996, 2.17.3.2). Because the consumption data of PFCs and SF_6 are confidential, only the HFC emissions (2F1 and 2F9) are reported. To comply with the IPCC Good Practice Guidance (IPCC, 2001), IPCC Tier 2 methods are used to estimate emissions of the sub-categories Stationary refrigeration, Mobile air-conditioning, Aerosols, Foams and Semiconductor manufacturing. The country-specific methods for the sources Sound-proof windows and Electron microscopes are equivalent to IPCC Tier 2 methods. For 2007 and 2008, the country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3b method and from 2009 onwards to the IPCC Tier 3a method.
Portugal	For those sources with sufficient available data, actual emissions where estimated with a Tier 2 (advanced or actual method) approach which is considered Good Practice in accordance with GPG. This approach allows the quantification of emissions in the year in which they actually occurred accounting for the time lag between consumption and emissions. On the contrary, the Tier 1, or potential emission estimation approach, allocates emissions in the year that the chemical is sold into a particular end-user. As a general rule, bottom-up methodologies were used, and thus overall methodology should be classified as Tier 2a. This approach departs from the knowledge of the number of equipment using fluorinated compounds and estimates emissions to atmosphere from charge (amount of chemical used in the equipment), service life, emission rate during the various periods of the equipment life and possible recovery of emissions. Whenever possible emission estimates include: - assembly emissions - when equipment is first filled; - operation emissions - occurring during equipment lifetime or usage and resulting mainly from leaks; - disposal emissions - the remaining charge that is released to the atmosphere at end of equipment life and where the remaining charge is neither recycled or destroyed. No recalculations were made in the 2014 submissions.
Spain	*No general description, see sub-category specific descriptions.* *For both refrigeration and air conditioning and foam blowing Tier 2 of the 2000 IPCC Good Practice Guidance and of the new 2006 IPCC Guidelines have been applied. Fire extinghishing equipment: For the annual stock calculation information on the life time of fixed and portable systems has been gained for electronic and non-electronic equipment. The share between electronic and non-electronic*

Member States	Description of methods
	equipment is estimated 80%/20%. Aerosols: According to the 1996 IPCC Guidelines emissions from aerosols are assumed to arise 50% in the first, and 50% in the second year of use. Refrigeración y aire acondicionado: La metodología de estimación de las emisiones se ha basado en la expuesta en la Sección 2.17.4.2 del Manual de Referencia 1996 IPCC y en las secciones 3.7.4 y 3.7.5 de la Guía de Buenas Prácticas 2000 IPCC. Espumado de plásticos: Para estimar las emisiones de esta sub-categoría se ha aplicado el método de nivel 2 de IPCC con factores de emisión por defecto que figuran en la Tabla 7.6 de la Guía 2006 IPCC. Equipos de extinción de incendios: Para realizar el cálculo del stock existente en cada año, se ha utilizado: i) información sobre la vida útil de los equipos de extinción, distinguiendo dentro de los equipos fijos y portátiles, entre equipos electrónicos y el resto de equipos ii) información de la representatividad de cada tipo de equipo sobre la cantidad consumida de gases (20% para equipos electrónicos y 80% para el resto de equipos) Aerosoles: Los gases de los aerosoles se liberan en un corto espacio de tiempo después de la producción: un promedio de 6 meses después de la venta. La emisión es el 100% del gas inyectado en el aerosol. De conformidad con lo anterior y con la Sección 2.17.4.5 del Manual de Referencia 1996 IPCC y la Sección 3.7.1 de la Guía de Buenas Prácticas 2000 IPCC, se asume que un 50% de la emisión se produce en el año de venta del producto y el 50% restante en el año siguiente, para así tener en cuenta el promedio de 6 meses de retraso desde la venta hasta la utilización.
Sweden	In estimating the actual emissions in all subcategories, as far as possible, a national model has been used, corresponding to the IPCC Tier 2 approach. The basis for the emission estimates are the annual bulk import and export statistics of fluorinated greenhouse gases recorded in the Swedish Chemicals Agency's Products Register. However, the register does not cover all chemicals already included in products imported to or exported from Sweden (e.g. air-air heat pumps). In order to make a complete reporting of fluorinated greenhouse gas emissions and, as far as possible, to facilitate allocation of emissions onto the IPCC source categories, additional information from various trade associations and companies are collected annually. The model takes into consideration changes in accumulated amounts each year resulting from additional amounts of HFC, PFC and SF_6 imported and used within the country, as well as the decline in accumulated stock caused by exports or emissions from operating systems. In 2011, a study has been carried out to analyze the model's flexibility to adapt to the newly introduced international and national legislations on fluorinated greenhouse gases. In addition, the study aimed at updating model factors using available information, but also to analyze the accuracy of the estimates of e.g. emissions from disposal. The study resulted in several recalculations for the 2012 submission, but also suggestions on future improvements. Due to a recurring one year lag of updating of the data from the Products Register from the Swedish Chemicals Agency, data on bulk import and export in 2011 are updated. This results in revised data on actual emission estimates from stationary refrigeration and air-conditioning equipment (2.F.1), from fire extinguishers (2.F.3) and from electrical equipment (2.F.8) for 2011 due to the calculation system.
United Kingdom	No general description, see sub-category specific descriptions

Source: NIR 2014 unless stated otherwise

Table 4.67 provides descriptions on methods used for estimating HFC emissions from 2F1 Refrigeration and Air-Conditioning Equipment.

Table 4.67 2F1 Refrigeration and Air-conditioning equipment: Description of national methods used for estimating HFC emissions

Member States	Description of methods
Austria	This sub sector can be divided into: a) Category of stationary refrigeration covering large plants/facilities that are filled on site, emissions are estimated using a top down model: - Industrial refrigeration - Supermarkets (Part of CRF category commercial refrigeration) - Other commercial refrigeration (Part of CRF category commercial refrigeration) - Stationary air conditioning (part of CRF category stationary air conditioning) b) Rest of the sector 2F1 including parts that are, for the most part, not filled in Austria (or at least not filled on site), emissions are estimated using a bottom up approach: - Room air conditioning (part of the CRF category stationary air conditioning) - Heat pumps (part of CRF category stationary air conditioning) - Commercial stand-alone refrigeration equipment manufacturing (part of CRF category commercial refrigeration) - Domestic refrigeration

Member States	Description of methods
	- Transport refrigeration - Mobile air conditioning
Belgium	For the refrigeration sector, emissions have been estimated separately for the following source categories: industrial and commercial installations, household refrigerators, air conditioning of private cars, air conditioning of buses and coaches, and refrigerated transport. In accordance with the IPCC guidelines, the assembly emissions, the operation emissions and the disposal emissions are being determined separately. For each substance, the assembly emissions are calculated as a function of the estimated amount charged into new systems and the percentage assembly losses, the operation emissions as a function of the amount stocked in existing systems and assumptions on annual leakage rates, and the disposal emissions in function of the amount in systems at time of disposal and the estimated recovered fraction. An annual inquiry is made on the consumption of the major F-gas containing product manufacturers, among which the 4 car manufacturers. These data are used for calculating the 'product' potential emissions as well as the assembly emissions. Industrial and commercial 'installations' represent all on-site assembled systems for industrial & commercial refrigeration as well as stationary air-conditioning applications. They represent the largest single source of F-gas emissions. The consumption and emission of refrigerants are modelled on the basis of an annual inquiry among refrigerant suppliers on their national supply by refrigerant mixture, as well as on assumptions on average loss rates, from which the estimated supply for refilling vehicles is subtracted. No distinction is made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it is not possible to disaggregate the consumption data between these sub-sectors, because of the presence of intermediary wholesalers, and the fact that no inventory of installations is available. The refrigerant consumption and emissions in the mobile air conditioning sector are estimated by modelling the evolution of the vehicle stock, on the basis of the number of new vehicle registrations and of the percentage of new vehicles equipped with air conditioning, by category of vehicles (cars, buses and coaches). The emissions from refrigerated transport are calculated on the basis of the annual number of new registrations of refrigerated trucks and trailers by gross / net weight categories, the average quantity of refrigerant (by type of refrigerant) contained in each vehicle (by vehicle category) and emission factors taken from the literature.
Denmark	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. In case of commercial refrigerants and Mobile Air Condition (MAC), information from Danish suppliers has been used. Import/export data for sub-source categories where import/export is rele-vant (MAC, fridge/freezers for household) are quantified on estimates from import/export statistics of products + default values of the amount of gas in the product. The estimates are transparent and described in the annex to the report referred to above. Detailed information on the amount of HFCs used for refilling of mobile A/C has been available for 2009 - 2011, and therefore, a new approach has been implemented in the calculation of emissions. HFCs for mobile A/C are only used for refilling, and therefore the amount used for mobile A/C is as-sumed to be the same as the amount emitted during use (Poulsen & Musae-us, 2014): Consumption of HFC for MAC = refilled stock = emission.
Finland	Refrigeration and air conditioning (CRF 2.F.1) Top-down Tier 2, Tier 1a, Tier 1b The Tier 2 top-down method is used for all sources in this category, both stationary and mobile. Data are not collected for separate subcategories because such statistics are either not available or the preparation of such statistics would entail a very high reporting burden on companies. There is also some evidence that simpler questionnaires lead to better response activity. HFC-23 emissions from this source were not reported separately due to confidentiality 2003-2005, 2007-2009 and 2011-2012.
France	*The HFC emission estimates are based on a model which has been developed by MINES ParisTech (Centre Energétique et Procédés (CEP), using Tier 2 methods. Refrigeration and air conditioning is distinguised in to 8 sub categories with different equipment types. This approach requires data on the annual sales of equipment, of its capacity, average charge and refrigerant type, and on the life cycle of the equipment (manufacturing, use, maintenance, decommissioning). Basic data have been provided by RIEP (Refrigerant Inventory of Emission Previsions), which allow determination of the equipment stock over all its lifetime from 7 to 30 years. RIEP is used by CITEPA for the annual French inventories.* Les émissions de HFC sont déterminées à l'aide du modèle développé par les MINES ParisTech (Centre Energétique et Procédés (CEP)) qui utilise une méthode de rang 2 du GIEC avancée. Depuis 1996 le CEP inventorie les émissions de fluides frigorigènes par une approche détaillée. Les systèmes frigorifiques et de climatisation sont répartis en 8 familles, chacune pouvant comporter plus d'une dizaine d'équipements différents. Cette approche par application suppose des enquêtes sur les ventes annuelles d'équipements et une connaissance de l'équipement quant à la puissance, la charge moyenne et le type de fluide frigorigène employé, l'aptitude à la fuite au cours de son cycle de vie (fabrication, exploitation, maintenance et mise au rebut). Une base de données extensive, RIEP (Refrigerant Inventory of Emission Previsions), élaborée par le CEP, permet de reconstituer les parcs d'équipements sur leur durée de vie variant de 7 à 30 ans. L'actualisation annuelle de la base est éditée sous différentes formes, dont le Common Reporting Format (CRF). RIEP est utilisé par le CITEPA pour les inventaires annuels français.
Germany	IPCC Tier 2a. This category is divided into the sub-categories of household refrigeration, commercial refrigeration, transport refrigeration, industrial refrigeration, stationary air-conditioning systems and

Member States	Description of methods
	room air-conditioners, and mobile air-conditioning systems. For calculation of HFC emissions from the sub-categories of refrigeration and stationary air conditioning systems, individual data are collected, or refrigerant models used. Any refrigerant models used are described in connection with the relevant method. The emission factors used are the result of surveys of experts. For some sub - source categories, disposal emissions occurred for the first time in 2003. The application of new refrigerant models with different calculation steps and new data sources in the subsectors commercial refrigeration 2.F.1.b, industrial refrigeration 2.F.1.d, stationary air conditioning and heat pumps (2.F.1.e) as well as mobile refrigeration (2.F.1.f) as well as the first-time collection of data for heat pump tumble dryers led to multiple recalculations in the 2013 and 2014 submissions of the inventory, most of them for the whole time series from 1992/93/94 to 2011.
Greece	Refrigeration and air-conditioning F-gases emissions are estimated based on the Tier 2a methodology described in the IPCC Good Practice Guidance. This is a bottom-up approach based on detailed equipment data and emission factors representing various types of leakage per equipment category. It should be noted that the application of the Tier 1 methodology (calculation of potential emissions based on imports, exports and domestic consumption of each gas) and Tier 2b (calculation of actual emissions based on detailed sales data per gas and activity) is not possible for the time being, as the available information is not reported in the way required by these methodologies. Total emissions are calculated as the sum of *assembly* emissions (emissions associated with product manufacturing, even if the products are eventually exported), *operation* emissions that include annual leakage from equipment stock in use (regardless of where they were manufactured) as well as servicing emissions and *disposal* emissions that include the amount of refrigerant released from scrapped systems, regardless of where they were manufactured. Regarding the activity data (number of equipment, the following should be mentioned. Changes in the time series of Activity Data operating in the system (for the subcategories: small commercial applications, Large commercial applications, Split unit systems and semi central systems, Central air conditioning – Chillers, Other applications of central air conditioning), and consequently in the emissions of stocks are attributed to updated data. In addition numerical errors have been also corrected in the working files and the time series were recalculated.
Ireland	Potential emissions from the sector are calculated using a Tier 1 approach as follows: Potential emissions = production + import – export – destruction As there is no manufacture of fluorinated gases in Ireland, the production term above is zero. Imported HFCs are calculated using the data supplied as described above. Exports are calculated on the basis of refrigeration unit manufacturers' share of exports. In Ireland there is no known destruction of HFCs. Recovered gas is used either in other equipment or exported for recycling or destruction. A bottom-up approach is not feasible for estimating actual emissions from stationary refrigeration and air conditioning in Ireland due to the lack of data available on equipment types and HFC sales data in equipment sub-categories. Therefore emissions are estimated using a top-down approach based on reported sales data and information on market shares, which are applied to calculate estimates of total HFC sales in the Irish stationary refrigeration and air-conditioning sectors. As a result, emissions arising from sub-sectors *2.IIA.F.1.1 Domestic Refrigeration, 2.IIA.F.1.3 Transport Refrigeration, 2.IIA.F.1.4 Industrial Refrigeration* and *2.IIA.F.1.5 Stationary Air-Conditioning* are reported under *2.IIA.F.1.2 Commercial Refrigeration*. Emissions of HFCs from sub-category *2.IIA.F.1.6 Mobile Air-Conditioning* are estimated using a Tier 3b bottom-up analysis which uses national vehicle fleet statistics (Table E.5, Annex E) and assumed rates of air-conditioning unit penetration in the national vehicle fleet (AEA, 2011). The methodology used takes account of vehicle lifetime (12 years), the percentage of vehicles having HFC in their air-conditioning systems, average charge per unit, product manufacturing emissions (AEA, 2011), effective lifetime leakage rates (incorporating emissions from normal operating losses and accidental releases arising from collision damage) and decommissioning losses (EP and CEU, 2006). Recalculations in the sub-categories *2.F*, HFC and SF_6 gases are mainly due to a new F-gas study conducted in 2013 including revised activity data from new and existing supplier sources in sector *2.F.1 Refrigeration and stationary air conditioning*.
Italy	Refrigeration and air-conditioning: IPCC Tier 2a For the sub-source category Stationary Refrigeration, emissions are estimated for Domestic Refrigeration, Commercial Refrigeration and Stationary Air Conditioning. Industrial Refrigeration and Transport Refrigeration estimations are included in Commercial Refrigeration because no detailed information is available to split consumptions and emissions in the different sectors. Appropriate losses rates have been applied for each gas, taking into account the equipment where refrigerants are generally used, as suggested by a pool of experts during a specific meeting held at the Ministry of the Environment, Land and Sea (ISPRA-MATTM, 2013), in order to assess F-gas emissions from refrigeration and air conditioning, with a focus on commercial refrigeration. On the basis of their knowledge, appropriate emission factors have been determined. Based on the European and national legislation on certain fluorinated greenhouse gases every year by the 31 May, the operator of the refrigeration, air conditioning and heat pump equipment, as well as fire protection systems, which contain more than 3 kg of fluorinated greenhouse gases must submit to ISPRA data on emissions referred to those applications. ISPRA has developed a specific website, where each operator requests username and password and compiles the Declaration. The year 2012 has been the first year of the data collection, and actually ISPRA is opening the new 2014 collection (data collected will refer to the year 2013). Data are still of course not complete, and consequently not comparable with inventory data, but a preliminary analysis has been done. Basic data have been supplied by industry: specifically, for the mobile air conditioning equipment the national motor company and the agent's union of foreign motor-cars vehicles have provided the yearly consumptions (FIAT, several years; IVECO, several years; UNRAE, several years; CNH, several

Member States	Description of methods
	years); for the other refrigeration and air conditioning equipment the producers supply detailed table of consumption data by gas (Solvay, several years).
Luxembourg	Emissions from *industrial and commercial installations* have been calculated on the basis of a life-cycle approach and on the basis of an inquiry among the refrigerant distributors on their national supply by refrigerant mixture on the year 2006. The evolution in time of the total supply by refrigerant has been assumed to be the same as in Belgium. No distinction has been made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it was not possible to disaggregate the consumption data between these sub-sectors because of the presence of intermediary wholesalers. The emissions are calculated on the basis of the assumption of 3% assembly losses , the annual losses (9.3% in 2012), the average equipment lifetime of 20 years and an end-of-life recovery rate of 50%. Emissions from *domestic refrigeration* have been estimated to be negligible. Emissions from *cars* have been calculated on the basis of a life-cycle approach and on the basis of the evolution of the national car fleet. Assumptions have been taken for the percentage of new cars equipped with air conditioning (96% in 2012), the average quantity of HFC 134a in a new car (0.61 kg in 2012), the percentage of annual losses (6.9% regular losses and 1.9% accidentally losses in 2012) and the annual refilling rate (3% in 2012). Moreover, it is assumed that there is no dismantling of end-of-life cars in Luxembourg since all old cars are exported. Emissions from *buses* have been calculated on the basis of a life-cycle approach and on the basis of the evolution of the national bus fleet. Assumptions have been taken for the percentage of new buses equipped with air conditioning (100% in 2012), the average quantity of HFC 134a in a new bus (10.6 kg in 2012) and the percentage of annual losses (15% in 2012). Moreover it is assumed that there is no dismantling of end-of-life buses in Luxembourg since all old buses are exported. Emissions from *transport refrigeration* are calculated on the basis of the emissions reported by Germany (Schwarz, 2009) for the operation and dismantling and expressed per capita with the relative population in Luxembourg (conversion factor 0.0055).
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. The activity data used to estimate the emissions are based on the following sources: Consumption data of HFCs have been obtained from the annual report by PriceWaterhouseCoopers (PWC, 2011). For Mobile air-conditioning the number of cars (per year of construction) and the number of scrapped cars (per year of construction) are obtained from Statistics Netherlands (CBS). The recycled and destroyed amounts of refrigerants are obtained via ARN, a waste processing organisation. Emission factors used to estimate the emissions in this category are based on the following sources: • Stationary refrigeration: Annual leak rates are based on surveys (De Baedts et al., 2001). • Mobile air-conditioning: Annual leak rates are based on surveys (De Baedts et al., 2001) and other literature (Minnesota Pollution Control Agency, 2009; YU & CLODIC, 2008).
Portugal	F-Gas emissions from operation and disposal of domestic refrigeration, stationary refrigeration, transport refrigeration, domestic and industrial stationary air conditioning were estimated using the bottom-up approach (Tier 2a or actual method) as proposed in chapter 3.7.4 of the GPG. F-Gases emissions for each particular compound were estimated from total Refrigeration Fluid emissions and considering the percentage of F-Gas use in total Refrigeration Fluid use in each year. The stock of domestic refrigeration equipment was estimated from the number of households and from the percentage of households with refrigeration equipments, available for years 1990, 1995 and 2000, according to an unpublished report from INE. From year 2000 onwards the percentage of equipment per household was forecasted by APA based on gross domestic product behaviour. The number of households refers to INE-Family Survey. There are no available national statistics concerning the number and dimension of non-domestic refrigeration equipment used in commerce, industry, tourism, services and institutional activities. A survey on Hotels, Hostels and Camping Parks was conducted with the support of “Turismo de Portugal, ip” and “AHP – Associação da Hotelaria de Portugal”, in order to obtain real data concerning the number and dimension of non-domestic refrigeration equipment. Data pertaining to other commerce and services activities was estimated with the technical support of APIRAC, Importers and DGE (Enterprise and Industry General Directorate). Calculations for Hypermarkets were made separately. HFC emissions from operation and disposal of Mobile Air Conditioning (MAC) systems were estimated using the bottom-up approach (Tier 2a or actual method) as proposed in chapter 3.7.5.1 of the GPG. Estimates for Road Transportation and Railways were made separately. The number of light vehicles with MAC was estimated from the total number of light vehicles sold each year, using the same information used to establish the time series of car sales and fleet in chapter 1A3, and the percentage of new cars sold with MAC at each year was estimated according to data provided by manufacturers.

Member States	Description of methods
Spain	*Information about these sectors have been provided for several years by industrial associations, considering the difference between refrigeration/stationary air conditioing and automotive air conditioning; for the latter questionnaires have been used filled by the automotive manufacturing plants. The estimation approaches are mostly based on the capters 3.7.4 and 3.7.5 of the IPCC 2000 Good Practice Guidance.* Para estos sectores se ha contado con información suministrada para algunos años por las asociaciones empresariales del frío y climatización y, por lo que respecta a su uso en la industria de automoción, con información obtenida vía cuestionario a las plantas de fabricación de automóviles. Para los equipos estacionarios de refrigeración y climatización, el equipo de trabajo del inventario ha extendido las tasas de variación interanual para completar los últimos años de la serie al no haberse podido disponer de otra información en esta edición del inventario. Los factores de emisión son, por lo que respecta a la producción nacional de automóviles, datos derivados de la información de cuestionarios a las plantas fabricantes, y para los demás sub-sectores se han tomado de las guías de IPCC. La metodología de estimación de las emisiones se ha basado en la expuesta en la Sección 2.17.4.2 del Manual de Referencia 1996 IPCC y en las secciones 3.7.4 y 3.7.5 de la Guía de Buenas Prácticas 2000 IPCC. Según estas referencias las emisiones se pueden originar en las fases de montaje, funcionamiento y retirada de los equipos. A cada una de estas fases corresponde un algoritmo de cálculo de las emisiones. La emisión total será la suma de las emisiones generadas en cada una de las tres fases.
Sweden	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. Input data for the calculation of actual emissions consists of information from various sources; the Swedish Chemicals Agency, equipment producers and importers. The values for chemical charge, lifetime and emission factors for the applications used in the Swedish inventory are based on information from the equipment producers and IPCC default values. When data from equipment producers is used it has been compared against IPCC default data and been judged as reasonable. In a recent study (SMED), based on contacts with the Swedish road vehicles manufacturers, several factors were modified for MAC for 2010 onwards to be more in line with the present status of the Swedish road vehicle fleet.
United Kingdom	The previous version of the refrigeration/air conditioning inventory model developed by AEA (2010) was updated by ICF International in the summer/autumn of 2011 based on revised industry input and a more transparent, robust Tier 2 modelling approach. Specifically, the model was reorganized from nine to 13 end-uses, for which detailed assumptions were developed to utilise a fully bottom-up approach. Since most end-uses defined by the previous version of the model were modelled using a top-down approach, many input assumptions were developed for the first time. This transition from a largely top-down approach (based on total refrigerant sales data) for estimating the UK's refrigeration and air conditioning emissions to a fully bottom-up approach (based on equipment stocks and average charge size from available market data) was performed in order to improve the accuracy of emissions allocated to end-uses and improve the understanding of the end-uses to better inform policy. For all end-uses, market data and other country-specific information were considered in the development of assumptions on equipment stocks, market growth, equipment lifetimes, refrigerant market penetrations, charge sizes, manufacturing loss rates, operational loss rates, and disposal loss rates for each end-use across the 1990-2050 time series. To revise and develop new input assumptions, an extensive literature review was conducted and key industry stakeholders were contacted. Priority industry stakeholders were selected across all end-uses and initially contacted to fill data gaps and corroborate information found in the literature. Following the development of preliminary assumptions for all end-uses, draft assumptions were then shared with a broader range of stakeholders to solicit additional industry input and vet assumptions In developing modelling input assumptions by end-use, expert judgment was applied to select appropriate values when more than one estimate was provided by literature and/or stakeholders. In general, more weight was given to estimates that are UK- or regional specific and/or more recent. In cases of equal data quality where numerous data points were available, values were selected based on the mid-point of the data range. Where no UK- or EU-specific information was available, the 2000 Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance default assumptions were relied on to estimate emissions. The 1996 and 2006 IPCC reports were also reviewed and considered, but the latter (most recent) assumptions could not be adopted at this time without additional supporting information, per IPCC guidance.

Source: NIR 2014 unless stated otherwise

Table 4.68 provides an overview of all sources reported under 2F9 Other by EU-15 Member States for the year 2012. The largest contributor to emissions is Germany with 59 %. Most Member States report emissions from double glaze windows in this source category.

Table 4.68 2F9 Other: Overview of sources reported under this source category for 2012

Member State	2.F.9 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	Double glaze windows, Research and other use	NA,NO	NA,NO	0.01	247	6%
Belgium	Double glaze windows	NO	0.2	0.004	104	2%
Denmark	Double glaze windows, Laboratories, Fibre optics	1.4	3	0.004	109	2%
Finland	Grouped confidential data	2.9	1	0.001	34	1%
France	Shoes application, Closed application, Open application	NA,NO	183	0.007	353	8%
Germany	Car Tyres, Shoes, Trace gas, Double glaze windows, Coating, AWACS maintenance, Optical Glass Fibre, Solar Technology, Welding	0.2	0.03	0.1	2 629	59%
Greece	NA,NO	NA,NO	NA,NO	NO	-	0%
Ireland	Medical Applications, Tracer in Leak Detection, Double glaze windows, Sporting goods	NA,NO	NA,NO	0.0001	3	0.1%
Italy	NA,NO	NA,NO	NA,NO	NO	-	0%
Luxembourg	Noise reduction windows	NA,NO	NA,NO	0.0003	7	0.2%
Netherlands	No specific allocation due to confidentiality of data	275.3	NA,NO	0.008	471	11%
Portugal	NA,NO	NA,NO	NA,NO	NO	-	0%
Spain	NA	NA	NA	NA	-	0%
Sweden	Shoes, Double glaze windows	NA,NO	2	0.00005	3	0.1%
UK	Semiconductors, Electrical and production of trainers, One Component Foams, Gibraltar F Gas Emissions	NA,NO	79	0.02	460	10%
EU-15 Total		**280**	**269**	**0.2**	**4 421**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.69 summarises information by Member State on emissions for the key source SF_6 from 2F9 Other sources of SF_6. The emission trend is mainly driven by the emission trend in Germany.

Figure 4.15 2F9 Other: EU-15 SF_6 emissions

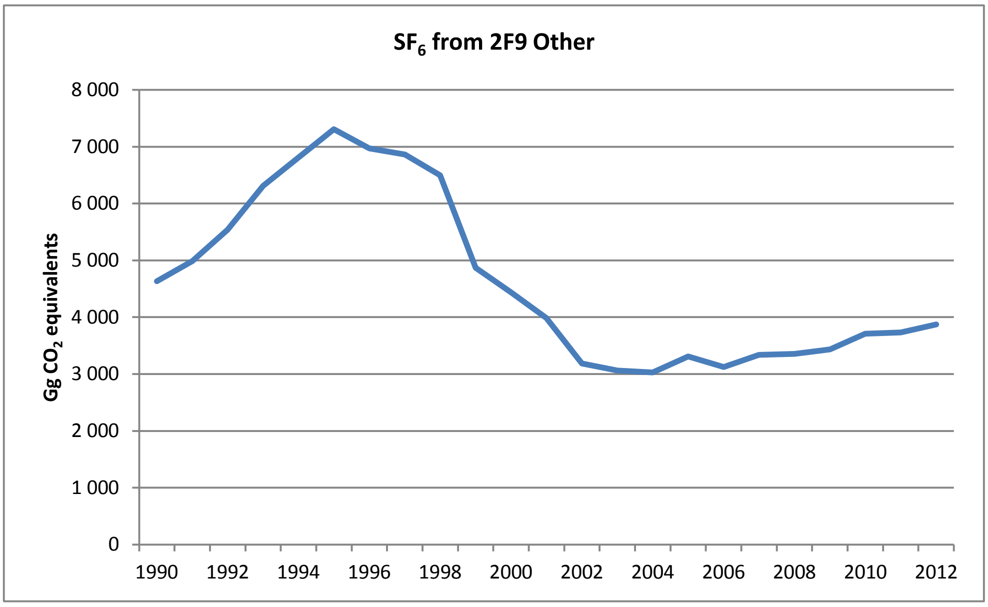


Table 4.69 2F9 Other: Member States' contributions to SF_6 emissions

Member State	SF6 emissions (Gg CO2 equiv.)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	127	250	247	6%	-3	-1%	121	95%
Belgium	84	97	104	3%	7	7%	20	24%
Denmark	12	59	105	3%	46	77%	93	775%
Finland	8	28	30	1%	2	7%	22	277%
France	375	165	171	4%	5	3%	-204	-54%
Germany	3 211	2 572	2 629	68%	57	2%	-582	-18%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	14	3	3	0.1%	0.2	6%	-11	-78%
Italy	NO	NO	NO	-	-	-	-	-
Luxembourg	1	7	7	0.2%	0	6%	6	1109%
Netherlands	218	147	196	5%	49	34%	-22	-10%
Portugal	NE	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	2	4	1	0.03%	-3	-75%	-1	-56%
United Kingdom	582	398	381	10%	-17	-4%	-200	-34%
EU-15	**4 632**	**3 730**	**3 873**	**100%**	**143**	**4%**	**-759**	**-16%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.70 provides descriptions on methods used for estimating SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.70 2F6-2F9 Consumption of halocarbons and SF_6: Description of national methods used for estimating SF_6 emissions

Member States	Description of methods
Austria	Semiconductors: All consumption data and data about actual emissions from semiconductor manufacture are based on direct information from industry. Emissions are calculated by the companies themselves from the annual consumption of each fluid by plant and the effectiveness of the respective abatement technologies (Tier 2a according to IPCC 2006). Because of confidentiality claimed for consumption data in this industry emissions are reported in the CRF only for the sum of HFC and PFC. Electrical Equipment: Information on SF_6 stocks in electrical equipment from 2003 onwards was obtained from energy suppliers and industrial facilities (as mentioned above, there is a reporting obligation for opera-tors of SF_6 filled equipment since 2004). Data for 2000–2002: estimation based on an annual growth rate 2003–2007 of 16.9% for MV-GIS and 4.1% for HV-GIS. 2% was added to the re-ported stock to account for equipment used in industry that is not reported otherwise. For 1990–1999 the stock was calculated from consumption data of this sector. The operating EF of HV and MV GIS correspond to the default emission factors of the IPCC GL 2006 at 0.7% (HV) and 0.1% (MV) per year, respectively. Manufacturing emissions from first filling were estimated to be 1% according to reported data, the disposal EF is assumed to equal 2%. Noise insulating windows: Activity data were estimated based upon information from experts from industry. Approximately one-third of the total amount of SF_6 used for filling of the double glass windows is released during assembly. For the stock of gas remaining inside the window (bank), an annual leakage rate of 1 percent is assumed. At the end of the lifetime, about 75% of the initial stock remains and is lost by disposal. As of 2003, the Austrian F-gas regulation stopped by legal prohibition the usage of SF_6 as filling gas for soundproof glazing. Emissions at disposal became relevant in 2005, because the average life time is estimated to be 25 years and the first SF_6 filled windows were introduced in Austria in 1980. They are calculated by assuming that the remaining quantity of SF_6 in windows produced in 1987 is emitted in 2012. Tyres: SF_6 used as filling gas for tyres was supplied by only one SF_6 importer, who reported on the amount of SF_6 sold to the Austrian tyre and automotive trade. Due to the Austrian F-gas regulation this use has been legally prohibited. According to IPCC GL 2006 it is assumed that SF_6 completely emits from car tyres with their disposal three years after filling. Shoes: Operating emissions during use of the footwear are not considered. The lifetime of sport shoes is estimated to be 3 years. At the disposal of old shoes 100% of the initial filling is released to the atmosphere (i.e. EF = 100%). Disposal emissions are therefore assumed to equal the amount imported in sport shoes three years earlier. Research: Manufacturers and operators of particle accelerators (linear accelerators, linacs) provided

Member States	Description of methods
	the number of devices operating in Austria. Data on filling volume and refilling have been collected from the institutions and companies operating the equipment, from manufacturers and from service companies. The annual F-gas consumption (first filling of new products) normally is very small (in the order of kg) and exceeded 400 kg in one year only. The stock is below 1 t for all years. The implied EF is in the order of 6%, but there is a wide difference between the several types of equipment. Emissions from bank are equal to the amounts provided in company reports for refilling of losses.
Belgium	SF_6 emissions from the electricity sector are small (11.3 kt CO_2-eq in 2012). In Belgium there is no manufacturing of electrical equipment containing SF_6. Therefore only emissions resulting from the installation of new equipment on site have been considered as “Manufacturing emissions”, for which a conservative emission factor of 1% has been used. Emissions from stock are based on figures on the stock of SF_6 and on emission factors provided by the production sector (source: FEBEG), the transport sector (ELIA) and the distribution sector (source: SYNERGRID). For 2012, the corresponding emission factors are 0.12%, 0.84% and 0.03% respectively. As the equipment lifetime is assumed to be 40 years [78] disposal emissions are not expecte before 2015, except for those of one significant plant in the transport sector that has been dismantled in 2011. The SF_6 emissions originating from the production and the stock of soundproof double-glazing are calculated from the SF_6 consumption data, which have been obtained from the main manufacturers. The stock of SF_6 contained in existing glazing in Belgium is evaluated on the basis of a balance between production, import, export, annual losses and disposal of this glazing over the years. The emission rate of glazing from the bank is assumed to be 1% /year. The emissions from production have now disappeared, notably as a result of EU Regulation 842/2006. The disposal emissions are based on an assumed unique lifetime of 25 years.
Denmark	The data collection is described in the overview of the sector, General methodology. See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Finland	Electrical equipment (CRF 2.F. 8) Tier 3c (country-level mass-balance), Tier 1b Tier 1a estimates cannot be calculated for this source because of lack of historical data. Tier 1b estimates have been calculated, however, based on survey and emissions data cf. Section 3.1 of Oinonen (2003). Running shoes (CRF 2.F. 9) Method for adiabatic property applications, Tier 1b Tier 1a is not applicable to this category because all SF_6 used is imported not in bulk, but in products (i.e. shoes). Emissions from this source are not reported separately due to confidentiality. The emissions from running shoes ended in 2007.
France	*Manufacturing of semiconductors (2F7): Emissions are calculated according to Tier 2c based on the consumption communicated from the plants.Electic equipment (2F8): Manufacturing emissions in the production plants are calculated on the quantities communicated by the manufacturers to their industrial association. Emission from use are estimated by the electic power utilities.* *Fabrication de semi-conducteurs (2F7)* Les émissions de PFC, HFC-23 et SF_6 sont calculées selon la méthode de rang 2c du GIEC à partir des consommations de gaz déclarées par les sites. *Equipements électriques (2F8)* Les émissions à la charge des équipements sur les sites de production sont calculées à partir des quantités déclarées par les industriels à leur syndicat. Les émissions de l’ensemble du réseau électrique sont estimées par entreprises de services d'électricité via des enquêtes qui distinguent les fuites à l’usage et lors de la maintenance. *Autres (2F9)* Certains usages sont totalement émissifs (recherche, chaussures de sport). Les émissions issues de quelques secteurs (industries, AWACS) sont déclarées par les exploitants à partir d’un bilan matière. Enfin, des facteurs d’émission des lignes directrices du GIEC ont été utilisés pour estimer les émissions des accélérateurs de particules.
Germany	Semiconductor manufacture: The emissions cannot be determined solely on the basis of input quantities (sales by gas vendors), because the difference between consumption and emissions depends on a number of factors, including only partial chemical transformation in plasma reactors and the effects of downstream exhaust-gas-scrubbing systems. Furthermore, a residue of approximately 10 % per gas bottle must be taken into account as non-consumption. The reporting includes for the first time the use of C6F14 as heat transfer fluid. Experts reconstructed the time series 1990-2012 for consumption and emissions (operating emission factor 10%). Electrical equipment: The emissions figures are based largely on a mass balance. Increasingly, they are also being combined with emission factors for sub-areas in which the technical measurement limits for mass-balancing have been reached or in which mass-balancing would necessitate unreasonably high costs. The methods used are based on the new 2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 3, Chapter 8: Tier 3, Hybrid Life-Cycle Approach. Sound proof glazing: The EF production is 33 %, with respect to new annual consumption. An emission factor of 1 % is applied to the SF_6 stock accumulated as of 1975. As the lifetime is assumed to be 25 years, first disposal year was 2000. In 2012 the new-filled windows from 1987 have been decommissioned, resulting in emissions of ca. 75% of the original charge. Car tyres: The (disposal) emissions are calculated using equation 3.23 of IPCC-GPG (2000).For further applications of SF_6 such as AWACS radar systems, particle accelerators, optical glass fibres, welding, photovoltaic (Si-thinfilm-technology, country-specific emission factors are used.
Greece	Electrical equipment In the context of the present inventory, emissions are estimated on the basis of information provided by PPC regarding losses in the transmission and the distribution system. The data provided cover the

Member States	Description of methods
	period 1995 – 2012. Emissions estimates are being performed on the basis of the quantity of SF_6 consumed during the year, by the Directorate of Strategy and Planning of the PPC. As regards to the rest of the emission, namely for the years 1990 – 1994, they are estimated (by the inventory team) by means of a linear extrapolation. In 2013 centralized review, the ERT strongly recommends that Greece provide additional information on the method used to estimate SF_6 emissions in its next annual submission, in order to improve the transparency of its reporting. The emissions refer to the escape of the gas due to old, used insulating parts of equipment (mainly gaskets) and, far more rarely, to a failure of the system. Any fluctuation to the time-series depicts the maintenance issues that have risen, according to the information received from PPC, in the particular year. In general fluctuations are more intense in the Transmission system (375 kg in 2007 versus 280 kg in 2008). The contact persons in the Transmission system have indicated that many times experience is used as a driver and therefore, a particular type of gasket that has been reported for unsuccessful insulating operation has been replaced in the systems, leading to a decrease of the escaped SF_6 in the next year.
Ireland	Electrical Equipment (2.F.8): Electrical equipment containing SF_6 is imported into Ireland. Quantities of SF_6 are needed for servicing and repair of existing equipment. There are, therefore, no manufacturing emissions. The inventory estimates assume that the usage of SF_6 in equipment maintenance for one year is equal to the leakage emissions from electrical equipment in the same year. This means that the emission estimates are potential emission estimates rather than actual emission estimates. This method was reviewed by the project team and deemed to be acceptable and in line with IPCC GPG. Emissions are estimated using a Tier 1 approach based on an analysis of opening and closing stocks of SF_6. Other Emission Sources (2.F.9): This category includes emissions of SF_6 from minor uses within Ireland including emissions from double glazed windows, medical applications, sporting goods and as a gas-air tracer in leak detection. SF_6 was previously used as an insulation gas in double-glazing; however its use has been phased out in response to F-gas regulations and is assumed not to have occurred since 2000. Typically windows are manufactured using air or inert gases such as argon between double-glazing layers. Emission estimations account for opening and closing stock of the gas, assembly losses for Irish manufactured products, stocks in imported windows and leakage once installed. Even though the use of SF_6 was discontinued in window insulation after 2000, the bank of gas in installed units is an emission source and is therefore accounted for in emission estimates. Recalculated estimates for this source were undertaken in this submission to account of disposal emissions that weren't previously Environmental Protection Agency. SF_6 is used in certain medical application such as eye surgery where it is used to seal retinal holes internally and to hold reattached retina in place. Use of the gas is small with one hospital reporting the use of one 10-litre cylinder every three years. Based on this data, it is assumed that a similar quantity is used in a total of 10 hospitals, which undertake similar procedures. It is assumed that actual and potential emissions are equal on the basis that in each of the 10 hospitals once a cylinder is used (over a three year period) it is replaced. The remaining minor uses of SF_6 in Ireland are as a tracer gas for leak detection in the testing of seals on cans containing tennis balls and as a tracer gas for agricultural research to determine the rates of CH_4 emissions from enteric fermentation in cattle. The latter source is considered negligible in an Irish context. The use of SF_6 in leak detection was previously a relatively large source in the period 1990-2004. However the company who used SF_6 for the purpose of leak detection has since ceased trading. A number of research projects, conducted in 2009, were identified and included in the inventory. The total use of SF_6 amounted to 80kg. No projects since have been identified so this sub-category is no longer a source of emissions of SF_6 in the Irish inventory. Additional information on experiments carried out. in 2009 were obtained from the relevant researchers and included in the inventory.
Italy	As regard SF_6 emissions from electrical equipment, these have been estimated according to the IPCC Tier 2a approach. Concerning manufacturing and installation emissions, since 1995 the methodology used is largely in accordance with the IPCC Tier 3b methodology. In 1997, the ANIE Federation has begun a statistical survey within their associated companies, in accordance with ISPRA, in order to monitor yearly SF_6 used in electrical equipment > 1kV, and thus SF_6 manufacturing emissions (ANIE, 2001). ANIE Federation is the Confindustria member representing the electrotechnical and electronic companies operating in Italy. ANIE has developed data sheets for their associated companies in accordance with the methodology drawn up by CAPIEL, the Coordinating Committee for the Associations of Manufacturers of Switchgear and Controlgear equipment in the European Union: the CAPIEL inventory methodology covers all sorts of use of SF_6 in the electrical sector, from the SF_6 purchase till the end of life of the equipment and covers all aspects of the required data (CAPIEL, 2002). It is based on a Mass Balance Methodology, as given by IPCC Tier 3b, comparing the input and output on a yearly basis. In the Figure 4.4 the summary sheet used for manufacturing inventory, referred to the year 2011, is reported (ANIE, several years).
Luxembourg*	F7 – Electrical Equipment - A country specific methodology is applied: Emissions= EF● AR. The activity rate (AR) is based on the installed capacity with the total nameplate capacity from the largest operator (CREOS) in Luxembourg (80% coverage). The yearly emissions are assumed to vary between 0.1 and 0.9% depending on the type of switchgear according to the EF's applied in Germany. F8 – Noise reduction windows - A life-cycle approach is applied: *Emissions= EF● AR+D*. The activity rate (*AR*) is the calculated SF_6 stock on the basis of the estimated installed noise reduction windows, based on imported double glassed windows into Luxembourg with noise reduction fraction from Germany. The annual leakage rate of SF_6 is assumed to be 1% (EF=1%) and the lifespan 25 years. Disposal emissions (D) of the reminding SF_6 stock occur after a lifetime of 25 years.
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.

Member States	Description of methods
	The source Electrical equipment comprises SF_6 emissions of users of highvoltage circuit breakers and the only international test laboratory for power switches. The emissions from the circuit breakers are obtained from EnergieNed, the Federation of Energy Companies in the Netherlands and the emissions from testing in the test laboratory.
Portugal	SF_6 emissions from electrical equipment Different estimates methodologies for electricity distribution at: (a) Very High Voltage (>110 kV): a methodology based on "Correspondent States Principle" was used; (b) distribution at Low (≤1 kV), Medium (>1 kV and ≤45 kV) and High Voltage (>45 kV and ≤110 kV): was estimated with a tier T3b, based on data provided by "EDP Distribuição", excluding the details in life-cycle and using a country-specific emission factor. Separate estimates were made for Gas Circuit Breakers; Outdoor Gas Insulated Switchgears; Gas Insulated Switchgears; High and Medium Voltage Sectioning Posts.
Spain	*Tier 2. Category 2F8 includes the SF_6 emissions from electrical equipment. This is the only source generating emissions of this gas which is reported by Spain.* De una forma general, las emisiones se pueden generar en cada uno de los siguientes puntos del ciclo de vida de los equipos eléctricos que incorporan SF_6 como aislante: 1) En la fase de fabricación del equipo (lo que incluye las operaciones de prueba y la carga de los equipos). 2) Durante la instalación en el lugar de funcionamiento del equipo. 3) Durante la fase de funcionamiento del equipo. 4) En la retirada de funcionamiento del equipo. Estos cuatro puntos o fases del ciclo vida que dan origen a las emisiones se corresponden con los respectivos cuatro términos que figuran en el segundo miembro de la ecuación siguiente, y que es la trascripción de la Ecuación 3.16 de la Guía de Buenas Prácticas de IPCC correspondiente al método de nivel 2a, que es el que se ha adoptado para la estimación de las emisiones de esta actividad: ET = EF + EI + EO + ERdonde: ET = Emisiones totales; EF = Emisiones en fabricación; EI = Emisiones en instalación; EO = Emisiones en operación de los equipos; ER = Emisiones en la retirada de los equipos.
Sweden	Semiconductor manufacture: Information concerning the annually used amounts of various fluorinated substances has been provided by the company, and as far as possible been compared to information from the Products Register at the Swedish Chemicals Agency. Emissions are calculated by using the Good Practice Guidance Tier 1 method (top-down calculations) using an average expected lifetime of 1 year. Electrical equipment: SF_6 emissions from electrical equipment have been estimated according to the IPCC Tier 2a approach from 1990 to 1994 because facility level specific data are not available, IPCC Tier 3c has been used since 1995 (for both medium and high voltage electrical equipment). The SF_6 emissions from production have decreased in later years due to measures taken at the production facility. These estimates, obtained from industry, are of medium to high quality, with better quality in later years. For the early 1990s, assumptions on the emitted amounts of SF_6 from GIS manufacture were made in cooperation with industry. Industry has also provided information concerning the used amount of SF_6 for GIS manufacture, as well as the share of products that are exported from the country, which exceeds 90 % of the production. Emissions from installed amounts of SF_6 for insulation purposes in operating systems have previously contributed less to the actual annual emissions. In 2001-2002, a questionnaire was sent out to power companies from the trade association Swedenergy 150 (Svensk Energi) asking for the installed amounts of SF_6 in operating equipment, and the replaced amounts of SF_6 during service. The results showed an installed accumulated amount of approximately 80 Mg SF_6 and an annual leakage rate of 0.6 % (equals the amount replaced from the questionnaire) and these were used as input data in the inventory. For later years, data on replaced amounts of SF_6 in operating systems results in a calculated annual leakage rate of 0.5 % (Swedenergy and power distribution companies). Other (2.F.9): The estimated emissions from the use of SF_6 in jogging shoes and in sound-proof windows are reported in CRF 2.F.9. No production of SF_6-containing shoes occurs in Sweden. Manufacturers of windows had provided data on the amount of SF_6 used in the manufacture of barrier gas windows. The manufacturers had also provided estimates of the share of SF_6 emitted in production. These estimates vary considerably between manufacturers, from 5-50%. Calculating a weighted average of the emission factor at production results in a national figure in the order of 30%, which is in line with the point estimate of 33% given in the IPCC Good Practice Guidance. Since 2008 SF_6 has not been used in production of sound-proof windows.
United Kingdom	Semiconductor manufacture: The methodology used to estimates emissions corresponds to an IPCC Tier 1 method. Estimates of PFC and SF_6 emissions from electronics in 2001 are based on data supplied by UK MEAC – the UK Microelectronics Environmental Advisory Committee (in conjunction with the former UK DTI). The data supplied were the purchases, used by the semiconductor industry, of SF_6 and NF3, and the following PFC species: C2F6, CF4, CHF3, C3F8, and C4F8. Emissions were then calculated using the IPCC Tier 1 methodology, which subtracts the amount of gas left in the shipping container (the "heel" amount, 10%), the amount converted to other products (between 20% and 80% depending on the gas) and the amount fed to abatement. The general equation used to calculate the emissions is given later in this section. Estimates of PFC and SF_6 consumptions in the years before and after 2001 are made from assumptions about the annual growth rates, and the annual rate of change of usage per unit consumption. These assumptions were supplied by MEAC. Emissions of SF_6 from semiconductor manufacturing are combined with emissions from training shoes and electrical insulation in source category 2F9 for reasons of commercial confidentiality.

Member States	Description of methods
	Electrical Equipment: A review of the data sources and methodology used to estimate emissions from electrical switchgear was carried out in 2013. Data was collected from all the key UK users of Gas Insulated Switchgear (GIS), including National Grid and the UK electricity distribution companies. Data was also obtained from ENA (Electrical Networks Association) and from the electricity industry Regulator, Ofgem. Since the introduction of the EU F-Gas Regulation in 2006, the UK electricity industry has made significant efforts to monitor and reduce consumption of SF_6. The Regulator collects annual data from each electricity company. These data were used to estimate the size of the SF_6 bank in GIS and emissions for 2008-2012. Emissions from earlier years were estimated by extrapolating the data backwards, using the previously reported bank size in 1995 and 2000 and previously reported leakage rates. This approach ensured time series consistency, whilst making best use of good quality available data. Being based on reported consumption and emission data, this methodology is a considerable improvement on previous estimates. Use of SF_6 as a tracer in scientific research**:** SF_6 is used as a tracer gas in UK studies of greenhouse gas emissions from ruminant livestock. It is currently the only viable way to measure emissions of methane from ruminant livestock individuals at pasture (Defra, *per. comm*.). Emissions for this source, which are very small, are now included under 2F9 from 2011 onwards. A small charge of SF_6 is stored in a permeation tube, which is then introduced to the rumen of the animal. The gas emissions are vacuum sampled from eructation via a tube near the animal's muzzle connected to an evacuated flask. The total CH_4 emissions are inferred from the differential concentrations of SF_6 and CH_4 between the flask and atmosphere..

Source: NIR 2014 unless stated otherwise

Table 4.71 summarizes the recommendations from the latest UNFCCC reviews of the inventory report in relation to the category 2F Consumption of Halocarbons. The overview shows that some recommendations have been implemented. For several Member States the review report 2013 had not been available at the time of the compilation of this NIR.

Table 4.71 2F Consumption of halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2013 inventory submissions

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
Austria	The ERT recommends that Austria clearly indicate in the NIR the years for which data are collected and for which data are extrapolated for all subcategories. The ERT also notes that for MDIs, aerosols and solvents the Party specifies in the NIR the use of its gross domestic product (GDP) as the driving variable to interpolate or extrapolate AD, but for all other subcategories Austria does not specify in the NIR the interpolation or extrapolation methods used. The ERT recommends that Austria include in the NIR a description of the interpolation and extrapolation methods applied for all subcategories.	Resolved: Table 127 (pp. 228) includes detailed information on all sub-categories.
Belgium	The ERT recommends that Belgium report emissions from transport refrigeration separately from commercial refrigeration in its next annual submission.	Resolved: CRF 2.F.1
	The ERT recommends that Belgium report the emissions from industrial refrigeration and stationary air-conditioning as "IE" in CRF table 2(II).F in the next annual submission. The Party informed the ERT that it will do so in its next annual submission.	Resolved: CRF 2.F.1
	Semiconductor manufacture: The ERT recommends that Belgium include, in the next NIR information on the AD, EFs and method used and on the confidentiality of the plant-specific measurements, in order to increase the transparency of its reporting.	Resolved: CRF 2.F.7 NIR 2014, ch. 4.5.2.2 (p. 136)
	SF_6 in electrical equipment. The ERT recommends that Belgium also report, in its next annual submission, emissions for the years 1990–2008. Further, the ERT strongly recommends that the Party report the emissions from "disposal" for 2010 onwards and explain, in the NIR, why the disposal emissions from electrical equipment only occur from 2010 onwards.	Resolved: CRF 2.F.8 NIR 2014, ch. 4.5.2.2 (p. 136)

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
	The ERT recommends that Belgium explain the source of the C3F8 emissions for 2008 and why those emissions only occurred in one year. The ERT further recommends that the Party calculate the F-gas emissions from laboratory and other uses for before 2007 and describe the data sources and the methods used to calculate the emission estimates in its next annual submission. The ERT therefore encourages Belgium to conduct research in order to ascertain whether there are any uses of SF_6 in addition to double-glazed windows in Belgium, in order to ensure the completeness of the reporting, and to report the results of the research in future annual submissions.	C3F8 emissions and emissions from laboratory use deleted Follow-up necessary: Further SF_6 emissions identified only before 2007 (sport shoes)
Denmark	58. The ERT noted that in CRF table 2(II).F the notation keys used by the Party for the amount of gas remaining in the products at decommissioning (e.g. refrigeration and air conditioning equipment, foam blowing, and aerosols/metered dose inhalers) are reported as not estimated ("NE"). In response to questions raised by the ERT during the review, Denmark explained that, according to Danish law, refrigerators, air-conditioning equipment, and aerosols/metered dose inhalers must be emptied before shredding. Thus, the notation key "NO" should be used for these subcategories. Denmark confirmed that it will use the correct notation key in the next annual submission.	Follow-up necessary: "NE" still used in CRF 2(II).F
Finland	The ERT noted that notation keys in some specific categories (SF_6 used in aluminium and magnesium foundries) are not used in line with the requirements of the UNFCCC reporting guidelines. Notation key "NO" (not occurring) is used instead of "NA" (not applicable) in CRF tables 2(II).C. The ERT recommends that Finland correct the use of notation keys in its annual submission.	Follow-up necessary: "NO" still used in CRF 2(II).C
France	70. The ERT found that the NIR lacks transparency in terms of the reporting of AD for and emissions of HFCs from the use of aerosols/MDI: the reported HFC emissions are only a fraction of the reported stock (AD), while the IPCC good practice guidance indicates that emissions from sales of aerosols are emitted within two years. In response to questions raised by the ERT during the review, France commented that emissions due to the production of aerosols are included in the product-life emissions. The ERT concluded that, if the reported AD for stock relate to the sum of the stock stored at producers and the sales in a particular year, this could explain the low implemented product-life EF of 8 to 11 per cent related to the total stock. The ERT recommends that France provide more transparency on this issue in its next annual submission. The ERT reiterates the recommendation made in previous review reports that France improve the transparency of the NIR by providing the most recent information on the model used, including information on background reports, the assumptions used, data collection, QA/QC checks, model validation and peer reviews, in its next annual submission.	Resolved: NIR 2014, Annex 3, p. 177 Resolved: NIR 2014, ch. 4.7.3/4.7.4
Germany	49. In the 2013 annual submission, Germany recalculated the emissions from the category Consumption of halocarbons and SF_6 – HFCs due to the introduction of a new model and data for calculating HFC emissions from commercial refrigeration, industrial refrigeration, stationary air-conditioning systems and mobile air-conditioning systems. The ERT concluded that the approach taken by the Party is in line with good practice and improves the accuracy of the inventory. The ERT commends the Party for its detailed explanation and recommends that the Party include this information in the NIR to improve the transparency.	Resolved: Detailed information included in NIR 2014 (pp.349)
Greece	33. Potential emissions of fluorinated gas (F-gases) have not been estimated per gas type and per subcategory (see CRF table 2(I)), or	Follow-up necessary

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
	as aggregated emissions due to a lack of data as indicated in the CRF, and have therefore been reported as "NE" (not estimated). … Common Ministerial Decision No. 18694 was published in Greece on 11 April 2012, which defines data collection procedures regarding the enterprises that produce, import, export, recover, recycle and trade F-gases on an annual basis until the end of March every year. As a result of this new development, reporting of potential emissions of F-gases is planned for the 2014 annual submission. The ERT recommends that Greece continue to collect the data necessary to estimate potential emissions of F-gases per gas type as an integral part of its inventory improvements plan.	Unresolved: The notation keys in the CRF tables for the period 1990-2003 have not been changed.
	34. The ERT noted some discrepancies and errors in the use of the notation keys in the CRF tables for several categories and subcategories for some years of the time series, including (…) consumption of halocarbons and SF_6. For example, some of the F-gas emissions (octafluoropropane (C3F8), perfluorobutane (C4F10), octafluorocyclobutane (c-C4F8), nonafluoro-2-(trifluoromethyl)butane (C5F12) and perfluorohexane (C6F14)) from aluminium production for the period 1990–2003 have been reported as "NE", while the notation key "NA" (not applicable) has been reported for the other years of the time series. In response to a question raised by the ERT during the previous review, the Party explained that the notation key "NA" should be reported for all years of the time series. However, this has not been corrected in the 2013 submission. The ERT recommends that Greece improve its QA/QC procedures to ensure accuracy and consistency in the use of the notation keys in its next annual submission.	Resolved: Information about ongoing activities and improvements is included in NIR (Ch. 4.14.2, p.202)
	36. In response to a recommendation from the previous review report that the Party include estimates of HFC emissions from imported foam (foam blowing), Greece conducted a survey to collect data from the industry association PanHellenic Association of Insulating Companies. … However, noting that Greece explained that only 20 per cent of the association members responded to the survey, the ERT strongly recommends that the Party continue its efforts to collect data on HFC emissions from imported foam, and provide information on the progress made and results obtained in the next annual submission.	Resolved: Additional information included in NIR (Ch. 4.15.2, pp. 213)
	39. In CRF table 2(II).F Greece has reported SF_6 emissions from installation losses for high-voltage switchgear used in the country under the subcategory electrical equipment. These emissions should be reported as emissions "from manufacturing", in accordance with the IPCC good practice guidance. However, Greece has used the notation key "IE" to report emissions "from manufacturing", and has reported the total emissions as the emissions "from stocks". In response to a question raised by the ERT during the review, Greece informed the ERT that the emissions were estimated on the basis of the quantity of SF_6 consumed during the year according to the information provided by the Public Power Corporation. The method uses the weighting of	

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
	the compressed SF_6 cylinder before and after the filling of the equipment, but the amount reported by the Public Power Corporation each year refers only to the gas escaped, and emissions from the filling of new equipment are not included. The ERT strongly recommends that Greece provide additional information on the method used to estimate SF_6 emissions in its next annual submission, in order to improve the transparency of its reporting.	
Ireland	The ERT encourages Ireland to include additional information from section 4.6 of the NIR (e.g. the updated disposal factor for vehicles at 'end of life', the revised product lifetime factor from 0.01 per cent to 0.049 per cent for fire extinguishers) in the relevant sections of the NIR where the methodological issues are described. 55. The ERT noted that Ireland still uses the notation keys "IE" and "NA" in CRF table 2(II).F to report the AD and corresponding estimates of HFC emissions from refrigeration and air-conditioning equipment, except mobile air conditioning. The emission estimates for manufacturing and for the disposal of commercial refrigeration equipment are reported as "IE" and included under "stock", and the AD are reported as "NA", thereby preventing the ERT from replicating the bottom-up approach. The ERT strongly reiterates the recommendation in previous review reports that Ireland investigate this matter further by reviewing the use of the notation keys for this category, in order to improve the transparency of its reporting in its next annual submission.	Resolved: EF changed to 1%. NIR 2014, ch. 4.4.2.3, p. 98 Follow-up necessary: "NE" and "NA" still used in CRF table 2(II).F Discussed in NIR 2014, ch. 4.8, p.104
Italy	34. HFC emissions from domestic refrigeration, small and large commercial units and chillers have all been reported under domestic refrigeration in the NIR and the CRF table 2(II). …. The ERT strongly recommends that Italy report separately the AD, product life factors, product manufacturing factors and emissions for domestic and commercial refrigeration in CRF table 2(II) and document the factors used in the NIR of the next annual submission. 35. As outlined in paragraph 34 above, Italy uses a bottom-up method to estimate emissions from refrigeration. In addition, Italy stated in the NIR and CRF tables that the emissions from equipment disposal have been included in the emissions during the product's life for the whole time series. In order to improve the transparency of the inventory, the ERT recommends that Italy improve the description of the estimation methodology and use a top-down approach to cross-check the final emission estimate. 36. The country-specific product life factor for HFCs in large commercial refrigeration used by Italy is 5.0 per cent. … The ERT noted that the country-specific product life factor of HFCs in large commercial refrigeration was not sufficiently substantiated and thus concluded that the emissions could have been underestimated and included it in the list of potential problems and further questions. 37. Product life factor for chillers and the product manufacturing factors for both refrigeration and chillers: The ERT strongly recommends that Italy use the revised factors in the estimation of emissions in its next annual submission and that it document the methods appropriately in the NIR by specifying the manufacturing and product life factors used for each application.	Resolved: Reporting is done for different subcategories of 2F1 in CRF 2(II) and additional information is provided in the NIR (Ch.4.7.2; pp.139; Ch.4.7.5; pp. 147). Partly resolved: Description of methodology is provided in the NIR. Top-down approach for a cross-check of estimates is not used. Resolved: Table on manufacturing factors and (revised) product life factors for HFCs is provided (Ch.4-7-2; p.141)

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2014 submission
Luxembourg	40. The ERT noted that the Party had not completed the background tables for the category consumption of halocarbons and SF_6. … The ERT strongly reiterates the recommendation made in the previous review report that Luxembourg improve the consistency and completeness of its reporting. Further, the ERT recommends that the Party enhance the transparency of its reporting of F-gases by providing all of the relevant background information used for the calculations in both the NIR and the CRF tables. 41. During the review, the ERT asked Luxembourg to elaborate on the methods used to estimate SF_6 emissions from electrical equipment. … the ERT recommends that Luxembourg provide a more detailed explanation in the NIR of the methodologies and AD used to estimate SF_6 emissions from electrical equipment in order to increase the transparency of its reporting. 42. The ERT notes that Luxembourg continues to use the notation key "NO" to report potential emissions of PFCs from refrigeration and air-conditioning equipment in the CRF tables. The previous review report recommended that the Party replace the notation key "NO" either with a value, or with the notation key "NE" (not estimated), given that it has been demonstrated that actual emissions occur in Luxembourg. As the Party has not yet made the requested correction, the ERT encourages Luxembourg to reconsider the recommendation and replace the notation key "NO" with "NE". 43. The ERT further notes that Luxembourg still uses AD from neighbouring countries for the subcategories under consumption of halocarbons and SF_6 (transport refrigeration, foam blowing and aerosol/metered dose inhalers – from Belgium and Germany). … The ERT reiterates the recommendation made in the previous review report that the Party make greater efforts to collect and use country specific data in the calculation of emissions from consumption of halocarbons and SF_6 to improve the accuracy of its annual submission. Where country-specific data continue to be unavailable, the ERT reiterates the recommendation made in the previous review report that the Party provide the background information used in the calculations in the NIR.	Unresolved: CRF tables are still not consistent (CRF2(I) vs. CRF2(II)F.) Resolved: Description of AD provided in the NIR (Ch. 4, p.31) Unresolved: Notation keys in CRF tables (2(I)s2)have not been changed. Unresolved: Data from Germany and Belgium are used while no additional background information from these countries are referenced.
Netherlands	42. The ERT noted that in the CRF tables, HFC emissions from stocks in industrial refrigeration and mobile air-conditioning are reported, but the AD and IEFs are reported as "NA", "NE" or not occurring ("NO"). The ERT recommends that the Netherlands report the AD and IEFs in order to improve transparency. 43. The ERT noted that, according to the NIR, "from this submission onwards the potential emissions for the period 1990–2011 are included in the CRF". However, in the CRF tables, the potential HFC emissions from production are reported as "NO", and potential HFC emissions from import, export and destroyed amount are	Unresolved: CRF 2(II)Fs1 still contains notation keys. Unresolved: CRF tables do not provide values. A comment explains that no data are available at this level of detail. But statement "from this submission onwards the potential emissions for the period 1990–2012 are included in the CRF" is given in NIR (p.124).

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2014 submission**
	reported as "NE" for all years of the time series. The ERT recommends that the Netherlands ensure consistency between the NIR and the CRF tables and encourages the Party to complete and report the potential HFC emissions for the entire time series, in accordance with the UNFCCC reporting guidelines in order to ensure the completeness of the reporting. 46. The Party has reported in the NIR that potential PFC and SF_6 emissions from consumption of halocarbons and SF_6 have not been reported due to confidentiality reasons; … The ERT encourages the Party to further consider the possibilities of reporting the potential emissions of PFCs and SF_6.	Unresolved.
Portugal	The ERT noted that the two models used to estimate the potential and actual emissions are based on many assumptions; these assumptions are described in the NIR and are based mainly on expert judgment or default values from the IPCC good practice guidance or the 2006 IPCC Guidelines. The ERT also noted that Portugal has compared the results of the models, thereby allowing the Party to verify the assumptions and results. The ERT recommends that Portugal enhance the transparency of its reporting by providing information on the outcomes of the comparison of the results from the two models.	Follow-up not necessary: Potential emissions of F-gases will no longer be reported as of 2015.
Spain	Spain has not estimated potential emissions (reported as "NE"), providing the justification that production, import and export data are available only for some subcategories and are not complete for individual gas species. Therefore, the ERT reiterates the encouragement made in the previous review report (ARR 2011) for Spain to provide, in its next annual submission, estimates of potential emissions of HFCs, PFCs and SF_6 from consumption of halocarbons and SF_6. Emissions from semiconductor manufacture are reported as not applicable ("NA") in the CRF tables. Responding to a question raised by the ERT during the review, the Party explained that two surveys on the use of PFCs were carried out in 2007 and 2010, with both concluding that the single company producing semiconductors in the country makes no use of these substances in the manufacturing process. The ERT took note of the information provided and recommends that Spain change the notation key used to report the emissions for this subcategory from "NA" to not occurring ("NO").	Follow-up not necessary: Potential emissions of F-gases will no longer be reported as of 2015 Partly resolved: Notation keys "NA" and "NE" replaced by empty cells
Sweden	56. The ERT noted a lack of clarity about whether collection/destruction is accounted for in the model. … The ERT recommends that Sweden further investigate the application of this regulation and its coverage, and confirm availability of data that may be available for use in the inventory, and that the Party incorporate these findings in the NIR of its next annual submission. The ERT also encourages Sweden to incorporate available data on collection/destruction into the model for the next annual submission. 57. Description of subcategories in the model: The ERT recommends that Sweden provide and clearly describe, in the NIR of its next annual submission, information similar to that described above, where groups of equipment are treated differently by age class or size, etc., and are assigned different EFs, in order to increase the transparency of the model used. 58. The ERT also noted that the notation key "NA" has been used in a number of cases where F-gas emissions from an activity probably occur, but no emissions occur at a certain point in time, such as	Unresolved: Additional data on collection/destruction are not mentioned in the NIR. Partly resolved. Resolved: Notation keys have been changed.

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2014 submission
	electrical equipment, where emissions from disposal currently do not occur, in which case they should be reported as "NO". The ERT recommends that Sweden reassess its use of the notation key "NA" and modify, where necessary, the notation keys used to report all emissions from this category in its next annual submission.	
UK	The ERT noted that the move to disaggregate actual emissions by species has only taken place in recent years, while potential emissions are not currently available in this format. The United Kingdom confirmed that it will review and improve the transparency of its reporting in the next annual submission and, as a minimum, will add a note to the NIR to explain the current reporting limitations. The ERT welcomes this planned improvement and recommends that the United Kingdom, in its next annual submission, report a correct and realistic estimate of the potential to actual emissions ratio for the unspecified mix of HFCs for the United Kingdom as a whole.	Resolved: Discussion of potential F-gas emissions in NIR 2014, Annex 3.3 (pp. 656-658)

Sources: Review Reports 2012 and 2013 unless stated otherwise; NIR 2014 unless stated otherwise

4.2.6 Other (CRF Source Category 2G) (EU-15)

Table 4.72 shows that four Member States report GHG emissions under 2G Other for the year 2012. The Netherlands include CO_2, CH_4 and N_2O emissions from fireworks and candles, degassing of drinking water from groundwater and process emissions in other economic sectors, Germany reports fluorinated gas emissions from shoes and from AWACS (Airborne Warning and Control System) maintenance, Denmark includes CO_2 emissions from lubricants in this category and Italy reports emissions of HFC134a used in magnesium foundries.

Table 4.72 2G Other: Overview of sources reported under this source category for 2012

Member State	Type of source	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA	NA	NA	NA	NA	NA	NA	-	0%
Belgium	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	-	0%
Denmark	Lubricants	32	NA	NA	NA	NA	NA	32	6%
Finland	NA	NA	NA	NA	NA	NA	NA	-	0%
France	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0%
Germany	Other non-specified: confidential emissions of SF6 from 2.E production, 2.F.9 Other - sport shoes and 2.F.9 Other - AWACS maintenance	NO	NO	NO	139	IE,NA,NO	IE	139	28%
Greece	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Ireland	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Italy	HFC134a used in Magnesium Foundries	NA	NA	NA	4.2	NA,NO	NO	4	1%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0%
Netherlands	Degassing drinkwater from groundwater, fireworks and candles, process emissions in other economic sectors	273	2	0.04	NA,NO	NA,NO	NO	320	65%
Portugal	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
Spain	NA	NA	NA	NA	NA	NA	NA	-	0%
Sweden	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0%
UK	NA	NA	NA	NA	NA	NA	NA	-	0%
EU-15 Total		**305**	**2**	**0**	**143**	**0**	**-**	**495**	**100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 2 an overview of the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 4.73 shows the total EU-15 uncertainty estimates for the sector 'Industrial processes' and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for N_2O from 2G (71 %) and the lowest for CO_2 from 2A (4 %). With regard to trend HFC from 2F shows the highest uncertainty estimates, CO_2 from 2G the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 4.73 Sector 2 Industrial processes: Uncertainty estimates for the EU-15

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A Mineral Products	CO_2	108 882	80 988	-26%	4%	0.0%
2.A Mineral Products	CH_4	29	20	-31%	62%	0.8%
2.A Mineral Products	N_2O	0	0		0%	0.0%
2.B Chemical Industry	CO_2	30 761	31 371	2%	9%	0.0%
2.B Chemical Industry	CH_4	201	121	-40%	27%	0.1%
2.B Chemical Industry	N_2O	99 051	7 731	-92%	7%	0.2%
2.C Metal Production	CO_2	52 392	36 759	-30%	5%	0.0%
2.C Metal Production	CH_4	31	43	37%	14%	0.1%
2.C Metal Production	N_2O	35	18	-48%	67%	0.3%
2.C Metal Production	HFC	0	0		0%	0.0%
2.C Metal Production	PFC	7 492	300	-96%	8%	0.1%
2.C Metal Production	SF_6	474	71	-85%	21%	0.1%
2.D Other Production	CO_2	5	3	-47%	17%	0.0%
2.D Other Production	CH_4	5	6	20%	21%	0.0%
2.D Other Production	N_2O	66	78	18%	21%	0.0%
2.E Production of Halocarbons and SF_6	CO_2	0	0		0%	0.0%
2.E Production of Halocarbons and SF_6	CH_4	0	0		0%	0.0%
2.E Production of Halocarbons and SF_6	N_2O	0	0		0%	0.0%
2.E Production of Halocarbons and SF_6	HFC	15 913	216	-99%	10%	0.1%
2.E Production of Halocarbons and SF_6	PFC	2 567	1 395	-46%	12%	0.1%
2.E Production of Halocarbons and SF_6	SF_6	1 846	113	-94%	10%	0.2%
2.F Consumption of Halocarbons and SF_6	CO_2	0	0		0%	0.0%

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.F Consumption of Halocarbons and SF_6	CH_4	0	0		0%	0.0%
2.F Consumption of Halocarbons and SF_6	N_2O	0	0		0%	0.0%
2.F Consumption of Halocarbons and SF_6	HFC	3 191	56 825	1681%	36%	3.4%
2.F Consumption of Halocarbons and SF_6	PFC	298	531	78%	37%	0.5%
2.F Consumption of Halocarbons and SF_6	SF_6	8 922	4 827	-46%	12%	0.0%
2.G Other	CO_2	354	331	-6%	46%	0.0%
2.G Other	CH_4	297	287	-3%	51%	0.0%
2.G Other	N_2O	3	11	273%	71%	1.9%
2.G Other	HFC	442	139	-69%	15%	0.1%
2 (werhe no subsector data were submitted)	*all*	*16 608*	*18 381*	11%	*13%*	*3%*
Total - 2	**all**	**349 866**	**240 566**	-31%	**8.9%**	**7.0%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories

4.4 Sector-specific quality assurance and quality control (EU-15)

There are two main activities for improving the quality of GHG emissions from industrial processes: (1) Before and during the compilation of the EU GHG inventory several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency. (2) In the second half of the year the EU internal review is carried out for selected source categories. In 2006 the following source categories have been reviewed by Member States experts: 2A Mineral Products, 2B Chemical Industry, 2C Iron and Steel Production and Fluorinated Gases, 2E Production of Halocarbons and SF_6 and 2F Consumption of Halocarbons and SF_6. In 2008, completeness and allocation issues have been reviewed by Member States experts for all source categories in Industrial Processes. In 2012 a comprehensive review was carried out for all sectors and all EU Member States in order to fix the base year 2020 under the EU Effort Sharing Decision. (ESD review 2012).

For the inventory 2005 for the first time plant-specific data was available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2). During the ESD review 2012 consistency checks were carried out between EU ETS data and the inventory estimates.

In 2013 two workshops were organized in the context of the MS assistance project with the aim of supporting Member States in improving their inventories related to the use of EU ETS data and related to F-gases. Both workshops were very well attended.

In 2014, the initial checks for F-gases were extended: (1) the time series of HFC emissions of the EU Member States was checked at 3-digit level (2.F.1, 2.F.2,…) and at 4-digit level for 2.F.1 (i.e. 2.F.1.1, 2.F.1.2,…); (2) time series and comparability across EU Member States was checked for per capita HFC emissions of category 2-F.1 and its subcategories (2.F.1.1, 2.F.1.2, …). As a result of the checks 74 issues were clarified with EU Member States. furthermore, in 2014 additional quality checks of the EU NIR chapter waste were carried out in order to improve the consistency between the CRF tables and the EU NIR and consistency of tables and figures with text in the EU NIR.

4.5 Sector-specific recalculations (EU-15)

Table 4.74 shows that in the industrial processes sector the largest recalculations in absolute terms were made for CO_2 and HFCs in 1990 and 2011.

Table 4.74 Sector 2 Industrial processes: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2011by gas (Gg CO_2 equivalents) and percentage)

1990	**CO_2**		**CH_4**		**N_2O**		**HFCs**		**PFCs**		**SF_6**	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-2 695	-0.1%	5 153	1.2%	2 343	0.6%	-50	-0.2%	-54	-0.3%	212	2.0%
Industrial Processes	483	0.2%	0	0.0%	41	0.0%	-50	-0.2%	-54	-0.3%	212	2.0%
2011												
Total emissions and removals	-11 579	-0.4%	8 425	2.9%	5 586	2.1%	-441	-0.6%	-233	-6.7%	-78	-1.3%
Industrial Processes	-603	-0.4%	-8	-1.3%	42	0.5%	-441	-0.6%	-233	-6.7%	-78	-1.3%

Table 4.75 provides an overview of Member States' contributions to EU-15 recalculations.

Table 4.75 Sector 2 Industrial processes: Contribution of Member States to EU-15 recalculations for 1990 and 2011by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2011					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	-42	0	0	0	-56.6	0	-122	0	0	0	0	0
Belgium	3	0	0	NA,NO	0.0	-12	334	0	0	80	0.04	0.04
Denmark	0	0	0	NA,NO	NA,NO	0	-2	0	0	0	0	0
Finland	2	0	0	0	0.0	0	-15	0	0	6	0	0
France	0.3	0	45	-85	0.0	267	63	0	39	903	3	117
Germany	-52	0	0	0	2.2	0	-32	0	0.05	-23	12	0
Greece	533	0	0	0	0.0	0	-76	-0.01	0	-97	1	0
Ireland	0	0	0	-0.8	0.0	0	0	0	0	454	0	-0.6
Italy	0	0	0	0	0.0	0	-90	-0.63	0.05	-502	0	0
Luxembourg	0	0	0	0	NA,NO	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0.0	0	-16	-0.21	0	-1	0	0
Portugal	0	0	0	NE,NO	NE	0	-131	-0.006	5	1	-0.0003	0.8
Spain	0	0	0	38	0.0	0	0.5	0	0	-489	-249	-148
Sweden	129	16	0	0.03	0.0	0	-319	0	0	7	0.476	-0.2
UK	-89	-15	-4	-2	0.0	-43	-197	-7	-2	-780	0.003	-48
EU-15	**483**	**0.3**	**41**	**-50**	**-54.4**	**212**	**-603**	**-8**	**42**	**-441**	**-233**	**-78**

5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

This chapter provides sections on emission trends, methods and on recalculations in CRF Sector 3 Solvent and Other Product Use. In response to the UNFCCC review findings this report for the second time includes more detailed descriptions of methods used by Member States.

The IPCC 2006 Guidelines summarize the most important background information on solvents and other product use as follows: “The use of solvents manufactured using fossil fuels as feedstocks can lead to evaporative emissions of various non-methane volatile organic compounds (NMVOC), which are subsequently further oxidised in the atmosphere. Fossil fuels used as solvent are notably white spirit and kerosene (paraffin oil). White spirit is used as an extraction solvent, as a cleaning solvent, as a degreasing solvent and as a solvent in aerosols, paints, wood preservatives, lacquers, varnishes and asphalt products. In Western Europe about 60 percent of the total white spirit consumption is used in paints, lacquers and varnishes. White spirit is the most widely used solvent in the paint industry.” (IPCC, 2006).

A comprehensive methodology for estimating NMVOC emission for all sources is provided neither in the IPCC guidelines nor in the EMEP/EEA Air pollutant emission inventory guidebook 2009. The current methodology for estimating NMVOC from solvents lacks comparability between countries transparency and uncertainty quantification.[38]

The EMEP/EEA Air pollutant emission inventory guidebook 2009 is structured according to the Nomenclature for Reporting (NFR), which is the reporting format of the Guidelines for Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution (LRTAP). This nomenclature closely resembles the IPCC source nomenclature developed for reporting under the UNFCCC. Cross-referencing to the Selected Nomenclature for reporting of Air Pollutants (SNAP) 97 developed by the EEA's European Topic Centre (ETC/AE)[39] is presented in the following overview (Table 5.1). (EMEP/EEA, 2009)

Table 5.1 Cross-referencing to the Selected Nomenclature for reporting of Air Pollutants (SNAP) 97 developed by the EEA's European Topic Centre (ETC/AE)

CRF	SNAP	Description	CRF	SNAP	Description
3 A	0601	Paint application	3 B	0602	Degreasing, dry cleaning and electronics
	060101	Paint application: manufacture of automobiles		060201	Metal degreasing
	060102	Paint application: car repairing		060202	Dry cleaning
	060103	Paint application: construction and buildings		060203	Electronic components manufacturing
	060104	Paint application: domestic use (except 060107)		060204	Other industrial cleaning
	060105	Paint application: coil coating	3 D	0604	Other use of solvents and related activities
	060106	Paint application: boat building		060401	Glass wool enduction
	060107	Paint application: wood		060402	Mineral wool enduction

38 See http://www.tfeip-secretariat.org/assets/Meetings/Documents/CI-Feb-2010-Meeting-Documents/MeetingReport CIWorkshop17Feb2010final.pdf

39 European Topic Centre on Air Emissions (ETC-AE); replaced by European Topic Centre on Air pollution and Climate change Mitigation (ETC/ACM)

CRF	SNAP	Description	CRF	SNAP	Description
	060108	Other industrial paint application		060403	Printing industry
	060109	Other non industrial paint application		060404	Fat, edible and non edible oil extraction
3 C	0603	Chemical products manufacturing or processing		060405	Application of glues and adhesives
	060301	Polyester processing		060406	Preservation of wood
	060302	Polyvinylchloride processing		060407	Underseal treatment and conservation of vehicles
	060303	Polyurethane processing		060408	Domestic solvent use (other than paint applicat.)
	060304	Polystyrene foam processing		060409	Vehicles dewaxing
	060305	Rubber processing		060411	Domestic use of pharmaceutical products
	060306	Pharmaceutical products manufacturing		060412	Other (preservation of seeds,...)
	060307	Paints manufacturing		0605	Use of HFC, N_2O, NH_3, PFC and SF_6
	060308	Inks manufacturing		060501	Anaesthesia
	060309	Glues manufacturing		060505	Fire extinguishers
	060310	Asphalt blowing		060506	Aerosol cans
	060311	Adhesive, magnetic tapes, films &photographs		060508	Other
	060312	Textile finishing	NOT included in this sector		
	060313	Leather tanning	2 F 1	060502	Refrigeration and air conditioning equipments
	060314	Other	2 G	060503	Refrigeration and air conditioning equipments using other products than halocarbons
			2 F 2	060504	Foam blowing (except 060304)
			2 F 6	060507	Electrical equipments (except 060203)

5.1 Overview of sector (EU-15)

CRF Sector 3 Solvent and Other Product Use contribute 0.21 % to the total EU-15 GHG emissions in 2012 (Table 5.5). The EU-15 Member states jointly achieved an emissions reduction of about 43 % from 13.26 Tg in 1990 to 7.55 Tg in 2012 (Figure 5.1 and Table 5.2).

This emission reduction was achieved by

- Germany (-2 782 Gg CO_2eq; -61 %);
- France (-983 Gg CO_2eq; -46 %);
- The Netherlands (-341 Gg CO_2eq; -62 %);
- Italy (-939 Gg CO_2eq; -38 %);
- Spain (-249 Gg CO_2eq; -16 %);

- Austria, Belgium, Finland, Sweden, Luxembourg, Ireland and Portugal (together 442 Gg CO_2eq; -3.4 %)

The GHG emission of the Member States Denmark and Greece increased slightly (together 50.3 Gg CO_2eq; 0.4 %) in the same period (Table 5.2 and Figure 5.2).

Figure 5.1 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions for 1990–2012 in CO_2 equivalents (Tg)

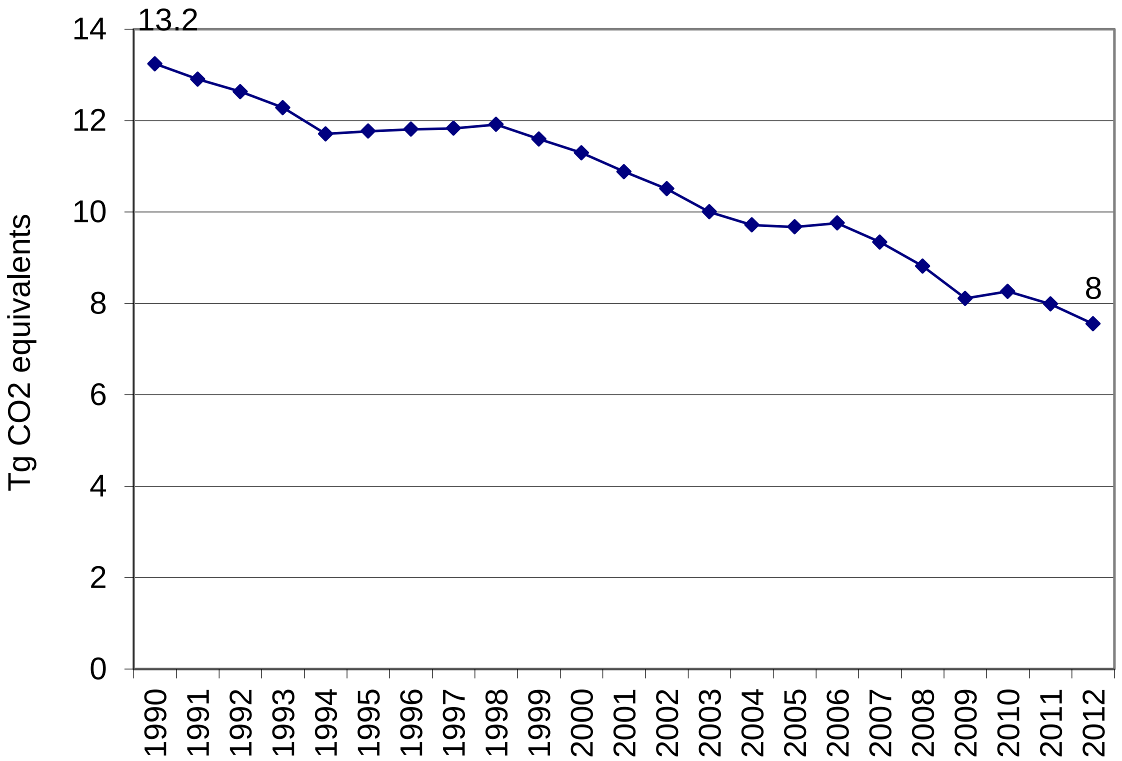
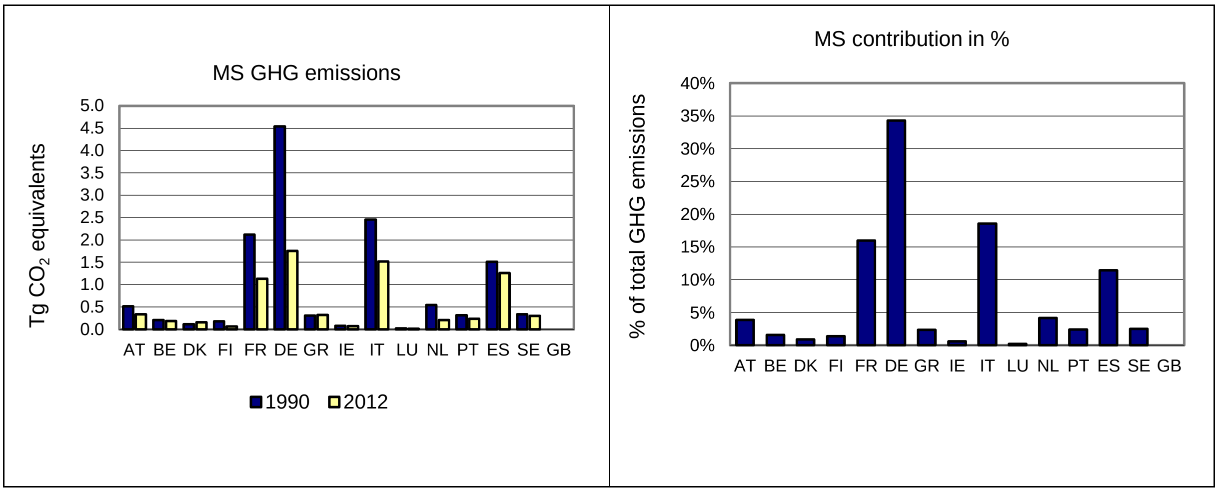


Figure 5.2 Sector 3 Solvent and Other Product Use: GHG emissions of EU-15 MS for 1990 and 2012 as well as Member States' contributions to GHG emissions for 2012 in percentage



In 2012, the emissions decreased by 5.4 % compared to 2011 (Table 5.2). In this period the highest emission reduction in absolute terms was achieved by Spain (-176 Gg CO_2eq; -12 %), Italy (-132 Gg CO_2eq; -8 %) Germany (-76 Gg CO_2eq; -4 %) and France (-30 Gg CO_2eq; -3 %). Notable emission increases between 2011 and 2012 occurred in the Member State Austria (15 Gg CO_2eq; +5%).

The Member States France, Germany, Italy and Spain are jointly responsible for 75 % of the total EU-15 GHG emissions in this sector in 2012 (Table 5.2). The United Kingdom do not estimate emissions from this sector, as there is no clear guidance provided in the 1996 Guidelines on estimating CO_2 from NMVOC.

Table 5.2 Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emissions

Member State	Greenhouse gas emissions (Gg CO2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	(%)	Gg CO2 equiv.	(%)
Austria	512	320	335	4%	15	5%	-177	-35%
Belgium	204	183	183	2%	-0.3	0%	-22	-11%
Denmark	116	168	156	2%	-11	-7%	40	35%
Finland	178	70	66	1%	-4	-5%	-112	-63%
France	2 116	1 162	1 133	15%	-30	-3%	-983	-46%
Germany	4 539	1 833	1 756	23%	-76	-4%	-2 782	-61%
Greece	308	316	318	4%	2	1%	10	3%
Ireland	80	72	73	1%	1	1%	-7	-9%
Italy	2 455	1 648	1 516	20%	-132	-8%	-939	-38%
Luxembourg	24	14	12	0%	-2	-12%	-12	-49%
Netherlands	547	215	206	3%	-9	-4%	-341	-62%
Portugal	317	245	233	3%	-12	-5%	-85	-27%
Spain	1 512	1 439	1 263	17%	-176	-12%	-249	-16%
Sweden	332	303	303	4%	0	0%	-30	-9%
United Kingdom	NE	NE	0	0%	0	-	0	-
EU-15	**13 241**	**7 987**	**7 552**	**100%**	**-435**	**-5%**	**-5 689**	**-43%**

In the Sector 3 Solvent and Other Product Use in addition to CO_2 emission NMVOC and N_2O emission are identified. The most important GHG from Solvent and Other Product Use is CO_2. In 2012 the CO_2 emissions had a share of 0.18 % of the 'Total EU-15 CO_2 Emissions and Removals' and a share of 0.15 % of the 'Total EU-15 GHG emissions' (Table 5.3). In 2012 the N_2O emissions had a share of 0.84 % of the 'Total EU-15 N_2O emissions' and a share of 0.06 % of the 'Total EU-15 GHG emissions' (Table 5.4). The sector Solvent and Other Product Use does not contain a key source.

Table 5.3 Sector 3 Solvent and Other Product Use: EU-15 CO_2 emissions as well as their share

	Unit	1990	2012
CO_2 emission in 'Solvent and Other Product Use'	[Gg]	8 841	5 337
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 241	7 552.0
Share of CO_2 emission in Total GHG in 'Solvent and Other Product Use'		*67%*	*71%*
Total National CO_2 Emissions and Removals (excluding net CO_2 from LULUCF)	[Gg]	3 368 712	2 987 926
Share of CO_2 emission from 'Solvent and Other Product Use' in Total CO2 Emissions and Removals		*0.3%*	*0.2%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4 262 100	3 619 471
Share of CO_2 emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.2%*	*0.1%*

Table 5.4 Sector 3 Solvent and Other Product Use: EU-15 N_2O emissions as well as their share

	Unit	1990	2012
N_2O emission in 'Solvent and Other Product Use'	[Gg]	14.2	7.1
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 241	7 552
Share of N_2O emission in Total GHG in 'Solvent and Other Product Use'		*33%*	*29%*
Total National N_2O Emissions	[Gg]	1 298	852
Share of N_2O emission from 'Solvent and Other Product Use' in Total National N_2O Emissions		*1%*	*0.8%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4 262 100	3 619 471
Share of N_2O emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.1%*	*0.06%*

Table 5.5 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions as well as their share

	Unit	1990	2012
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13 241	7 552
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4 262 100	3 619 471
Share of GHG emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.3%*	*0.2%*

In Table 5.6 the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU-15 and for all EU-15 Member States are listed.

Table 5.6 Sector 3 Solvent and Other Product Use: EU-15 emissions of CO_2, N_2O, NMVOC and GHG

A. Paint Application	CO_2	N_2O	NMVOC	Total emissions
	Gg			Gg CO_2 eq
AT	59		22	59
BE	NA		14	NA
DK	7		3	7
FI	18		8	18
FR	347		111	347
DE	526		239	526
GR	36		12	36
IE	19		6	19
IT	508		163	508
LU	2		1	2
NL	48		16	48
PT	46		15	46
ES	299		96	299
SE	38		14	38
GB	NE		69	NE
EU15	1 954		789	1 954

B. Degreasing and Dry Cleaning	CO_2	N_2O	NMVOC	Total emissions
	Gg			Gg CO_2 eq
AT	29	NA	11	29
BE	NA	NA	3	NA
DK	0.000001	NA	0.000003	0.000001
FI	1	NO	0.3	1
FR	16	NA	5	16
DE	86	NO	39	86
GR	9	NA	3	9
IE	4	NA	1	4
IT	60	NA	19	60
LU	2	NA	1	2
NL	2	NO	3	2
PT	7	NO	2	7
ES	77	NO	25	77
SE	0.2	NA	0.1	0.2
GB	NE	NE	21	NE
EU15	292	0	133	292

C. Chemical Products, Manufacture and Processing	CO_2	N_2O	NMVOC	Total emissions
	Gg			Gg CO_2 eq
AT	13		7	13
BE	NA		5	NA
DK	12		5	12
FI	6		3	6
FR	87		28	87
DE	112		51	112
GR	NA		IE	NA
IE	8		3	8
IT	NA		59	NA
LU	0.5		0.3	0.5
NL	NA		IE	NA
PT	60		19	60
ES	NA		73	NA
SE	1		0	1
GB	NE		12	NE
EU15	299		264	299

D. Other	CO_2	N_2O	NMVOC	Total emissions
	Gg			Gg CO_2 eq
AT	88	0.5	39	234
BE	NA	1	20	183
DK	125	0.04	19	137
FI	15	0.1	7	42
FR	548	0.4	176	684
DE	712	1	324	1 032
GR	118	1	40	274
IE	42	NA,NE	14	42
IT	433	2	139	947
LU	4	0.01	1	7
NL	69	0.3	38	156
PT	77	0.1	25	120
ES	395	2	127	888
SE	165	0.3	79	263
GB	NE	NE,NO	238	0
EU15	2 792	7	1 285	5 007

Total Solvent and Other Product Use	CO_2	N_2O	NMVOC	Total emissions
	Gg			Gg CO_2 eq
AT	189	0.5	79	335
BE	NA	1	42	183
DK	144	0.04	27	156
FI	40	0.1	18	66
FR	997	0.4	320	1 133
DE	1 436	1	653	1 756
GR	163	1	55	318
IE	73	NA,NE	23	73
IT	1 001	2	380	1 516
LU	9	0.0	3	12
NL	120	0.3	57	206
PT	190	0.1	61	233
ES	771	2	320	1 263
SE	204	0.3	94	303
GB	NE	NE,NO	339	0
EU15	5 337	7	2 472	7 552

5.2 Methodological issues and uncertainties (EU-15)

This sector does not contain any key source. An overview of methodologies used by the Member States to estimate emissions from this sector is given in Table 5.7. The methodologies used by the Member States are very different. Generally they are based on:

- Methodology provided by IPPC Guidelines and CORINAIR Guidebook;
- Bottom up and top down approach / consumption-based emissions estimating;
- Chemical approach

- mass balance for single substances or groups of substances
- plant specific surveys / expert judgment.

No additional overview of qualitative uncertainty estimates is provided. Altogether it can be noted that very high uncertainties are reported because of lack of information and rough assumptions.

The following overview (Table 5.7) consists mainly of excerpts of Member State NIRs. In some cases the information given in Member State NIRs is summarised. The references given in the following overview are taken directly from the Member State NIRs. The full reference can be found in the list of references in the respective NIR.

Table 5.7 Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Austria (NIR AT 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	CO_2
Uncertainties:	CO_2: 11 %, N_2O: 20 %	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	no
Recalculation:	yes		
Sector specific QA/QC and verification:		Tier 1 & 2 QA/QC activities	

Methodology (CO_2 emissions):

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. As a first step the quantity of solvents used and the solvent emissions were calculated. To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained. Emission estimates only based on the top-down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE, ETBE, formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE and ETBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector. Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

Activity:

The top-down approach is based on (A) import-export statistics, (B) production statistics on solvents in Austria, (C) survey on non-solvent-applications in companies, and regularly questionnaires (D) survey on the solvent content in products and preparations at producers & retailers. The bottom up approach is based on an extensive survey on the use of solvents in the year 2000 and 2008. In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected. Information about the type of application of the solvents was gathered, divided into the three categories 'final application', 'cleaner' and 'product preparation' as well as the actual type of waste gas treatment, which was divided into the categories 'open application', 'waste gas collection' and 'waste gas treatment'.

Emission factor:

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000. In a second step a survey in 1800 households was made for estimating the domestic solvent use. Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

Methodology, Activity & Emission factor (N_2O Emissions):

N_2O Emissions in CRF 3: 3 D 1 Use of N_2O for anaesthesia and 3 D 3 Use of N_2O in aerosol cans: A specific methodology for these activities has not been prepared yet. 100 % of N_2O used for anaesthesia/ aerosol cans is released into atmosphere, which means that activity data = emission (1.00 Mg N_2O/ Mg product use)

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Belgium (NIR BE 2014)			
GHG & pollutant:	NMVOC, N_2O	**GHG Key Category:**	No
Uncertainties:	N_2O: AD: 3 %, EF: 100%	**Completeness:**	Yes
Time series consistency:	Yes	**Planned improvements:**	No
Recalculation:	Yes		
Sector specific QA/QC and verification:		Tier 1 quality control checks are performed in the 3 regions for the Belgian key source categories only.	

In Belgium the emissions of NMVOC in the source category 'Solvent and other product use' include paint application (building industry, households and road markings), production of medicines, paints, inks and glues, domestic use of other products (incl. glues and adhesives), coating processes in general (incl. assembly of automobiles), printing industry, wood conservation, treatment of rubber, recuperation of solvents, extraction of oil, cleaning and degreasing and dry cleaning. No estimation of the CO_2 equivalent emissions of the solvent consumption is carried out in Belgium.

The greenhouse gas emissions in this category 3 are related in Belgium to the use of N_2O as anesthetics.

Methodology (NMVOC):

The regions in Belgium are using comparable methodologies to estimate the emissions of solvent and other product use in their region. The emissions of NMVOC in Flanders are estimated by using the results of a study started by the University of Gent in 1998 and continued by the Flemish Environment Agency (VMM). In Wallonia, the calculation is based on a methodology established by Econotec. In the Brussels region, the emissions are calculated by using the results of the research projects.

Broadly speaking, emissions of NMVOC are estimated in Belgium based on (More information in the IIR):

- Production figures that are given by the specific industry or professional federations. The emission factors used, are mainly the solvent content of the product.
- Information gathered in the industrial databases mainly originating from the yearly reporting obligations of the industrial companies.

Methodology (N_2O):

The emission calculation for the emission of N_2O from anaesthesia (3D1) is based on the number of hospital beds in Belgium and the average consumption of anaesthetics per bed. The emission factor is 10.3 kg N_2O/bed/year. This factor was determined by inquiries carried out in 1995 by the independent consultant agency Econotec.

It has been assumed that all of the nitrous oxide used for anaesthetics will eventually be released to the atmosphere. The number of beds used for the emissions calculations was obtained from the DGASS (General Directorate for Health and Social Action) and from the Health Public Federal Service. The N_2O emissions from fire extinguishers (3D2) are not estimated because of a lack of activity data. The N_2O emissions from aerosol cans (3D3) are newly estimated on the basis of the average European consumption (number of food aerosol can/inhab) obtained from DETIC (Belgian-Luxembourg Association of producers and distributors of soaps, cosmetics, detergents, cleaning products, hygiene and toiletries, glues, and related products) for the year 2012. Because of a lack of activity data before 2012, this average consumption is assumed to be constant over time. The activity data (number of aerosol cans) is then calculated for the complete time series on the basis of the number of inhabitant. The emission factor for N_2O is 7.6 g/can (as estimated in the Netherlands on the basis of data provided by one producer) and is assumed to be constant over time.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Denmark (NIR DK 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	no
Uncertainties:	CO_2 equiv: total emissions 23 %, trend: 10 %	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	yes
Recalculation:	yes		
Sector specific QA/QC and verification:		provided	

Methodology (CO_2 emissions):

Until 2002 the Danish solvent emission inventory was based on questionnaires, which were sent to selected industries and sectors requiring information on solvent use. In 2003 it was decided to implement a method that is more complete, accurate and transparent with respect to including the total amount of used solvent, attributing emissions to industrial sectors and households and establishing a reliable model that is readily updated on an annual basis.

Emission modelling of solvents can basically be done in two ways: 1) By estimating the amount of (pure) solvents consumed, or 2) By estimating the amount of solvent containing products consumed, taking account of their solvent content (EMEP/EEA, 2009).

In 1) all relevant solvents must be estimated, or at least those together representing more than 90 % of the total pollutant emission, and in

2) all relevant source categories must be inventoried or at least those together contributing more than 90 % of the total pollutant emission. A simple approach is to use a per capita emission for each category, whereas a detailed approach is to get all relevant consumption data (EMEP/EEA, 2009).

The detailed method 1) is used in the Danish emission inventory for solvent use, thus representing a chemicals approach, where each pollutant is estimated separately. The sum of emissions of all estimated pollutants used as solvents equals the pollutant emission from solvent use.

Method 2) is used for determining emissions from fireworks, tobacco, candles and charcoal for barbeques included in 3D Other Use.

Pollutant list

NMVOC is the most abundant chemical group in relation to Solvent and Other Product Use. Additionally there is also some use and/or emissions of NO2 and CO_2.

The definitions of solvents and VOC that are used in the Danish inventory (Nielsen et al., 2012) are as defined in the solvent directive (Directive 1999/13/EC) of the EU legislation: “Organic solvent shall mean any VOC which is used alone or in combination with other agents, and without undergoing a chemical change, to dissolve raw materials, products or waste materials, or is used as a cleaning agent to dissolve contaminants, or as a dissolver, or as a dispersion medium, or as a viscosity adjuster, or as a surface tension adjuster, or a plasticiser, or as a preservative”. VOCs are defined as follows: “Volatile organic compound shall mean any organic compound having at 293.15 K a vapour pressure of 0.01 kPa or more, or having a corresponding volatility under the particular condition of use”.

This implies that some NMVOCs, e.g. ethylenglycol, that have vapour pressures just around 0.01 kPa at 20 °C, may only be defined as VOCs at use conditions with higher temperature. However, use conditions under elevated temperature are typically found in industrial uses. Here the capture of solvent fumes is often efficient, thus resulting in small emissions (communication with industries).

The Danish list of NMVOCs comprises approx. 30 pollutants or pollutant groups representing more than 95 % of the total emission from solvent use.

Activity data

For each pollutant or product a mass balance is formulated:

Consumption = (production + import) – (export + destruction/disposal + hold-up) (Eq. 1)

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Denmark (NIR DK 2014)

Data concerning production, import and export amounts of solvents and solvent containing products are collected from StatBank DK (2012), which contains detailed statistical information. Manufacturing and trading industries are committed to reporting production and trade figures to the Danish Customs & Tax Authorities in accordance with the Combined Nomenclature.

Import and export figures are available on a monthly basis from 1990 to present and contain trade information from approx. 200 countries worldwide. Production figures are reported quarterly as industrial commodity statistics by commodity group and unit from 1990 to present.

Destruction and disposal of solvents lower the pollutant emissions. In principle this amount must be estimated for each pollutant in all industrial activities and for all uses of pollutant containing products. At present the solvent inventory only considers destruction and disposal for a limited number of pollutants. For some pollutants it is inherent in the emission factor, and for others the reduction is specifically calculated from information obtained from the industry or literature.

Hold-up is the difference in the amount in stock in the beginning and at the end of the year of the inventory. No information on solvents in stock has been obtained from industries. Furthermore, the inventory spans over several years so there will be an offset in the use and production, import and export balance over time.

In some industries the solvents are consumed in the process, e.g. in the graphics and plastic industry, whereas in the production of paints and lacquers the solvents are still present in the final product. These products can either be exported or used in the country. In order not to double count consumption amounts of pollutants it is important to keep track of total solvent use, solvents not used in products and use of solvent containing products. Furthermore some pollutants may be represented as individual pollutants and also in chemical groups, e.g. "o-xylene", "mixture of xylenes" and "xylene". Some pollutants are better inventoried as a group rather than individual pollutants, due to missing information on use or emission for the individual pollutants. The Danish inventory considers single pollutants, with a few exceptions.

Activity data for pollutants are thus primarily calculated from Equation 1 with input from StatBank DK (2012). When StatBank (2012) holds no information on production, import and export or when more reliable information is available from industries, scientific reports or expert judgements the data can be adjusted or even replaced.

Emission factors

For each pollutant the emission is calculated by multiplying the consumption with the fraction emitted (emission factor), according to:

Emission = consumption * emission factor

The present Danish method uses emission factors that represent specific industrial activities, such as processing of polystyrene, dry cleaning etc. or that represent use categories, such as paints and detergents. Some pollutants have been assigned emission factors according to their water solubility.

Higher hydrophobicity yields higher emission factors, since a lower amount ends in waste water, e.g. ethanol (hydrophilic) and turpentine (hydrophobic).

Emission factors for solvents are categorised in four groups in ascending order:

(1) Lowest emission factors in the chemical industry, e.g. lacquer and paint manufacturing, due to emission reducing abatement techniques and destruction of solvent containing waste, (2) Other industrial uses, e.g. graphic industry, have higher emission factors, (3) Non-industrial use, e.g. auto repair and construction, have even higher emission factors, (4) Diffuse use of solvent containing products, e.g. painting, where practically all the pollutant present in the products will be released during or after use.

For a given pollutant the consumed amount can thus be attributed with two or more emission factors; one emission factor representing the emissions occurring at a production or processing plant and one emission factor representing the emissions during use of a solvent containing product. If the chemical is used in more processes and/or is present in several products more emission factors are assigned to the respective chemical amounts.

Emission factors can be defined from surveys of specific industrial activities or as aggregated factors from industrial branches or sectors. Furthermore, emission factors may be characteristic for the use pattern of certain

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Denmark (NIR DK 2014)
products.   The emission factors used in the Danish inventory also rely on the work done in the joint Nordic project (Fauser et al., 2009).   **D1 Other: Use of N_2O for Anaesthesia, 3D4 Other: Other Use of N_2O & 3D5 Other: Other**   Five companies sell N_2O in Denmark and only one company produces N_2O. N_2O is primarily used in anaesthesia by dentists, veterinarians and in hospitals and in minor use as propellant in spray cans, use in laboratories, racing cars and in the production of electronics. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknown. An emission factor of 1 is assumed for all uses, which equals the sold amount to the emitted amount. Sold amounts are obtained from the respective companies and the produced amount is estimated from communication with the company.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Finland (NIR FI 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	yes
Uncertainties:	NMVOC: AD: ±100; EF: ±10% N_2O: ±10%;	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	Check of activity data
Recalculation:	no		
Sector specific QA/QC and verification:	The bilateral quality meeting, which function as Tier 1 QA audit, is held annually between the inventory unit and the sectoral expert. TIER 1 QC according to GPG 2000, Table 8.1.		

Methodology (CO_2 emissions):

NMVOC emissions from printing industry are based on the emission data from the VAHTI system (detailed information in Annex 2 to the Finnish NIR 2013), a questionnaire to presses and oil mills that do not report their emissions to the VAHTI system, activity data from the Finnish Safety and Chemicals Agency's (Tukes) database (Kotiranta, S. 2012), Finnish Food Safety Authority (Hynninen, E-L. 2012) and Finnish Cosmetics, Toiletry and Detergents Association. The detailed description of these calculations is included in the Finnish IIR (Finnish Environment Institute, 2013).

Indirect CO_2 emissions from solvents and other product use have been calculated from NMVOC emissions for the time series 1990-2011 using the equation below. It was assumed that the average carbon content is 60% by mass for all categories under the sector of solvents and other products use in accordance with the 2006 IPCC Guidelines. As described in the Guidelines, the used fossil carbon content fraction of NMVOC is based on limited published national analyses of speciation profile.

$\text{Emissions}_{CO2} = \text{Emissions}_{NMVOC} *$ Percent carbon in NMVOCs by mass * 44 /12

Methodology (N_2O Emissions):

The N_2O emissions are calculated by Statistics Finland. The country-specific calculation method is consistent with a Tier 2 method. In the estimation of the N_2O emissions sales data are obtained from the companies delivering N_2O for medical use and other applications in Finland. For the years 1990 to 1999 the emissions have been assumed constant based on activity data obtained for the years 1990 and 1998. Since 2000 annual and more precise data have been received from the companies. The emission estimation is based on the assumption that all used N_2O is emitted to the atmosphere in the same year it is produced or imported to Finland. A very small part of emissions is estimated due to non-response.

Activity: For the estimation of N_2O emissions production or importation data are obtained from companies for the years 1990, 1998 and all years starting from 2000. In 2011 one company reported that they have continued to export and that has been also taken into account in the calculations

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Germany (NIR DE 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	yes
Uncertainties:	CO_2: 7.9%; N_2O: 47%	**Completeness:**	yes
Time series consistency:	yes	**Planned improvements:**	no
Recalculation:	yes		
Sector specific QA/QC and verification:	TIER 1 & 2 QC checks		

Methodology (CO_2 emissions):

NMVOC emissions are calculated in keeping with a product-consumption-oriented approach. In this approach, the NMVOC input quantities allocated to these source categories, via solvents or solvent-containing products, are determined and then the relevant NMVOC emissions (for each source category) are calculated from those quantities via specific EFs. This method is explicitly listed, under "consumption-based emissions estimating", as one of two methods that are to be used for emissions calculation for this source category. Use of this method is possible only with valid input figures – differentiated by source categories – in the following areas:

1. Quantities of VOC-containing (pre-) products and agents used in the report year,
2. The VOC concentrations in these products (substances and preparations),
3. The relevant application and emission conditions (or the resulting specific EF).

To take account of the highly diverse structures throughout the sub-categories 3A – 3D, these input figures are determined on the level of 37 differentiated source categories, and the calculated NMVOC emissions are then aggregated. The product/substance quantities used are determined at the product-group level with the help of production and foreign-trade statistics. Where possible, the so-determined domestic-consumption quantities are then further verified via cross-checking with industry statistics.

The values used for the average VOC concentrations of the input substances, and the EFs used, are based on experts' assessments (expert opinions and industry dialog) relative to the various source categories and source-category areas. Not all of the necessary basic statistical data required for calculation of NMVOC emissions for the most current relevant year are available in final form; as a result, the data determined for the previous year are used as an initial basis for a forecast for the current report. The forecast for NMVOC emissions from solvent use for the relevant most current year is calculated on the basis of specific activity trends. As soon as the relevant basic statistical data are available for the relevant most current year, in their final form, the inventory data for NMVOC emissions from solvent use will be recalculated.

For the 2014 report, indirect CO_2 emissions from NMVOC have been calculated. According to Chapter 7 Precursors and Indirect Emissions of the 2006 IPCC Guidelines the following relationship was used for pertinent conversion: $EM_{indirect\ CO2} = EM_{NMVOC}$ * molar mass CO_2 / molar mass C * 60%.

Methodology, Activity & Emission factor (N_2O Emissions):

Anaesthesia: The 1990 figure for N_2O emissions from medical applications is based on an extrapolation of a statistical plant survey conducted in 1990 in the territory of the former GDR. N_2O emissions of 6 200 t were estimated, as a rough approximation, for Germany in 1990. The N_2O figure for 2001 was obtained via a written memorandum, dating from 2002, of the Industriegaseverband e.V. (IGV) industrial-gas association. That figure was tied to a range of 3 000 ~ 3 500 t/a. The mean value from that range (3 250 t/a) was then used for generation of an N_2O-emissions time series. Since 2005, the Industriegaseverband (IGV) industrial-gas association has carried out surveys of N_2O sales for all applications in Germany. In addition, the IGV has made the data from those surveys available to the Federal Environment Agency for reporting purposes. In 2010, the IGV entered into a voluntary agreement, with the Federal Ministry of Economics and Technology (BMWi), regarding annual provision of N_2O-sales data for purposes of emissions reporting. The gaps in the data relative to uses in anaesthesia are closed via interpolation and extrapolation. The pertinent emission factor is 100%.

Whipped-cream aerosol cans: Use of N_2O in aerosol cans for whipped cream, in Germany, has to be carefully differentiated. In Germany, there is one maker of aerosol cans for whipped cream. That maker also fills the cans

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Germany (NIR DE 2014)
in Germany. In emissions calculations, it is assumed, on the basis of the above described research, that that company accounts for a share of about 3 % of the laughing-gas sales of the IGV industrial-gas association. The majority of the companies who deal with such aerosol cans has them filled abroad and then imports them into Germany. The relevant sales of such companies are thus not included in the data of the IGV industrial-gas association. The MIV dairy-industry association has reported to the Federal Environment Agency the results of a one-time survey that showed that 50.2 million units of whipped-cream aerosol cans were sold in 2008. At the same time, the MIV association reported that the units involved vary in size, and that it is not possible to break the figures down by can sizes. Internet research showed that pressurized cartridges for this area are sold in Germany: cartridges with 8g of N_2O, for 0.5l cans, and cartridges with 16g of N_2O, for 1.0l cans. Comparison calculations have shown that 8g of N_2O is a safe approximation, for purposes of calculation, for the amount of laughing gas contained per sold unit (whipped-cream aerosol can). That, in turn, leads to an input figure of 401.6 t N_2O for whipped-cream aerosol cans in 2008 in Germany. Since no pertinent data are available for the years prior to 2008, that value is assumed to be constant. The emission factor for whipped-cream aerosol cans is assumed to be 100%. **Semiconductor manufacturing:** On a one-time basis, the German Electrical and Electronic Manufacturers‘ Association (ZVEI) has provided information on quantities of laughing gas sold in the years 1990, 1995, 2000, 2001 and 2008. Values between those points are obtained via interpolation. In addition, the ZVEI estimated the emission factor for 2008 to be about 40 %, in keeping with conversion of laughing gas within the pertinent process and with downstream treatment processes. The ZVEI was unable to provide any figures for 1990. But since it can be assumed that levels of waste-gas treatment in 1990 were not nearly as high as they were in 2008, an emission factor of 100 % is used as a conservative estimate for 1990. The emission factor for the period between 1990 and 2008 was obtained via interpolation. **Explosives:** In 2003, a total of 59 kt of explosives was produced in Germany. Of that figure, 13 kt were exported abroad, and 5.8 kt were imported into Germany. Those figures, in turn, yield a figure of 51.8 kt for the amount of explosives used in Germany. Of that amount, ANFO accounts for a share of 60 %, emulsion explosives account for 25 % and dynamite explosives account for 15 %. ANFO explosives consist of 94 % ammonium nitrate and 6 % fuels. The corresponding relationship for emulsion explosives is 80 % to 20 %; for dynamite explosives, it is 50 % to 50 %. At present, nitrous oxide amounts in detonation clouds are not determined, while amounts of NO and NO2 are determined. […]The emission factor for use of explosives is 0.1036 kg N_2O/t explosives. That emission factor was determined, via measurement, by the BAM in February 2010. As a result, the emission factor has been corrected downward, considerably, with respect to the Submission 2010.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Great Britain (NIR GB 2014)			
GHG & pollutant:	NMVOC	**GHG Key Category:**	no
Uncertainties:	no	**Completeness:**	NMVOC CO_2: NE N_2O: NE
Time series consistency:	yes	**Planned improvements:**	General QA/QC
Recalculation:	yes		
Sector specific QA/QC and verification:	TIER 1 & 2 QC checks		

No direct GHG emissions are reported in this category.

Emissions of CO_2 for this sector are currently not estimated although emissions from this source are

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Great Britain (NIR GB 2014)
considered to be very small.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Greece (NIR GR 2014)			
GHG & pollutant:	CO_2, NMVOC	**GHG Key Category:**	Yes
Uncertainties:	CO_2: 300%; $N_2$2: 300%	**Completeness:**	NMVOC, CO_2, N_2O
Time series consistency:	yes	**Planned improvements:**	Yes
Recalculation:	no		
Sector specific QA/QC and verification:		Not provided	

Methodology (CO_2 emissions):

The calculation of NMVOC emissions requires a very detailed analysis of the use of solvents and other products containing volatile organic compounds. There are two basic approaches for the estimation of emissions from Solvent and Other Product Use, which depend on the availability of data on the activities producing emissions and the emission factors.

Production-based. In cases that solvent or coating use is associated with centralised industrial production activities (e.g. automobile and ship production), it is generally possible to develop NMVOC emission factors based on unit of product output. Next, annual emissions are estimated on the basis of production data.

Consumption-based. In many applications of paints, solvents and similar products, the end uses are too small-scale, diverse, and dispersed to be tracked directly. Therefore, emission estimates are generally based on total consumption (i.e. sales) of the solvents, paints, etc. used in these applications. The assumption is that once these products are sold to end users, they are applied and emissions generate relatively rapidly. Emission factors developed on the basis of this assumption can then be applied to data from sales for the specific solvent or paint products.

The application of both approaches needs detailed activity data, concerning either e.g. the amount of pure solvent consumed or the amount of solvent containing products consumed. The availability of such activity data in Greece is limited and as a result the default CORINAIR methodology is applied for the estimation of NMVOC emissions. Carbon dioxide emissions are calculated from NMVOC emissions, assuming that the carbon content of NMVOC is 85%.

Paint application: Data availability concerning the use of products containing solvents for "Vehicle manufacture and Vehicle refinishing" is limited and as a result the respective emissions are not estimated. Emissions from "Domestic use and construction" are estimated on the basis of population figures and default emission factors from CORINAIR (0.5 kg / capita).

Metal Degreasing and Dry Cleaning: Emission estimates are given only for the dry cleaning sector. These estimates are based on population figures and default emission factors from CORINAIR (0.25 kg /capita) that is applicable to all types of dry cleaning equipment.

Other Use of Solvents and Related Activities: The emission factors used for some of the activities defined in CORINAIR and for which it was possible to obtain the corresponding activity data from the Hellenic Statistical Authority, are:

- Production and processing of PVC: 40 kg / t of product produced or processed.
- Production of pharmaceutical products: 14 g /capita.
- Ink production: 30 kg / t of product.
- Glue production, applied emission factor: 20 kg /t of product
- For the wood preservation: 24 kg / t of wood preserved
- For fat edible and non edible oil extraction: 14 kg NMVOC/ t of seed processed
- For domestic solvent use (except paint application): 2.6 kg NMVOC/capita/year

In the case of printing industry, the estimation of emissions was based on the consumption of ink. Printing ink is mostly used for the publishing of newspapers, books and various leaflets. According to the estimations of one publishing organisation, the amount of ink used for the printing of a daily newspaper is approximately 3.7 g of ink. The quantity of ink used for printing books etc. was calculated by subtracting the total quantity used for the newspapers from the total ink consumed.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Greece (NIR GR 2014)

The emission factor applied (260 kg / t ink) is the average of emission factors for newspaper printing (54 kg /t ink) and for books and other leaflets printing (132-800 kg / t ink).

N_2O emissions (source categories 3D1 & 3D3)

For source categories 3D1 and 3D3, neither national activity data nor IPCC methodology are available for the estimation of N_2O emissions. The inventory team in order to provide emissions for these source categories proceeded as follows:

1. The inventory team started by investigating the NIRs and ERT audit reports of other Annex I parties, as concerns the estimation of emissions for the 3D1 and 3D3 source categories.

2. The ratio of N_2O emissions per population (ktN_2O/1000s capita) for a cluster of Annex I parties was computed. Four European countries were selected: Italy and Spain (which have similarities with Greece as concerns climate etc), Austria and Netherlands (in order to be conservative in the estimation of emissions).

3. The mean value of the above mentioned ratios was calculated.

4. By using the population of Greece as a driver (activity data) and the above calculated ratio as “Emission factor”, the emissions for the whole time series 1990-2011 of the 3D1 and 3D3 were estimated.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Irelandd (NIR IE 2014)			
GHG & pollutant:	CO_2, NMVOC	**GHG Key Category:**	No
Uncertainties:	AD: 30%; EF: 5%	**Completeness:**	NMVOC, CO_2; N_2O: NE
Time series consistency:	Yes	**Planned improvements:**	Yes
Recalculation:	Yes		
Sector specific QA/QC and verification:		TIER 1 QC	

Methodology (CO_2 emissions):

The levels of solvent use and the emissions from solvents have changed substantially in response to product replacement and reformulation and emission controls being implemented under Integrated Pollution Prevention Control (IPPC) and the Solvents Directive (CEC, 1999). Given these developments, the inventories of NMVOC emissions from solvent use were assessed in 2005 when a project was commissioned to carry out an in-depth analysis of the specified NMVOC source categories (CTC, 2005). This work enabled the best possible estimates of emissions for the period 1990- 2004 to be derived, and built upon earlier commissioned work in 1998 (Finn et al, 2001). The revised estimates for the time series 1990-2003 indicated lower NMVOC emissions than had been previously reported and used as the basis for estimating CO_2 in the sector Solvent and Other Product Use. In 2011, further improvements were undertaken which focussed on the appropriateness of activity data and emission factors and the consistency of emission estimates for the time series 1990-2008.

CTC (2005) developed a bottom-up approach for estimating NMVOCs from activities that are subject to IPPC licensing in the four source categories (3.A Paint Application, 3.B Degreasing and Dry Cleaning, 3.C Chemical Products and 3.D Other Solvent Uses). Relevant data on emissions and solvent use were extracted from their electronic or paper Annual Environmental Reports (AERs) or Pollution Emissions Registers (PERs). Where such information was not available, European PERs were assessed.

Top-down methods were used for activities (i.e. the use of paints and the use of domestic solvents) that are not covered by the IPPC licensing system. For these activities, Irish statistics such as vehicle stock, population and housing stock were used.

Input, usage and emissions data for each individual activity is collated into IPPC and non-IPPC spread sheets.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Irelandd (NIR IE 2014)
Emissions are estimated by applying EMEP/CORINAIR methods, using default, UK and literature emission factors and general guidance as appropriate. Interpolation and extrapolation are used to elaborate a time series where no annual specific data is available. These are combined with Irish statistics for the number of vehicles, population, housing stock and a range of other activity data. In some instances activity data is currently not available in Ireland and where this occurs emission estimates are undertaken using Irish and UK population statistics and UK emission data. In other instances, emissions are estimated using GDP as a surrogate activity data. The estimates of CO_2 emissions from Solvent and Other Product Use for the period 1990-2012 are performed. However, the overall impact of the sector on total GHG emissions has been minimal and responsible for similar level of 0.1 per cent of the share in the total trend. Emissions from the sector increased by 8.2 per cent between 1990 (at 80.03 Gg CO_2) and 1998 when they reached their peak (at 86.63 Gg CO_2) to decrease by 16.1 per cent in 2012 (at 72.72 Gg CO_2). Overall emissions decreased by 9.1 per cent between 1990 and 2012. Source category 3.A Paint Application is a significant source of NMVOC, accounting for 26.2 per cent of total NMVOC emissions in 2012. Emissions from this sub-category in 2012 have substantially fallen (by 32.1 per cent) since their peak in 1998 and by 10.5 per cent since 1990 as the solvent content of paint (both water and solvent based paints) has decreased. This trend has primarily been driven by legislation such as the Deco Paints Directive (EP and CEU, 2004b; DEHLG, 2007) and the Solvents Directive (CEC 1999). Both Directives have had a substantial impact on the solvent content of paints, coatings and other products. Integrated Pollution Prevention and Control has also impacted on the industrial users of solvents, requiring solvent management plans and improvements to working practices and the implementation of abatement techniques.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Netherlands (NIR NL 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	No
Uncertainties:	NMVOC: 30%; C-content: 10%; CO_2: 27%	**Completeness:**	Yes
Time series consistency:	Yes	**Planned improvements:**	No
Recalculation:	Yes		
Sector specific QA/QC and verification:		general QA/QC procedures	

Methodology (CO_2 emissions):

Detailed information on the activity data and emission factors of NMVOC estimates can be found in the monitoring protocol 13-014 on the website www.nlagency.nl/nie.

Activity data: consumption data and NMVOC contents of products are mainly provided by trade associations, such as the VVVF (for paints), the NCV (for cosmetics) and the NVZ (for detergents). Consumption of almost all solventcontaining products has increased since 1990. However, the general NMVOC content of products (especially paints) has decreased over the last years, resulting in a steady decline in NMVOC emissions since 1990 (see section 2.4). Due to the increased sales of hairspray and deodorant sprays NMVOC emissions have increased slightly in 0recent years. It is assumed that the NMVOC contents of these products have remained stable. Emission factors: it is assumed that all NMVOC in the product is emitted (with the exception of some cleaning products and methylated spirit, which are partly broken down in sewerage treatment plants after use, or used as fuel in BBQs or fondue sets (methylated spirit). The carbon contents of NMVOC emissions are documented in the monitoring protocol on the website www.nlagency.nl/nie.

Methodological issues: Country-specific carbon contents of the NMVOC emissions from 3A Paint application, 3B Degreasing and dry cleaning and 3D Other product use are used to calculate indirect CO_2 emissions. Monitoring of NMVOC emissions from these sources differs per source. Most of the emissions are reported by branch organisations (e.g., paints, detergents and cosmetics). The indirect CO_2 emissions from NMVOC are calculated from the average carbon contents of the NMVOC in the solvents: 3A: 0.72 C-content NMVOC (%); 3B: 0.16 C-content NMVOC (%); 3D: 0.69 C-content NMVOC (%)

The carbon content of degreasing and dry cleaning is very low due to the high share of chlorinated solvents (mainly tetra chloro-ethylene used for dry cleaning). The emissions are then calculated as follows:

CO_2 (in Gg) = {NMVOC emission in subcategory i (in Gg) x C-fraction subcategory i} x 44/12

The fraction of organic carbon (of natural origin) in the NMVOC emissions is assumed to be negligible.

Methodology (N_2O emissions):

Activity data and implied emission factors: Detailed information on the activity data and emission factors of N_2O estimates are found in the monitoring protocol 13-014 on the website www.nlagency.nl/nie.

Activity data: The major hospital supplier of N_2O for aesthetic use reports the consumption data of aesthetic gas in the Netherlands annually. The Dutch Association of Aerosol Producers (NAV) reports data on the annual sales of N_2Ocontaining spray cans. Missing years are then extrapolated on the basis of this data. Domestic sales of cream in aerosol cans have shown a strong increase since 1990. The increase is reflected in the increased emissions. Emission factors: the emission factor used for N_2O in anaesthesia is 1 kg/kg. Sales and consumption of N_2O for anaesthesia are assumed to be equal each year. The emission factor for N_2O from aerosol cans is estimated to be 7.6 g/can (based on data provided by one producer) and is assumed to be constant over time.

Methodological issues: Country-specific methodologies are used for the N_2O sources in Sector 3. Since the emissions in this source category are from non-key sources for N_2O, the present methodology complies with the IPCC Good Practice Guidance (IPCC, 2001). A full description of the methodology is provided in the monitoring protocol 13-014 on the website www.nlagency.nl/nie.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions							
Portugal (NIR PT 2014)							
GHG & pollutant:	CO_2, NMVOC, N_2O					**GHG Key Category:**	Yes – CO_2
Uncertainties:			AD	EF	EMI	**Completeness:**	**Yes**
	CO_2	3A	8%	7%	11%		
		3B	7%	0%	7%		
		3C	5%	26%	26%		
		3D	6%	1918%	1918%		
	N_2O	3D	10%	0%	10%		
Time series consistency:	Yes					**Planned improvements:**	no
Recalculation:	Yes						
Sector specific QA/QC and verification:						general QA/QC procedures	

Methodology, Activity data & Emission factor (CO_2 emissions):

NMVOC emissions estimates must be converted in CO_2 emissions whenever the carbon that is present in organic compounds has fossil fuel origin (originated from feed-stocks from petroleum/coal/natural gas), and being assumed that NMVOC compounds are fully oxidized in air to carbon dioxide contributing thence to the atmospheric pool.

Ultimate CO_2 emissions were calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory as CO_2e. U_{CO2} = NMVOC * 0.85 * (44/12). Where U_{CO2} - Ultimate CO_2 (ton/yr); MVOC - Global emissions of NMVOC (ton/yr).

Paint Application (CRF 3A): NMVOC emissions from use of coating materials are estimated in a simple manner using the following formulation: $Emi_{NMVOC(a,p,y)} = \Sigma_a \Sigma_p [EF_{(p)} * Coating_{CONS(a,p,y)}] * 10\text{-}3$; where $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from use/application of coating substances during year y; $Coating_{CONS(a,p,y)}$ – Use of coating substance p in economic activity a during year y; $EF_{(p)}$ – NMVOV EF (solvent content) resulting from application of substance;

For specific sectors were more detailed activity data and emissions factors were available a product base methodology was used. This is the case for: (a) Cars manufacturing; (b) Truck cabin coating; (c) Leather finishing. The product based methodology can be described as following: $Emi_{NMVOC(p,y)} = \Sigma_a \Sigma_p [EF_{(p)} * Coating_{CONS(a,p,y)}] * 10\text{-}3$. Where $Emi_{NMVOC(p,y)}$ – NMVOC emissions resulting the production of product p during year y (t/yr); Product(p,y) – Production units of product p during year y (cars/yr, truck cabins/yr, kg leather/yr); $EF_{(p)}$ – NMVOV emission factor for production of product p (kg/car, kg/truck cabin, kg/kg leather) p – product (cars, truck cabin, leather). <u>Emission factors</u> were taken from EMEP/CORINAIR guidebook 2009. Control strategies were obtained from GAINS model developed by IIASA. Default emission factors and abatement technologies were obtained from EMEP/CORINAIR, then the control strategy suggested by IIASA was applied in the following manner.

$EF_{NMVOC(y)} = CS_{(t,y)}$ *10^-2 * 1 - $AT_{(t)}$ – *10^-2 $EF_{NMVOC(default)}$ – Default NMVOC emission factor.

Where: $EF_{NMVOC(y)}$ – NMVOC emission factor in year y (t/yr); $CS_{(t,y)}$ – Control strategy, share of abatment technology t during year y (%); $AT_{(t)}$ – Efficiency of abatement technology t (%); t – abatement technology; $EF_{NMVOC(default)}$ – Default NMVOC emission factor.

In cases where industrial detailed information was not available, Tier 1 emission factors for industrial paint application were used. This emission factor is based on the quantity of coating applied.

<u>Activity data:</u> The available and reliable information concerning the use of paints is restricted to a small number of activities in Portugal. From IAIT and IAPI industrial surveys, compiled by national statistics, it is only possible to determine consumption of paint in industrial activities, but the remaining, and larger part of consumption, is not known. Therefore total consume of paint and varnish in Portugal had first to be estimated from internal production, importation and exportation according to: TotalCons(y)=Production(y)+Imports(y)–Exports(y); Where: TotalCons(y)-Consumed paint and varnish of type p in year y; Production(y) - National Produced paint and varnish of type p in

year y; Imports(y) - Imported paint and varnish of type p in year y; Exports(y)-Exported paint and varnish of type p in year y.

Degreasing and dry cleaning (CRF 3B): Assuming that all solvents consumed during degreasing and dry-cleaning evaporate, NMVOC emission will be equal to the amount of solvents used. If it is considered that annual consumption of solvents in an economic activity is used to replenish the quantity of solvent that was lost, then annual NMVOC emissions may be estimated from the annual consumption of solvent. This methodology overcomes the need of being aware of the portion of solvent that is recovered. In the case of the dry-cleaning activity it was assumed that either the solvent is lost directly to atmosphere, or if it is conveyed to water or retained in clothes, but it will eventually reach atmosphere by evaporation. For the dry cleaning sector other methodologies, based on quantities of washed cloths, are recommended by several sources (USEPA, 1981; EMEP/CORINAIR). However, in Portugal there is no sufficient information to use this other approach.

Activity Data Statistical information concerning total solvent use, from the National Statistics Institute (INE), was used to estimate VOC emissions. Consumption of solvents, presented in Table 5.29, was based on consumption of volatile organic materials in the metal and plastic industries, from IAIT statistical survey. There is no available statistical information concerning consumption of solvents and other materials in dry-cleaning activity, because this activity is not included under IAIT and IAPI industrial surveys. Therefore, it was assumed that all PER (Tetra-chloro-ethylene)79 consumed in Portugal is used in dry-cleaning80 activity and that all PER used is imported (no national production). Annual apparent consumption was estimated from INE's statistical databases on external trade from 1990 to 2009 and assumed as equal to solvent use.

Chemical products, manufacture and processing (CRF 3C): Emissions were estimated by the use of emission factors that are multiplied by the quantity of material produced: $EMI_{NMVOC} = EF * Activity_{Rate} * 10^{-3}$ where EMI_{NMVOC} - annual emission of NMVOC (ton/yr); $Activity_{Rate}$ - Indicator of activity in the production process. Quantity of product produced per year as a general rule for this emission source sector (ton/yr); EF - emission factor (kg/ ton); It was assumed that NMVOC result mostly from solvents with fossil origin, therefore contributing fully to ultimate carbon dioxide emissions.

Polyester processing: Emissions from polyester processing were estimated according with the EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). A tier 2 approach was used as activity data and emissions factors were stratified for polyester processing. The technology specific emission factor was obtained from EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). The emissions factor was assumed constant for all covered period. Data on polyester is available from the IAPI industrial surveys from INE.

Polyvinylchloride processing: Emissions from polyvinylchloride processing were estimated according with the EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). A tier 1 approach was used as specific emissions factors from the EEA/EMEP guidebook were not available for polyvinylchloride processing. The default emission factor was obtained from EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). The emissions factor was assumed constant for all covered period. Data on polyvinylchloride is available from the IAPI industrial surveys from INE.

Polyurethane and polystyrene foam processing: Emissions from polyurethane and polystyrene foam processing were estimated according with the EEA/EMEP air pollutant emission inventory guidebook (EEA/EMEP, 2009). A tier 2 approach was used as activity data and emissions factors were stratified for polyurethane and polystyrene foams. Data on polyurethane and polystyrene foam is available from the IAPI industrial surveys from INE.

Rubber processing: Emissions from rubber processing was estimated according with EMEP/CORINAIR Guidebook. Rubber processed for tyre production is not included in this sector. Statistical information for year 2008 was not yet available, therefore emissions were estimated according with a forecast based on historical emissions from the last five year period. The emission factor used for rubber processing was obtained from EMEP/CORINAIR guidebook. The same emission factor was used for year 1990 to 2008. Production data of rubber artefacts was available from the IAIT and IAPI industrial surveys from INE.

Paints, Inks and Glues Manufacturing: Emissions from paints, inks and glue manufacturing were estimated according with EMEP/CORINAIR Guidebook. Emission factors were taken from EMEP/CORINAIR guidebook 2009. Control strategies were obtained from GAINS model developed by IIASA (http://gains.iiasa.ac.at). Default emission factors and abatement technologies were obtained from EMEP/CORINAIR, then the control strategy suggested by IIASA was applied in the following manner. Production data of paints, inks and glue was available from the IAIT and IAPI industrial surveys from INE. Production data of paints, inks and glue was available from the IAIT and IAPI industrial surveys from INE.

Manufacture of Tyres: Emissions from tyre manufacturing were estimated according with EMEP/CORINAIR Guidebook. Emission factors were taken from EMEP/CORINAIR guidebook 2009. Control strategies were obtained from GAINS model developed by IIASA (http://gains.iiasa.ac.at). Default emission factors and abatement technologies were obtained from EMEP/CORINAIR, then the control strategy suggested by IIASA was applied in the following manner. Since the final emission factor is expressed in g/kg tyre, a conversion factor was used to obtain emission factor expressed in g/tyre in order to use the activity data provided by INE. A conversion factor of 15kg/tyre was used. Production data for tyres was available from the IAIT and IAPI industrial surveys from INE.

Other use of solvents and related activities (CRF 3D):

Use of N_2O for Anaesthesia (3.D.1)

Methodology: The N_2O consumed in Portugal is primarily for medical use as anaesthesia. The new 2006 guidelines propose that emissions be estimated from supply "It is good practice to estimate N_2O emissions from data of quantity of N_2O supplied that are obtained from manufacturers and distributors of N_2O products". There will be a time delay between manufacture, delivery and use but this is probably small in the case of medical applications because hospitals normally receive frequent deliveries to avoid maintaining large stocks. Therefore, it is reasonable to assume that the N_2O products supplied will be used in one year.

Emission Factors: It is assumed that none of the administered N_2O is chemically changed by the body, and all is returned to the atmosphere. It is reasonable to assume an emission factor of 1.0

Activity Data: Consumption of N_2O emissions are calculated from data collected from enterprises (1990 to 2012). This set of activity data includes estimatives due to lack of data.

Fire Extinguishers (3.D.2), N_2O from Aerosol Cans (3.D.3) and Other Use of N_2O (3.D.4) Emissions from this category are not occurring.

Other (3.D.5)

Printing: Emissions from printing industry was estimated according with Tier 1 methodology from EMEP/CORINAIR Guidebook. $EMI_{NMVOC(y)} = EF_{(i)} * INK_{CONS(y)} \times 10^{-3}$ where $EMI_{NMVOC(y)}$ – NMVOC emissions resulting from printing activities during year y (t/yr); $Ink_{CONS(y)}$ – Use of printing ink during year y (t/yr); EF(i) – NMVOC emission factor (solvent content) for ink use (g/kg ink). The emission factor used for printing activities was obtained from EMEP/CORINAIR guidebook. The same emission factor was used for year 1990 to 2010. Consumption of inks in printing industry according to printing product is available from the INE's statistical database

Edible and non edible oil extraction Emissions of NMVOC were estimated considering that the annual hexane consumption by the industrial plant, hexane make-up, is due to losses to the air, and hence: $EMI_{NMVOC(y)} = MakeUp_{Solvents(y)}$ where: $EMI_{NMVOC(y)}$ - Emissions of NMVOC (ton/yr); $MakeUp_{Solvents(y)}$ - annual consumption of solvent in edible and non-edible oil industry, to replenish losses (ton/yr). The national emission factor for NMVOC was calculated as the ratio of the amount of solvents consumed during manufacture processes to the quantities of edible and non edible oil manufactured. However, from the available data from INE, this emission factor could be only estimated from IAIT industrial survey, i.e. from 1989 to 1991, because solvent consumption is not available from IAPI survey. Statistical information used in actual calculations of annual emission factor are presented in Table 5.52, together with the average emission factor in 1989- 1991, value that was used to estimate annual NMVOC emissions for the whole covered periodOil refining data was available from INE's industrial surveys: IAIT for 1990 and 1991 and IAPI thereafter until 2000.

Industrial application of glues and adhesives $NMVOC = Cons_{Nat} \times FE_{Nat} + Imp \times FE_{imp}$ where: NMVOC = Global emissions of NMVOC (ton); ConsNat = Domestic consumption of glues and adhesives produced in Portugal (ton) FE_{Nat} = Emission factor for glues and adhesives produced in Portugal (kg NMVOC/ton Ink) Imp = Imported glues and adhesives (ton) FE_{imp} = Emission factor associated with the use of imported glues and adhesives. $Cons_{Nat} = Prod_{Nat} - Exp$ where: $Cons_{Nat}$ = Consumed glues and adhesives produced in Portugal (ton) $Prod_{Nat}$ = National

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Portugal (NIR PT 2014)

production of glues and adhesives (ton) Exp = Exported glues and adhesives (ton). To estimate the emission factor applied for the use of national glues and adhesives, the ratio of the amount of solvents consumed during manufacture processes with the amount of glues and adhesives manufactured was computed, and an average emission factor obtained. The emission factor for VOC emission from the manufacture of glue and adhesives was subtracted from this value to obtain the emission factors for use of national produced glue and adhesives.

Wood Preservation $EMI_{NMVOC\ (y)}$ = Consumption(y) * $FE_{Consumption}$ where: $EMI_{NMVOC(y)}$ - Emissions of NMVOC associated to consumption of wood preservation products (ton) Consumption(y) - Consumption of wood preservation products (ton) $FE_{Consumption}$ - Emission factor associated to the consumption of wood preservation products. CORINAIR90 Emission Factor Handbook proposes three emission factors for VOC emission from wood preservation, depending on the type of product used. The emission factor is 100 kg/ton of product applied for creosote; 900 kg/ton for solvent based products and 0 for water based products. The available data do not discriminate the share of the several types of preservation products, therefore, it was assumed that the main product used in Portugal is creosote. Activity Data (Wood Preservation products Consumption) were obtained from National Statistics Institute (INE)

Domestic solvent use including fungicides This secotr addresses emissions from the use of solvent containing products by the public in their homes. This sector does not include the use of decorative paints which is covered by source category 3.A. Paint Application. MVOC's are used in a large number of products sold for use by the public. These include: - Cosmetics and toiletries; Products for the maintenance or improvement of personal appearance, health or hygiene. - Household products; Products used to maintain or improve the appearance of household durables. - Construction/Do-It-Yourself; Products used to improve the appearance or the structure of buildings such as adhesives and paint remover. - Car care products; Products used for improving the appearance of vehicles to maintain vehicles or winter products such as antifreeze. Pesticides such as garden herbicides and insecticides and household insecticide sprays may be considered as consumer products. Most agrochemicals, however, are produced for agricultural use and fall outside the scope of this section. Emission from this sector were calculated using a Tier 1 approach. This approach uses a single emission factor expressed on a person basis which was multiplied by the population to derive emissions from domestic solvent use. $NMVOC_i$ = Population i x EF_{NMVOC} where: $NMVOC_i$ - Emissions of NMVOC, Population i – inhabitants in year i; EF_{NMVOC} - Emission factor associated with the use of domestic products containing solvents [kg/person/year] Emission Factors Emission factor for NMVOC was obtained from EMEP/CORINAIR Guidebook, 2009. This default emission factor has been derived from an assessment of the emission factors presented in GAINS model developed by IIASA. Activity data were obtained from National Statistics Institute (INE).

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Luxembourg (NIR LU 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	no
Uncertainties:	CO_2 AD: 5.0% EF: 10.0% N_2O EMI: 20.0%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	No
Recalculation:	Yes		
Sector specific QA/QC and verification:		Source specific QA/QC procedures	

Methodology (CO_2 emissions):

As a first step the quantity of solvents used and the solvent emissions were calculated. To determine the quantity of solvents used, in Luxembourg, in the various applications, a bottom up and a top down approach were combined.

The top down approach provides total quantities of solvents used in Luxembourg. The share of solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. It was based on the economic structure in Luxembourg, applying solvent use and emission factors from the Austrian survey by linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained. This model has been developed for Austria (WINDSPERGER et al. 2002a, 2004) and was in the meantime applied for different European countries within the network "non-energy use of fossils and CO_2 emissions" (WINDSPERGER & STEINLECHNER, 2006). The application for Luxembourg is suitable as both countries show similar situation regarding economic and technical structure, and moreover as members of the EU similar legal framework conditions.

A study compiled for Austria (WINDSPERGER et al. 2002a) showed huge overestimation of NMVOC emissions when emission estimates are based on a top down approach only because a large amount of substances is used for "non-solvent-applications". "Non-solvent applications" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE/ETBE, formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE/ETBE which is used as fuel additive and finally combusted; these emissions are considered in the transport sector. Additionally, the comparison of the top-down and the bottom-up approaches helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, de-icing agents of aeroplanes, tourism, which were not considered in the top-down approach.

Top down Approach is based on:

1) import-export statistics on solvent substances and solvent containing products (foreign trade balance) (STATEC);

2) production statistics on solvents in Luxembourg;

3) a survey on non-solvent-applications in companies in Austria (Windsperger et al. 2004a);

4) survey on the solvent content in products and preparations at producers and retailers in Austria (Windsperger et al. 2002a).

ad (1) and (2): Total quantity of solvents used in Luxembourg were obtained from import-export statistics and production statistics provided by STATEC. Nearly a full top down investigation of substances of the import-export statistics from 1993 to 2008 was carried out (data 1990 – 1992 were interpolated). One problem is that the methodology of the import-export statistics changed over the years. In case of severe deviations between some years smoothing the time series with the mean values was used. In Luxembourg, there are only few facilities producing solvents. The production of solvents considerably decreased, especially in the last years.

ad (3): In a study on the comparison of top down and bottom up approach in Austria (WINDSPERGER et al. 2002a), the amount of solvents used in "non-solvent-applications" was identified. The most important companies in Austria were identified and asked to report the quantities of solvents they used over the considered time period in „non-solvent-applications". In combination with import-export statistic for these solvent substances the percentages of

„non-solvent-applications" were calculated. For Luxembourg, these percentages of "non-solvent-applications" were adapted to the country's specific situation according to information from companies in Luxembourg.

ad (4): Relevant producers and retailers provided data on solvent content in products and preparations in Austria. These data were also adapted to Luxembourg due to the country specific situation.

Bottom up Approach

In a first step, an extensive survey on the use of solvents in the year 2000 was carried out in 1 300 Austrian companies (WINDSPERGER et al. 2002b). In this extensive survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected.

Furthermore, information was gathered on:

1) type of application of the solvents:"final application", "cleaner" and "product preparation" as well as

2) actual type of waste gas treatment: "open application", "waste gas collection" and "waste gas treatment".

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000. The survey in 1 300 Austrian companies in the year 2000 was carried out at all industrial branches with solvent applications at NACE-level-4. Within these NACE-levels data on solvent use distinguished in substance categories was collected from the companies and a factor of "solvent use per employee" was calculated. For the calculation of the total amounts within the SNAP-digit (level 3) the number of employees in the respective NACE-levels in 2000 was used (WINDSPERGER et al. 2002b). In accordance with statistics in other European countries the structural business statistics (number of employees (NACE Rev.1.1)) were taken from Eurostat 2008. In a second step a survey in 1 800 households was made (WINDSPERGER et al. 2002a) for estimating the domestic solvent use (37 categories in 5 main groups: cosmetic, do-it-yourself, household cleaning, car, fauna and flora). Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated. The comparison of top down and bottom up approach helped to identify several additional applications that make an important contribution to the total amount of solvents used. Thus in a third step the quantities of solvents used in these applications such as windscreens wiper fluids, antifreeze, hospitals, de-icing agents of aeroplanes, tourism were estimated in surveys.

The outcome of these three steps was the total amount of solvents used for each application in the year 2000 (at SNAP level 3) in Austria (WINDSPERGER et al. 2002a).

To adapt the values for Luxembourg coefficients of the solvent consumption per employee (respective inhabitant) were used and applied to the employees of the industry sectors in Luxembourg (resp. Inhabitants). The outcome was the total amount of solvents for every application in the year 2000 in Luxembourg.

To achieve a time series, the development of the economic and technical situation in relation to the year 2000 was considered. It was distinguished between "general aspects" and "specific aspects". The information about these defined aspects were collected for two pillar years (1990 and 1995) and were taken from several studies (SCHMIDT et al. 1998, BARNERT 1998) and expert judgements from associations of industries (chemical industry, printing industry, paper industry) and other stakeholders. On the basis of this information calculation factors were estimated. With these factors and the data for solvent use and emission of 2000 data for the two pillar years was estimated. For the years in between, data was linearly interpolated. Since 2000, no new survey has been conducted so that the data remain constant since then.

Because of unavailability of data of employees in 1990 in the European database, the number of employees was taken out from 1995.

For the pillar year 2005 and 2010 country specific data are used to update the bottom-up approach:

· update by of emission factors, type of waste gas treatment and solvent content by using information from solvents balances reported under the Solvent Ordinance.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Luxembourg (NIR LU 2014)
· update of plant specific, information from associations of industries and statististiccal data for “general aspects” and “specific aspects” . **Combination Top-down – Bottom-up approach and updating** To verify and adjust the data, the solvents given in the top down approach and the results of the bottom up approach were differentiated in the pillar years (1995, 2000, 2003, 2005). The differences between the quantities of solvents from the top down approach and bottom up approach respectively are lower than 10%. As the data of the top down approach were obtained from national statistics, they are assumed to be more reliable than the data of the bottom up approach. That’s why the annual quantities of solvents used were taken from the top down approach while the share of the solvents for the different applications (on SNAP level 3) and the solvent emission factors have been calculated on the basis of the bottom up approach. Calculation of CO_2 emissions from Solvent Emissions The basis for the calculation of the carbon dioxide emissions were the quantities of solvent emissions differentiated by the 15 groups of substances (acetone, methanol, propanol, solvent naphtha, paraffins, alcohols, glycols, ester, aromates, ketones, aldehydes, amines, organic acids, cyclic hydrocarbons, and others). Substance specific carbon dioxide factors for these 15 substance groups have been created in Austria on the basis of the carbon content and the stoichiometrically formed CO_2. **N_2O emissions from Anaesthesia (3D1)** For the period 1990-2002, no data from the hospitals on the consumption of N_2O could be obtained. Hence, N_2O emissions from anaesthesia usage were estimated by combining reported emissions in Germany with the relative population in Luxembourg. From 2003 to 2010, the use of N_2O in hospitals for anaesthesia was directly obtained from the “Entente des hôpitaux luxembourgeois”. Thus, country-specific data was used. It was assumed that all the N_2O used for anaesthesia is completely released to the atmosphere.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Italy (NIR IT 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	Yes
Uncertainties:	CO_2: AD: 30%; EF: 50%; N_2O: AD: 50%; EF: 10%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned improvements:**	No
Recalculation:	Yes		
Sector specific QA/QC and verification:	For specific categories, emission factors and emissions are also shared with the relevant industrial associations; this is particularly the case of paint application for wood, some chemical processes and anaesthesia and aerosol cans. In addition, for paint application, data communicated from the industries in the framework of the EU Directive 2004/42, implemented by the Italian Legislative Decree 161/2006, on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products have been used as a verification of emission estimates. Additional verifications of the emissions from the sector occurred in 2012, on account of the bilateral independent review between Italy and Spain and the revision of national estimates and projections in the context of the National emission ceilings Directive for the EU Member States and the Gothenburg Protocol of the Convention on Long-Range		

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions	
Italy (NIR IT 2014)	
	Transboundary Air Pollution (CLRTAP).

Methodology (CO_2 emissions):

Emissions of NMVOC from solvent use have been estimated according to the methodology reported in the EMEP/CORINAIR guidebook, applying both national and international emission factors (Vetrella, 1994; EMEP/CORINAIR, 2007). Country specific emission factors provided by several accredited sources have been used extensively, together with data from the national EPER Registry; in particular, for paint application (Offredi, several years; FIAT, several years), solvent use in dry cleaning (ENEA/USLRMA, 1995), solvent use in textile finishing and in the tanning industries (TECHNE, 1998; Regione Toscana, 2001; Regione Campania, 2005; GIADA 2006). Basic information from industry on percentage reduction of solvent content in paints and other products has been applied to EMEP/CORINAIR emission factors in order to evaluate the reduction in emissions during the considered period. Emissions from domestic solvent use have been calculated using a detailed methodology, based on VOC content per type of consumer product.

As regards household and car care products, information on VOC content and activity data has been supplied by the Sectoral Association of the Italian Federation of the Chemical Industry (Assocasa, several years) and by the Italian Association of Aerosol Producers (AIA, several years [a] and [b]). As regards cosmetics and toiletries, basic data have been supplied by the Italian Association of Aerosol Producers too (AIA, several years [a] and [b]) and by the national Institute of Statistics and industrial associations (ISTAT, several years; UNIPRO, several years); emission factors time series have been reconstructed on the basis of the information provided by the European Commission (EC, 2002). The conversion of NMVOC emissions into CO_2 emissions has been carried out considering that carbon content is equal to 85% as indicated by the European Environmental Agency for the CORINAIR project (EEA, 1997), except for CO_2 emissions from the 3C sub-sector which are not calculated to avoid double-counting. These emissions are, in fact, already accounted for in sectors 1A2c and 2B.

Methodology, Activity data & Emission factor (N_2O emissions):

Emissions of N_2O have been estimated taking into account information available by industrial associations. Specifically, the manufacturers and distributors association of N_2O products has supplied data on the use of N_2O for anaesthesia from 1994 to 2011 (Assogastecnici, several years). For previous years, data have been estimated by the number of surgical beds published by national statistics (ISTAT, several years). Moreover, the Italian Association of Aerosol Producers (AIA, several years) has provided data on the annual production of aerosol cans. It is assumed that all N_2O used will eventually be released to the atmosphere, therefore the emission factor for anaesthesia is equal to 1 Mg N_2O/Mg product use, while the emission factor used for aerosol cans is 0.025 Mg N_2O/Mg product use, because the N_2O content in aerosol cans is assumed to be 2.5% on average (Co.Da.P., 2005).

For the estimation of N_2O emissions from explosives, data on the annual consumption of explosives have been obtained by a specific study on the sector (Folchi and Zordan, 2004); as stated in the document, this figure is believed to be constant for all the time series with a variation within a range of 30%. As for the emission factor, the estimated N_2O emissions represent the theoretically maximum emittable amount; in fact, no figures are available on the amount of N_2O emissions actually emitted upon detonations and the value of 3 400 Mg N_2O/Mg explosive use is provided by a German reference (Benndford, 1999) which corresponds to the assumption of 68 g N_2O per kg ammonium nitrate. N_2O emissions have been calculated multiplying activity data, total quantity of N_2O used for anaesthesia, total aerosol cans and explosives, by the related emission factors.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Spain (NIR ES 2014)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	No
Uncertainties:	AD: 50%; EF: 25%	**Completeness:**	**Yes**
Time series consistency:	Yes	**Planned**	Yes

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Spain (NIR ES 2014)			
Recalculation:	Yes	**improvements:**	
Sector specific QA/QC and verification:		Source specific QA/QC procedures.	

Methodology (CO_2 emissions):

For NMVOC the methodology for estimating the emissions is the EMEP/EEA, complemented by contributions and consultations of IIASA and EGTEI.

Some particularly relevant emission sources, information has been collected and processed at the individual plant level (case of automobile manufacturing plants). For the remaining emission sources, information on activity data which is relevant for the vast majority of the business associations, include the following: Asociación Española de Fabricantes de Pinturas y Tintas de Imprimir (ASEFAPI); Federación Empresarial de la Industria Química Española (FEIQUE); Confederación Española de Empresarios de Plástico (ANAIP); Asociación Técnica del Poliuretano Aplicado (ATEPA); Asociación Nacional de Poliestireno Expandido (ANAPE); Asociación de la Industria del Poliuretano Rígido (IPUR); Consorcio Nacional de Industriales del Caucho (COFACO); Asociación Nacional de Empresas para el Fomento de las Oleaginosas y su Extracción (AFOEX); Asociación Nacional de Empresas de Protección de la Madera (ANEPROMA). Also general statictics, as the publication of the National Statistics Institute (INE), la Encuesta Industrial (INE) or the publication "La Industria Química en España" of the Ministry of Industry, Energy and Tourism (MINETUR).

As for the emission factors, the methodology attempts to quantify the content of NMVOCs in solvents and other products containing these substances.

Where appropriate, the corresponding reduction factors are incorporated into the various application techniques and the resulting emissions abatement. In the case of paint application is particularly relevant to differentiate between different types of paint (water-based, solvent, etc.). To the extent that information is available on the change of these techniques over time, factors appear different for each year.

It should be noted that each plant ofcar factories has been treated individually, collecting information on quantities of concentrate and solvent used and its VOC content in the different phases of the process, lines painted productive and processes of recovery and disposal implanted in each center, so that the emission is estimated by mass balance.

Once the immediate NMVOCs emissions are determined, CO_2 conversion is done using the following algorithm: CO_2 emission = Emission NMVOC x 0.85 x 44/12; where 0.85 is the coefficient to pass to the mass of carbon mass NMVOCs, and 44/12 to express the mass of carbon in CO_2 mass.

Methodology, Activity data & Emission factor (N_2O emissions):

With regard to the use of N_2O it should be mentioned that in the Spanish inventory it has only been identified as an emitting source using this gas in anaesthesia, an activity that falls within the category 3D. Therefore all emissions that refer to N_2O are limited and therefore considered in the inventory to occur only in anaesthesia. Nitrous oxide which is characteristically lipsosoluble in water is transported in gaseous form in the blood to the nervous system where the state of unconsciousness or narcosis occurs. Like many other volatile anaesthetics, N_2O leaves the body without undergoing a transformation. For this reason N_2O emissions are considered to be equal to the gas consumption for this use. This consumption is calculated based on the information provided by the Ministry of Health, Social Services and Equality for the years 2000-2011, the consumption for the years 1990-1999 was estimated by extrapolation, using data as supplementary information supplied by one of the largest companies in the sector.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
France (NIR FR 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	Yes (TIER2)
Uncertainties:	AD: 20%; EF: 20%	**Completeness:**	Yes
Time series consistency:	Yes	**Planned improvements:**	Yes
Recalculation:	No		
Sector specific QA/QC and verification:		Generale QA/QC procedures.	

Methodology (CO_2 emissions):

The applied methodology is Tier 1, 2 or 3 for the sub-sectors. The CO_2 emissions resulting from the transformation of NMVOC is calculated by applying an average carbon content of 85%.

3.A. AD: Mix of top-down (using statistics of the sector) and bottom-up if plant specific information is available. EF: Estimated country specific. Recalculations result from plant specific emission factors if available for every instiallation.

3.B. AD: Estimation of total solvent consumption

EF: For metal degreasing directly reduced from NMVOC emissions. For the dry cleaning estimated on the base of industrial data.

3.C. AD: Use of consumption statistics at national level or bottom-up approach for the sectors.

EF: Specified at sectoral level. National values as default or plant specific value when available.

3.D. AD: consumption data are derived from national statistics or bottom-up following the sectors. EF: sector-specific, national values are default or plant specific.

Methodology, Activity data & Emission factor (N_2O emissions):

The emissions of N_2O result from the use of gas as aerosol propellant in food applications (wipped cream). The emissions are relatively stable during the inventory period (155 t in 1990 and 156 t in 2012). These emissions are calculated starting from the number of sales of whipped cream boxes with aerosols in France (data is estimated by the Comité de Francais des Aérosols) and the rate of N_2O included in the boxes (estimated at 6g N_2O/unit). The entire N_2O contained in boxes is assumed to be emitted to the atmosphere during the year of sale.

3.D. AD: Population; EF: Default value

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions			
Sweden (NIR SE 2013)			
GHG & pollutant:	CO_2, NMVOC, N_2O	**GHG Key Category:**	No
Uncertainties:	CO_2 3A - AD: 11%; EF: 15% 3B - AD: 15%; EF: 20% 3C - AD: 15%; EF: 20% 3D - AD: 14%; EF: 19% N_2O 3D - AD: 10%; EF: 10%	**Completeness:**	**Yes**
Time series consistency:	Yes except 2012	**Planned improvements:**	Yes
Recalculation:	yes		
Sector specific QA/QC and verification:		General QA/QC procedures.	

Methodology (CO_2 emissions):

3.A: All activity data from 1995 has been obtained from the Products register at the Swedish Chemicals Agency. Emissions from 1988 are taken from a time series that was compiled in a special study concerning NMVOC emissions, carried out by SMED in 2002. The emissions for 1990-1994 have been interpolated based on the information from the late 1980´s and known data for 1995.

3.B: All activity data from 1995 has been obtained from the Products Register at the Swedish Chemicals Agency. Emission data for 1988 is based on reported quantities of tetrachloroethylene from the Swedish Chemicals Agency. After 1995 also other substances for degreasing and dry cleaning are included. Of the total amount of NMVOC used within CRF 3B these “non tetrachloretylene” substances contribute approximately 30%. As not only tetrachloroethylene is included in the time series after 1995, the NMVOC emissions reported 1988 is recalculated using a correction factor based on the proportion of other NMVOCs of the total NMVOC for 1995 (tetrachloroethylene plus 30%). Emissions between 1990 and 1994 have been interpolated based on the information from the late 1980´s and known data for 1995. The solvents used within CRF 3B includes a lower carbon share compared to the solvents used in the other sub-codes within CRF 3.

3.C: The category includes emissions from car manufacturing, paint industry and from rubber industry. Emissions from car manufacturing contributed in 2005 by approximately 50%, paint industry by 35 % and rubber industry by 15% of the reported emissions in CRF 3C. The corresponding figures for 2012 are 30%, 43% and 27%, respectively. Emission data for car manufacturing has been compiled from environmental reports for 1990 and data for 1991-1994 has been interpolated. For paint industry emission data for 1990-1994 has been taken from the old time series given in a special study concerning NMVOC emissions, carried out by SMED in 2002133. Emission data for the rubber industry is known for 1988133 and data for 1990-1994 have been interpolated based on the information from the late 1980´s and known data for 1995.

3.D : Solvents used in printing industry, for preservation of wood, in leather industry and in textile industry have been estimated separately. The code also includes solvents used by other industries not reported separately, and also solvents for domestic use. The printing industry contributes to totally reported CO_2 and NMVOC in CRF 3.D by around 8 %. The corresponding figure for preservation of wood and leather and textile industry is below 1%, while general solvent use represents over 90% of the total reported emissions in CRF 3D. Emission data for 1988 is known for most industries included in CRF 3D and in most cases the emissions for 1990-1994 have been interpolated based on information from the late 1980´s and known data for 1995. CO_2 emissions for 1990 - 1994 have been estimated using the ratio NMVOC/CO_2 for 1995 according to the Good Practice Guidance overlap method. For the years before 1996 no activity data is available.

Methodology, Activity data & Emission factor (N_2O emissions):

There are two companies in Sweden selling N_2O in gas cylinders. Information on sold amounts was obtained from one of the companies (1990 - 1991) and from the Products Register at the Swedish Chemicals Agency (1992 - 2011). The time series of use of N_2O in Sweden are reported in Other use of N_2O (3.D.4) since no background data is available to separate between the source categories Use of N_2O for Anaesthesia (3.D.1) and N_2O from Aerosol cans (3.D.3). Consequently CRF codes 3.D.1 and 3.D.3 are both reported as IE.

5.3 Sector-specific quality assurance and quality control (EU-15)

It is the second time time that sector specific quality assurance and quality control was implemented for the sector Solvents and other product use. Before and during the compilation of the EU GHG inventory, Member States data was checked. The checks focused on completeness (including the use of the notation keys “NE”, “NO” and “NA”), time series consistency and plausibilty of emission data, comparison of data across Member States and checks of internal consistency. The findings were communicated to Member States. It is planned to extend this procedure in the next years.

5.4 Sector-specific recalculations (EU-15)

Table 5.8 shows that in the solvent sector recalculations were made for CO_2 and N_2O.

Table 5.8 Sector 3 Solvent and Other Product Use: Recalculations of total GHG emissions and recalculations of GHG emission for 1990 and 2011 by gas (GgCO_2-equivalents and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
		percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-2 695	-0.1%	5 153	1.2%	2 343	0.6%	-50	-0.2%	-54	-0.3%	212	2.0%
Solvent and other product use	-4	0.0%	0	0.0%	33	0.7%	NO	NO	NO	NO	NO	NO
2011												
Total emissions and removals	-11 579	-0.4%	8 425	2.9%	5 586	2.1%	-441	-0.6%	-233	-6.7%	-78	-1.3%
Solvent and other product use	-29	-0.5%	0	0.0%	0	0.0%	NO	NO	NO	NO	NO	NO

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Table 5.9 provides an overview of Member States’ contributions to EU-15 recalculations:

- Spain provided recalculations of CO_2 emissions for 1990;
- No MS provided recalculations of N_2O emissions for 1990;
- Denmark, France, Germany, Italy, Luxembourg, Portugal, Spain and Sweden provided recalculations of CO_2 emissions for 2011.
- No Belgium provided recalculations of N_2O emissions for 2011.

Table 5.9 Sector 3 Solvent and Other Product Use: Contribution of Member States to EU-15 recalculations for 1990 and 2011 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2011					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0.000	0	0	NO	NO	NO	0.03	0	0	NO	NO	NO
Belgium	NA	0	-9	NO	NO	NO	NA	0	0	NO	NO	NO
Denmark	0	0	0.02	NO	NO	NO	1	0	0	NO	NO	NO
Finland	-0.4	0	0	NO	NO	NO	-0.3	0	0	NO	NO	NO
France	-0.04	0	48	NO	NO	NO	-6	0	0	NO	NO	NO
Germany	0	0	0	NO	NO	NO	-23	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO	-0.4	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO	-8	0	0	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	-1	0	0	NO	NO	NO
Netherlands	0	0	6	NO	NO	NO	0	0	0	NO	NO	NO
Portugal	0	0	-12	NO	NO	NO	-21	0	0	NO	NO	NO
Spain	-4	0	0	NO	NO	NO	-10	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	41	0	0	NO	NO	NO
UK	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
EU-15	**-4**	**0**	**33**	**NO**	**NO**	**NO**	**-29**	**0**	**0**	**NO**	**NO**	**NO**

5.5 Responses of EU-15 Member States to UNFCCC Reviews for findings in the Sector Solvents and other Product Use

Table 5.10 provides an overview of EU-15 member state's responses to the UNFCCC Review findings in the sector Solvents and other product use. The choice was based on the date when the ARRs were published.

Table 5.10 EU-15 member State's responses to UNFCCC review findings for Solvents

Gas	Member State	UNFCCC review findings for the 2012/2013 submission	MS response
-	Austria	No review finding	-
N_2O	Belgium	ARR 2012 § 81: Although N_2O emissions are reported for the use of N_2O for anaesthesia (213.97 Gg CO_2 eq in 2010), the AD and IEF for this category have been reported as "NE". In response to a question raised by the ERT during the review, Belgium indicated that the number of hospital beds in Belgium was used as the AD. The ERT recommends that the Party replace the notation key "NE" with the AD on the number of hospital beds in Belgium in the next annual submission.	New activity data (number of beds obtained from the Health Public Federal Service) has been taken into account in the Walloon region for the complete timeseries to estimate the emissions of N_2O from anesthesia (category 3D2).
-	Denmar k	No review finding	-
CO_2	Finland	50. Non-methane volatile organic compound (NMVOC) emissions from other (fat, edible and non-edible oil extraction) are used to estimate indirect CO_2 emissions. The ERT noted that the NIR includes a detailed methodology description, including that NMVOC/CO_2 emissions from this category arise from biomass. The CRF tables do not facilitate distinguishing between CO_2 emissions from biomass and fossil components under the category total solvent and other product use. This approach slightly overestimates national total CO_2 emissions, as CO_2 emissions from biomass are accounted for under fossil CO_2 emissions. The ERT recommends that Finland develop a way of reporting indirect CO_2 emissions which will allow CO_2 emissions from biomass to be distinguished from those from the fossil component and use this in the CRF tables of its annual submission, and provide an appropriate methodology and process description in its NIR.	It is not possible to develop on a system which would identify CO_2 emissions between fossil and biological. These separations must be done case by case.
-	France	No review finding	-
NMV OC, CO_2	German y	ARR 2012 § 75: The ERT commends Germany for reporting indirect CO_2 emissions for this category. The ERT noted that the Party has changed the EF for converting NMVOCs to CO_2 from 75 per cent carbon in NMVOCs to 60 per cent carbon, without justifying that the recalculation reflects its national conditions. Even though this is a minor issue, the ERT considers that it is not good practice to change from one EF to a new and lower one without justifying the change. The ERT therefore encourages the Party to justify in its next NIR that the new EF better reflects the NMVOC species in Germany. ARR 2013 § 40: The notation key "IE" (included elsewhere) is used in the industrial processes sector to report CO_2 emissions from limestone and dolomite use and from ceramic production (a country-specific subcategory under other (mineral products)), CO_2 and CH_4 from pig iron, coke and sinter, and N_2O from medical use (country-specific subcategory under other (chemical industry)). In the solvent and other product use sector, emissions from aerosol cans are reported as "IE". The Party has explained under which categories the emissions are reported, but the ERT encourages the Party to decrease the number of instances where the notation key "IE" is used.	- In NIR chapter 5.2.2 it is explained that Germany wants to use the same method as the EU for the conversion of NMVOC emissions to CO_2 emissions and because of this Germany uses the default factor of the IPCC GL 2006. No recalculations are required.
-	Greece	No review finding	-
-	Ireland	No review finding	-

Gas	Member State	UNFCCC review findings for the 2012/2013 submission	MS response
-	Italy	No review finding	-
CO_2 N_2O	Luxem-bourg	ARR 2010, § 52 Solvent and other product use - CO_2: Luxembourg bases its CO_2 emission estimates for this category on AD from Luxembourg using an implied CO_2 EF from Austria. The ERT reiterates the recommendation from the previous review that Luxembourg enhance the accuracy of these estimates by using country-specific data. ARR 2013, §44: N_2O emissions from anaesthesia have been estimated for the period 1990–2002 by combining emissions data from Germany with the relative population in Luxembourg. For the period 2003–2011, emissions have been estimated using country-specific data collected from hospitals in Luxembourg. In response to questions raised by the ERT during the review regarding Luxembourg's efforts to ensure time-series consistency, the Party responded that it is currently reviewing whether statistical data on the number of surgical operations for the period 1990–2012 are available, and whether a correlation between these data and the use of N_2O in anaesthesia could be found. If successful, then an extrapolation based on surgical operations could be implemented, otherwise an extrapolation based on population would continue to be required. The ERT welcomes the efforts by Luxembourg and reiterates the recommendation made in the previous review report that the Party strive to develop country-specific background data to estimate emissions, and provide transparent background data (whether country-specific or based on another Party) in the NIR. Further, the ERT reiterates the recommendation made in the previous review report that the Party ensure time-series consistency either by using data-specific techniques from the IPCC good practice guidance or by collecting country-specific data for the entire time series.	3 (CO_2): update of data of the top-down apporoach: production statistics, import and export statistics data of the bottom-up upproach: update by of emission factors, type of waste gas treatment and solvent content by using information from solvents balances reported under the Solvent Ordinance. update of plant specific, information from associations of industries and statistical data for "general aspects" and "specific aspects" . 3D1: 2003-2011: revised activity data provided by Luxembourg's hospital federation, now covering all hospitals was incorporated which resulted in a slight increase of emissions compared to the previous submission. The transparency was also increased by adding more detailed explanations on background data in the NIR.
-	Netherla nds	No review finding	-
-	Portugal	No review finding	-
-	Spain	No review finding	-
-	Sweden	Recommendation: Explanation of the reasons for the IE for 3D4 need to be modified in the NIR.	See NIR sections 5.5.1 and 5.5.2. Due to confidentiality (confimed by the Swedish Chemicals Agency), data for 3.D.1 – Use of N_2O for Anaesthesia and 3.D.3 – N_2O from Aerosol cans cannot be reported separately.
-	United Kingdom	No review finding	-

6 AGRICULTURE (CRF SECTOR 4)

Half the European Union's land is farmed. This fact alone highlights the importance of farming for the EU's natural environment. Farming and nature exercise a profound influence over each other. Farming has contributed over the centuries to creating and maintaining a variety of valuable semi-natural habitats. Today these shape the majority of the EU's landscapes and are home to many of the EU's richest wildlife. Farming also supports a diverse rural community that is not only a fundamental asset of European culture, but also plays an essential role in maintaining the environment in a healthy state[40].

The links between the richness of the natural environment and farming practices are complex. While many valuable habitats in Europe are maintained by extensive farming, and a wide range of wild species rely on this for their survival, agricultural practices can also have an adverse impact on natural resources. Pollution of soil, water and air, fragmentation of habitats and loss of wildlife can be the result of inappropriate agricultural practices and land use.

Agriculture in Europe is determined by the Common Agricultural Policy (CAP) of the European Union. The CAP dates from 1957, and its foundations are entrenched in the Treaty of Rome. Initially, the emphasis of the CAP was to increase agricultural productivity, partly for food security reasons, but also to ensure that the EU had a viable agricultural sector and that consumers had a stable supply of affordable food (Gay et al., 2005). With the MacSharry reform of 1992 several steps were taken by the EU to shift CAP subsidies away from price and market support towards direct support for farmers. This was further pursued with the Agenda 2000 reform, as signified by the shift in focus towards the maintenance and enhancement of the rural environment and the growing recognition of agriculture as a multifunctional activity. In environmental terms, the focus is on

- less-favoured areas and areas with environmental restrictions, and
- on agricultural production methods designed to protect the environment and to maintain the countryside.

However price support and income payments, together with milk quotas, remained the dominant support measures. The 2003 CAP reform made further progress in the direction initiated by the Agenda 2000 reform, by aiming to make European agriculture more market oriented and giving a stronger focus to environmental protection. With the CAP reform, cross-compliance became an obligatory element of the CAP. Cross-compliance establishes a link between the granting of income support to the farmers and the compliance by the beneficiary with specified requirements of public interest (Oenema, 2008). These are given in

- “Statutory management requirements” (SMR, (Annex III of Regulation (EC) No 1782/2003) which are set in 19 community legislative acts on environment, food safety, animal health and welfare, as well as
- the obligation to maintaining land in good agricultural and environmental conditions (GAECs) and maintaining permanent pasture at level at 1.5.2004. Definitions of GAEC are specified at national or regional level and should warrant appropriate soil protection, ensure a minimum level of maintenance of soil organic matter and soil structure and avoid the deterioration of habitats.

In 2013, the Council of the EU Agriculture Ministers adopted four Basic Regulations for a reformed CAP following a CAP Health Check[41] in 2008 and a Commission Communication on the CAP towards 2020[42] in 2011. The four legislative texts that regulate the post-2013 CAP are:

- **Rural Development**: Regulation 1305/2013 [43]

[40] http://ec.europa.eu/agriculture/envir/index_en.htm

[41] http://ec.europa.eu/agriculture/healthcheck/index_en.htm

[42] http://ec.europa.eu/agriculture/cap-post-2013/communication/index_en.htm

- **"Horizontal" issues** such as funding and controls: **Regulation 1306/2013** [44]
- **Direct payments** for farmers: **Regulation 1307/2013** [45]
- **Market measures**: **Regulation 1308/2013** [46]

The *Nitrates Directive* (Council Directive 91/676/EEC) is the SMR with the largest impact on greenhouse gas emissions from agriculture. The directive aims at reducing and preventing water pollution caused by nitrates from agricultural sources with the goal that nitrate concentrations in groundwater will not exceed 50 mg NO3 L^{-1} and listing codes of good practice (Annex II A) to be implemented by the farmers on a voluntary basis. Nitrate vulnerable zones must be designated on the basis of monitoring results which indicate that the groundwater and surface waters in these zones are or could be affected by nitrate pollution from agriculture. The action program must contain mandatory measures relating to: (i) periods when application of animal manure and fertilisers is prohibited; (ii) capacity of and facilities for storage of animal manure; and (iii) limits to the amounts of animal manure and fertilisers applied to land.

This has affected emissions in most countries, for example in Belgium, manure Action Plans (based on the Nitrate directive) in Flanders affected NH_3 volatilization from manure application. The first action plan in 1991 regulated the reduced in which manure can be spread and foresees low-emission techniques for the application of manure on land. The MAP2bis in 2000 focuses on the reduction of the manure surplus and manure processing in order to reduce the NH_3 emissions from manure application on land. Other MAP's followed.

In Denmark, the environmental policy has introduced a series of measures to prevent loss of nitrogen from agricultural soils to the aquatic environment. The measures include improvements to the utilisation of nitrogen in manure, a ban on manure application during autumn and winter, increasing area with winter-green fields to catch nitrogen, a maximum number of animals per hectare and maximum nitrogen application rates for agricultural crops. All farmers are obliged to do N-mineral accounting at farm and field level with the N-excretion data from FAS (Faculty of Agricultural Sciences). The N figures also include the quantities of mineral fertilisers bought and sold. Suppliers of mineral fertilisers are required to report all N sales to commercial farmers to the Plant Directorate. An active environmental policy has brought about a decrease in the N-excretion and a decrease of emission per produced animal, because of more efficient feeding. As a result of increasing requirements to reduce the nitrogen loss to the environment, the consumption of nitrogen in synthetic fertiliser has more than halved from 1990 to 2007.

In the Netherlands, manure and fertiliser policy influences livestock numbers. Especially young cattle, pigs and poultry numbers decreased by the introduction of measures like buying up part of the so-called pig and poultry production rights (ceilings for total animal numbers) by the government and lowering the maximum nutrient application standards for manure and fertiliser.

However, greater compliance to standards and requirements for animal welfare and the housing of animals may contribute to increasing emissions (so-called pollution swapping).

Beside the environmentally-targeted directives, also the so-called first pillar of the CAP (dealing with market support in contrast to pillar two covering rural development measures) had a strong impact on the greenhouse gas emissions from agriculture in Europe, namely through the milk quota system, which lead to a strong reduction of animal numbers in the dairy sector to compensate for the increasing animal performance during the last decades.

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[43] **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:en:PDF**

[44] **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0549:0607:en:PDF**

[45] **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0608:0670:en:PDF**

[46] **http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0671:0854:en:PDF**

Other important policies affecting greenhouse gas emissions from agriculture, particularly by addressing the abatement of air pollution through the control of NO_X and NH_3 emissions include, under others,

- the 1999 *Gothenburg Protocol* under the *Convention on Long Range Transboundary Air Pollution (CLRTAP*[47]*)* to 'Abate Acidification, Eutrophication and Ground-level Ozone', which entered into force on 22 June 2006;
- the National Emission Ceilings Directive (NEC - Directive 2001/81/EC[48]), which sets upper limits for each Member State for the total emissions in 2010 of the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution;
- the *Integrated Pollution Prevention and Control* (IPPC) Directive (Directive 2008/1/EC[49]), which was established in 1996, and aims at minimizing pollution from point sources, i. e., intensive animal production facilities (pig and poultry farms, with > 2 000 fattening pigs; more than750 sows or more than 40,000 head of poultry). These are required under the directive to apply control techniques for preventing NH_3 emissions according to Best Available Technology (BAT).

Structural changes are caused also by the general development of countries. For example, in Finland, the membership in the EU resulted in changes in the economic structure followed by an increase in the average farm size and a decrease in the number of small farms (Pipatti 2001), causing also a decrease in the livestock numbers for most animal types. Swedish agriculture has undergone radical structural changes and rationalisations over the past 50 years. One fifth of the Swedish arable land cultivated in the 1950s is no longer farmed. Closures have mainly affected smallholdings and those remaining are growing larger. In 1999, some 31,000 agricultural holdings were livestock farms, 14,000 were purely crop husbandry farms, and only 5,000 were a combination of the two. Livestock farmers predominately engage in milk production and the main crops grown in Sweden are grain and fodder crops. The decrease of agricultural land area has continued since Sweden joined the European Union in 1995 and the acreages of land for hay and silage has increased. Organic farming increased from 3% of the arable land area in 1995 to 17% in 2007.

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[47] http://www.unece.org/env/lrtap/multi_h1.html

[48] http://ec.europa.eu/environment/air/pollutants/ceilings.htm

[49] http://ec.europa.eu/environment/air/pollutants/stationary/ippc/summary.htm

6.1 Overview over the sector

Figure 6.1 *EU-15 GHG emissions for 1990–2012 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg)*

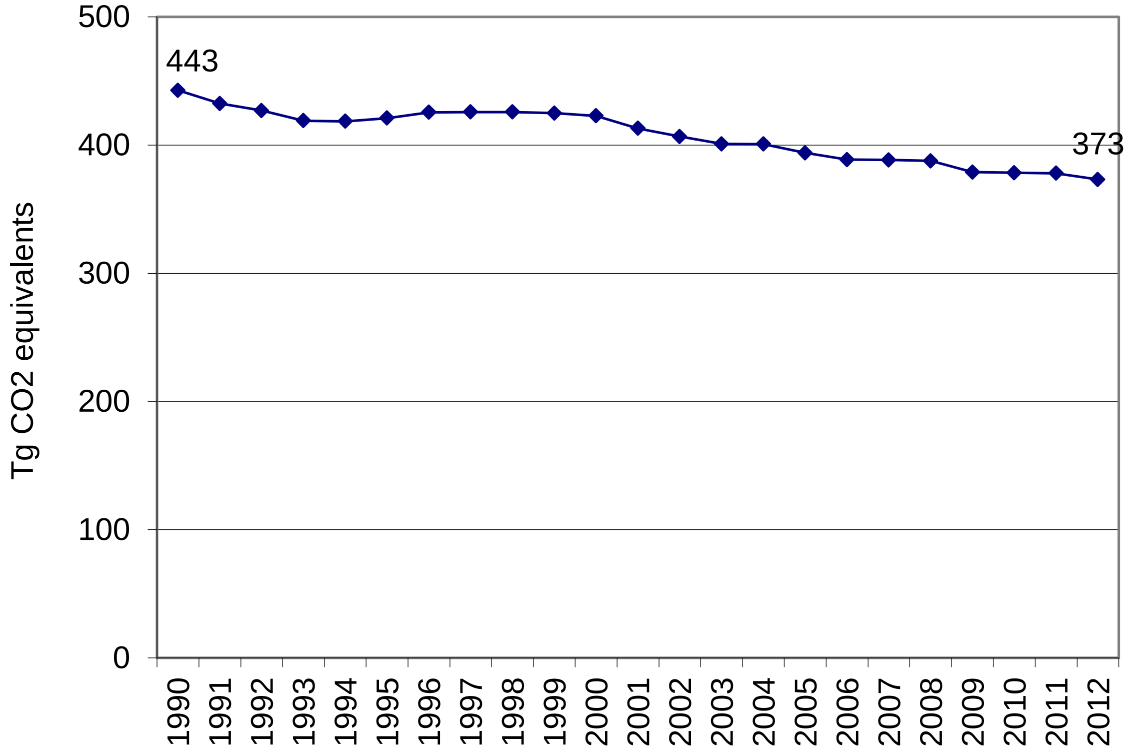
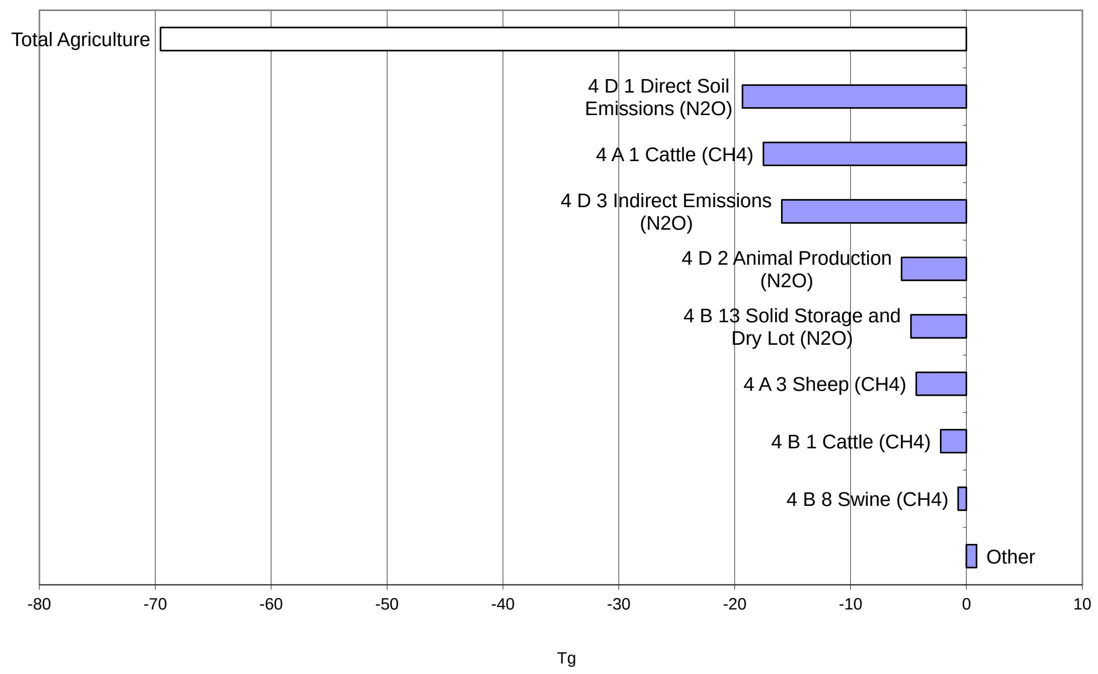
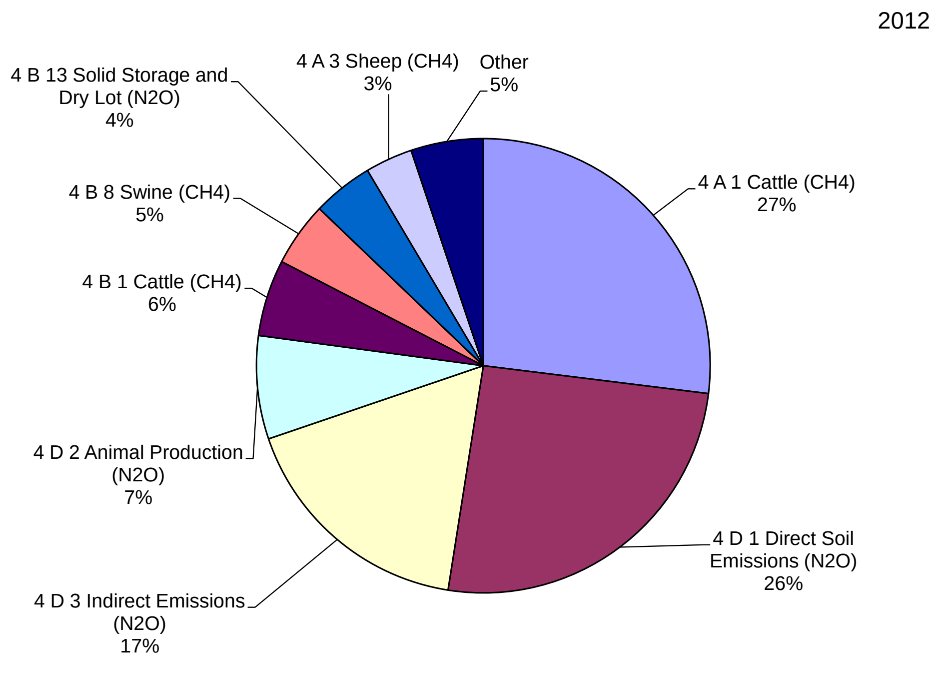


Figure 6.2 shows that large reductions occurred in the largest key sources N_2O from 4.D.1: 'Direct soil emissions', 4.D.3: 'Indirect emissions' and CH_4 from 4.A.1: 'Cattle'. The main reasons for this are decreasing use of fertiliser and manure and declining cattle numbers in most Member States.

Figure 6.2 *Absolute change of GHG emissions by large key source categories 1990–2012 in CO_2 equivalents (Tg) in CRF Sector 4: 'Agriculture' and share of largest key source categories in 2012*





6.2 Source Categories

6.2.1 Enteric fermentation (CRF Source Category 4A) (EU-15)

Table 6.1 shows total GHG and CH_4 emissions by Member State from 4A Enteric Fermentation. Between 1990 and 2012, CH_4 emission from 4A Enteric fermentation decreased by 15 %. The decrease was largest in Germany.

Table 6.1 4A Enteric Fermentation: Member States' contributions to total GHG and CH_4 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)
Austria	3 753	3 193	3 753	3 193
Belgium	4 232	3 561	4 232	3 561
Denmark	3 247	2 904	3 247	2 904
Finland	1 832	1 544	1 832	1 544
France	30 741	28 201	30 741	28 201
Germany	29 594	20 833	29 594	20 833
Greece	3 130	3 123	3 130	3 123
Ireland	9 574	8 811	9 574	8 811
Italy	12 278	10 667	12 278	10 667
Luxembourg	261	239	261	239
Netherlands	7 648	6 555	7 648	6 555
Portugal	2 729	2 727	2 729	2 727
Spain	11 120	10 260	11 120	10 260
Sweden	2 951	2 540	2 951	2 540
United Kingdom	18 775	15 464	18 775	15 464
EU-15	**141 867**	**120 622**	**141 867**	**120 622**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from cattle is the largest single source of CH_4 emissions in the EU-15 accounting for 3 % of total GHG emissions in 2012. Between 1990 and 2012, CH_4 emissions from enteric fermentation from cattle declined by 15 % in the EU-15 (Table 6.2).). In 2012, the emissions decreased by 0.1% compared to 2012. The main driving force of CH_4 emissions from enteric fermentation is the number of cattle, which was 18 % below 1990 levels in 2012. The Member States with most emissions from this source were France and Germany (together 45 %). All Member States except Spain, Portugal and Greece reduced CH_4 emissions from enteric fermentation of cattle between 1990 and 2012.

Table 6.2 4A1 Cattle: Member States' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	3 551	3 007	2 985	3%	-22	-1%	-566	-16%
Belgium	3 980	3 370	3 308	3%	-62	-2%	-672	-17%
Denmark	2 929	2 428	2 508	2%	80	3%	-421	-14%
Finland	1 025	779	775	1%	-4	0%	-250	-24%
France	27 771	25 861	25 682	26%	-179	-1%	-2 089	-8%
Germany	28 266	19 834	19 795	20%	-39	-0.2%	-8 472	-30%
Greece	806	846	846	1%	-0.1	-0.01%	40	5%
Ireland	8 485	7 811	8 120	8%	308	4%	-365	-4%
Italy	10 138	8 355	8 450	8%	95	1%	-1 688	-17%
Luxembourg	257	237	233	0.2%	-5	-2%	-24	-9%
Netherlands	6 777	5 762	5 789	6%	27	0.5%	-988	-15%
Portugal	1 876	2 171	2 169	2%	-1	-0.1%	294	16%
Spain	6 026	6 405	6 256	6%	-149	-2%	231	4%
Sweden	2 578	2 184	2 149	2%	-34	-2%	-429	-17%
United Kingdom	13 640	11 627	11 527	11%	-100	-1%	-2 114	-15%
EU-15	**118 105**	**100 676**	**100 591**	**100%**	**-85**	**0%**	**-17 514**	**-15%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from sheep is the forth largest single source of CH_4 emissions in the EU-15 and accounts for 0.3 % of total GHG emissions in 2012. Between 1990 and 2012, CH_4 emissions from enteric fermentation of sheep declined by 26 % in the EU-15 (Table 6.3). In 2012, the emissions were 2 % lower compared to 2012. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 27 % below 1990 levels in 2012. The Member States with most emissions from this source were Spain and the United Kingdom (51%). Most Member States reduced CH_4 emissions from enteric fermentation of sheep.

Table 6.3 4A3 Sheep: Member States' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	52	61	61	0.5%	1	1%	9	18%
Belgium	32	17	18	0.1%	1	8%	-14	-45%
Denmark	33	34	33	0.3%	-1	-3%	-1	-2%
Finland	15	23	23	0.2%	0	1%	8	55%
France	2 200	1 700	1 667	13%	-33	-2%	-532	-24%
Germany	549	279	276	2%	-3	-1%	-273	-50%
Greece	1 662	1 684	1 682	13%	-2	0%	20	1%
Ireland	1 032	571	612	5%	41	7%	-420	-41%
Italy	1 468	1 334	1 179	9%	-156	-12%	-290	-20%
Luxembourg	1	2	1	0.01%	-0.1	-8%	0.2	13%
Netherlands	286	183	175	1%	-8	-4%	-111	-39%
Portugal	582	411	394	3%	-18	-4%	-188	-32%
Spain	4 269	3 109	2 965	24%	-144	-5%	-1 305	-31%
Sweden	68	105	103	1%	-2	-2%	34	50%
United Kingdom	4 662	3 322	3 393	27%	71	2%	-1 269	-27%
EU-15	**16 912**	**12 833**	**12 582**	**100%**	**-251**	**-2%**	**-4 331**	**-26%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.2 Manure management (CRF Source Category 4B) (EU-15)

Table 6.4 shows total GHG, CH_4 and N_2O emissions by Member State from 4B Manure Management. Between 1990 and 2012, CH_4 and N_2O emissions from 4B Manure Management decreased by 7 % and 17 % respectively.

Table 6.4 4B Manure Management: Member States' contributions to total GHG emissions, CH_4 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N2O emissions in 2012 (Gg CO2 equivalents)
Austria	1 365	1 242	431	324	934	917
Belgium	2 400	2 167	1 438	1 401	962	766
Denmark	1 585	1 688	985	1 297	600	391
Finland	689	666	203	251	487	416
France	14 977	15 082	8 485	10 110	6 492	4 972
Germany	10 534	7 742	6 648	4 954	3 887	2 788
Greece	964	993	423	399	541	594
Ireland	2 789	2 702	2 354	2 238	435	464
Italy	7 401	5 446	3 467	1 704	3 934	3 742
Luxembourg	120	122	79	89	41	32
Netherlands	4 235	3 635	3 053	2 628	1 183	1 007
Portugal	1 707	1 329	1 180	1 036	527	293
Spain	6 517	8 462	5 172	6 941	1 345	1 521
Sweden	982	755	249	313	733	442
United Kingdom	12 302	9 259	8 956	6 599	3 346	2 660
EU-15	**68 567**	**61 291**	**43 121**	**40 286**	**25 446**	**21 005**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B1 Cattle account for 1 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CH_4 emissions from this source decreased by 10 % (Table 6.5). The UK and France are responsible for 49 % of the total EU-15 emissions from this source. Eight Member States had reductions between 1990 and 2012. In absolute terms, Germany, the UK and Italy had the most significant decreases from this source.

Table 6.5 4B1 Cattle: Member States' contributions to CH_4 emissions

Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	(%)
Austria	283	227	224	1%	-3	-1%	-59	-21%
Belgium	350	292	288	1%	-4	-1%	-62	-18%
Denmark	511	593	611	3%	18	3%	100	20%
Finland	72	91	91	0.4%	-0.4	-0.5%	18	25%
France	4 688	5 869	5 822	29%	-47	-1%	1 134	24%
Germany	4 505	3 217	3 173	16%	-45	-1%	-1 332	-30%
Greece	48	46	46	0.2%	0	-1%	-3	-5%
Ireland	1 888	1 585	1 665	8%	80	5%	-223	-12%
Italy	1 636	708	536	3%	-172	-24%	-1 101	-67%
Luxembourg	47	53	52	0.3%	-1	-2%	5	10%
Netherlands	1 593	1 795	1 803	9%	8	0.5%	210	13%
Portugal	43	65	65	0.3%	0.01	0.01%	22	52%
Spain	1 715	1 582	1 557	8%	-25	-2%	-157	-9%
Sweden	150	226	223	1%	-3	-1%	73	49%
United Kingdom	5 019	4 218	4 181	21%	-36	-1%	-838	-17%
EU-15	**22 549**	**20 566**	**20 335**	**100%**	**-231**	**-1%**	**-2 214**	**-10%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B8 Swine account for 0.5 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CH_4 emissions from this source decreased by 1 % (Table 6.6). France and Spain are responsible for 53 % of the total EU-15 emissions from this source. In absolute terms, Spain had the most significant increases from this source.

Table 6.6 4B8 Swine: Member States' contributions to CH_4 emissions

Member State	CH4 emissions Gg CO2 equiv.			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	123	75	73	0.4%	-1	-2%	-49	-40%
Belgium	1 065	1 074	1 081	6%	7	1%	16	1%
Denmark	423	629	596	3%	-33	-5%	173	41%
Finland	IE	IE	IE	-	-	-	-	-
France	3 291	3 793	3 735	22%	-58	-2%	444	14%
Germany	2 024	1 597	1 644	10%	47	3%	-380	-19%
Greece	146	128	127	1%	-1	0%	-19	-13%
Ireland	332	414	409	2%	-5	-1%	77	23%
Italy	1 432	896	670	4%	-226	-25%	-762	-53%
Luxembourg	31	37	37	0.2%	0.4	1%	6	19%
Netherlands	1 154	770	757	4%	-13	-2%	-397	-34%
Portugal	1 088	854	860	5%	6	1%	-228	-21%
Spain	3 264	4 851	5 222	31%	371	8%	1 958	60%
Sweden	64	51	47	0.3%	-3	-7%	-17	-26%
United Kingdom	3 322	1 772	1 790	11%	18	1%	-1 531	-46%
EU-15	**17 758**	**16 940**	**17 048**	**100%**	**108**	**1%**	**-710**	**-4%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B13 Solid Storage and Dry Lot account for 0.4 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source decreased by 23 % (Table 6.7).

Italy and France are responsible for 50 % of the total EU-15 emissions from this source.All counties but Greece and Ireland decreased their emissions between 1990 - 2012. In absolute terms, France had the most significant decrease from this source.

Table 6.7 4B13 Solid Storage and Dry Lot: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	750	683	679	4%	-3	-1%	-71	-9%
Belgium	894	713	707	4%	-5	-1%	-187	-21%
Denmark	314	76	70	0.4%	-6	-7%	-244	-78%
Finland	420	327	322	2%	-5	-1%	-97	-23%
France	6 329	4 801	4 767	30%	-34	-1%	-1 562	-25%
Germany	2 492	1 649	1 643	10%	-5	-0.3%	-849	-34%
Greece	533	586	586	4%	1	0.1%	54	10%
Ireland	371	377	399	2%	22	6%	27	7%
Italy	3 741	3 255	3 346	21%	90	3%	-395	-11%
Luxembourg	40	31	30	0.2%	-1	-3%	-9	-24%
Netherlands	947	891	851	5%	-41	-5%	-96	-10%
Portugal	509	276	273	2%	-3	-1%	-236	-46%
Spain	348	315	297	2%	-18	-6%	-51	-15%
Sweden	654	313	310	2%	-3	-1%	-344	-53%
United Kingdom	2 581	1 852	1 849	11%	-3	-0.1%	-732	-28%
EU-15	**20 923**	**16 143**	**16 129**	**100%**	**-14**	**0%**	**-4 794**	**-23%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B14 Other account for 0.1 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source increased by 32 % (Table 6.8). Spain and the UK are responsible for 68 % of the total EU-15 emissions from this source.

Table 6.8 4B14 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	151	214	212	7%	-2	-1%	61	40%
Belgium	57	49	49	2%	-0.04	-0.1%	-8	-15%
Denmark	192	250	244	8%	-5	-2%	52	27%
Finland	55	73	75	3%	3	4%	20	36%
France	NA	NA	NA	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	NA	NA	NA	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	304	244	8%	-60	-20%	244	-
Luxembourg	0.02	0.29	0.28	0.01%	-0.01	-2%	0.3	1056%
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	997	1 338	1 223	42%	-115	-9%	227	23%
Sweden	64	110	108	4%	-1	-1%	44	70%
United Kingdom	685	762	747	26%	-15	-2%	62	9%
EU-15	**2 201**	**3 098**	**2 902**	**100%**	**-196**	**-6%**	**702**	**32%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.3 Agricultural soils (CRF Source Category 4D) (EU-15)

N_2O emissions from this source category account for 5 % of total GHG emissions. Table 6.9 shows total GHG and N_2O emissions by Member State for N_2O from 4D Agricultural Soils. N_2O emissions from this source decreased by 18 % between 1990 and 2012. All EU-15 Member States decreased emissions.

Table 6.9 4D Agricultural Soils: Member States' contributions to total GHG and N_2O emissions

Member State	GHG emissions in 1990 ($Gg\ CO_2$ equivalents)	GHG emissions in 2012 ($Gg\ CO_2$ equivalents)	N_2O emissions in 1990 ($Gg\ CO_2$ equivalents)	N2O emissions in 2012 ($Gg\ CO_2$ equivalents)
Austria	3 437	3 064	3 430	3 055
Belgium	4 807	3 529	4 807	3 529
Denmark	7 692	5 004	7 692	5 004
Finland	4 026	3 497	4 026	3 497
France	54 797	45 853	54 797	45 853
Germany	47 693	40 916	47 693	40 916
Greece	7 208	4 798	7 208	4 798
Ireland	7 271	6 454	7 271	6 454
Italy	19 557	16 624	19 557	16 624
Luxembourg	362	309	362	309
Netherlands	10 669	5 714	10 669	5 714
Portugal	3 484	2 941	3 484	2 941
Spain	19 256	18 167	19 256	18 167
Sweden	5 114	4 347	5 114	4 347
United Kingdom	33 695	27 086	33 695	27 086
EU-15	**229 068**	**188 301**	**229 061**	**188 293**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The main driving force of direct N2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 28 % and 12 % below 1990 levels in 2012, respectively. N2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction in fertiliser use is also due to directives such as the nitrate directive and to the extensification measures included in the agro-environment programmes (EC, 2001)

Table 6.10 provides information on emission trends of the key source from 4D1 Direct soil emissions by Member State. Direct N_2O emissions from agricultural soils is the largest source category of N_2O emissions and accounts for 3 % of total EU-15 GHG emissions in 2012. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2012, emissions declined by 17 % in the EU-15. The Member States with most emissions from this source were France and Germany. All Member States reduced N_2O emissions from agricultural soils.

The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 28 % and 12 % below 1990 levels in 2012, respectively. N_2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction in fertiliser use is also due to directives such as the nitrate directive and to the extensification measures included in the agro-environment programmes (EC, 2001)

Table 6.10 4D1 Direct soil emissions: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	1 909	1 862	1 807	2%	-55	-3%	-102	-5%
Belgium	2 567	2 063	1 961	2%	-101	-5%	-606	-24%
Denmark	4 414	3 151	3 069	3%	-82	-3%	-1 345	-30%
Finland	3 069	2 778	2 728	3%	-50	-2%	-341	-11%
France	25 722	22 766	21 012	22%	-1 754	-8%	-4 709	-18%
Germany	29 148	26 302	25 791	27%	-511	-2%	-3 357	-12%
Greece	2 850	1 563	1 534	2%	-28	-2%	-1 315	-46%
Ireland	3 022	2 489	2 516	3%	28	1%	-505	-17%
Italy	9 673	7 407	8 051	8%	645	9%	-1 622	-17%
Luxembourg	161	137	136	0.1%	-1	-1%	-25	-16%
Netherlands	4 137	3 310	3 233	3%	-77	-2%	-904	-22%
Portugal	1 454	1 049	1 053	1%	4	0.4%	-402	-28%
Spain	9 285	8 616	8 614	9%	-2	-0.02%	-671	-7%
Sweden	2 826	2 493	2 404	3%	-88	-4%	-421	-15%
United Kingdom	14 343	11 790	11 345	12%	-445	-4%	-2 998	-21%
EU-15	**114 580**	**97 775**	**95 256**	**100%**	**-2 519**	**-2.6%**	**-19 324**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D2 Pasture, Range and Paddock Manure account for 1 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source decreased by 17 % (Table 6.11). France and the United Kingdom are responsible for 51 % of the total EU-15 emissions from this source. The Netherlands had the greatest reduction in absolute terms while Portugal had the largest increases.

Table 6.11 4D2 Pasture, Range and Paddock Manure: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	169	95	94	0.3%	-1	-1%	-75	-44%
Belgium	992	761	753	3%	-8	-1%	-239	-24%
Denmark	334	208	211	1%	3	2%	-123	-37%
Finland	191	188	186	1%	-2	-1%	-5	-3%
France	9 050	8 265	8 185	30%	-80	-1%	-865	-10%
Germany	2 118	1 321	1 315	5%	-6	-0.5%	-803	-38%
Greece	1 539	1 483	1 480	5%	-3	-0.2%	-59	-4%
Ireland	2 868	2 624	2 687	10%	63	2%	-182	-6%
Italy	1 736	1 549	1 426	5%	-123	-8%	-310	-18%
Luxembourg	59	54	53	0.2%	-1	-2%	-6	-10%
Netherlands	3 150	1 108	1 045	4%	-63	-6%	-2 105	-67%
Portugal	687	814	812	3%	-3	-0.3%	124	18%
Spain	2 922	2 997	2 907	11%	-90	-3%	-15	-1%
Sweden	436	440	435	2%	-4	-1%	-1	0%
United Kingdom	6 752	5 819	5 820	21%	1	0%	-931	-14%
EU-15	**33 001**	**27 725**	**27 407**	**100%**	**-318**	**-1%**	**-5 594**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D3 Indirect Emissions account for 2 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source decreased by 20 % (Table 6.12). France, the UK, Spain, Germany and Italy are responsible for 83 % of the total EU-15 emissions from this source.

Table 6.12 4D3 Indirect Emissions: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	1 352	1 145	1 154	2%	9	1%	-198	-15%
Belgium	1 248	825	811	1%	-15	-2%	-438	-35%
Denmark	2 944	1 755	1 724	3%	-31	-2%	-1 219	-41%
Finland	767	600	583	1%	-16	-3%	-183	-24%
France	20 025	18 062	16 656	26%	-1 407	-8%	-3 369	-17%
Germany	16 428	14 141	13 810	21%	-331	-2%	-2 618	-16%
Greece	2 819	1 808	1 784	3%	-25	-1%	-1 035	-37%
Ireland	1 381	1 232	1 251	2%	19	2%	-130	-9%
Italy	8 148	6 468	7 147	11%	680	11%	-1 000	-12%
Luxembourg	142	123	120	0.2%	-2	-2%	-22	-15%
Netherlands	3 358	1 485	1 432	2%	-53	-4%	-1 926	-57%
Portugal	1 342	1 079	1 076	2%	-2	0%	-266	-20%
Spain	7 049	6 699	6 645	10%	-54	-1%	-404	-6%
Sweden	1 135	827	823	1%	-4	0%	-311	-27%
United Kingdom	12 337	9 596	9 518	15%	-78	-1%	-2 819	-23%
EU-15	**80 474**	**65 845**	**64 535**	**100%**	**-1 310**	**-2%**	**-15 939**	**-20%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.3 Methodological issues and uncertainty

All Member States consider their greenhouse gas inventories in the agricultural sector for complete for those categories that are reported to occur in the countries. For categories 4.A, 4.B (both methane and nitrous oxide) and 4.D (nitrous oxide) emissions in all relevant sub-categories are considered (CRF Tables 7s2). CH_4 emissions from rice fields are reported for France, Greece, Italy, Portugal and Spain.

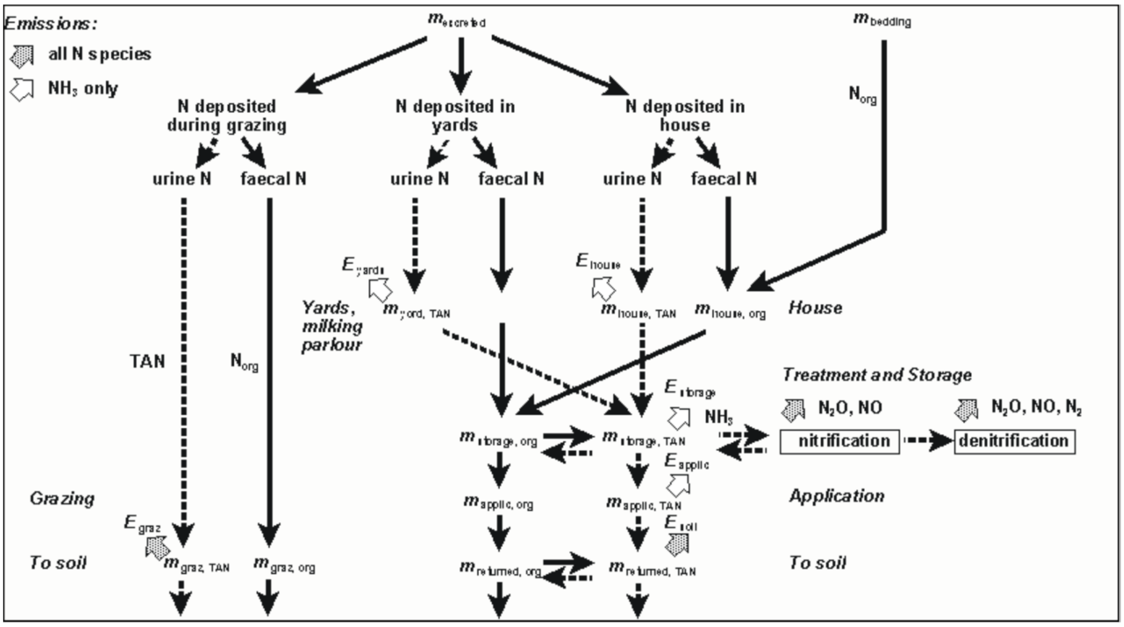
Many countries recognize that in the agriculture sector the emissions from the different categories are inherently linked and are best estimated in a comprehensive model that covers not only greenhouse gases (CH_4 and N_2O) in a consistent manner, but also ammonia. Estimations of ammonia emissions are required for reporting under the Convention on Long-Range Transboundary Air Pollution and are needed to estimate indirect N_2O emissions. Hence, some countries have developed comprehensive models covering consistently different source categories and different gases.

- Austria: For the calculation of the losses of gaseous N species the mass-flow procedure pursuant to EMEP/CORINAIR is used. A detailed emission model for NH_3, NMVOC and NO_X has been integrated into the national inventory.
- Germany: Germany uses the emission inventory model GAS-EM (see Figure 6.3) to calculate consistently emissions of CH_4, NH_3, N_2O, and NO from agricultural sources. It is based on IPCC methodologies and has been developed in recent years with a comprehensive description found in Roesemann et al. (2013). Basis of the model is the feed intake which determine emissions in category 4A and which determines N and C excretion rates relevant for category 4B and also 4D. Data are available at district (Landkreis, livestock characterisation, housing systems, manure management systems) and regional (Bundesland) level. N-emissions are considered within an N-flow concept (Daemmgen and Hutchings, 2005). In the N-flow concept, only remaining N in manure is transferred to storage systems,

after subtraction of emissions in housing systems. Emissions are subtracted from the total N-pool.

- Denmark: The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called IDA (Integrated Database model for Agricultural emissions). The model complex is designed in a relational data-base system (MS Access). Input data are stored in tables in one database called IDA_Backend and the calculations are carried out as queries in another linked database called IDA. This model complex is implemented in great detail and is used to cover emissions of NH_3, particulate matter and greenhouse gases. Thus, there is a direct coherence between the NH_3 emission and the emission of N_2O.
- Finland: Finland uses a nitrogen mass flow model (except for N-fixing, crop residue and sewage sludge) accounts for nitrogen losses as ammonia and nitrous oxide emissions during manure management in animal houses, during storage and application; the calculation method was developed in order to avoid double-counting.

Figure 6.3 Flow of nitrogen in manure management systems (Dämmgen et al., 2007)



6.3.1 Enteric Fermentation (CRF source category 4.A)

6.3.1.1 Source category description

Methane is produced in herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. The amount of methane that is released depends on the type of digestive tract, age, and weight of the animal and on the quality and quantity of the feed consumed. Ruminant livestock (e.g., cattle, sheep) are major sources of methane, but there are also moderate amounts produced from non-ruminant livestock (e.g., pigs, horses). The ruminant gut structure fosters extensive enteric fermentation of their diet. Generally, higher feed intake induces also higher methane emission, but the extent of methane production may also be affected by the composition of the diet. Feed intake is positively related to animal size, growth rate, and production (e.g., milk production, wool growth, or pregnancy).

CH_4 emissions in the source category Enteric Fermentation stem for 8 Member States to over 85% from the sub-category “cattle”. Substantial emissions from the sub-category “Sheep” (up to 54% of emissions in category 4.A. for Greece) are reported by Greece, Italy, Portugal, Spain, and United Kingdom. Emissions accounting for more than 5% of the total emissions in this category are further reported by 5 countries for the sub-category “Goats” (Greece, 17%) and for the sub-category “Swine” (Belgium, Denmark, Netherlands, and Spain, with a maximum of 10%).

An overview of the CH_4 emissions, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EC-level) and also goats and swine are given in Table 6.13. Data are given for 2012 as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers with the exception of swine which are partly compensated by higher emissions per head due to intensification of livestock production in Europe.

Table 6.13: Total CH_4 emissions in category 4A and implied Emission Factor at EU-15 level for the years 1990 and 2012

1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2,697	2,927	805	76	134
Animal population [1000 heads]	26,211	65,001	114,812	12,850	113,561
Implied EF (kg CH_4/head/yr)	103	46	7.0	5.9	1.2

2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2,153	2,637	599	67	138
Animal population [1000 heads]	17,536	57,108	83,820	11,205	118,429
Implied EF (kg CH_4/head/yr)	123	47	7	6	1

Percent change 1990-2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	80%	90%	74%	88%	103%
Animal population [1000 heads]	67%	88%	73%	87%	104%
Implied EF (kg CH4/head/yr)	119%	102%	102%	101%	98%

Information source: CRF for 1990 and 2012, submitted in 2014

6.3.1.2 Methodological Issues

CH_4 emissions from enteric fermentation is a key source category for cattle and sheep. For cattle, this is also true for all member states. Accordingly, Member States have used Tier 2 methodology for calculating enteric CH_4 emissions, as shown in Table 6.14. In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category “enteric fermentation”, the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States.

The table indicates also the Tier level of the source category and of the emission estimates for the animal types considered. For this purpose we compare the implied emission factor for dairy cattle, non-dairy cattle and sheep with the IPCC default values for Western Europe of 100 kg CH_4 head^{-1} year-1, 48 kg CH_4 head^{-1} year-1 and 8 kg CH_4 head^{-1} year-1, respectively. For a detailed description on the methodology used to estimate the “Tier-level” for the EC, see Section 6.4.1. For cattle, almost all emissions are calculated with the help of country-specific data, while for sheep still 28% of the emissions are estimated with a Tier 1 approach.

Even though several Member States did not report disaggregated key source categories for category 4A, emission values show that sheep is not a key source category for most countries. However, considerable emissions from this category with more than 10% of total emissions in this category are reported by 5 countries. Therefore, most countries are applying Tier 1 methodology. Those Member States where sheep emissions are belonging to the key source categories have indeed developed a

Tier 2 approach. In the case of the United Kingdom, where the default value was used, but it is adjusted for lambs, considering also the lifetime of lambs. Thus we assigned a Tier level of 1.5.

On EU-15 level, 88% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach. Overall, a Tier level between Tier 1.4 and Tier 2.0 can be derived in all EU-15 countries for the source category ‘enteric fermentation’ with a Tier level of Tier 1.90 for EU-15. This estimate includes also the Tier level for goat (Tier 1.3), swine (Tier 1.6) and reindeer (estimated by Finland and Sweden with national emission factors). The thus aggregated Tier level accounts for 98% of the emissions in category 4A and has been complemented with ‘other emissions’ assuming that these are estimated with a Tier 1 approach giving overall a quality of Tier 1.9.

Table 6.14: Total emissions, contribution of the main sub-categories to CH_4 emissions in category 4A, methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and sheep. Data for the year 2012.

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	3,193	Tier 1.9	41%	Tier 2.0	53%	Tier 2.0	y	2%	Tier 1.0
Belgium	3,561	Tier 1.4	35%	Tier 2.0	57%	Tier 1.0	y	1%	Tier 1.0
Denmark	2,904	Tier 2.0	57%	Tier 2.0	29%	Tier 2.0	y	1%	Tier 2.0
Finland	1,544	Tier 1.9	50%	Tier 2.0	28%	Tier 2.0	y	1%	Tier 1.0
France	28,201	Tier 2.0	33%	Tier 2.0	58%	Tier 2.0	y	6%	Tier 2.0
Germany	20,833	Tier 2.0	57%	Tier 2.0	38%	Tier 2.0	y	1%	Tier 1.0
Greece	3,123	Tier 1.8	9%	Tier 2.0	18%	Tier 2.0	y	54%	Tier 2.0
Ireland	8,811	Tier 2.0	30%	Tier 2.0	63%	Tier 2.0	y	7%	Tier 2.0
Italy	10,667	Tier 1.4	43%	Tier 2.0	37%	Tier 1.0	y	11%	Tier 1.0
Luxembourg	239	Tier 2.0	42%	Tier 2.0	55%	Tier 2.0	y	1%	Tier 1.0
Netherlands	6,555	Tier 1.9	61%	Tier 2.0	27%	Tier 2.0	y	3%	Tier 1.0
Portugal	2,727	Tier 2.0	24%	Tier 2.0	55%	Tier 2.0	y	14%	Tier 2.0
Spain	10,260	Tier 2.0	18%	Tier 2.0	43%	Tier 2.0	y	29%	Tier 2.0
Sweden	2,540	Tier 1.9	37%	Tier 2.0	47%	Tier 2.0	y	4%	Tier 1.0
United Kingdom	15,464	Tier 1.9	27%	Tier 2.0	47%	Tier 2.0	y	22%	Tier 1.5
EU-15	**120,622**	**Tier 1.9**	**37%**	**Tier 2.0**	**46%**	**Tier 1.9**	**y**	**10%**	**Tier 1.7**
EU-15: Tier 1	12%		0%		11%			28%	
EU-15: Tier 2	88%		100%		89%			72%	

a Contribution to CH_4 emissions from enteric fermentation
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 6.15.

Table 6.15: Available background information on the methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	***Methodology***
Austria	*IPCC Tier 1 for swine, sheep, goats, horses and other animals (Deer). For Cattle Tier 2. For the calculation of emissions from category Poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. The agricultural practices related to poultry in Switzerland are very similar to those in Austria: Both countries have a small structured agriculture due to similar alpine conditions, comparable traditions and culture. In both countries more than 60% of the farms manage less than 20ha. In Austria, the animal category ‘other’ (4.A.10) corresponds to furred game. This category includes mainly deer, but no further data on the exact composition of this animal category is available. As the contribution to the overall emissions is very small, a simple approach has been chosen by applying the default emission factor of sheep because sheep is the most similar animal category to deer.*

Member State	***Methodology***
Belgium	*Tier 2 approach is used in both regions (harmonized), Flanders and Wallonia for key-source animal types (cattle). Tier 1 for cattle is in Brussels (low animal numbers). CH_4 emissions from enteric fermentation from the other, non-key source, animal categories (sheep, goats, swine, horses and mules and asses) are estimated using the Tier 1 methodology.*
Denmark	*The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called IDA (Mikkelsen, 2006; Mikkelsen and Gyldenkærne 2006). IDA operates with 38 different livestock categories, according to livestock category, weight class and age. These categories are subdivided into housing type and manure type, which results in 247 different combinations of live-stock subcategories and housing types. For each of these combinations, information on e.g. feed intake, digestibility, excretion and methane conversion factors is attached. The emission is calculated from each of these subcategories and then aggregated in accordance with the IPCC livestock categories given in the CRF. The implied emission factors for all animal categories are based on the Tier 2 or country-specific approach with the exception of poultry, ostrich and pheasants. Emissions from fur management is considered to be not applicable (Hansen, 2010).The category non-dairy cattle includes calves, heifer, bulls and suckler cows and the implied emission factor is a weighted average of these different subcategories. Data given for non-dairy cattle covers data for heifer older than ½ year. The category swine includes the subcategories sows, piglets and slaughtering pigs. The feed intake for sows and piglets has increased while the feed intake for slaughtering pigs has decreased as a result of improved fodder efficacy.*
Finland	*Tier 1 for horses, swine, goats and fur animal (Norway EFs). Tier 2 method for Cattle. CH_4 emissions from enteric fermentation of reindeer have been calculated by estimating the GE on the basis of literature (McDonald, 1988) by using national data for estimating dry matter intake and its composition (hay and lichen) and calculating the respective emission factor. The same methodology has been used for estimating GE and EF for sheep. Cattle's are not used for work in Finland. Piglets are included in the category 'sows with piglets'.*
France	*Tier 2 or 3; national emission factors based on methodologies slightly different to IPCC.*
Germany	*Tier 3 for dairy cows; Tier 2 for other cattle and swine. Tier 1 for other animals.*
Greece	*Dairy and non-dairy cattle and sheep by tier 2 methodology. Other animals by tier 1.*
Ireland	*Cattle: Tier 2. For Dairy cows and Suckler Cows, the country was divided into three regions: (1) south and east, (2) west and midlands, and (3) north west, coinciding with regions used for implementing the Nitrates Directive based on slurry storage requirements of local planning authorities. The cattle production systems in each region are defined in terms of calving date, the dates of winter housing and spring turn-out to grass, milk yield and composition, forage and concentrate feeding level, cow live-weight and live-weight change and lactation period. Emission factors for the beef cattle categories were determined by calculating lifetime emissions for the animal and by partitioning between the first, second and third years of the animal's life. This approach allows the published CSO animal populations for June to be used directly as the activity data most representative of the inventory year for enteric fermentation while taking into account the movement of cattle from one category to another (i.e. from 0-1 year old to 1-2 year old to over 2 years old), as enumerated by the June census, up to two times in their three-year lifetime (O'Mara, 2006). For other animals: Tier 1 Methodology, IPCC EFs default.*
Italy	*The Tier 2 IPCC GPG approach has been followed for Dairy, Non-Dairy and Buffalo. Country-specific emission factor suggested by the Research Centre on Animal Production for rabbits have been use. A Tier 1 approach, with IPCC default emission factors, has been used to estimate methane emissions from swine, sheep, goats, horses, mules and asses.*
Luxembourg	*The IPCC Tier 1 method has been applied to all farm animal categories with the exception of cattle for which a Tier 2 method has been used (option B).*
Netherlands	*For mature dairy cattle a country-specific method based on a Tier 3 approach using dynamic modelling (Tier 3; Smink, 2005). The model of Mills et al. (2001) is used, including updates (Bannink et al., 2005a,b). This model is based on the rumen model of Dijkstra et al. (1992). It has been developed for dairy cows and is therefore not suitable for all cattle categories. The model calculates the gross energy intake and methane production per cow per year on the basis of data on the share of feed components (grass silage, maize silage, wet by-products and concentrates) and their chemical nutrient composition (sugars, NDF, etc.). Calculations are split into Northwest and Southeast regions due to their different conditions, being the total emissions reported a sum of the emissions in the two regions.*
Portugal	*Tier 2 for all animal types except for horses, mules and asses, for which tier 1 is used. Enhanced characterization of livestock, with subdivision per age, sex and management conditions for most animal types. Milk yield was estimated dividing the annual production of milk cow over the number of cows in production, both of which are published by the National Statistical Institute (INE). Three different cattle types were considered: (1) Imported breeds; (2) Traditional breeds on pasture; (3) Traditional breeds on range. The methodology used by the French I.N.R.A. (INRA, 1984) was used to estimate feed intake for each swine and rabbit.*
Spain	*Sheep: Tier 2. Cattle and swine: Tier 3. Other animal categories: Tier 1. For sheep, national literature on the main animal breed present in Spain is used to estimate parameters which are not given by IPCC.*
Sweden	*Significant cattle subgroups: national emission factor (Tier 1). Reindeer: according to Tier 2 methodology using a Finnish value of gross energy requirements. Other animal categories: Tier 1. The national methodology for dairy cows, beef cows and other cattle.*
United Kingdom	*Tier 2 method for dairy and non-dairy cows, lambs and deer. Tier 1 for other animal types. The UK sheep production sector has a complex structure, with many different breeds of sheep and a range of hill, upland and lowland rearing and finishing systems. The UK is currently undertaking a programme of work to improve methodology for calculating emissions from this sector, which will include derivation of monthly sheep and*

Member State	*Methodology*
	lamb population models and country-specific emission factors.

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2012 are given in Table 6.16. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Luxembourg and the Netherlands have chosen to use the option B of the CRF for the classification of cattle. In order to allow the calculation of an EU implied emission factor for the categories listed under option A, these numbers were "converted" using the following rule: mature dairy cattle → dairy cattle; mature non-dairy cattle + young cattle → non-dairy cattle.

Other animal types with population data reported in Table4.A are reindeers (Finland, Sweden), deer (Austria, Denmark, Luxembourg, and UK), fur farming (Finland, Denmark), rabbits (Italy, Luxembourg, and Portugal), and other poultry (Denmark, Luxembourg and Spain).

Some information on the source of the animal numbers for the different Member States is given in Table 6.17.

Table 6.16: Animal population [1000 heads] in 2012.

Member State 2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	523	1,432	365	73	2,983	14,644
Belgium	455	2,046	106	35	6,656	33,826
Denmark	587	1,020	90	13	12,331	18,991
Finland	284	629	130	5	1,290	10,761
France	3,651	15,491	8,435	1,384	13,838	299,857
Germany	4,190	8,316	1,643	150	23,648	132,344
Greece	131	552	8,813	5,089	866	29,016
Ireland	1,101	5,609	4,843	10	1,532	15,342
Italy	1,857	3,886	7,016	892	8,662	198,768
Luxembourg[1)]	40	149	8	5	90	113
Netherlands[1)]	1,484	2,395	1,043	397	12,234	97,016
Portugal	241	1,265	2,163	412	1,973	34,164
Spain	832	5,077	16,339	2,637	26,482	133,859
Sweden	348	1,152	611	6	1,363	17,758
United Kingdom	1,812	8,089	32,215	98	4,481	160,061
EU-15	17,536	57,108	83,820	11,205	118,429	1,196,519

Information source: CRF for 1990 and 2012, submitted in 2014

1) Numbers for cattle have been calculated using the figure given under option B.

Table 6.17: Available background information on the source of animal population data

Member State	*Activity Data*
Austria	*The Austrian official statistics (Statistic Austria, 2006) provides national data of annual livestock numbers on a very detailed level. In 1998-2002 swine numbers were fluctuating due to a high elasticity to market prices. The animal numbers of Young Swine were not taken into account because the emission factors for Breeding Sows already includes nursery and growing pigs (Schechtner 1991). Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS database (Kirner and Schneeberger, 1999). From 2004 onwards INVEKOS data of organic cattle population as reported in the so called 'Green Reports' of the ministry of agriculture (BMLFUW 2007) was used. The Austrian inventory does not distinguish between horses and mules and asses. As mules and asses are only of very little importance in Austria.*

Member State	Activity Data
Belgium	"Statistics Belgium" (Statbel) publishes the livestock figures, agricultural land area and edible crop production of N-fixing and non-N-fixing crops yearly in its agricultural census. These data are available for and used by the three regions: Flanders, Wallonia, and Brussels. In Flanders, livestock figures from 2000 on are obtained by the Manure Bank of the Flemish Land Agency. Concerning the agricultural census, since 2008 this inquiry has changed slightly. 75% (before 2008 this was 100%) of all agricultural businesses (including the biggest farms) have to fill in a form each year about the situation at the farm on the 1st of May of that year. Mules and Asses are included in the category Horses. "Other" includes Horses, Mules and Asses, Goats and Rabbits.
Denmark	Livestock production is primarily based on the agricultural census from Statistics Denmark. The emission from slaughter pigs and poultry is based on slaughter data. Approximate numbers of horses, goats and sheep on small farms are added to the number in the Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares, where many of these animals are placed. Animal numbers of sheep, goats, ostriches and deer are based on the Central House animal farm Register (CHR). Pheasant numbers are based on expert judgement from NERI and the pheasant breeding association. Statistics Denmark – Agricultural Statistics www.dst.dk (DSt) provide data on livestock production, milk yield, slaughtering data, export of live animal (poultry), land use, crop production, and crop yield. The Danish Centre for Food and Agriculture, Aarhus University (DCA) provides data on N-excretion, feeding situation, animal growth, N-fixed crops, crop residue, N-leaching/runoff, and - NH_3 emissions factor. The Danish Agricultural Advisory Service www.lr.dk (DAAS) provides data on housing type (until 2004), grazing situation, manure application time and methods, estimation of extent of field burning of agricultural residue. The Danish Environmental Protection Agency www.mst.dk (EPA) provides data on sewage sludge used as fertiliser, industrial waste used as fertiliser. The Danish AgriFish Agency http://naturerhverv.fvm.dk (DAFA) provides data on synthetic fertiliser (consumption and type), housing type (from 2005), sewage sludge used as fertiliser (from 2005 based on the register for fertilization), number of animals from the Central Husbandry Register. The Danish Energy Agency www.ens.dk (DEA) provides data on manure used in biogas plants.
Finland	The number of cattle, sheep, swine, poultry and goats was received from the Matilda-database maintained by the Information Centre of the Ministry of Agriculture and Forestry (http://www.mmmtike.fi/en/) as well as from the Yearbook of Farm Statistics published annually by the Ministry of Agriculture and Forestry. The number of animals describes the number of animals in 1st of May (cattle, swine, and poultry) and it has been reported consistently over the time series. Cattle category has been divided into the following sub-categories: Dairy cows, suckler cows, bulls, heifers and calves for which separate emission factors have been calculated. Animal numbers are harmonized with the Nitrogen mass flow model used by the Finnish Environment Institute.
France	Agricultural statistics are issued by the ministry of agriculture (SCEES/AGRESTE). Activity data is a one year average. Heifers are included in other cattle, but heifers more than 2 years old (40% of the total heifer livestock) are considered as dairy cattle.
Germany	Animal types are disaggregated, if significant differences exist between emission factors. For example, dairy cattle are grouped into sub-categories in each district on the basis of animal performance and feeding indicators. Other cattle include calves, heifers, bulls (beef), suckler cows and mature males. Sows, suckling pigs and fattening pigs are calculated separately, as well as sheep and lambs, and the results are aggregated and IEFs covering both sub-categories are reported. The category 'poultry' is differentiated into the sub-categories laying hens, broilers, pullets, geese and ducks and turkey hens and cocks. The category horses is differentiated in large and small horses. Animal numbers are reported as 'animal places' referring to the average number of livestock over a complete year. A complete animal census at the "Kreise" level is available for every second year in the official agricultural statistics with the exception of goats, mules and asses, and buffalo. For the other years, animal numbers are available at the "Länder" level. Cattle numbers are obtained from the data base http://www.hi-tier.de. Pig numbers are lower than official statistics, as piglets up to 8 kg are considered with sows. For sheep numbers were estimated; the first census on sheep in 2010 showed that numbers were over-estimated, but the numbers were maintained. The number of horses is partly interpolated. Since 2010 numbers are aggregated to 'equides' including mules and asses; those are included in the category 'horses' but lead only to a small over-estimation due to the low number of mules and asses. Buffalo numbers are not published and obtained from the buffalo organisation; numbers are extrapolated for the years before 2000, resulting in no buffaloes for the years 1990-1995.
Greece	Animal population except Sheep, is a 3-year average. The data for population of dairy cattle was last updated following the results of a survey of ELSTAT. Milk yield derives from data of the annual Agricultural Statistics. Portion of female cattle, >2 year old, giving birth is estimated at 0.9 while milk production yield estimated at 0.1 kg/day (estimated for 365 days) and milk production yield during suckling estimated at 1.0 kg/day (estimated for 365 days). The average bodyweight of sheep at weaning is estimated at 15 kg while the average weights of female and male mature sheep (>1 year) are estimated at 53 kg and 70 kg respectively.
Ireland	Statistical data are compiled and published by the Central Statistics Office. Ireland uses one annual average population characterisation. For both dairy cows and suckler cows, the country is divided into three regions: (1) south and east, (2) west and midlands, and (3) north-west, coinciding with the regions used for the implementation of regulations on Good Agricultural Practices for the protection of Waters. The number of cows in each category, given by CSO statistics, is allocated to the three regions identified above using the Cattle Movement Monitoring System (CMMS) and Animal Identification and Movement (AIM) system reports published by the Department of Agriculture, Fisheries and Food (DAFF) and the Department of Agriculture Food and the Marine (DAFM). The CSO produces two censuses of animal numbers per year, one reflecting the number of animals nationally in June and the other referring to

Member State	Activity Data
	populations in December. For the purposes of calculating emissions from breeding cattle, an average of the number in each category of breeding animals present in the national herd in June and December is used. The publication of separate census data for June and December annually and the application of these statistics in order to achieve the most representative annual average population related to cattle and some other livestock explains differences that are often seen between national and FAO statistics for agriculture. The Irish cattle herd is now characterised by 11 principal animal categories for which annual census data are published by CSO. The number of Cows in each category given by CSO statistics was allocated to the regions using CMMS reports published by the Department of Agriculture and Food (DAF).
Italy	*Figures from the Farm Structure Survey 2007 (FSS 2007). Livestock data are collected from the National Institute of Statistics (ISTAT) and are based on specific national surveys carried out every 10 years. ISTAT collects comprehensive data through different surveys (Greco and Martino, 2001):* *• Structural surveys (Farm Structure Survey, survey on economic results of the farm, survey on the production means);* *• Interim surveys (survey on the area and production of the cultivation, livestock number, milk production, slaughter, etc.);* *• General Agricultural Census, carried out every 10 years (1990, 2000, 2010).*
Luxembourg	*The activity data are the livestock data reported in the national statistics.*
Netherlands	*Taken from the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl and in background documents (e.g., Van der Hoek and Van Schijndel, 2006). For cattle, three categories are distinguished:* *• mature dairy cattle: adult cows for milk production;* *• mature non-dairy cattle: adult cows for meat production;* *• young cattle: mixture of different age categories for breeding and meat production, including adult male cattle.*
Portugal	*Activity data are 3-years average except for last year. Annual livestock numbers were available from the statistical databases of the National Statistics Institute (INE) for cattle, swine, sheep, goats, horses, mules and donkeys, disaggregated per region, age and sex. For the 2010 inventory, new activity data was obtained from the Survey of the Agriculture Explorations Structure (INE, bi-annual) concerning number of broilers, hens, turkeys, ducks and rabbits. Data provided comprises total livestock in Portugal, and RGA 99 regional values were used for disaggregation purposes; gaps in time series were corrected with linear interpolation; disaggregation between hens for industrial egg production and for production of chicks had to be made since the new INE data reported only total hens. All original figures in statistical database represent stock numbers at a particular time of the year (usually December); for some species with strong seasonal reproducing periods, such as goat and sheep, these numbers had to be corrected and converted in average annual population, using statistics on the number of slaughtered lambs and kids.*
Spain	*Animal numbers are from the "Anuario de Estadistica Agroalimentaria" and from the "Encuestas Ganaderas" published by the ministry of agriculture, food and environment (MAGRAMA). Data are used at higher disaggregation. For cattle and swine numbers, statistics are available for May and November, so both data are used to calculate an annual average. Swine number are differentiated for extensive ('iberica' strain) and total swine ('iberica'+'blanca'), at the province level.*
Sweden	*The Farm Register provides the main basis for agricultural statistics in Sweden. The Register is administered by the Swedish Board of Agriculture and Statistics Sweden and provides annual information on the total number of animals of different categories on Swedish farms. The information on livestock refers to the situation prevailing in mid-June of that year and thus is considered to be equivalent to a one-year average. Mink and foxes are minor contributors to greenhouse gas emissions and are not included in the inventory due to a lack of well-founded emission factors. The number of slaughter chickens (mean number of chickens kept during the year) is provided by the Swedish Poultry Meat Association.*
United Kingdom	*Livestock population data are reported annually as statistical outputs of the four Devolved Administrations of the UK (i.e. England, Wales, Scotland and Northern Ireland), based on the annual June Agricultural Survey for each country. These data are summed to provide UK population data for the livestock categories and subcategories as used in the inventory compilation. Data for earlier years are often revised so information was taken from the England and the Devolved Administrations' agricultural statistics databases. Dairy cows - quoted assumes animal lives for a year; emission calculation assumes animal lives for 6 months. The average lifespan of lambs is estimated by Wheeler et al. (2012) as 8.1 months.*

Emission Factors and other parameters

Considerable variation is found in the Implied Emission Factor (IEF) for dairy and non-dairy cattle with values between 103 kg CH_4 head^{-1} yr^{-1} (Spain) and 135 kg CH_4 head^{-1} yr^{-1} (Germany) for dairy cattle, and 36 kg CH_4 head^{-1} yr^{-1} (Netherlands) and 57 kg CH_4 head^{-1} yr^{-1} (Portugal) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production. The IEF for the EU-15 Member States and the CH_4 conversion factors used are given in Table 6.18. For EU-15, the implied emission factor in 2012 was 123 kg CH_4 $head^{-1}$ yr^{-1} for dairy cattle.

For non-dairy cattle, the low IEF reported by the Netherlands (36 kg CH_4 $head^{-1}$ yr^{-1} in 2012) is explained by the fact that the Netherlands has a considerable population of white veal calves. Because of the low roughage intake MCF is 4% instead of 6% for these animals. This results in a lower average methane conversion rate for total cattle. In Denmark, the IEF is 40 kg CH_4 $head^{-1}$ yr^{-1} in 2012. The IEF for non-dairy cattle is lower compared with the default value, this is due to lower weight and lower feed intake and a higher digestibility of feed. Also in Germany the IEF is lower than IPCC default which is due to large share of cattle with low EF. The level of IEF seems to be comparable to that given by a number of other countries (comparison based on 2007 submissions, including Option B). Further, the low IEF is consistent with a low animal weight for non-dairy cattle in Germany.

The IEF for sheep and goats used in Denmark (Tier 2 methodology) is with 17.2 kg CH_4 $head^{-1}$ yr^{-1} and 13.1 kg CH_4 $head^{-1}$ yr^{-1} considerably higher than the IPCC default values and the numbers used in other Member States. This is explained by the Danish normative data, which operate with sheep including lamb and goats including kids. The emissions of lamb and kids are therefore included in the numbers for sheep and goats, respectively. On the other hand, the IEF for sheep for UK is with 5.0 kg CH_4 $head^{-1}$ yr^{-1} the lowest from EU and is similar to the IEF for developing countries according to the IPCC 2006 GL. The emission factor was fixed by Tier 1 with the assumption that IEF for lambs is 40% of that for adult sheep (breeding sheep are alive the whole year but that lambs and other non-breeding sheep are only alive 6 months of a given year).

For horses, Germany makes a distinction for large and small horses, whereby the IEF for large horses was taken from IPCC (2006) and the IEF for small horses used was smaller with 12 kg $head^{-1}$ yr^{-1}. The overall IEF for horses is thus smaller than the IPCC value.

The CH_4 conversion factor is IPCC default for most Member States.

More detailed information on the development of the emission factors for category 4A is given in Table 6.19.

Table 6.18: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory. Data for the year 2012.

Member State	Implied EF (kg CH_4/head/yr) [1]					CH_4 conversion (%) [1]				
2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	119	56	8.0	5	1.5	6.0	6.0	6.0	5.0	0.6
Belgium	132	48	8.0	5	1.5	6.0	6.0	NE	NE	NE
Denmark	134	40	17.2	13	1.1	6.0	6.0	6.0	5.0	0.6
Finland[1]	130	46	8.4	5	1.0	6.0	6.0	NA	NA	NA
France	120	51	9.4	12	0.8	6.2	6.4	NA	NA	NA
Germany	135	46	8.0	5	1.2	6.4	6.1	6.0	5.0	0.6
Greece	106	48	9.1	5	1.5	5.9	5.9	6.6	NE	NE
Ireland	113	47	6.0	5	1.1	6.5	6.5	7.0	NE	NE
Italy	116	48	8.0	5	1.5	6.0	4.4	NA	NA	NA
Luxembourg	120	42	8.0	5	1.5	6.0	6.0	6.0	5.0	0.6
Netherlands	128	36	8.0	5	1.5	5.8	5.8	NE	NE	NE
Portugal	131	57	8.7	8	1.3	6.5	5.9	6.0	5.0	0.6
Spain	103	42	8.6	5	1.0	5.1	4.7	6.6	NA	0.8
Sweden	130	50	8.0	5	1.5	6.2	7.0	6.0	5.0	0.6
United Kingdom	111	43	5.0	5	1.5	6.0	NE	NE	NE	NE
EU-15	123	46.7	7.1	6	1.2	6.1	6.0	6.6	5.0	0.7

Information source: CRF for 1990 and 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1] Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. The IEF has been calculated as a weighted average. [*] The IEF for Luxembourg and the Netherlands has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

Table 6.19: Available background information for CH_4 emissions in category 4.A. Emission Factor and other parameters

Member State	*Emission Factor and other parameters*
Austria	*Country specific emission factors for cattle calculated from the specific gross energy intake and the methane conversion rate (IPCC for "all other cattle" because there are few if any feedlot cattle with a high-energy diet). Austrian energy intake data were recalculated by from the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein (Poetsch et al. 2005, Gruber and Poetsch, 2006). Gross energy intake for all other cattle categories were calculated from typical Austrian diets by animal nutrition expert Andreas Steinwidder (Amon et al. 2002). These livestock categories show distinct differences in organic and conventional diets. The time series of average milk yields per dairy cow was taken from national statistics, milk yield of suckling cows is from Hausler (2009).* *Data for suckling cows are from the study 'Mutterkuh und Ochsenhaltung 2003: in which 56 holdings in Styria, Lower Austria, Carinthia and Salzburg were investigated. In a study with Austrian suckling cows (Simmental) carried out from 2004 to 2008, the influence of duration of suckling period (180 days and 270 days) on milk yield and body weight of cows and weight gain of calves was determined (Steinwidder et al. 2006). As no major changes in diets of non-dairy cattle occurred in the period since 1990, methane emissions from enteric fermentation of non-dairy cattle are calculated with a constant gross energy intake for the whole time series.* *For the calculation of emissions from poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. The animal category Other livestock corresponds to deer with default EF used for sheep.*
Belgium	*The EFs for dairy cattle are different in both regions based on milk production. The average animal weight and weight gain originate in Flanders from the Department Agriculture and Fishery and in Wallonia from average weights published by the federal finance department. In Flanders, data for feed digestibility (DE%) originate from a report [http://www.rivm.nl/bibliotheek/rapporten/680125001.html] from the Netherlands, a neighbouring country with comparable feeding situations. In both regions a methane conversion rate (Ym) of 6% is used to calculate the emission factor for each cattle type. The emission factors for all categories with exception for dairy cows stay constant over the entire time series. For dairy cows the emission factor increases with increasing milk production.*
Denmark	*Feed consumption for all animal categories is based on the Danish normative figures. The Tier 2/CS equation for EF of enteric fermentation is the sum of the feeding situation in winter and summer. The EF is based on actual feeding plans, which is provided from data for feed units (FU) for each livestock category.*

Member State	Emission Factor and other parameters
	Feeding with sugar beets is taken into account because sugar beet feeding gives a higher methane production rate compared to grass and maize due to the high content of easily convertible sugar. However, it is only dairy cattle and heifers which have sugar beets in the feed. To calculate the total gross energy (GE) intake, the GE per feed unit needs to be estimated. A feed unit in Denmark is defined as the feed value in 1.00 kg barley with a dry matter content of 85 %. For other cereals e.g. wheat and rye one feed unit is 0.97 kg and 1.05 kg, respectively. The calculation of GEFU (winter and summer) is based on the composition of feed intake and the energy content in proteins, fats and carbohydrates based on actual efficacy feeding controls or actual feeding plans at farm level, collected by DAAS or DCA. For dairy cows, the energy intake comes out at 18.3 MJ pr. FU in a standard winter feed regardless of whether the animal grazes or not, which is based on information from DCA. *Ym default, but a national factor is used for dairy cattle and heifers. The estimation of the national values of Ym is based on model "Karoline" developed by DCA based on average feeding plans for 20 % of all dairy cows in Denmark obtained from the Danish Agricultural Advisory Service DAAS (Olesen et al.; 2005). Sheep include lamb and an average Ym value for mother sheep and lamb is used.* *Tier 1 EFs are from Wang and Huang (2005).*
Finland	*IPCC gives no default emission factor for reindeer, thus it has been calculated by using national methodology for estimating gross energy intake of reindeer from the basis of their forage. The same equation has been used for sheep also. Emission factors for cattle are updated annually. EF´s for other animal groups will be updated if more national data will become available. Average daily weight gain for cattle was estimated to remain constant.*
France	*Emission factors are used for enteric fermentation from a study published in 2008 by the French National Institute of Agronomy. These emission factors are based on parameters equivalent to Ym and GE, and they have been updated based on the results of MONDFERENT project (INRA). Results for cattle have been included in this report, but for the monogastric and for the small ruminants calculations are still being updated and the former values from Vermorel 2008 have been maintained. For dairy cattle, emission factors are dependent of milk production. For non-dairy cattle, emission factors are constant in time and changes in total emissions will depend on the number of animals.*
Germany	*The calculation of the EF for dairy cattle (Daemmgen etal, 2012) is based on the approach from Kirchgessner et al. (1994) and based on the intake of fibres, N-free extracts, proteins and fat calculating total GE intake. For cows, heifers, bulls and male cattle > 2 years a MCF of 0.065 is used according to IPCC (2006) which is higher than IPCC default, but matches better German feed quality. MCF for calves is 0.02 after Kirchgessner (2008). MCF for swine is IPCC default.*
Greece	*The average milk production for domestic and in flock and for nomadic sheep was considered equal to 0.22 kg/day and 0.20 kg/day. For the estimation of net energy for dairy cattle activity, it was considered that they are confined to a small area thus no energy is required to acquire feed (Ca = 0). For the estimation of net energy for other cattle activity, it was considered that they are confined in areas with sufficient forage requiring modest energy expense to acquire feed (Ca = 0.17). The digestibility for dairy cattle is considered 70%, the default value corresponding to western Europe. For the calculation of the methane conversion factor, the correslation propossed by Cambra-Lopez (2008) is used.*
Ireland	*The Tier 2 emission factors for the 11 animal categories for 1990 and the years since 2003; interpolation was used to complete the time series. Substantial further subdivision was incorporated for dairy and beef cattle to adequately describe the wide range of cattle rearing and finishing systems applicable in Ireland (dairy cows: 12 systems ; suckler cows: 18 system types; male and female beef cattle: up to 30, O'Mara et. al., 2006).There is little statistical information on the live weight gain of the different types of cattle in the Irish cattle herd, but the weight of carcasses of all slaughtered cattle is recorded by the Department of Agriculture and Food. In the approach outlined by O'Mara (2006), the daily energy requirement of cows in each region is calculated by month or part thereof based on maintenance requirements, milk yield and composition, requirements for foetal growth and gain or loss of bodyweight (INRA, 1989). In this system, net energy requirement is defined in terms of unites fourragere lait (UFL), where 1 UFL is the net energy value of 1 kg of barley at 86 per cent dry matter and is equal to 7.11 MJ net energy for lactation (NEl). This international energy system, which is well established and used locally in Ireland, was considered more appropriate to the local conditions than the system and equations used by the IPCC guidelines and IPCC good practice guidance. The energy gains and losses refer to intra-annual changes for the animal and do not mean that average body weight for animals in the dairy herd is increasing from year to year. The live-weight of 535 kg for dairy cows is an indicative weight supplied by the Department of Agriculture, Food and the Marine, as dairy cow live-weights are not in general monitored on farms. The live-weight is adopted as the reference point for the annual emission factor derivation for the herd and is chosen to be consistent with other parameters relevant to the estimation of emissions from cattle, e.g. manure production.* *For beef cattle, analysis is undertaken for a total of 11 separate production systems covering the three groups of male and female beef cattle. Important parameters such as housing dates (expert opinion and Hyde et al., 2008), turnout dates (expert opinion and Hyde et al., 2008) and live-weight gains (expert opinion reconciled with actual national carcass weights) during winter housing periods and grazing seasons are defined for each system (O'Mara, 2006). Using data for the average carcass weight of male and female cattle, appropriate live -weight gains are applied to the various life stages of each animal category, such that when all categories are combined, that data is consistent with the national statistics for carcass weight (plus or minus 10 kg difference). Given data for liveweight and liveweight gain, energy requirements of animals were estimated during the winter housing periods and grazing seasons of the animal's lifetime using the INRAtion computer programme, version 3.0 (incl. adaptions to Irish conditions). This programme is devised by the French research organisation INRA, and is based on the net energy system for cattle.* *Bulls for breeding are mostly of continental breeds, and their emission factors are based on those for late*

Member State	Emission Factor and other parameters
	maturing male beef cattle of suckler origin in their second year. *In-calf heifers are assigned the same emission factors as female beef cattle in their second year (i.e. corresponding to the category 1–2 years old). In-calf heifers only require emissions associated with the period March – December of their second year to be accounted for, as they are subsequently enumerated as dairy or suckler cows in the CSO animal census thereafter.* *Other livestock: default EF adjusted on the basis of animal weight (resulting on lower values for sheep and swine than IPCC default).*
Italy	*Data to calculate the emission factor from dairy and non-dairy cattle are national (ISTAT, Centro Ricerche Produzioni Animali, Reggio Emilia - CRPA). This information has been discussed in a specific working group in the framework of the MidetAIRaneo project (CRPA, 2006; CRPA, 2005). The emission factor for buffalo has been calculated by Condor et al. (2006). The emission factor for rabbits is national.*
Luxembourg	*For the Tier 1 method, default GE are usually provided in the IPCC Guidelines. For the Tier 2 method, GE is the combination of various feed intake – or net energy – estimates relating to maintenance, activity, growth, etc. of the animals.*
Netherlands	*Country specific Tier 2 for cattle. The emission factors for three cattle types are calculated annually (e.g. adult dairy, adult non-dairy and young cattle, respectively). For swine, sheep, goats and horses, default IPCC emission factors are used. The increased milk production per cow is the result of both genetic changes (due to breeding programmes for milk yield) as well as the increase in feed intake and higher feeding quality of cattle diets. Specific model predicts the methane emission factor for mature dairy cattle (Bannink, 2011).*
Portugal	*Default EF for horses, mules and asses, due to the unavailability of a more detailed livestock characterization and specific characterization of national populations. In accordance with the unavailability of emissions factors in IPCC96 for broilers, laying hens, turkeys, ducks, geese, guinea fowl and other poultry, emissions from these classes were not estimated and were assumed as negligible.*
Spain	*Animal characterization and digestibility are obtained according to UPV (2006). Milk and wool production and number of births obtained from statistics by breed. For cattle and swine a Tier 3 methodology has been developed (MAGRAMA, 2010) on the basis of the feed and energy requirement balances defining a typical feed composition. Similar tier 3 approach for poultry, but the lack of reliable data for Ym parameter has prevented the calculation of emissions of these animals.*
Sweden	*A national methodology based on feed energy requirements expressed as metabolisable energy is used in the Swedish inventory to estimate emission factors for dairy cows, beef cows and other cattle. The calculations for dairy cows were revised some years ago. The emission factors for other cattle groups were also re-evaluated, using the same methodology. The initial step in estimating emission factors for cattle according to the Swedish method is enhanced characterisation of feed intake estimates (Tier 2 methodology). The energy requirements for maintenance, growth, lactation and pregnancy are estimated, but expressed as metabolisable energy (MJ/day) instead of as net energy. The metabolisable energy requirement is then recalculated to digestible energy. A lactation period of 305 days and a non-lactating period of 60 days was used (Bertilsson, 2002; Nieminen, 1998). The default values in the IPCC Guidelines are used for the less significant animal groups. Reindeer: according to IPCC GPG (Tier 2) and using a Finnish value of gross energy requirements.*
United Kingdom	*Apart from cattle, lambs and deer, the methane emission factors are IPCC Tier 1 defaults. The emission factor for lambs is assumed to be 40% of that for adult sheep (Sneath, 1997). The UK emission factor for deer is based on Sneath et al. (1997). A country-specific value (75%) for the digestibility of feed (DE), value is based on typical diets for cows over the lactating and non-lactating period, combining forage and concentrates, with energy values for the various feeds according to MAFF (1990) (Bruce Cottrill, ADAS, pers. comm.). The forage component represents 62% of annual dietary dry matter intake (consist of fresh grass (grazed), grass silage and maize silage, in the ratio 4:4:1, with a weighted average DE value of approximately 72%). The constituents of the concentrate feed are assumed to be barley grain, sugar beet pulp (molasses), wheat feed, wheat grain, rapeseed meal, soya bean meal and sunflower meal, with a weighted average DE value of approximately 82%. The overall weighted average DE value for the diet is therefore estimated as 75%.*

Milk productivity is one of the most important factors determining the level of CH_4 emissions from dairy cattle. Several countries have reported milk productivity, which are reproduced in Table 6.20 and Table 6.21 beside information on feed intake, animal weight, and feed digestibility. The data show clearly that a strong intensification of cattle husbandry occurred, with increases in the milk yield ranging from 24% (Ireland) to 116% (Spain) between 1990 and 2012. This is thus more than the increase in the CH_4 emission factor. The increased production was only partly achieved by increased energy intake (up to a maximum of 38%, but some countries report also a stable feed intake), and partly by an improved feed efficiency. This is expressed in the feed digestibility, which for some countries increased by up to 7%, however it must be kept in mind that most countries do not estimate a time-varying feed digestibility (only 5 do, compared to 14 countries which report a time-dependent milk productivity). Higher feed digestibility reduces the portion of carbon intake that is transformed to methane in ruminants. As the feed intake increase is smaller than the increase in milk productivity (for EU-15 the numbers are 24% and 51%, respectively), the feed quality and consequently also the feed digestibility increase most probably in more countries. Given that emission calculations are based on milk production, this suggests that these countries tend to overestimate the increase in methane emissions from enteric fermentation of dairy cattle. Calculating the average for those countries which have reported data, the milk yield was higher by 11% than the default value for Western Europe (11.5 kg/day) in 1990, and increased to a level which was 68% above IPCC default in 2012. Even though feed digestibility for dairy cattle was not separately estimated for each year by all countries, the level is 19% to 20% above IPCC default digestibility (60%).

Table 6.20: Additional background information for calculating CH_4 emissions from enteric fermentation from dairy cattle. Data for the year 2012.

Member State	Dairy Cattle			
2012	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	302	700	18	71
Belgium	336	600	21	75
Denmark	344	580	23	71
Finland	331	649	22	70
France	297	NA	19	NA
Germany	321	646	20	75
Greece	275	600	16	65
Ireland	245	535	14	75
Italy	295	603	18	65
Luxembourg	306	650	20	70
Netherlands	335	NA	NA	NA
Portugal	308	600	22	73
Spain	310	647	21	70
Sweden	321	NA	24	69
United Kingdom	281	637	20	75
EU-15	305	624	19	72

Member State	Dairy Cattle			
1990	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	247	700	10	66
Belgium	261	600	11	75
Denmark	278	550	17	71
Finland	253	520	16	70
France	242	NA	13	NA
Germany	260	608	13	73
Greece	199	600	7	65
Ireland	222	535	11	75
Italy	240	603	12	65
Luxembourg	247	650	13	70
Netherlands	280	NA	NA	NA
Portugal	227	600	12	73
Spain	225	598	10	69
Sweden	276	NA	19	69
United Kingdom	222	572	14	75
EU-15	247	595	13	71

Information source: CRF for 1990 and 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Table 6.21: Additional background information for calculating CH_4 emissions from enteric fermentation from non-dairy cattle. Data for the year 2012.

Member State 2012	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	142	421	NO	73
Belgium	121	390	5	76
Denmark	130	320	NO	71
Finland	116		NA	70
France	119	433	NA	NA
Germany	109	378	NE	73
Greece	124	415	0.1	65
Ireland	126	335	8	75
Italy	143	388	NA	NA
Luxembourg[2)]	107	353	NA	64
Netherlands[2)]	94	NE	NE	NE
Portugal	150	403	3	62
Spain	123	434	4	72
Sweden	181	NA	NE	69
United Kingdom	NE	NE	NE	NE
EU-15	122	401	5	72

Member State 1990	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	123	364	NO	74
Belgium	109	762	5	76
Denmark	107	290	NO	71
Finland	89		NA	70
France	116	428	NA	NA
Germany	106	348	NE	73
Greece	120	382	0.1	65
Ireland	132	349	8	75
Italy	141	376	NA	NA
Luxembourg[2)]	104	322	NA	64
Netherlands[2)]	98	NE	NE	NE
Portugal	138	355	2	62
Spain	124	395	4	67
Sweden	181	NA	NE	69
United Kingdom	NE	NE	NE	NE
EU-15	118	399	5	72

Information source: CRF for 1990 and 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head. 2) Numbers calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

Trends

Animal population. In all countries, the numbers of cattle and sheep are considerably reduced since 1990, on the average by 33% for dairy cattle and 12% for non-dairy cattle, and by 27% for sheep. An increase in the number of cattle has only been observed in the category of non-dairy cattle in Spain (46%), Portugal (29%), Greece (15%), Ireland (2%) and Sweden (1%). Largest decrease of the number of dairy cattle occurred in Luxembourg (2012 at 34% of the 1990 level). For non-dairy cattle, largest decrease occurred in Netherlands (2012 at 39% of the 1990 level).

The picture is a little bit different for the categories goats and swine, as some countries have encountered a significant increase of the populations, for example the goat population in Belgium in 2012 has increased by 300% compared to 1990; in the Netherlands this figure amounts to 553%. However, due to a decrease of the goat number in other countries with a high population (mainly Spain with 2,637,000 heads in 2012), the goat population at EU-15 level was rather stable (2012 at 87% of 1990-level).

The swine population increased especially in Denmark (30%), Spain (62%), and Ireland (25%), but this was balanced from reductions in other countries. Poultry numbers saw a slight increase of 13% in EU-15; only Austria and Luxembourg reported CH_4 emissions from enteric fermentation of poultry.

The trend in animal numbers is to a large extent influenced by EU policy such as suckler cow premia, milk quota, but also environmental legislation linked to agricultural policy through cross-compliance and rural development. Animal development is also determined by epidemics such as the avian flu (reducing e. g. the number of poultry in the Netherlands in 2003), the BSE crisis between 2001 and 2003. Further examples for driving forces of the observed trends are given in Table 6.22 below.

Implied emission factor. At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 103 kg CH_4 $head^{-1}$ yr^{-1} to 123 kg CH_4 $head^{-1}$ yr^{-1} while at the same time the animal number of dairy cattle decreased by 33%, resulting in a decrease of European CH_4 emissions from enteric fermentation in the category of dairy cattle by dairy cattle.

Changing IEFs, however, are not necessarily due to a changing (assumed) productivity of non-dairy cattle sub-categories, but can rather be the consequence of a different composition of non-dairy cattle

(e. g. ratio of heifers to young cattle) with different implied emission factors. Nevertheless, the IEF for non-dairy cattle was more stable than that for dairy cattle and changed only by 2% between 1990 and 2012 from 45.6 kg CH_4 $head^{-1}$ yr^{-1} to 46.7 kg CH_4 $head^{-1}$ yr^{-1}.

For sheep, the implied emission factors changed since 1990 in 6 countries, but stayed close to the 1990-value for EU-15 aggregate. Finland, Ireland, France, Portugal and Spain saw an increase of the IEF for sheep between by 2% and 23%.

Figure 6.4 through Figure 6.16 show the trend in the activity data for the key source in the category of enteric fermentation as well as the trend of one important indicator for animal productivity, the average daily gross energy intake for dairy and non-dairy cattle and sheep. The trend of the populations of swine, goat, and poultry are included as well. Table 6.22 gives additional information on the trend in category 4A as reported in the national inventory reports.

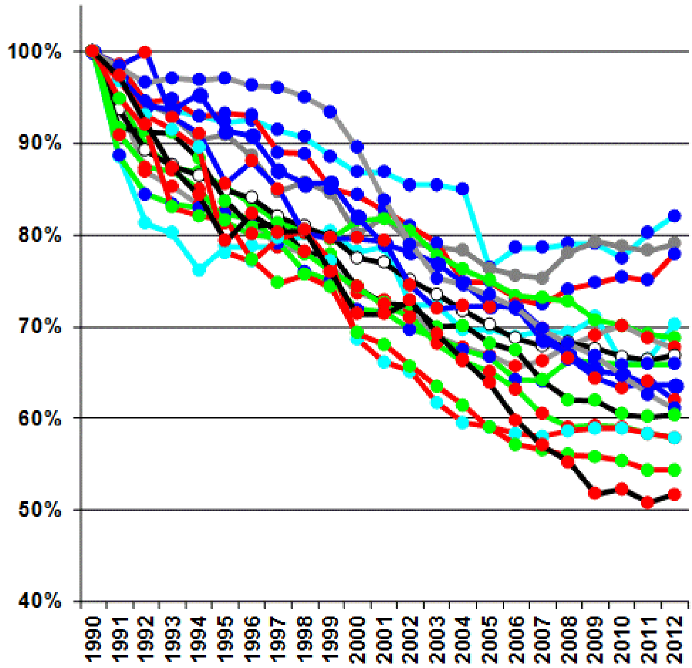
Table 6.22: Available background information on the trend for CH_4 emissions in category 4.A.

Member State	***Trend in category 4A***
Austria	*Up to the early 1990s Austrian dairy husbandry was determined by traditional Austrian green feeding and traditional Austrian races. From the mid 1990s onwards milk production has been intensified: diets with higher energy concentration were fed and the share of high yield breeds (e.g. Holstein Friesian) in dairy farming was increased.* *Cattle: From 1990 onwards: The continuous decline of dairy cattle numbers is connected with the increasing milk yield per cow: For the production of milk according to Austria's milk quota every year a smaller number of cows is needed. 1995: The financial support of suckling cow husbandry increased significantly in 1995 when Austria became a Member State of the European Union. The husbandry of suckling cows is used for the production of veal and beef; the milk yield of the cow is only provided for the suckling calves. Especially in mountainous regions with unfavourable farming conditions, suckling cow husbandry allows an extensive and economic reasonable utilisation of the pastures. Suckling cow husbandry contributes to the conservation of the traditional Austrian alpine landscape. 1996–1998: The market situation affected a decrease in veal and beef production, resulting in a declining suckling cow husbandry. Farmers partly used their former suckling cows for milk production. Thus, dairy cow numbers slightly increased at this time. Reasons are manifold: Changing market prices, BSE epidemic in Europe and change of consumer behaviour, milk quota, etc.* *Swine: 1998–2000; 2006–2008: increasing/ decreasing swine numbers: The production of swine has a high elasticity to prices: Swine numbers are changing due to changing market prices very rapidly. Market prices change due to changes in consumer behaviour, saturation of swine production, epidemics, etc.*
Belgium	*In Belgium, there is the trend of disappearance of small businesses, also reinforced by the BSE crises. This affected only swine in 2001 and 2002, but in 2003 also bovine animals and poultry. Additionally in Flanders, this can be partly explained due to the subsidized cut down of the number of cattle. Nevertheless the land area used for agricultural purposes remained identical during this period. In 2005 Wallonia was 55% of the land used for agriculture, but 67% of agricultural businesses were situated in Flanders. The land area used for farming is on average 19 ha per farm in the Flemish region and 47 ha per farm in the Walloon region.*
Denmark	*The increase in the IEF for dairy cattle from 1990-2007 is the result of increasing feed consumption due to rising milk yields. On average, the milk yield has increased from 6200 litre per cow per year in 1990 to approximately 8600 litre per cow per year in 2007 (Statistics Denmark). The interannual increase of methane IEF for non-dairy cattle in 2008/2009 is 7%. This is due to an increase in the number of heifers >½ year, which have a relatively high EF.*
Finland	*Following the inclusion of Finland in the EU, emissions from the agricultural sector decreased by 12% (period 1990-2011) due to changes in the economic structure of the sector. There was a decrease in the number of farms, and increase of their size and a reduction in livestock numbers except for horses. Inter-annual variations on animal numbers are due to the agricultural policy and subsidies.* *The IEF for sheep is calculated annually on the basis of forage consumption and the number of animals (lambs and ewes separately). Thus, next to the relative numbers of lambs and ewes, changes in the diet are reflected in the IEF, which lead to an inter-annual fluctuation of the emissions.*
France	
Germany	*The reduction of animal numbers since 1990, and in particular between 1990 and 1991 is a consequence of the German unification causing a change in consumer behaviour. At the same time, animal performance (calculated for cattle and swine) increased.* *Cattle: since 2008 data are from HIT; which showed to be 2.9% higher than previous numbers. As a consequence, the emissions for the years before 2008 are slightly under-estimated.* There is some inconsistency in the time series of animal numbers in Germany due to the modification of the "Agrarstatistikgesetzes" with a rupture between 1998 and 1999. This applies particularly to sheep and horses, for both animal categories an

Member State	Trend in category 4A
	approach for correction has been developed and applied (Daemmgen, 2006). *Buffalo: Buffalo has been kept in Germany since 1996. In 1990, their population was zero. They are therefore not reported for the whole time series*
Greece	
Ireland	*Increased beef population is explained by the earlier finishing time for male beef cattle since the BSE crisis that affected agriculture during the 1990s.* *2010 was a particularly good year for Irish agriculture. Milk yield per cow increased by 8% from 4946 kg milk per cow to 5322 kg per cow. As a consequence, the IEF of methane EF dairy cattle increased between 2009 and 2010 by 3%.*
Italy	*Between 2011 and 2012 there was a shift in the number of heads of the different subcategories of the non-dairy cattle category causing an increase of the IEF by 5%.* *The average daily milk production increased from 2009 to 2010 (from 17.4 to 18.7 kg/head/day) and leading thus to a significant increase of the IEF for dairy cattle by 4%.*
Luxembourg	
Netherlands	*Decreases in emissions from cattle with a decrease in numbers and an increase in milk production per dairy cow, resulting in an unchanged total milk production. Milk production per cow increased significantly since 1990, a development which has resulted from both genetic changes in cattle (due to breeding programmes) and the change in amount and composition of feed intake. Total milk production in the Netherlands is determined mainly by EU policy on milk quota. Milk quota remained unchanged in the same period. In order to comply with the unchanged milk quota, animal numbers of (dairy) cattle had to decrease to counteract the effect of increased milk production per cow. The numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease (Van Schijndel and Van der Sluis, 2008). Goat numbers increased by a factor 5 and horse numbers nearly doubled in this period. The increase in the number of goats might be explained as an effect of the milk quota for cattle.* *The increased number of swine in 1997 was a direct result of the outbreak of classical swine fever in that year. In areas where this disease was present, the transportation of pigs, sows and piglets to the slaughterhouse was not allowed, so the animals had to remain on the pig farms for a relatively long period (accumulation of pigs).* *An increase in the number of poultry is observed between 1990 and 2002. In 2003 however, poultry numbers decreased by almost 30% as a direct result of the avian flu outbreak. In the years afterwards the population recovered, reaching a level only slightly below the 2002 number in 2011.*
Portugal	*Decrease in dairy cows, consistent with the increase in productivity and the limits imposed by the EU on milk quotas.* *Data from National Statistics show a decrease in net stripped weight per animal from 2007 to 2008 causing an inter-annual decrease in emission factor for sheep by 5%.*
Spain	*Inter-annual variation in the emissions from enteric fermentation of sheep due to changes in the composition of the herd; the IPCC sheep categories correspond to 8 different categories in the Spanish livestock inventory, and for each of those categories an emission factor has been calculated. Inter-annual variations in sheep emissions are due to these different categories and how weights are assigned from the national EFs to meet the categories defined by the IPCC.*
Sweden	*Decrease of agricultural land since Sweden joined the EU. Livestock is mainly focused on milk production and crops are grain and fodder crops. Increase of organic farming from 6% in 1995 to 17% in 2010.*
United Kingdom	*In 2005, the "Over Thirty Month" rule was lifted, which is a measure to control the exposure of humans to the disease BSE. As a consequence, the slaughter weights increased from 238 kg in 2004 to 343 kg in 2005 (increase of 44%). This led to an increase of the CH_4 emission factor for enteric fermentation from 97.7 to 112.7 kg CH_4/head/year.*

Figure 6.4: Trend of activity data (population) for dairy cattle.

Dairy cattle: Population (1000 head)



	1990	2012	Trend (%) 1990-2012
Ireland	1,341	1,101	82%
Netherlands	3,755	2,968	79%
Denmark	753	587	78%
Italy	2,642	1,857	70%
France	5,310	3,651	69%
Luxembourg	118	80	68%
EU-15	26,211	17,536	67%
Germany	6,355	4,190	66%
United Kingdom	2,848	1,812	64%
Greece	212	131	62%
Portugal	394	241	61%
Sweden	576	348	60%
Finland	490	284	58%
Austria	905	523	58%
Belgium	839	455	54%
Spain	1,611	832	52%

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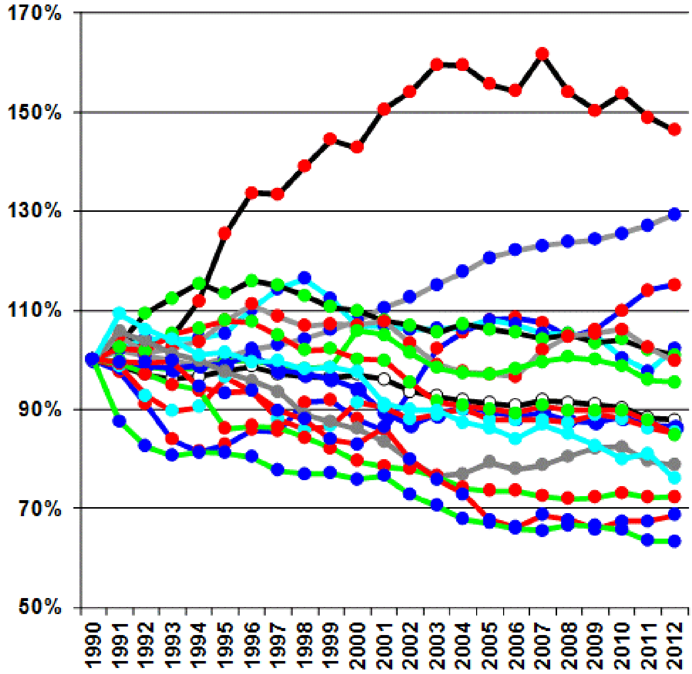
Figure 6.5: Trend of activity data (population) for non-dairy cattle.

Non-dairy cattle: Population (1000 head)



	1990	2012	Trend (%) 1990-2012
Spain	3,471	5,077	146%
Portugal	978	1,265	129%
Greece	479	552	115%
Ireland	5,481	5,609	102%
Sweden	1,142	1,152	101%
Luxembourg	186	186	100%
France	16,211	15,491	96%
EU-15	65,001	57,108	88%
United Kingdom	9,344	8,089	87%
Austria	1,679	1,432	85%
Belgium	2,410	2,046	85%
Netherlands	3,168	2,494	79%
Italy	5,110	3,886	76%
Finland	870	629	72%
Denmark	1,486	1,020	69%
Germany	13,133	8,316	63%

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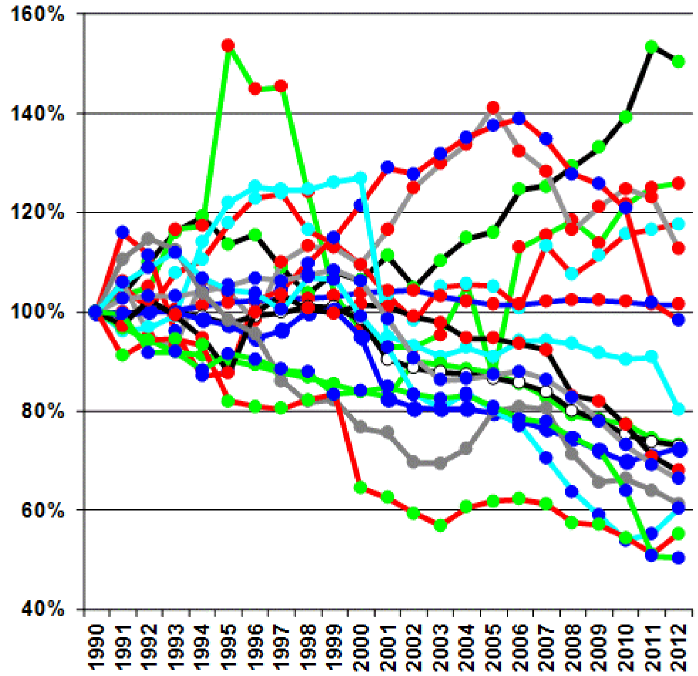
Figure 6.6: Trend of activity data (population) for sheep

Sheep: Population (1000 head)



	1990	2012	Trend (%) 1990-2012
Sweden	406	611	150%
Finland	103	130	126%
Austria	310	365	118%
Luxembourg	7	8	113%
Greece	8,692	8,813	101%
Denmark	92	90	98%
Italy	8,739	7,016	80%
France	11,513	8,435	73%
EU-15	114,812	83,820	73%
United Kingdom	44,469	32,215	72%
Spain	24,037	16,339	68%
Portugal	3,262	2,163	66%
Netherlands	1,702	1,043	61%
Ireland	8,021	4,843	60%
Belgium	192	106	55%
Germany	3,266	1,643	50%

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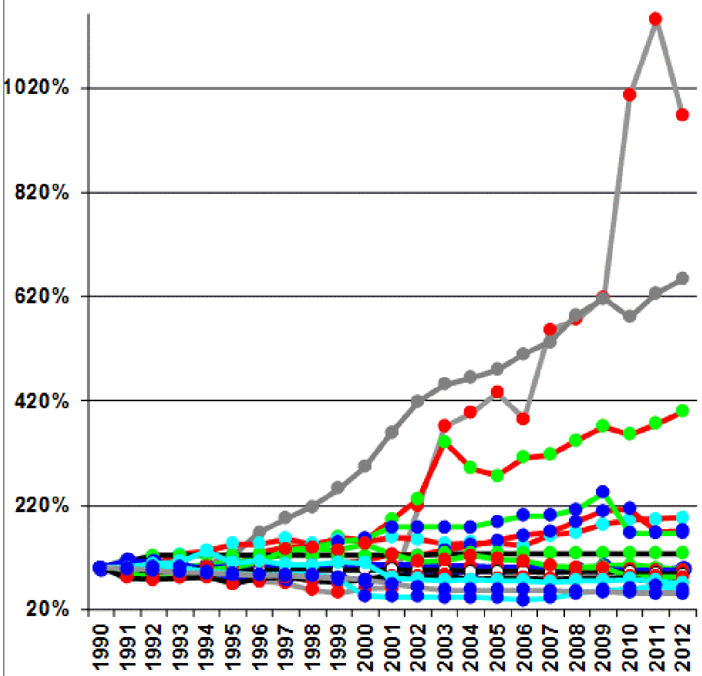
Figure 6.7: Trend of activity data (population) for goats

Goats: Population (1000 head)



	1990	2012	Trend (%) 1990-2012
Luxembourg	1	5	968%
Netherlands	61	397	653%
Belgium	9	35	400%
Austria	37	73	196%
Denmark	7	13	171%
Germany	90	150	167%
Sweden	4	6	128%
United Kingdom	98	98	100%
France	1,449	1,384	96%
Greece	5,339	5,089	95%
EU-15	12,850	11,205	87%
Finland	6	5	83%
Spain	3,663	2,637	72%
Italy	1,259	892	71%
Ireland	17	10	59%
Portugal	810	412	51%

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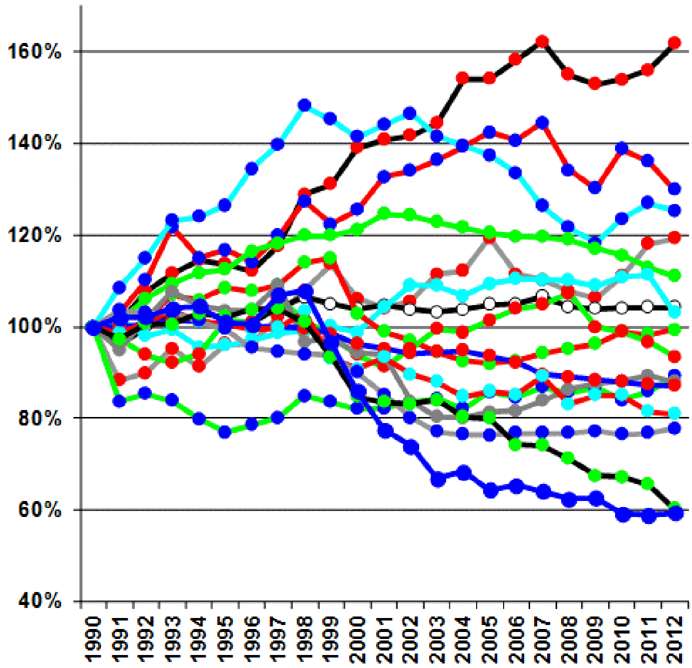
Figure 6.8: Trend of activity data (population) for swine

Swine: Population (1000 head)



	1990	2012	Trend (%) 1990-2012
Spain	16,371	26,482	162%
Denmark	9,497	12,331	130%
Ireland	1,222	1,532	125%
Luxembourg	75	90	119%
France	12,461	13,838	111%
EU-15	113,561	118,429	104%
Italy	8,407	8,662	103%
Belgium	6,700	6,656	99%
Finland	1,381	1,290	93%
Germany	26,502	23,648	89%
Netherlands	13,915	12,234	88%
Greece	994	866	87%
Austria	3,688	2,983	81%
Portugal	2,535	1,973	78%
Sweden	2,264	1,363	60%
United Kingdom	7,548	4,481	59%

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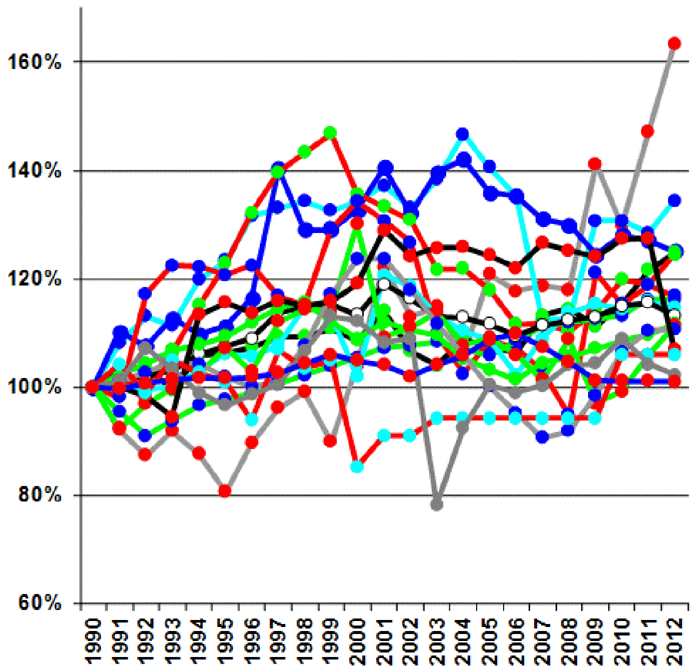
Figure 6.9: Trend of activity data (population) for poultry

Poultry: Population (1000 head)



	1990	2012	Trend (%) 1990-2012
Luxembourg	69	113	163%
Ireland	11,413	15,342	134%
United Kingdom	127,952	160,061	125%
Sweden	14,222	17,758	125%
Belgium	27,167	33,826	125%
Denmark	16,249	18,991	117%
Germany	113,879	132,344	116%
Italy	173,342	198,768	115%
EU-15	1,056,398	1,196,519	113%
France	268,791	299,857	112%
Finland	9,663	10,761	111%
Portugal	30,891	34,164	111%
Spain	125,292	133,859	107%
Austria	13,821	14,644	106%
Netherlands	94,902	97,016	102%
Greece	28,747	29,016	101%

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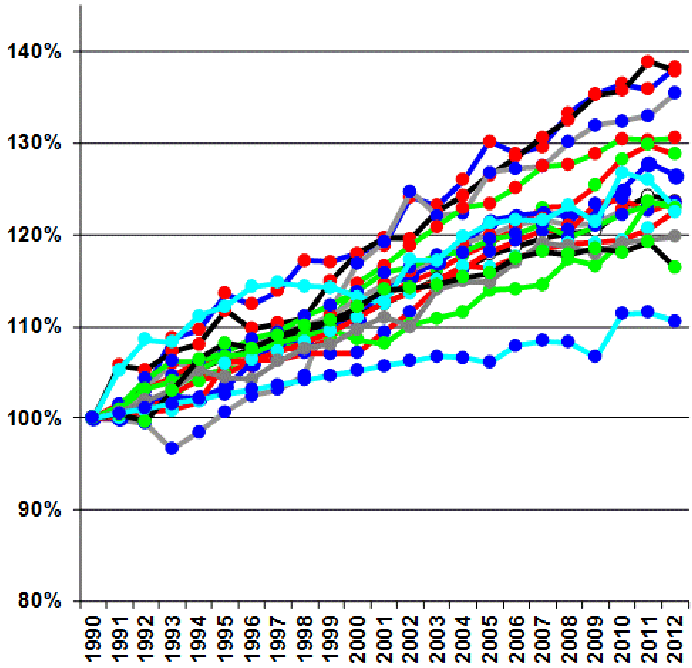
Figure 6.10:. Trend of activity data (gross energy intake) for dairy cattle.

Dairy cattle: Average gross energy intake (GE) (MJ/head/day)



	1990	2012	Trend (%) 1990-2012
Greece	199	275	138%
Spain	225	310	138%
Portugal	227	308	135%
Finland	253	331	131%
Belgium	261	336	129%
United Kingdom	222	281	126%
EU-15	247	305	124%
Luxembourg	247	306	124%
Denmark	278	344	124%
Germany	260	321	124%
Italy	240	295	123%
France	242	297	123%
Austria	247	302	122%
Netherlands	280	335	120%
Sweden	276	321	116%
Ireland	222	245	111%

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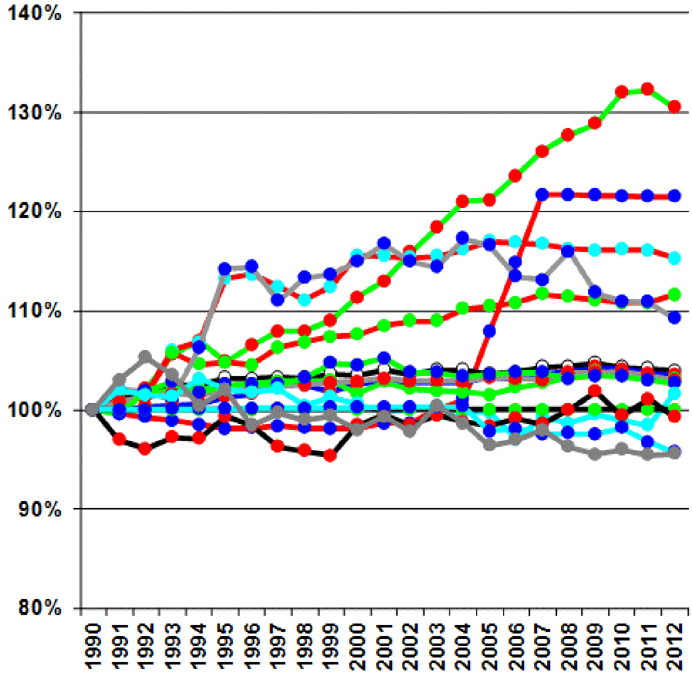
Figure 6.11: Trend of activity data (gross energy intake) for non-dairy cattle.

Non-dairy cattle: Average gross energy intake (GE) (MJ/head/day)



	1990	2012	Trend (%) 1990-2012
Finland	89	116	131%
Denmark	107	130	121%
Austria	123	142	115%
Belgium	109	121	112%
Portugal	138	150	109%
EU-15	118	122	104%
Greece	120	124	103%
France	116	119	103%
Luxembourg	104	107	103%
Germany	106	109	103%
Italy	141	143	102%
Sweden	181	181	100%
Spain	124	123	99%
Ireland	132	126	96%
Netherlands	98	94	96%
United Kingdom			

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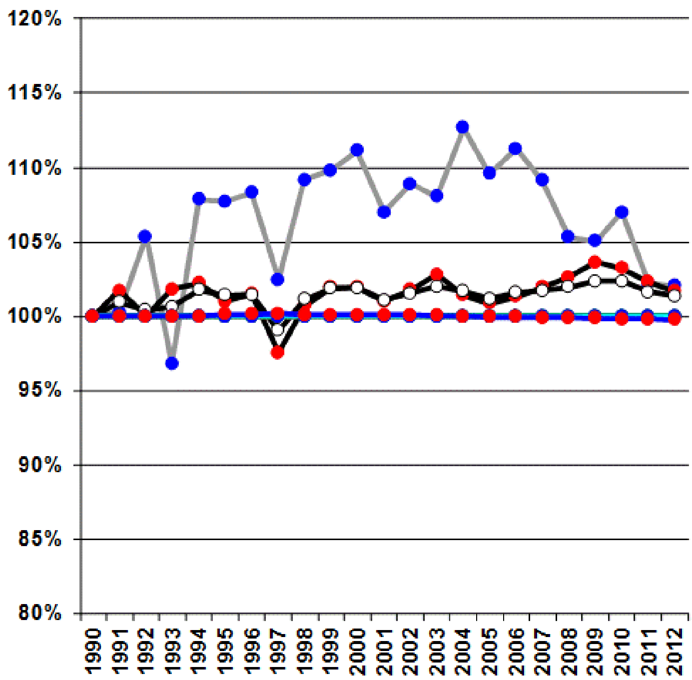
Figure 6.12: Trend of activity data (gross energy intake) for sheep

Sheep: Average gross energy intake (GE) (MJ/head/day)



	1990	2012	Trend (%) 1990-2012
Portugal	22	22	102%
Spain	19	19	102%
EU-15	20	20	101%
Denmark	44	44	100%
Austria	20	20	100%
Luxembourg	20	20	100%
Germany	20	20	100%
Sweden	20	20	100%
Ireland	20	20	100%
Greece	21	21	100%
Finland			
Belgium			
France			
Italy			
Netherlands			
United Kingdom			

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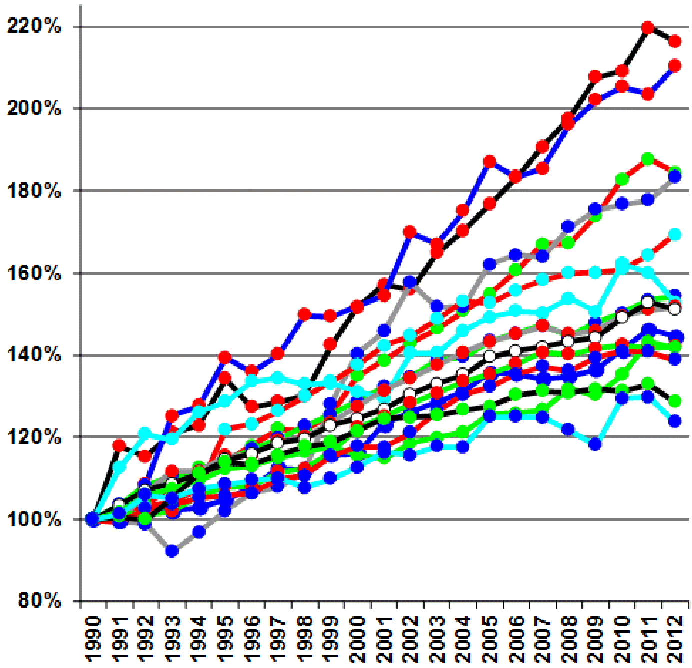
Figure 6.13: Trend of activity data (milk productivity) for dairy cattle

Dairy cattle: Milk yield (kg/head/day)



	1990	2012	Trend (%) 1990-2012
Spain	9.9	21.4	216%
Greece	7.5	15.8	210%
Belgium	11.2	20.6	184%
Portugal	12.2	22.4	183%
Austria	10.4	17.6	169%
Germany	12.9	19.9	154%
Italy	11.5	17.6	153%
Luxembourg	13.1	19.9	152%
EU-15	12.8	19.3	151%
United Kingdom	14.1	20.4	145%
Finland	15.7	22.2	142%
France	13.1	18.5	142%
Denmark	16.5	22.9	139%
Sweden	18.6	23.9	129%
Ireland	11.5	14.2	124%
Netherlands			

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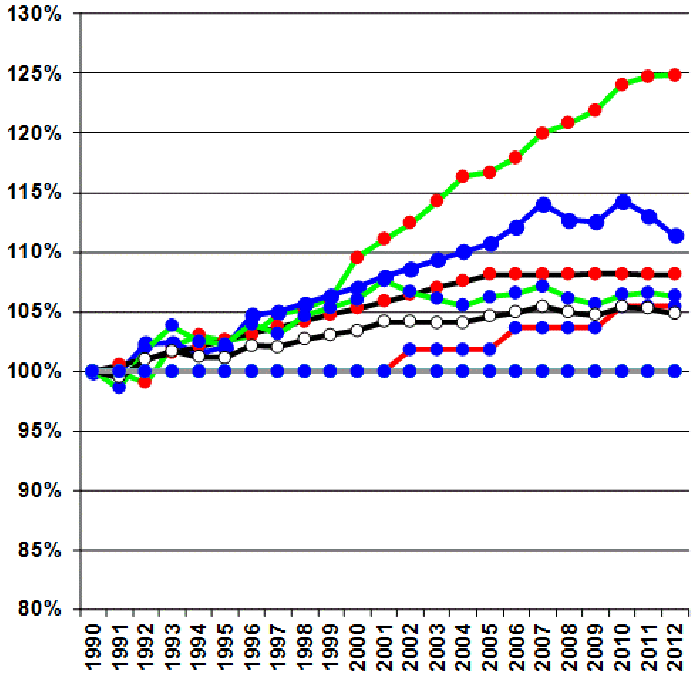
Figure 6.14: Trend of livestock characterisation: animal mass for dairy cattle

Dairy cattle: Typical animal mass (kg)



	1990	2012	Trend (%) 1990-2012
Finland	520	649	125%
United Kingdom	572	637	111%
Spain	598	647	108%
Germany	608	646	106%
Denmark	550	580	105%
EU-15	595	624	105%
Belgium	600	600	100%
Sweden	600	600	100%
Austria	700	700	100%
Luxembourg	650	650	100%
Ireland	535	535	100%
Italy	603	603	100%
Portugal	600	600	100%
France			
Greece			
Netherlands			

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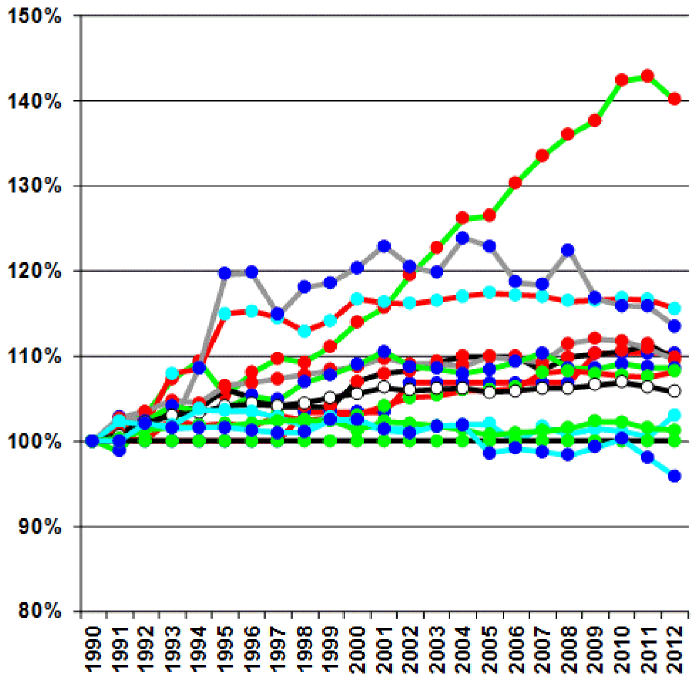
Figure 6.15: Trend of livestock characterisation: animal mass for non-dairy cattle

Non-dairy cattle: Typical animal mass (kg)



	1990	2012	Trend (%) 1990-2012
Finland	278	390	140%
Austria	364	421	116%
Portugal	355	403	114%
Denmark	290	320	110%
Spain	395	434	110%
Luxembourg	322	353	110%
Germany	348	378	109%
Belgium	381	412	108%
EU-15	383	405	106%
Italy	376	388	103%
France	428	433	101%
Sweden	550	550	100%
Ireland	349	335	96%
United Kingdom			
Greece			
Netherlands			

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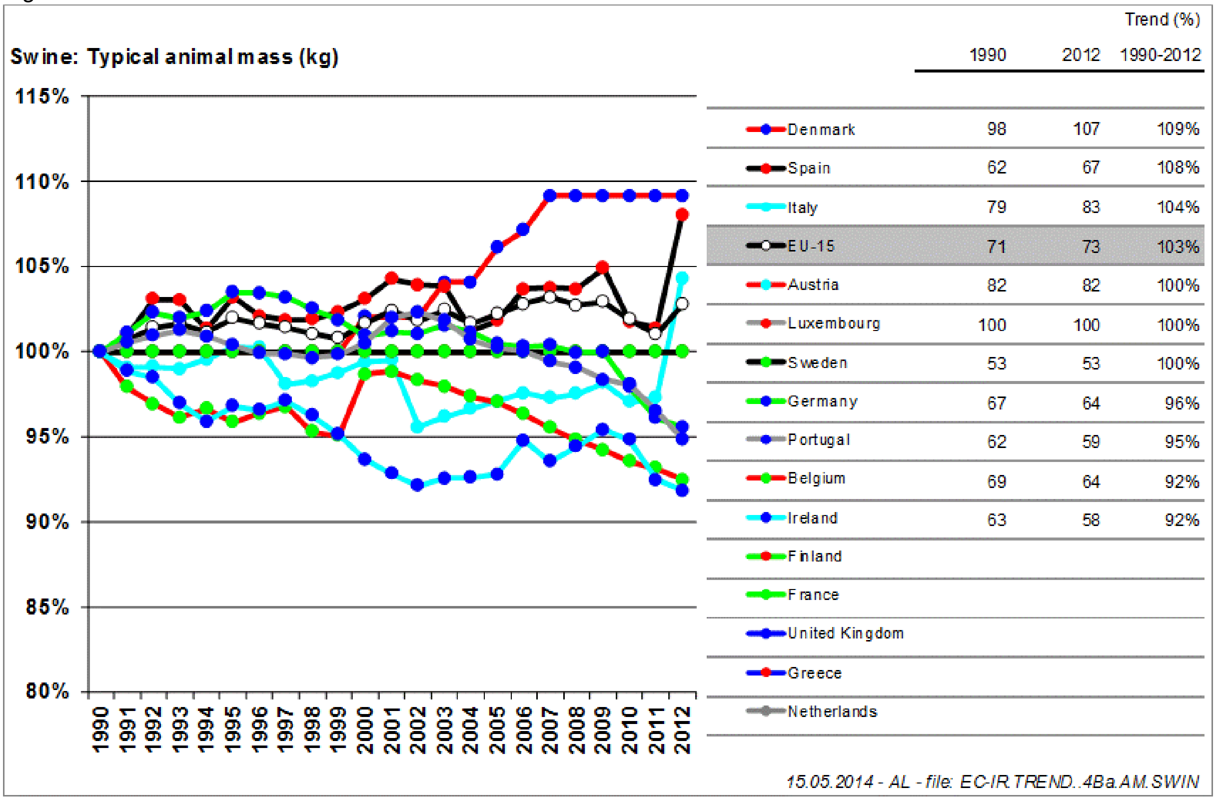
Figure 6.16: Trend of livestock characterisation: animal mass for swine



6.3.1.3 Uncertainty and time series consistency

CH_4 emissions from enteric fermentation belong to the source categories in agriculture, which are less uncertain. Animal numbers are assumed to be correct with a maximum uncertainty of 20%, and also the emission factor, which is calculated to a large extent with the Tier 2 methodology, is estimated to be known with a precision better than 20% for most countries, with 40% being the highest uncertainty estimate (Belgium and France) for cattle and 50% (Portugal) for other animal types. One exception is the high uncertainty assigned to some animal types (mules and asses, poultry and rabbit) in Portugal. The absence of statistic numbers for poultry, the need to estimate a time-series based on surrogate drivers, and the prevalence of dispersed animals in small farms, naturally causes higher uncertainty values for these animals. Finally, animals that are usually not considered as meat, such as equines, are less controlled and numbers tend to be known with less rigour.

The contribution of enteric fermentation to the overall inventory uncertainty is 1% or less for all countries. For the EU-15 aggregate its contribution is 0.3%.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.23 and Table 6.24. An overview of uncertainty estimates for agriculture at country and EU-15 levels will be given in Section 6.4. Note that some countries (Finland) are using Tier 2 methodology for combining uncertainty estimates in agriculture at a much finer level of disaggregation and thus do not report AD and EF uncertainty estimates separately. Instead, due the combined uncertainty estimate is reported also in the cells for the EF uncertainty and the AD uncertainty is set to zero.

Table 6.25 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from enteric fermentation.

Table 6.23: Relative uncertainty estimates for activity data in category 4A

Member State	**Total**	**Cattle**	**Dairy Cattle**	**Non-Dairy Cattle**	**Buffalo**	**Swine**	**Poultry**	**Other**
Austria		10						
Belgium	5		5	5		5		
Denmark	2							
Finland	13							
France	5							
Germany			4	2	4			
Greece	5							
Ireland			1	1				1
Italy	20							
Luxembourg		2						
Netherlands			5	5		5		5
Portugal	6							
Spain	3							
Sweden	2							
United Kingdom	0							

Table 6.24: Relative uncertainty estimates for implied emission factors in category 4A

Member State	**Total**	**Cattle**	**Dairy Cattle**	**Non-Dairy Cattle**	**Buffalo**	**Swine**	**Poultry**	**Other**
Austria		20						
Belgium	20		20	20		20		
Denmark	20							
Finland	13							
France	15							
Germany			40	25	25			
Greece	30							
Ireland			15	15				30
Italy	20							
Luxembourg		20						
Netherlands			15	20		50		30
Portugal	12							
Spain	9							
Sweden	11							
United Kingdom	20							

Table 6.25: Available background information for the uncertainty estimates in category 4.A

Member State	***Background information to uncertainty estimates***
Austria	*Activity Data: Animal numbers, in accordance to Winiwarter (2008) were estimated at 10% uncertainty and considered statistically independent.* *Emission Factor: Uncertainties of emission factors for CH_4 emissions of enteric fermentation, according to Amon et al. (2002) were considered 20% for cattle and sheep (representing ruminants) and 30% for all other animals. EFs are correlated. Uncertainties of CH_4 emissions from Enteric Fermentation were estimated with a “Monte Carlo” simulation. Assuming a normal probability distribution, the calculated standard deviation is 4%. This indicates there is a 95% probability that CH_4 emissions are between +/- 2 standard deviations. Uncertainties considered are Gross Energy Intake, Methane Conversion Factor, Livestock, Share of organic farming, emission factor. Uncertainty in the emission factors for the Tier 2 method are determined by the uncertainty of the gross energy intake and that of the CH_4 conversion rate.*
Belgium	*Activity Data: The only activity data here is the national livestock census. The uncertainty is judged small taken into account the features of the monitoring (census twice a year, individual earmarks and registration for all bovines, …).* *Emission Factor: The emission factors are mainly the IPCC default values, using Tier 1 methodology.*

Member State	*Background information to uncertainty estimates*
	Consequently, the IPCC uncertainty estimate of 40% is used for the emission factor.
Denmark	*Activity Data: Due to the large number of farms included in the norm figures, the arithmetic mean can be assumed as a very good estimate, with a low uncertainty. All cattle have their own ID-number (ear tags) and, hence, the uncertainty in this number is almost non-existent. The Danish Plant Directorate, as the controlling authority, performs analysis of feed sold to farmers. On average, 1600 to 2000 samples are analysed every ear. Uncertainty in the data is seen as negligible. The combined effect of low uncertainty in actual animal numbers, feed consumption and excretion rates gives a very low uncertainty in the activity data. The major uncertainty, therefore, relates to the emission factors.*
Finland	In the agriculture sector, Monte Carlo simulation was applied directly to the calculation parameters of emission calculation models (MTT calculation model and Nitrogen Mass Flow model). The calculated uncertainties by category and GHG were included in the overall uncertainty model of the inventory. The correlations between 1990 and 2012 were also simulated for emissions calculated using the MTT calculation model, whereas correlations in emissions calculated with the Nitrogen Mass Flow model were estimated based on expert judgement. The higher uncertainty values (usually the upper bound of uncertainty range) of simulated AD and IEFs were used as AD and EF uncertainties in Tier 1 method. In the cases in which uncertainty estimates could not be divided between AD and IEF/EF, only emission uncertainty was presented. Activity Data: Uncertainty estimates of animal numbers were based on knowledge on the reliability and coverage of data collection. Cattle has individual earmarks that enable very accurate assessment of animal numbers (uncertainty of ±3%), but uncertainty in animal numbers for other species in farms is higher (±5%). The uncertainty in animal numbers is estimated to be the highest for reindeer (±10%). *Emission Factor: IPCC default uncertainties for emission factors were used excluding reindeer, for which the national emission factor has been used. The uncertainty in the Tier 2 method for evaluating emissions from enteric fermentation of cattle was assessed by estimating uncertainty in each calculation parameter (except coefficients, whose importance was expected to be minor) and combining uncertainties using Monte Carlo simulation. Uncertainty in CH_4 emissions from enteric fermentation of domestic livestock were estimated at -20% to +30% in 2007.*
France	
Germany	*Activity Data: For the IEF for swine, a comparison shows that those countries with an explicit calculation use higher IEF than IPCC default; this suggests that IPCC (1996 and 2006) are not suitable to represent mid-European conditions for swine.* *Emission Factor: The uncertainties in the methane emission factors are on the order of 30 % (EMEP, 2000: Chapter B1040-6). The primary sources of inaccuracy in these figures include the methane conversion factor (for cattle, 0.06 ± 0.005, i.e. 10 %, cf. IPCC, 2006) and the actual federation composition, especially that for cattle.*
Greece	*The uncertainty associated with activity data is 5% according to uncertainty given by NSSG for the livestock population data.* *Uncertainty associated with emission factors is 30% as it is estimated according to Good Practice Guidance.*
Ireland	
Italy	*Montecarlo analysis was also applied to estimate uncertainty.*
Luxembourg	*Activity Data: Animal numbers' uncertainty is estimated between 2% (for cattle, which are extremely well covered due to their inclusion in a register) and 10% for animals distributed over many small farms (sheep, horses, chicken).* *Emission Factor: The uncertainty in CH_4 emission factors for livestock categories (sheep, goats, horses) is reported to be ±20%.*
Netherlands	*Activity Data: For cattle, uncertainty in animal numbers 5% (Olivier et al.,2009),* *Emission Factor: For cattle, uncertainty in emission factor 15% (Bannink, 2009).The uncertainty in the emission factor for swine and other animals is estimated to be 50% and 30%, respectively (Olivier et al.,2009)*
Portugal	*Activity Data: Uncertainty for cattle and swine is lower than for other animal types due to the longer growing priod and to the strong control made on these animals. For sheep and goats, herd numbers are less known due to strong seasonal character of breeding and to significant importance of auto-consumption. Animals not for meat, like horses, are less controlled and numbers tend to be less rigorous. Values of uncertainty were obtained comparing national and FAO statistics (except for sheep). Inconsistency between number of laying hens given by FAO and INE statistics. INE includes animals producing eggs for consumption and eggs used to obtain broilers, as well as poultry kept in domestic rural houses and not only in farms and agro-industries; this explains constant higher numbers in national statistics than the ones reported by FAO. Also for sheep, there is a big difference between FAO and*

Member State	Background information to uncertainty estimates
	national numbers, being FAO always much lower. *Emission Factor: The uncertainty of the emission factor was assumed to be 20 per cent for all animals where tier 2 was used and 50 per cent when tier 1 emission factors were used, in accordance with the Good Practice Guidebook (IPCC, 2000).*
Spain	*Activity Data: Uncertainty in the level of activity is estimated to be 3% (from "Encuestas Ganaderas")* *Emission Factor: For animal categories where tier 1 is used (other than sheep, cattle and swine), default IPCC uncertainty level. For sheep, where tier 2 is used with national parameters, 10% uncertainty is considered. For animals where tier 3 is used, 8% is considered, based on the assumption that the uncertainty will slightly decreased compared to tier 2.*
Sweden	*Activity Data: Methane from enteric fermentation may be a bit more certain with an error of about 30 %.*
UK	*Tier 1 estimation*

The following issues related to time-series consistency are identified for population and IEF data:

- *Austria*

  The FAO agricultural data base provides worldwide harmonized data (FAO Agr. Statistical System 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets.

  1991: A minimum counting threshold for poultry was introduced. Farms with less than 11 poultries were not considered any more. However, the contribution of these small farms is negligible, both with respect to the total poultry number and to the trend. The increase of the soliped population between 1990 and 1991 is caused by a better data collection from riding clubs and horse breeding farms. 1993: New characteristics for swine and cattle categories were introduced in accordance with Austria’s entry into the European Economic Area and the EU guidelines for farm animal population categories. This shift is considered to be insignificant. In the same year “Young swine < 50 kg” were shifted to “Fattening pigs > 50 kg” (before 1993 the limits were 6 months and not 50 kg which led to the shift) causing distinct inconsistencies in time series. Following a recommendation of the Centralized Review 2003, the age class split for swine categories of the years 1990–1992 was adjusted using the split from 1993.

- *Belgium*

  In Flanders from 2000 on another source for animal numbers is used, but a consistency check has been performed. The animal number between Statbel and the manure bank is not exact the same. Statbel collects data on the 1st of May, which means that farmers give the animal number present at the farm at the 1st of May. For the manure bank farmers give the average animal population of the past year.

- *Denmark*

  Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares. Statistics Denmark is the source for the database kept by FAO (Food and Agriculture Organization of the United Nations). This explains why the number of sheep, goats and horses in FAO and the Danish emission inventory disagree. The largest difference is found for horses. Improvements to the documentation of number of horses, sheep and goats on small farms, in cooperation with DAAC, are planned for the 2010 reporting. Since the year 2007, a decision was taken to improving methodology in estimation of animal number to add number of sheep, goats and horses on small farms less than 5 ha.

- *Germany*

  Cattle: since 2008 data are from HIT; which showed to be 2.9% higher than previous numbers. As a consequence, the emissions for the years before 2008 are slightly under-estimated.

  There is some inconsistency in the time series of animal numbers in Germany due to the modification of the "Agrarstatistikgesetzes" with a rupture between 1998 and 1999. This applies particularly to sheep and horses, for both animal categories an approach for correction has been developed and applied (Daemmgen, 2006).

Buffalo: Buffalo has been kept in Germany since 1996. In 1990, their population was zero. They are therefore not reported for the whole time series

- *Sweden*

  The time series in the agricultural sector in Sweden are calculated consistently but the data needed are not always available for every year covered by the inventory. In cases where statistics are not produced annually, interpolation and extrapolation are necessary tools for the imputation of estimates. Methane from enteric fermentation may be a bit more certain with an error of about 30 %.

- *United Kingdom, AD general*

  In the United Kingdom, the time-series consistency of these activity data is very good due to the continuity in data provided. There is an increase in slaughter weight from 2004 (238kg) to 2005 (343kg). This increase was a result of the lifting of the Over Thirty Month rule, which is a measure to control the exposure of humans to the disease BSE.

6.3.2 Manure Management CH_4 (CRF source category 4.B(a))

6.3.2.1 Source category description

During storage and management of manure, CH_4 can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term 'manure' is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. Source category 4.B(a) excludes emissions that originate from burning of manure. The decomposition of manure generates CH_4 under anaerobic conditions (i.e., in the absence of oxygen). These conditions occur most readily when large numbers of animals are managed in a confined area (e.g., dairy farms, beef feedlots, and swine and poultry farms), and where manure is disposed of in liquid-based systems. If manure is managed or treated in liquid systems, it decomposes anaerobically and can produce a significant quantity of CH_4. The temperature and the retention time of the storage unit greatly affect the amount of methane produced.

Table 6.26 shows that at the European level, swine and cattle contribute more or less equally to CH_4 emissions from manure management (50% and 42% of total emissions in category 4B(a), respectively). For cattle, this splits over the contribution of dairy (27%) and non-dairy cattle (24%). The highest contribution of cattle to CH_4 emissions from manure management are observed in Ireland (74%) and Sweden (71%); the lowest in Portugal and Greece, where cattle contribute with only 6% and 11% respectively. In Portugal, this is compensated with the emissions from swine manure with 83% of the total CH_4 from manure management. As also for enteric fermentation, significant emissions from sheep and goat occur in Greece with 33% and 5% of total CH_4 from manure management, respectively. Italy has also the highest contribution of poultry to CH_4 emissions from manure management with 20%.

At the EU-15 level, CH_4 emissions from manure management have decreased for cattle and sheep, and swine, which is mainly due to an intensification of swine production resulting in a higher IEF. Emissions from goats and poultry remained more or less stable.

Table 6.26: Total CH_4 emissions in category 4B(a) and implied Emission Factor at EU-15 level for the years 1990 and 2012

	Dairy Cattle	Non-dairy cattle	Swine
	1990		
Total Emissions of CH_4 [Gg CH_4]	556	518	846
Total Population [1000 heads]	26,211	65,001	113,561
Implied Emission Factor [kg CH_4 / head / year]	21	8	8
	Dairy Cattle	Non-dairy cattle	Swine
	2012		
Total Emissions of CH_4 [Gg CH_4]	509	459	812
Total Population [1000 heads]	17,536	57,108	118,429
Implied Emission Factor [kg CH_4 / head / year]	29	8	7
	Dairy Cattle	Non-dairy cattle	Swine
	2012 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	92%	89%	96%
Total Population [1000 heads]	67%	88%	104%
Implied Emission Factor [kg CH_4 / head / year]	137%	101%	92%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2012, submitted in 2014

Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

6.3.2.2 Methodological Issues

Methods

CH_4 emissions from manure management are a key source category for cattle and swine at EU-15 level. This is true also for many Member States. Table 6.27 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it is reported whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management implies the need to estimate for each animal category the excretion of volatile organic solids (VS) and a maximum methane producing capacity (B_0); furthermore, for each animal category and manure management system, a methane conversion factor must be determined, which is dependent on the climate region. Each country must determine the fractions of the manure managed in all AWMS-climate region combinations. A weighted average of the methane conversion factor over all occurring climate regions must then be calculated for each animal waste management system. The IPCC *Guidelines* list default values for all these parameters. In Table 6.27, we report also the Tier that has been used by the Member States to estimate CH_4 emissions from manure management according to the approach described in section 6.4.1 (see Table 6.87 through Table 6.90).In the case of CH_4 emissions from manure management, a Tier 2 approach was assigned according to the “median-rule” with the weighting factors 0.75, 0.13, and 0.13 for VS, B_0, or MCF, respectively (see Section 6.4.1.2 for details). For the methane conversion factor, we calculated the default value by using the allocation to the different climate regions reported by the countries and multiplying with the respective IPCC value. For the Netherlands, no background data are given, so the level of the method could not be calculated. However, according to the NIR of the Netherlands, a country-specific Tier 2 method has been applied.

Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.4 and Tier 2.0 with a Tier level for EU-15 of Tier 1.8 (corresponding to 85% of the emissions being calculated with country-specific data). This relatively low quality for this source category is due to the fact that countries with a high number of animals have intermediate quality (e.g. because no country-specific estimation of VS has been done).

Some additional information on the methodological approaches for some Member States is given in Table 6.28.

Table 6.27: *Total emissions and contribution of the main sub-categories to CH_4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine. Data for the year 2012.*

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	324	Tier 1.8	31%	Tier 1.9	38%	Tier 1.9	y	23%	Tier 1.9
Belgium	1,401	Tier 1.9	12%	Tier 1.9	9%	Tier 1.9	y	77%	Tier 1.9
Denmark	1,297	Tier 1.9	32%	Tier 1.9	15%	Tier 1.9	y	46%	Tier 1.9
Finland	251	Tier 1.6	36%	Tier 1.9	17%	Tier 1.9	y	41%	Tier 1.2
France	10,110	Tier 1.8	30%	Tier 1.8	27%	Tier 1.8	y	37%	Tier 1.8
Germany	4,954	Tier 2.0	35%	Tier 2.0	29%	Tier 2.0	y	33%	Tier 2.0
Greece	389	Tier 1.4	6%	Tier 1.8	3%	Tier 1.8	y	33%	Tier 1.0
Ireland	2,238	Tier 1.8	21%	Tier 1.8	53%	Tier 1.8	y	18%	Tier 1.9
Italy	1,704	Tier 1.7	15%	Tier 2.0	16%	Tier 2.0	y	39%	Tier 2.0
Luxembourg	89	Tier 1.8	37%	Tier 1.8	21%	Tier 1.8	y	41%	Tier 1.8
Netherlands	2,628	Tier 2.0	51%	Tier 2.0	17%	Tier 2.0	y	29%	Tier 2.0
Portugal	1,036	Tier 1.9	3%	Tier 1.8	4%	Tier 1.8	y	83%	Tier 1.9
Spain	6,941	Tier 1.8	18%	Tier 1.8	4%	Tier 1.8	y	75%	Tier 1.8
Sweden	313	Tier 1.9	22%	Tier 1.9	49%	Tier 1.9	y	15%	Tier 1.9
United Kingdom	6,599	Tier 1.7	25%	Tier 1.9	39%	Tier 2.0	y	27%	Tier 1.2
EU-15	**40,275**	**Tier 1.8**	**27%**	**Tier 1.9**	**24%**	**Tier 1.9**	**y**	**43%**	**Tier 1.8**
EU-15: Tier 1	15%		11%		9%			21%	
EU-15: Tier 2	85%		89%		91%			79%	

a Contribution to CH_4 emissions from manure management
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 6.28: *Available background information for the calculation of CH_4 emissions in category 4.B(a)*

Member State	***Methods***
Austria	*Cattle and swine: Tier 2 (key sources); sheep, goats, horses and other soliped, chicken, other poultry and other animals: Tier 1.*
Belgium	*Tier 2 methodology is used for both cattle and swine in Flanders and in Wallonia. Tier 1 is used in Brussels region. Although sheep, goats, poultry, horses, mules and asses are no key sub-source categories, however a region specific approach is used. EF used in de current methodology are close to the IPCC value. Because of the availability of detailed statistics on livestock composition in Flanders, including data on e.g. slaughter weights, a more extended variant of the IPCC methodology has been applied. Accounting for the fact that the weight of the cattle over the whole lifetime is not the same as the slaughter weight, the weight is integrated from birth to slaughtering. A study performed by the Flemish Institute for Technological Research (Vito), indicates that CH_4 emissions during manure processing are negligible.*
Denmark	*The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen, 2006). The IPCC Tier 2 approaches are used for the estimation of the CH_4 emission from manure management. The amount of manure is calculated for each combination of livestock subcategory and stable type. A significant share of cattle and pig slurry is treated in biogas plants (DEA 2010). Treated slurry in biogas plants has a lower emission of both CH_4 and N_2O. No description on how to include biogas treated slurry in the inventories is provided in the IPCC guidelines. Therefore, the Danish inventory uses data based on a Danish study (Sommer et al., 2001). The lower CH_4 emission as a consequence of biogas treated slurry is calculated as the difference between non-treated slurry and treated slurry. Based on results from Sommer et al. (2001) it is assumed that the emission from treated cattle slurry is reduced by 23% compared with untreated slurry and results from treated pig slurry show a 40 % lower emission than for untreated slurry.*
Finland	*Methane emissions from manure management are calculated in the same generic way as emissions from enteric fermentation, i.e. by multiplying the number of the animals in each category with the emission factor for each category. The national emission factor for each cattle subcategory has been calculated by using the IPCC Tier 2 methodology.*
France	*Tier 1 or 2. The AWMS, the nitrogen excretion factors and the volatile organic solids (VS) come from national data. For the other parameters, IPCC defaults are considered.*
Germany	*Tier 2 for all animal categories with the exception of gooses.*
Greece	*Dairy cattle, non-dairy cattle and sheep: Tier 2. Other animals: Tier 1.*
Ireland	*Cattle: Tier 2. Other livestock: Tier 1.*
Italy	*IPCC Tier 2 approach has been used for estimating CH_4 EFs for manure management from cattle, buffalo and swine. For estimating slurry and solid manure EFs and the specific conversion factor, a detailed*

Member State	Methods
	methodology (Method 1) has been applied at a regional basis (cattle and buffalo categories). Then, a simplified methodology, for estimating EFs time series, has been followed (Method 2). Since the 2006 submission, a reduction of CH_4 emissions because of biogas production has been considered.
Luxembourg	Tier 1 method has been applied to estimate methane emissions from manure management – i.e. for all animal categories except cattle. Population and methane emission growths are exactly the same as in enteric fermentation. What distinguishes one Tier from the other is the fact that, for cattle, the average gross energy intake – as a component of the volatile solid daily excretion – is not a default value but, rather, the value obtained when estimating enteric fermentation methane related emissions with a Tier 2 method.
Netherlands	Tier 2 approach is used based on country specific data on animal manure production per animal, on manure characteristics (like organic matter (OM) content) and (liquid) manure storage conditions.
Portugal	All animal types: Tier 2. Emission factors by animal type and climatic conditions. Emission factors for each animal type were established according to the Tier 2 methodology, which considers the use of country specific information concerning the quantity of manure produced per animal and the share of each manure management system that is used for each animal type. Results differ considerably from the ones obtained using the IPCC defaults, due to: swine manure in Portugal is treated in anaerobic lagoons (which have the highest MCF); management of wasted form dairy cows kept in stalls is split among solid storage and short retention pits; dairy cows in pasture are more common in Portugal than the default assumption of IPCC; non-dairy cows with milking calves are usually kept on pasture, but fattening animals are usually grown in confined areas and solid storage is the prevalent method; daily spread and usage as fuel are rare; there is a small percentage of traditional swine kept outdoors and foraging in pastures; some poultry is kept outside; and there are no substantial seasonal variations in the share of management systems. Use of country-specific values for DE (%).
Spain	Tier 3 for cattle, swine and poultry; Tier 1 for other animal categories.VS is estimated using a national methodology based on the digestible energy and the type of diet for cattle, swine and poultry. Smooth functions for the MCF and the FE for Tier 1 approaches are used (modification accepted by IPCC). It has been calculated by interpolating IPCC default factors for the three climatic regions (with mid-point mean annual temperature of 10, 20, and 28°C) using the formula: MCF(T)=MCF(10°C) + b (10-T)^m, where b and m are parameters that vary with animal waste management system.
Sweden	Include emissions from grazing animals. Tier 2 for Cattle and Swine, Tier 1 methodology is used for other animal groups.
United Kingdom	Tier 2 for cattle and deer, Tier 1 for other animals.

Activity Data

Table 6.29 and Table 6.30 summarize the allocation of the produced manure over the animal wastes management systems ‘liquid systems’, ‘solid storage and dry lot’ and ‘pasture, range and paddock’ for the animal categories dairy and non-dairy cattle, swine and poultry in 2012 and 1990, respectively. The table shows, that in most countries more manure is managed in liquid systems for swine than for cattle, whereby in Italy, Ireland and the Netherlands, 100% of the swine manure is managed in liquid systems. Only in the UK more manure is managed in solid than in liquid systems for swine. In the category cattle, generally more manure is managed in liquid systems for dairy cattle than for non-dairy cattle, expressed in relative numbers, with the exception of Italy and Ireland.

Substantial changes in the allocation of manure to manure management systems are reported for Sweden, Germany, Finland, and Denmark, however, with different signs of the direction of the changes. For example, liquid systems were more frequently used to manage manure from dairy cattle in Sweden (from 23% in 1990 to 62% in 2012).

Table 6.29: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 2012

Member State	Dairy Cattle - Allocation of AWMS (%)					Non-Dairy Cattle - Allocation of AWMS (%)				
2012	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	32%	NO	49%	3%	16%	24%	NO	43%	6%	26%
Belgium	11%	NO	25%	43%	21%	4%	NO	38%	45%	13%
Denmark	88%	NO	2%	5%	5%	31%	NO	1%	29%	39%
Finland	46%	NO	27%	26%	1%	NO	NO	NO	NO	NO
France	41%	NO	20%	39%	NO	29%	NO	33%	38%	NO
Germany	74%	NO	16%	11%	NO	43%	NO	38%	19%	NO
Greece	6%	NO	86%	8%	NO	NO	3%	64%	33%	NO
Ireland	29%	NO	2%	70%	NO	33%	NO	12%	56%	NO
Italy	38%	NO	57%	5%	NO	54%	NO	43%	3%	NA
Luxembourg	37%	NO	6%	50%	7%	16%	NO	36%	45%	3%
Netherlands	90%			10%		82%		2%	16%	
Portugal	20%	NO	50%	30%	NO	12%	NO	NO	88%	NO
Spain	NO	NO	NO	NO	100%	NO	NO	NO	86%	14%
Sweden	62%	NO	13%	24%	1%	18%	NO	19%	46%	17%
United Kingdom	41%	5%	9%	45%	NO	4%	0%	34%	62%	NO
EU15	50%	0%	19%	24%	6%	27%	0%	27%	42%	3%

Member State	Swine - Allocation of AWMS (%)					Poultry - Allocation of AWMS (%)				
2012	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	75%	NO	7%	NO	18%	3%	NO	90%	NO	7%
Belgium	6%	3%	6%	NO	85%	20%	NO	62%	0%	18%
Denmark	98%	NO	2%	0%		1%	NO		1%	98%
Finland	60%	NO	35%		5%	1%	NO	37%	NO	62%
France	93%	NO	6%	1%	NO	4%	NO	89%	7%	NO
Germany	92%	NO	8%	NO	NO	NO	NO	100%	NO	NO
Greece	90%	NO	10%	NO	NO	NO	NO	100%	NO	NO
Ireland	100%	NO	NO	NO	NO	13%	NO	85%	2%	NO
Italy	100%	NO	NA	NA	NA	3%	NO	72%	NO	25%
Luxembourg	90%	NO	5%	NO	5%	NO	NO	75%	NO	25%
Netherlands	100%					1%		99%		
Portugal	92%	NO	2%	6%	NO	51%	NO	47%	1%	NO
Spain	NO	NO	NO	NO	100%	NO	NO	NO	NO	100%
Sweden	82%	NO	15%	NO	3%	25%	NO	55%	NO	20%
United Kingdom	38%	NO	50%	12%	NO	NO	NO	NO	2%	98%
EU15	66%	0%	6%	1%	28%	4%		62%	2%	31%

Source of information: CRF 4.B(a) for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] Anaerobic lagoon + Liquid system.

Table 6.30: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 1990

Member State	Dairy Cattle - Allocation of AWMS (%)					Non-Dairy Cattle - Allocation of AWMS (%)				
1990	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	33%	NO	49%	11%	7%	27%	NO	45%	10%	18%
Belgium	10%	NO	27%	43%	20%	3%	NO	37%	45%	15%
Denmark	70%	NO	13%	15%	2%	36%	NO	3%	28%	33%
Finland	23%	NO	51%	25%	2%	NO	NO	NO	NO	NO
France	26%	NO	34%	39%	NO	23%	NO	40%	37%	NO
Germany	55%	NO	27%	18%	NO	58%	NO	26%	15%	NO
Greece	6%	NO	86%	8%	NO	NO	3%	64%	33%	NO
Ireland	32%	NO	2%	66%	NO	29%	NO	11%	60%	NO
Italy	38%	NO	57%	5%	NO	58%	NO	40%	2%	NA
Luxembourg	23%	NO	32%	45%		19%	NO	31%	50%	
Netherlands	70%			30%		66%		2%	32%	
Portugal	35%	NO	35%	30%	NO	NO	NO	27%	73%	NO
Spain	NO	NO	NO	27%	73%	NO	NO	NO	82%	18%
Sweden	23%	NO	52%	25%	1%	17%	NO	32%	42%	8%
United Kingdom	33%	4%	19%	45%	NO	4%	0%	34%	62%	NO
EU15	38%	0%	28%	29%	5%	31%	0%	29%	38%	3%

Member State	Swine - Allocation of AWMS (%)									
1990	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	69%	NO	11%	NO	20%	40%	NO	60%	NO	0%
Belgium	3%	3%	6%	NO	87%	21%	NO	71%	0%	8%
Denmark	89%	NO	11%			3%	NO		0%	96%
Finland	36%	NO	58%	0%	5%	NO	NO	64%	NO	36%
France	83%	NO	17%	1%	NO	2%	NO	93%	5%	NO
Germany	79%	NO	21%	NO	NO	NO	NO	100%	NO	NO
Greece	90%	NO	10%	NO	NO	NO	NO	100%	NO	NO
Ireland	100%	NO	NO	NO	NO	12%	NO	86%	2%	NO
Italy	100%	NO	NA	NA	NA	32%	NO	68%	NO	NO
Luxembourg	90%	NO	5%	NO	5%	NO	NO	75%	NO	25%
Netherlands	100%					58%		42%		
Portugal	95%	NO	3%	2%	NO	NO	NO	100%	0%	NO
Spain	NO	NO	NO	NO	100%	NO	NO	NO	NO	100%
Sweden	44%	NO	52%	NO	5%	25%	NO	55%	NO	20%
United Kingdom	60%	NO	37%	2%	NO	NO	NO	NO	1%	99%
EU15	66%	0%	13%	0%	20%	13%		60%	1%	26%

Source of information: CRF 4.B(a) for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] Anaerobic lagoon + Liquid system.

For some countries, background information on in addition to what is reported in Table 6.17 on the activity data used for the estimation of CH_4 emissions from manure management is given in the respective National Inventory Reports and is listed in Table 6.31.

Table 6.31: Available background information on the allocation to animal waste management systems used for the calculation of CH_4 and N_2O emissions in category 4.B(a)

Member State	***Activity data***
Austria	*AWMS distribution was taken from the research project "Animal husbandry and manure management systems in Austria" (Amon et al. 2007) which was a a comprehensive survey on the agricultural practice in Austria. As a result of TIHALO, for 2005 new representative data on animal husbandry and manure management systems all over Austria is available. Firstly, a questionnaire was developed to assess animal housing, manure storage and manure application on typical Austrian farms. In November 2005, the questionnaire was sent to 5 000 Austrian farms. The statistical sampling plan was set up with the assistance of the Statistics Austria to guarantee the selection of a representative sample of Austrian farms. A questionnaire return of about 40% had to be achieved to receive representative data on animal husbandry and manure management systems in Austria. The returned questionnaires were manually fed into a data template by the Statistics Austria. On the basis of this template, a data base was created that contained the questionnaire information. Anonymity of the farms that supplied data is guaranteed. The data base was*

Member State	Activity data
	checked for representativeness and plausibility. For the year 1990 AWMS data based on (Konrad 1995) is available. The AWMS data from 2005-2008 were derived by linear extrapolation. From 2008 onwards the AWMS distribution is held constant in order to prevent implausible trends by the end of the commitment period. It is not planned to have another survey before the end of the commitment period. In the 2008 inventory, the following new systems were taken into account: yard, deep litter, composting, aerobic treatment and anaerobic digester; these AWMS have been summarised under "other". Manure management systems are distinguished for dairy cattle, suckling cows and cattle 1–2 years in "summer situation" and "winter situation". For poultry and horses in addition the treatment of manure in anaerobic digesters is considered. The amount of manure treated in anaerobic digesters is obtained on data from the Austrian Energy Regulator E-Control (E-CONTROL 2011) on the basis of reports from biogas plants operators.
Belgium	*The fraction manure handled in each management system (MS%) is region-specific and can differ slightly. The allocation of animals to AWMS originate in Flanders from the Manure Bank of the Flemish land Agency (VLM). In Wallonia, the allocation of animals to each animal waste management system (AWMS) comes from the STATBEL agricultural census of 1992 and 1996, where those data were published by animal type. Those data are not collected yearly by the STATBEL given their slow pace of change. In all three regions swine and poultry stay 100% of their lifetime in house. Cattle (with exception of slaughter calves) spend more or less 50% of their lifetime on pasture. The amount (net export) is inventoried by the Manure Bank of the VLM and yearly published as the 'manure balance' in the following progress reports: http://www.vlm.be/lijsten/publicaties/Pages/MB_Voortgangsrapporten.aspx*
Denmark	*Since 2005, all farmers have to report to the Danish AgriFish Agency (DAFA) information concerning the use of housing type. Before 2005 there are no official statistics which cover the distribution of animals according to housing type. The distribution is, therefore, based on expert judgement from the Danish Agricultural Advisory Service (DAAS) and DCA. Approximately 90-95 % of Danish farmers are members of DAAS, which regularly collects statistical data from the farmers on different issues, andmakes recommendations with regard to farm buildings. Hence, have DAAS a very good feeling of which housing types that are currently in use.*
Finland	*Distribution over animal systems (slurry, solid storage, pasture) is country-specific from literature (MKL, 1993; Seppänen and Matinlassi, 1998) and expert judgement. Anaerobic lagoons and daily spread not used in Finland.*
France	*Surveys on the distribution of national animal housing systems were carried out in 1994, 2001, and 2008 and allow thus to cover the evolution of the systems in time. Distribution of manure over AWMS takes into account the time the animal spent within the housing and outside (pasture or yard) as well as the share of solid and liquid systems. As only days which were spent entirely in the housing systems were counted, 4 hours/day during the grazing period were added for dairy cattle to account for time they spent in the housings. Distribution over AWMS is interpolated between the years 1994, 2001 and 2008 and has been kept constant after 2008.*
Germany	*Information on feeding and stable types are taken from the agricultural model 'RAUMIS' available at vTI (Regionalisiertes Agrar- und UmweltInformationsSystems fuer Deutschland). The model is based on national statistics at district level, description of standard production methods from KTBL, information from the ministry for agriculture and results from surveys. Data gaps are filled by expert knowledge. RAUMIS could not be updated after 1999 and values between 1999 and 2010 were interpolated using new data from the 2010 Survey on Agricultural Production Methods (SAPM). Some assumptions were taken for missing data, e.g. regarding calves systems until 2002, solid systems for dairy cows are assumed to be deep litter which is most common in Germany etc. Also biogas installations are considered.* *Data on activity data of cattle and swine slurry in biogas installation as well as the storage of the digesters are from KTBL. No differentiated data on animal sub-categories is available, therefore it is assumed that cattle slurry is from dairy cows and swine slurry from fattening pigs. There is an increasing trend of slurry treated in biogas installation, which in some occasions exceeded the available quantity of slurry so that the trend (and emission reduction) is slightly under-estimated. The shares of cattle vs. swine slurry are known for the year 2010 and have been used to extrapolate back to 1990.*
Greece	*Values referring to Near East and Mediterranean category for the allocation of manure to animal waste management systems per animal species was followed. However, in some cases country-specific data was used based on the judgement of experts from several institutes, including the Agricultural University of Athens, the Ministry of Rural Development and Food, the Department of Animal Production at the School of Agricultural Technology (the Technological Educational Institute of Epirus) and the Office of Rural Development of the Prefecture of Thessaloniki. Greece continues efforts to improve the country-specific data. Country-specific data for dairy cattle, other cattle, buffalo and swine was considered. Dairy cattle are mainly stall or housed and they are used for milk production. Only for a small share of their life they are in pasture. The manure produced from them is mainly managed in solid storage and dry lot systems. In liquid management systems, which is a practise in some new units, manure separation of liquid-solid is performed. Most of the solid manure produced is stored in piles and is treated with solid practices, while 15% of solid is drifted by the liquid, stored in tanks and it is treated according to liquid practices. The percentage of dairy cattle farms that use liquid-solid separation systems is about the 40% of the total for dairy cattle. The majority of swine in Greece remain in properly designed building infrastructures and their manure is managed with liquid systems according to Greek legislation. A small share of swine's manure, about 10%, is managed with solid systems. This share mainly represents the manure produced by swine live in small production units. Sheep and goats are in pasture in Greece.*
Ireland	*The allocation to animal waste management system is based on the farm facilities survey. The same values are used for all years. The bulk of animal wastes in housing are managed in liquid storage systems. New information obtained from a national Farm Facilities Survey (Hyde et al., 2008). The survey was conducted on a representative sample of farms, and the results of which are available at both national level and for*

Member State	Activity data
	each of the three designated Nitrates Directive regions. The proportioning of Animal Waste Management Systems within the model is calculated on an individual subsystem basis (dairy cows: 12 systems, suckler cows: 18 system types, beef cattle: up to 30 systems). The partitioning of the year into pasture and housing periods is based on expert opinion in conjunction with the results of the Farm Facilities Survey for each particular subsystem. Having derived the time spent at pasture and the time spent in housing for cattle, the Farm Facilities Survey is used to determine the partitioning of liquid and solid manures to AWMS within the housing period, and the estimation of the number of animals that are out-wintered (i.e. at pasture all year round). Approximately two-thirds of animal manure nitrogen is excreted on pastures annually, reflecting the relatively short period that cattle and sheep are housed in Ireland.
Italy	Liquid system, solid storage and other management systems (chicken-dung drying process system) are considered according to their significance and major distribution in Italy. Since 2006 submission, several parameters have been updated: average weight, production of slurry and solid manure and the nitrogen excretion rates. The source for updating these parameters was the Nitrogen Balance Inter-regional Project. A national census on biogas production/technology can be found in CRPA and CRPA/AIEL (CRPA, 2008; CRPA/AIEL 2008). Biogas production data are collected every year by the National Electric Network (TERNA, 2011).
Luxembourg	The allocation of AWMS for dry lot is included in solid storage. The activity data are the livestock data reported in the national statistics.
Netherlands	In the Netherlands animal manure is stored in cellars under the slatted floors of animal houses, and when it becomes full, it is pumped into outside storage facilities. Anticipating the ban on battery cage systems effective from 2012, farmers started to change their management practices towards ground housing or the aviary system. In the process they switch from solid manure without bedding (on which birds do not walk), to solid with bedding on which the birds do walk. A growing portion of the manure N is exported.
Portugal	Livestock numbers per animal type were available at Concelho level from two detailed agriculture surveys: RGA89 and RGA99. Livestock numbers in each Concelho area were allocated to each climate region, for year 1999, according to the land are percentage, and always assuming an homogeneous distribution of animals in the Concelho territorial area. Number of animals was summed at each Administrative Region (Região). Livestock population in each climate region and by Região was estimated annually from total livestock population in Região and considering the constant share and, finally, the total national livestock population for each region was calculated. Fraction of manure handled in each manure management system is established using expert opinion, and was last updated in 2010.
Spain	Data for waste management systems for cattle, swine and poultry are from national surveys. For other animal types the values are from expert judgement (UPV 2006). Within manure management systems, "others" has the highest share because most of the manure from cattle, swine and poultry is managed following a chain of connected processes which makes it difficult to associate them to any of the systems considered by IPCC.
Sweden	Information on waste management systems is collected from the surveys published in the biannual statistical report on the use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). Three manure management systems are considered apart from grazing animals: liquid systems (including semi-liquid manure), solid storage and deep litter (sometimes categorised as "other" in the national inventory). National estimates of stable periods are collected from the statistical report on use of fertilisers and animal manure in agriculture. This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990. Since dairy cows are often put in the stables at night, the data on stable periods for this animal category is combined with an assumption that 38% of its manure was produced in the stable during the grazing period (calculated according to the STANK model, Swedish Board of Agriculture, 2005)The Farm Register provides the main basis for agricultural statistics in Sweden. The Register is administered by the Swedish Board of Agriculture and Statistics Sweden and provides annual information on the total number of animals of different categories on Swedish farms. The information on livestock refers to the situation prevailing in mid-June of that year and thus is considered to be equivalent to a one-year average. Mink and foxes are minor contributors to greenhouse gas emissions and are not included in the inventory due to a lack of well-founded emission factors. The number of slaughter chickens (mean number of chickens kept during the year) is provided by the Swedish Poultry Meat Association.
United Kingdom	Country-specific data on the proportion of manure managed in the different AWMS data derive from a number of sources, including published ad-hoc surveys (e.g. Smith et al., 2000a, 2001b, 2001c; Sheppard 1998, 2002; Webb et al., 2001) and, more recently, relevant data from the Farm Practices Surveys for England and a time series is included to reflect changes in practice over time. Livestock population data are reported annually as statistical outputs of the four Devolved Administrations of the UK (i.e. England, Wales, Scotland and Northern Ireland), based on the annual June Agricultural Survey for each country. These data are summed to provide UK population data for the livestock categories and subcategories as used in the inventory compilation. Data for earlier years are often revised so information was taken from the England and the Devolved Administrations' agricultural statistics databases. Dairy cows - quoted assumes animal lives for a year; emission calculation assumes animal lives for 6 months. The average lifespan of lambs is estimated by Wheeler et al. (2012) as 8.1 months.

Emission Factors and other parameters

The implied emission factors for CH_4 emissions from manure management vary substantially among the Member States, as shown in Table 6.32. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers about one order of magnitude, which is more than the range proposed in the IPCC *Guidelines* for different climate regions (for dairy cattle in Western Europe, for example, an emission factor of 14 kg CH_4 $head^{-1}$ y^{-1} is proposed for cool climate regions and a factor of 81 kg CH_4 $head^{-1}$ y^{-1} for warm climate regions), but less than the ratio of the methane conversion factors of liquid (39% - 72%) and solid (1% – 2%) manure.

As mentioned above, the two most important factors influencing the amount of CH_4 emitted from manure management systems are the climate region and if solid or liquid systems are dominating. We have already discussed the large range of systems used in the EU-15 Member States. The other two factors, the excretion rate of volatile solids and the methane producing potential, are not significantly influencing the order of magnitude.

The ratio of the highest and the smallest IEF used by the Member States is 14 for dairy cattle, and 11 for non-dairy cattle and 18, 20, and 18 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Spain with 72.7 kg CH_4 $head^{-1}$ $year^{-1}$ and the smallest by Portugal with 5.3 kg CH_4 $head^{-1}$ $year^{-1}$.

For dairy cattle, the low IEF used in Portugal is explained by the fact that part of dairy cattle is managed in "Fossas" (pits), which corresponds best to the IPCC class "Pit storage below animal confinements". The storage time is very short, less than one month. Therefore, Portugal set the MCF to zero. In 2006 guidelines the MCF is revised to 3%, but no clear distinction is made between pits and liquid/slurry system. A more detailed assessment would require a country-specific study. Germany uses higher CH_4-IEF for dairy cattle than neighbouring countries. This might partly be caused by the use of MCF values from IPCC (2006), while most countries use data from IPCC (1996).

Spain uses a Tier 2 approach. Gross energy is calculated using Tier 2 methodology of enteric fermentation whilst percentages of manure management systems are taken from national references. The dominant systems for non-dairy cattle are solid storage and pasture, both of which have very a low MCF at 10ºC. In Denmark, non-Dairy Cattle" includes calves, heifers, bulls and suckler cows and the implied emission factor is a weighted average of these different subcategories. The Danish IEF for non-dairy cattle is lower compared with the default value, this is due to lower weight and lower feed intake and a higher digestibility of feed.

Table 6.32: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory 2012

Member State	Implied EF (kg CH_4/head/yr)					
2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	9	4	0.2	0.1	1	0.07
Belgium	17	3	0.6	0.8	8	0.04
Denmark	34	9	2.7	2.4	2	0.03
Finland[1)]	15	3	0.2	0.1	4	0.02
France	40	9	0.2	0.1	13	0.08
Germany	20	8	0.3	0.2	3	0.04
Greece	11	1	0.7	0.2	7	0.12
Ireland	21	10	0.2	0.1	13	0.45
Italy	7	3	0.2	0.1	4	0.08
Luxembourg	40	6	0.2	0.1	20	0.09
Netherlands	43	9	0.2	0.3	3	0.02
Portugal	5	1	1.8	1.8	21	0.01
Spain	73	3	0.2	0.2	9	0.01
Sweden	9	6	0.2	0.1	2	0.08
United Kingdom	43	15	0.3	0.5	19	0.12
EU-15	29	8	0.3	0.2	7	0.07

Source of information: CRF 4.B(a) for 2012, submitted in 2014 Abbreviations explained in the Chapter 'Units and abbreviations'

1) Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. Swine is reported under "other" in the categories: fattening pigs, sows with piglets and weaned pigs. The IEFs have been calculated as a weighted average. The IEF for the Netherlands and Luxembourg has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

The parameter of interest are the allocation of manure to climate regions (Table 6.33) and methane conversion factor used (Table 6.34). Most of Europe falls into the cool climate region with average annual temperatures below 15°C. Accordingly, most countries are allocating 100% of the animal population to the cool climate region, with Italy, Portugal and Spain allocating a part of the population into the temperate region (for dairy cattle for example 8%, 61% and 14%, respectively) and only Greece allocating 100% of the animals to the temperate climate region. France assumes 0.1% of the dairy cattle and 0.7% of the non-dairy cattle in the warm climate region, which is due to the extra-territorial regions; the remaining manure is allocated to the cool climate region. The distribution of the animals over the climate regions is somewhat different for different animal types; in Portugal, for example, the portion of animals living in the temperate region increases from dairy cattle over non-dairy cattle to swine.

For the categories dairy cattle, non-dairy cattle and swine, only in few cases is the allocation of animal population to climate regions reported to be dynamic. However, in Portugal, for example, a general shift of livestock production to warmer climate regions has been observed increasing the percentage of manure managed in the temperate region by 9%, 18%, and 7% for dairy cattle, non-dairy cattle, and swine, respectively.

The potential methane producing factor is IPCC default or close to IPCC default for most countries (Table 6.35); the amount of volatile organic solid excreted per animal (Table 6.36) and year varies across the countries on the basis of the animal characterization with a ratio of highest to lowest average VS excretion rate between 2.1 (Dairy Cattle) and 3.6 (Goats).

Table 6.33: Member State's allocation of dairy cattle, non-dairy cattle and swine to the climate regions "cool", "temperate" and "warm" in 2012

Member State	Dairy Cattle - Allocation by climate region[1)			Non-Dairy Cattle - Allocation by climate region[1)			Swine - Allocation by climate region[1)		
2012	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)
Austria	100%	NO	NO	100%	NO	NO	100%	NO	NO
Belgium	100%	NO	NO	100%	NO	NO	100%	NO	NO
Denmark	100%	NO	NO	100%	NO	NO	100%	NO	NO
Finland	100%	NO	NO	NO	NO	NO	100%	NO	NO
France	100%	NA	0.1%	99%	NA	0.7%	99%	NA	0.7%
Germany	100%	NO	NO	100%	NO	NO	100%	NO	NO
Greece	NO	100%	NO	NO	100%	NO	NO	100%	NO
Ireland	100%	NO	NO	100%	NO	NO	100%	NO	NO
Italy	92%	8%	NO	87%	13%	NO	97%	3%	NO
Luxembourg	100%	NA	NA	100%	NA	NA	100%	NA	NA
Netherlands	100%			100%			100%		
Portugal	39%	61%	NO	24%	76%	NO	16%	84%	NO
Spain	86%	14%	NO	64%	36%	NO	69%	31%	NO
Sweden	100%	NO	NO	100%	NO	NO	100%	NO	NO
United Kingdom[1)	100%	NO	NO	100%	NO	NO	100%	NO	NO
EU-15	97%	3%	0%	93%	7%	0%	91%	9%	0.1%

Source of information: CRF 4.B(a) for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1) The portion lacking for 100% are reported as daily spread (only UK) and 'other'.

Table 6.34: Member State's Methane Conversion Factor used for dairy cattle, non-dairy cattle and swine for the different animal waste management systems in 2012

Member State	Dairy Cattle - Methane Conversion Factor (%) [1)				Non-dairy Cattle - Methane Conversion Factor (%) [1)				Swine - Methane Conversion Factor (%) [1)			
2012	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock
Austria	NO	9%	1.0%	1.0%	NO	8%	1.0%	1.0%	NO	3%	1.0%	1.0%
Belgium	NO	19%	2.0%	1.0%	NO	19%	2.0%	1.0%	NO	19%	2.0%	NO
Denmark	NO	10%	1.0%	1.0%	NO	10%	1.0%	1.0%	NO	10%	1.0%	1.0%
Finland	NA	10%	1.0%	1.0%	NA	10%	1.0%	1.0%	NA	10%	1.0%	1.0%
France	NO	39%	1.0%	1.0%	NO	39%	1.0%	1.0%	NO	39%	1.0%	1.0%
Germany	NO	11%	2.0%	1.0%	NO	15%	8.6%	1.0%	NO	18%	6.6%	NO
Greece	NA	45%	1.5%	1.5%	NA	NA	1.5%	1.5%	NA	NA	NA	NA
Ireland	NA	39%	1.0%	1.0%	NA	39%	1.0%	1.0%	NA	39%	NA	NA
Italy	NO	14%	2.2%	1.1%	NO	15%	2.3%	1.1%	NO	22%	NA	NA
Luxembourg	NA	39%	1.0%	1.0%	NA	39%	1.0%	1.0%	NA	39%	1.0%	NA
Netherlands	NO	17%	NO	1.0%	NO	16%	0.1%	1.0%	NO	39%	NO	NO
Portugal	43%	NA	1.3%	1.3%	NA	NA	NA	1.4%	44%	NA	1.4%	1.4%
Spain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sweden	NO	4%	1.0%	1.0%	NO	4%	1.0%	1.0%	NO	4%	1.0%	NO
United Kingdom	NO	39%	39%	1.0%	NO	39%	39%	1.0%	NO	39%	39%	1.0%
EU15	43%	23%	5.8%	1.0%	NA	28%	8.3%	1.1%	44%	24%	5.4%	1.1%

Source of information: CRF 4.B(a) for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1) Anaerobic lagoon + Liquid system.

Table 6.35: Member State's methane producing potential for emissions from manure management for the main animal types in 2012

Member State	CH4 producing potential (Bo) (CH_4 m^3/kg VS)					
2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	0.24	0.17	NA	NA	0.45	NA
Belgium	0.24	0.17	0.19	0.17	0.45	0.32
Denmark	0.24	0.17	0.19	0.17	0.45	0.32
Finland	0.24	0.17	0.19	0.17	0.45	0.32
France	0.24	0.17	0.19	0.17	0.45	0.32
Germany	0.23	0.23	0.19	0.18	0.30	0.37
Greece	0.24	0.17	0.19	NE	NE	NE
Ireland	0.24	0.24	0.19	0.17	0.45	0.32
Italy	0.14	0.13	0.19	0.17	0.46	0.32
Luxembourg	0.24	0.17	0.19	0.17	0.45	0.32
Netherlands	0.25	0.25	0.25	0.25	0.34	0.34
Portugal	0.24	0.17	0.19	0.17	0.45	0.32
Spain	0.24	0.17	NA	NA	0.45	0.32
Sweden	0.24	0.17	0.20	0.20	0.45	0.30
United Kingdom	0.24	0.20	0.19	0.17	0.45	0.32
EU-15	0.23	0.19	0.19	0.18	0.41	0.33

Source of information: CRF 4.B(a) for 2012, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.36: Member State's volatile solid excretion from managed manure for the main animal types in 2012

Member State	VS excretion					
2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	4.3	1.9	NA	NA	0.3	NA
Belgium	4.1	1.5	0.5	0.5	0.4	0.03
Denmark	6.2	2.7	1.1	1.0	0.2	0.003
Finland	4.9	1.7	0.4	0.3	0.5	0.02
France	4.1	2.0	0.4	0.3	0.3	0.10
Germany	4.0	1.5	0.4	0.3	0.3	0.03
Greece	4.8	2.2	0.4	NE	NE	NE
Ireland	3.0	1.3	0.4	0.3	0.3	0.10
Italy	6.4	2.9	0.4	0.3	0.3	0.10
Luxembourg	4.6	1.9	0.4	0.3	0.5	0.10
Netherlands	4.6	1.2	0.5	0.6	0.2	0.02
Portugal	4.8	2.8	0.4	0.5	0.5	0.03
Spain	5.1	2.3	NA	NA	0.3	0.01
Sweden	5.6	1.5	0.4	0.3	0.4	0.29
United Kingdom	3.6	2.3	0.4	0.3	0.5	0.10
EU-15	4.4	1.9	0.4	0.3	0.3	0.07

Source of information: CRF 4.B(a) for 2012, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

Some additional background information on the factors and parameters used by the Member States is given in Table 6.37.

Table 6.37: Available background information on the emission factors and other parameters used for the calculation of CH_4 emissions in category 4.B(a)

Member State	**Emission Factors and other parameters**
Austria	Austrian specific values for dairy cows were calculated in dependency of annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content). The default MCF values for 'cool climate regions' were used. For liquid systems a national value is used based on measurements. For yard (which is not included in the GPG2000, the MCF of pasture, range and paddock has been taken. For deep litter the MCF of the 2006 IPCC Guidelines (17%) have been taken because the MCF of the GPG 2000 (39%) is not applicable to Austria's cold climate conditions. In Austria manure from deep litter systems is usually removed twice a year - in spring and in autumn. The bedding is continuously added, there is no mixing. Austrian measurements showed that CH_4 emissions from farmyard manure were always lower than CH_4 emissions from liquid manure. It would contradict latest scientific results to apply a higher MCF to deep litter systems than to liquid manure systems. Hence, for Austria the chosen MCF of 17% (IPCC 2006) is a conservative estimate. MCF for liquid systems are obtained from peer reviewed publications (AMON et al. 2002a, 2006, 2007a) based on a three-year measurement campaign on emissions from manure stores. The extensive emission measurements under field conditions showed, that an increase in methane emissions during slurry storage was only observed during the summer season. The low temperature in all other seasons in Austria reduces significantly methane formation during slurry storage. Emission measurements were carried out in one of the warmest Austrian region and therefore may tend to overestimate MCF values. Following the results of a German study (FNR, 2010), CH_4 losses of biogas plants are about 1-2% of the gas produced under cold climate conditions. Following these results and expert judgement, the MCF was set to 2% for manure treated in anaerobic digesters. B_0 is default. National values for dairy cows depend on milk yield and corresponding feed intake data. For the calculation of VS excretion of suckling cows an average milk yield of 3 000 kg was applied. Austrian specific values on VS excretion for all other cattle categories were calculated from typical Austrian diets under organic and conventional management. As no major changes in diets of non-dairy cattle occurred, methane emissions from manure management of non-dairy cattle are calculated with a constant gross energy intake and thus constant VS excretion rate. Constant value for the whole time series for swine (Schechtner 1991). From Manure Management for sheep, goats, horses, poultry and other livestock / deer are estimated with Tier 1 approach. For biogas digesters data show a leakage rate of 2%.
Belgium	Emission factors for each animal category have been developed by Siterem 2001. Those factors take into account the type and volume of manure produced during the time spent in stables, its density and carbon content, and its carbon volatilisation ratio. The resulting EF are comparable to the default IPCC for cool climate.
Denmark	B_0 and MCF IPCC default. For liquid systems, the MCF of 10 % in the Reference Manual (IPCC, 1997) is used. All data required to calculate VS excretion are based on Danish Normative data except of grazing days for dairy cattle and heifers. The Revised 1996 IPCC guidelines (IPCC, 1997) provide a default MCF of 10% for liquid/slurry, which is based on research of Hashimoto & Steed (1993) and Woodbury & Hashimoto (1993). This MCF value was changed to 39% in the IPCC Good Practice Guidance (IPCC, 2000), without any scientific argumentation, documentation or specific references. It has to be remarked that the 2006 IPCC Guidelines (IPCC, 2006) return to a MCF val ue of 10% for Danish conditions referenced to "Judgement of IPCC Expert Group in combination with Mangino et al. (2001) and Sommer et al. (2000)" (IPCC, 2006). The methane emission from liquid systems is very sensitive to temperature effects. Basically most of the manure is stored in Denmark under cold conditions (<5-10 degrees) .The CH_4 formation practically stops at 4°C and therefore there are no plausible arguments that 39% of total CH_4 capacity should be released under Danish conditions. Danish studies confirm this assumption (Husted, 1994 and Sommer et al., 2000). Furthermore, investigations based on measurements in Canada, where conditions are similar to Denmark, support this value (Massé et al., 2003). Support of this value is also found from a Swedish review (Dustan, 2002), taking both the cold climate and the fact that the slurry containers usually have a surface cover, into account. Considering the agricultural conditions in Denmark and the present scientific knowledge as described above a MCF of 10 % for liquid/slurry is more appropriate under the Danish conditions. The Danish decision of using a MCF of 10 % is as demonstrated above backed by several scientific papers as well as both the revised 1996 IPCC Guidelines and the IPCC 2006 Guidelines. Therefore Denmark intends to continue using a MCF value of 10 % until scientific knowledge become available. The IEF for sheep and goats includes lambs and kids, which correspond to the Danish normative data. This explains why the Danish IEF is nearly twice as high as the IPCC default value. Swine: typical animal mass is based on slaughter pigs. Old-style tethering systems with solid manure have been replaced by loose housing with slurry-based systems. For non-dairy cattle, the opposite development has taken place. An increasing proportion of bull-calves are raised in stables with deep litter, where the MCF is lower than for liquid manure.
Finland	Cattle: EF per subcategory calculated with IPCC Tier 2 methodology. National values for digestible energy (DE %), fraction of animal´s manure managed annually in each manure management system (MS), average milk production and animal weight. For reindeer it is assumed that all manure is deposited on pastures and for fur animals it is assumed that all manure is managed as solid. For fur animals, VSi value is based on expert judgement being 0.17 kg/head/day.
France	Data regarding manure management systems and excretion factors, and for cattle also VS are taken from national sources. For other parameters, default IPCC. For cattle, VS is estimated from the results of MONDFERENT project, based on energy needs (fodder units), which are transformed into net energy, then

Member State	Emission Factors and other parameters
	in digestible energy and finally in digestible organic matter ingested. From this, VS is deduced. VS is constant in time for non-dairy cattle, but for dairy cattle the calculation of VS is based on milk production and can vary with time. For animals other than cattle, IPCC defaults are taken. MCFs used correspond to cold climate.
Germany	*According to the calculation at district level, IEF are varying with time and space due to differences in AWMS distribution and climate. Emissions reductions due to biogas digesters are considered. The emission factors represent the general situation in Germany. Calculations are done at the district level. VS is obtained from dry matter intake using a national method (Daemmgen et al., 2011). Feed digestibility and ash content of the feed components are given from feed producers and Roesemann et al. (2013). For sheep and goats, horses and buffaloes IPCC default VS values. For B_0 for cattle and pigs a national factor is used (Daemmgen et al., 2012). Other animals default. For pullets a conservative value of 0.39 m3 CH_4/kg is taken from IPCC (2006). MCF values for cattle and swine are according to Daemmgen et al. (2012) according to IPCC (2006) for annual mean temperature of less than 10 degree Celsius; for liquid manure with cover the conservative MCF for liquid manure without cover was taken; for deep litter and pasture/range/paddock IPCC (2000) default. MCF for other animals IPCC default, taking for consistency reasons IPCC (2006). In Germany, in regions with annual mean temperature above 10ºC (Rheintal, Ruhrgebiet) livestock production is less significant. The MFC of biogas installations is obtained from leakage rate of the fermenter, the residual amount and the MCF of the storage of the digested manure based on IPCC 2000 (Roesemann et al. 2013). Leakage rate is set to 1%; for the calculation of the residual CH_4 see Roesemann et al. (2013). The share of digested manure stored gas tight (MCF=0) or in liquid systems is from KTBL. For gooses an EF of 0.78 kg/animal/yr is used corresponding to IPCC (1996) for poultry.*
Greece	
Ireland	*New information obtained from a national farm facilities survey (Hyde et al., 2008) and the work on emission factors for enteric fermentation in cattle are the basis of the CH_4 emission factors for manure management. The emission factors for manure management are derived using the quantified organic matter excretion as volatile solids (VS), BO, the allocation to animal waste management system based on the farm facilities survey and the corresponding values of MCF given for the cool climate zone. Ireland uses the value of 0.24 m3 CH_4/kg VS (the value for dairy cattle in the IPCC good practice guidance) for BO for all cattle based on input from agricultural experts who advise that the methane potential of dairy cattle manures and non-dairy cattle manures in Ireland is the same, given the similarity of their grass -based feeding systems. Volatile solids values for dairy cows and non-dairy cattle are estimated using the information provided in O'Mara (2006). These values differ from the default values provided in the IPCC Good Practice Guidance due to the higher digestibility of feeds in Ireland. The default digestibility of 60 per cent is very low in comparison to the digestibility of silage (70 per cent), grazed grass (80 per cent) and concentrates (80 per cent). Grazed grass and silage make up the majority of feed intake of cattle in Ireland due grass based production systems.*
Italy	*Emission factors for slurry and solid manure (g CH_4 $head^{-1}$ $month^{-1}$) are calculated for each month. The average methane conversion factors (MCF), for each manure management system (classified by climate), were estimated with data coming from the Agriculture Census from 1990 and 2000 and the FSS 2005 (ISTAT, 2007[a]). Average MCFs were not used for estimating manure management EF, but they are useful to verify the EF accuracy. Country-specific methane emission rate for swine was experimentally determined by the Research Centre on Animal Production (CRPA, 1996).*
Luxembourg	*For cattle, the IEF has been calculated by combining the country specific activity data, coefficients and parameters according to the Tier 2 methodology.*
Netherlands	*Country-specific CH_4 emission factors are calculated for all three manure management systems for every animal category on a Tier 2 level. These calculations are based on country-specific data on: (-) manure characteristics: organic matter (OM) and maximum CH_4 producing potential (B_0); (-) manure management system conditions (storage temperature and period) for liquid manure systems, which determine the methane conversion factor (MCF). MCF of 1.5% for all animal categories; for manure production in the meadow, it uses the IPCC default MCF value. New measurements on organic matter content of manure (Commissie Bemesting Grasland en Voedergewassen, 2012) have given rise to most of the shifts, since these reflect directly in the EFs being calculated. Lower values are seen for pigs and horses, and higher for rose veal (as a part of young stock) and fur-bearing animals (as part of other animals).* *For dairy cattle, the energy requirement expressed as net energy value of lactation (or VEM in Dutch) is calculated based on total milk production and feed composition. For young cattle the energy requirement is calculated on the basis of total weight gain and feed composition. The intake of grass silage, maize silage, wet by-products, concentrates and grass products is estimated from national statistics found at www.cbs.nl. More information on the Netherlands VEM system is presented in Smink et al. (2005) and Tamminga et al. (2004).*
Portugal	*Emission factors for each animal type were established according to the Tier 2 methodology, which considers the use of country specific information concerning the quantity of manure produced per animal and the share of each manure management system that is used for each animal type. Results differ considerably from the ones obtained using the IPCC defaults, due to: swine manure in Portugal is treated in anaerobic lagoons (which have the highest MCF); management of wasted form dairy cows kept in stalls is split among solid storage and short retention pits; dairy cows in pasture are more common in Portugal than the default assumption of IPCC; non-dairy cows with milking calves are usually kept on pasture, but fattening animals are usually grown in confined areas and solid storage is the prevalent method; daily spread and usage as fuel are rare; there is a small percentage of traditional swine kept outdoors and foraging in pastures; some poultry is kept outside; and there are no substantial seasonal variations in the share of management systems. Use of country-specific values for DE (%).*

Member State	Emission Factors and other parameters
Spain	*VS is estimated using a national methodology based on the digestible energy and the type of diet for cattle, swine and poultry. Smooth functions for the MCF and the FE for Tier 1 approaches are used (modification accepted by IPCC). It has been calculated by interpolating IPCC default factors for the three climatic regions (with mid-point mean annual temperature of 10, 20, and 28°C) using the formula: MCF(T)=MCF(10°C) + b (10-T)^m, where b and m are parameters that vary with animal waste management system.*
Sweden	*The VS value used is IPCC default. The B_0i and MCF factors used are the default values in the Good Practice Guidance, except for the MCF for liquid manure, where the value of 3.5 % is used. This value was developed by Rodhe et al. 2008 and is considered to be more appropriate for Swedish conditions.*
United Kingdom	*The emission factors for manure management are calculated following IPCC Tier 2 methodology using default IPCC data for volatile solids (VS) and methane producing potential (Bo) parameters for each livestock type (except for dairy and beef cows and deer) where a Tier 2 calculation is used to determine VS. Country-specific data for the proportion of manure from each livestock type managed according to the different animal waste management systems (AWMS), taking into account the limitations established by law about nitrogen application in nitrate vulnerable zones (NVZ), which supposes reduced allocation of manure to daily spread. Use of IPCC default methane conversion factors for the different AWMS.*

Allocation to climate regions

An independent estimate of the allocation of livestock to IPCC climate regions was performed by JRC for the inventory in 2013. The assessment was based on AGRI4CAST interpolated meteorological data (AGRI4CAST, 2012), available on a 50km by 50km grid for Europe. A climate map distinguishing the regions according to the definition in IPCC (1996) was created; obviously the “warm” climate region is not present in the EU area. The analysis of annual data between the years 1990 and 2010 (see Figure 6.17) show that the delineation of the climatic zones in Europe does not change to a large extent from year to year. This justified basing the analysis of livestock distribution within the climatic zones for each country in EU25 on the climate map derived from annual mean average temperature in the period 1990 – 2010 (lower right map of Figure 6.17).

Livestock data at grid level (1 km x 1 km) are obtained from Leip et al. (2008). The data are obtained from an ex-post simulation of the CAPRI model (Britz & Witzke, 2012)[50] for the base year 2002 (average 2001-2003), available at NUTS2. Disaggregation of animal number was done for two groups (i) land-based animals: cattle, sheep and goats (ruminants) and (ii) non land-based animals: pig and poultry (monogastrics).

Figure 6.18 shows the distribution of IPCC climate zones in Europe using meteorological information averaged over the years 2000-2010, and the distribution of livestock (as livestock units). Additional information is given in Table 6.38. 89% of the surface in Europe – as EU25[51] – falls into the cold climate zone with an annual mean temperature below 15ºC. Only 11% fall into the temperate zone[52].

Out of the 25 countries in the analysis, only five countries have a part of their **surface area** within the temperate climate zone (mean annual temperature between 15º and 25ºC): France (4%), Greece (56%), Italy (37%), Portugal (75%), and Spain (39%). Both Malta and Cyprus are in the temperate zone.

Overseas territory of France (included in the European Union: Guadeloupe, Martinique, Guyane, La Réunion, Saint-Barthélemy and Saint-Martin) have a total surface area of 88,869 km^2 which is 14% of the total French surface area part of the European Union (CITEPA, 2012).

According to the CAPRI data used, there were about 100 million LU in EU25, whereof 76% were ruminants and 24% were monogastric animals. The share of ruminant LU ranges between 39 and 94% with the lowest share in Denmark and the highest share in Ireland.

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[50] The simulation was carried out in 2009

[51] EU27 without Malta and Cyprus

[52] This value would not change if Cyprus (9251 km^2) and Malta (316 km^2) would be included in the assessment – they together make about 0.2% of the continental surface area of EU27.

Livestock density (LU km^{-2}) varies strongly within each country (Figure 6.18, Table 6.38). In France, hotspots such as the Bretagne and the Auvergne lead to a mean LU density of 33 LU km^{-2} in the cool climate zone, while the density in the temperate climate zone is only 5 LU km^{-2} (coastal areas of Provence-Alpes-Cote d'Azur and Languedoc-Roussillon). The animals in the temperate zone are all ruminants, with less than 0.5 LU km^{-2} of monogastric animals in that area. The situation is similar in Italy, where also mainly the coastal areas are classified as 'temperate' with lower livestock density, in particular for monogastric animals. In Greece and Spain, the livestock density is very similar in the area belonging to the cool and temperate climate zones, as also inland areas are part of the temperate zone, as Andalucía, Extremadura, and Western Castilla-la-Mancha in Spain. Finally, only a part of Northern Portugal belongs to the cool climate zone, with a higher livestock density in the Southern area and thus almost double LU in the temperate zone of Portugal than in the cool climate zone, with a larger difference for monogastric animals with respect to ruminants.

As a consequence, the **share of livestock units per climate zone** (Table 6.39) gives higher shares in the cool climate zone for France (99%), Italy (75%) and Spain (58%), while more LU are calculated for the temperate climate zone for Greece (63%) and Portugal (84%). Large differences between the two groups of livestock assessed are found for Italy (71% versus 92% of ruminants and monogastrics in the cool climate zone, respectively) and Portugal (19% versus 9% of ruminants and monogastrics in the cool climate zone, respectively).

Figure 6.17: Climate zones – cool, temperate, warm - , according IPCC (1996) derived from AGRI4CAST interpolated meteorological data for different years and long-term average 1990 – 2010

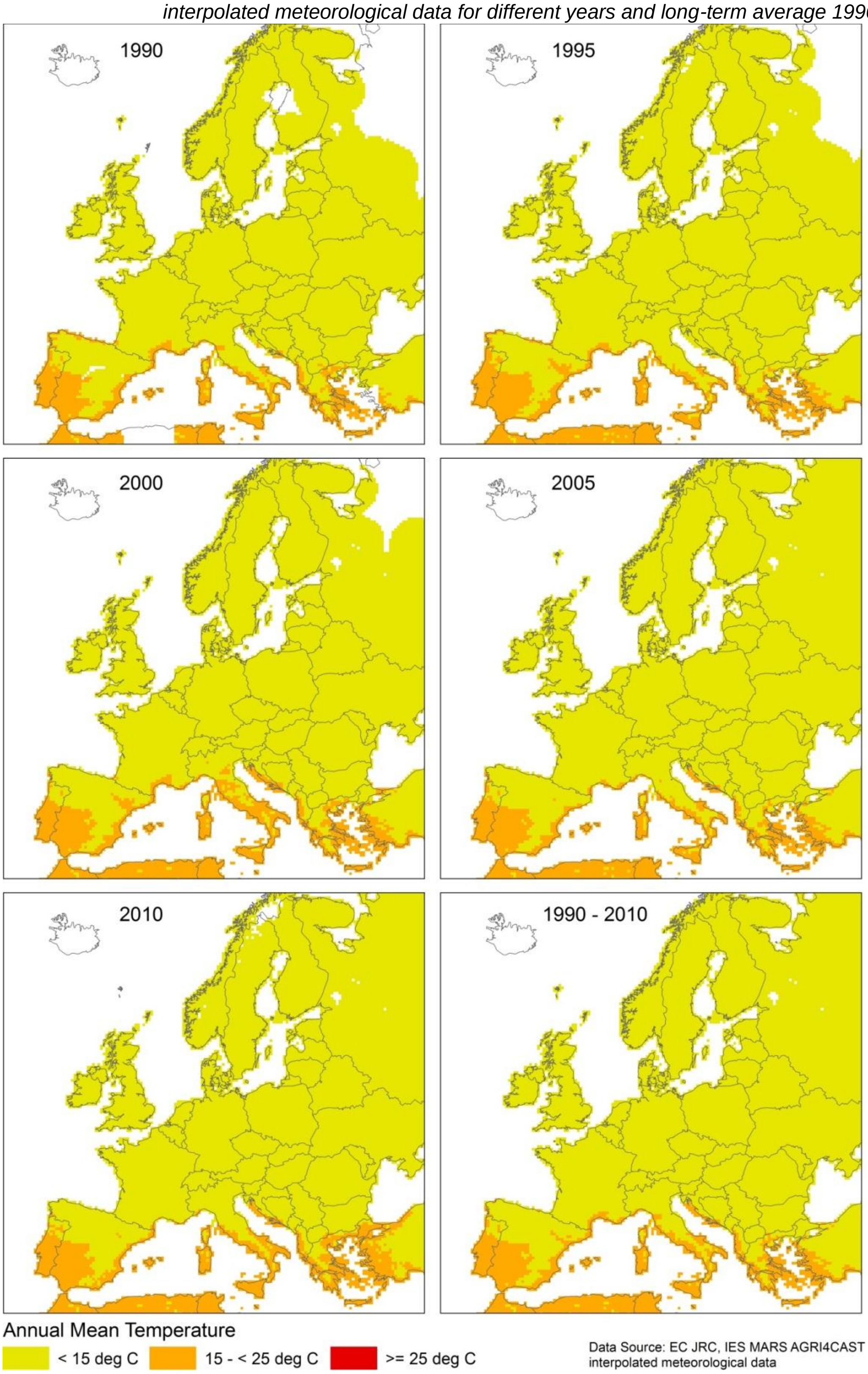


Figure 6.18: Distribution of livestock (livestock units km^{-2}) in Europe in relation with climate zones as defined by IPCC (1997). Maps are given for monogastric animals (upper left), ruminants (upper right) and total livestock units (lower left).

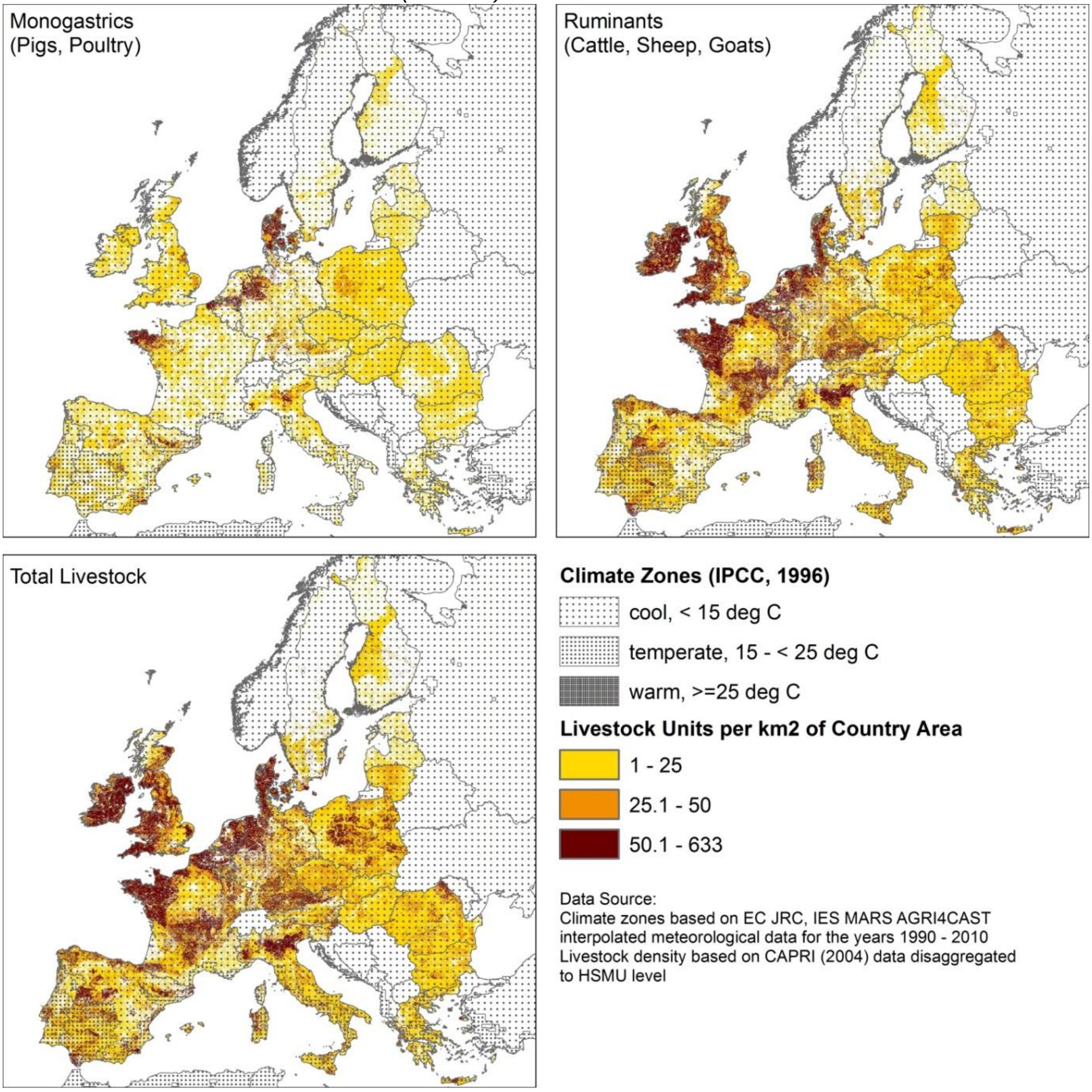


Table 6.38: *Information on country area by climate zones, livestock units for ruminants and monogastrics, and livestock unit density by Climate Zones. Data sources: climate zones definition according to in IPCC (1997), climate data for the years 2000-2010 from AGRI4CAST (2012), Livestock Unit distribution from Leip et al. (2008).*

	Country	Area		Livestock Units			Livestock Units Density in Climate Zones					
Country	Area	Share of climate zone		Total	Rumi-nants	Mono-gastrics	Total Livestock		Ruminants		Monogastric animals	
	(km2)	(% of country total)		1000 LU	(%)	(%)	(number of Livestock Units per km2)					
Country		Cool	Temp.				Cool	Temp.	Cool	Temp.	Cool	Temp.
Austria	83920	100	0	2057	77	23	25		19		6	
Belgium	30666	100	0	2835	65	35	92		60		33	
Bulgaria	110213	100	0	1423	83	17	13		11		2	
Czech Rep.	78869	100	0	1528	65	35	19		13		7	
Denmark	43338	100	0	3498	39	61	81		32		49	
Estonia	45357	100	0	234	80	21	5		4		1	
Finland	337889	100	0	960	76	23	3		2		1	
France	549161	96	4	17677	85	15	33	5	28	5	5	0
Germany	357590	100	0	13848	72	28	39		28		11	
Greece	131997	44	56	2018	88	12	13	17	11	15	2	2
Hungary	93011	100	0	1294	52	48	14		7		7	
Ireland	69939	100	0	5074	94	6	73		68		4	
Italy	301315	63	37	8236	84	16	32	19	26	18	7	1
Latvia	64599	100	0	334	87	13	5		4		1	
Lithuania	64882	100	0	862	87	12	13		12		2	
Luxembourg	2596	100	0	146	93	7	56		52		4	
Netherlands	37357	100	0	4394	59	41	118		70		48	
Poland	311927	100	0	6673	64	36	21		14		8	
Portugal	89635	25	75	1642	68	32	12	21	9	14	2	7
Romania	238456	100	0	3958	85	14	17		14		2	
Slovakia	49014	100	0	510	57	43	10		6		4	
Slovenia	20280	100	0	382	85	15	19		16		3	
Spain	505553	61	39	11970	70	30	23	25	16	17	7	8
Sweden	449765	100	0	1419	77	23	3		2		1	
UK	244514	100	0	10469	89	11	43		38		5	
EU25	**4311843**	**89**	**11**	**103440**	**76**	**24**	**24**	**21**	**19**	**16**	**6**	**5**

Table 6.39: Distribution of total livestock units, and livestock units of ruminants and monogastric animals by Climate Zone. Data sources: climate zones definition according to in IPCC (1997), climate data for the years 2000-2010 from AGRI4CAST (2012), Livestock Unit distribution from Leip et al. (2008)

Country	Share of Livestock Units in Climate Zones					
	Total Livestock		Ruminants		Monogastric animals	
	(% of country total)					
	Cool	Temperate	Cool	Temperate	Cool	Temperate
Austria	100	0	100	0	100	0
Belgium	100	0	100	0	100	0
Bulgaria	100	0	100	0	100	0
Czech Republic	100	0	100	0	100	0
Denmark	100	0	100	0	100	0
Estonia	100	0	100	0	100	0
Finland	100	0	100	0	100	0
France	99	1	99	1	100	0
Germany	100	0	100	0	100	0
Greece	37	63	37	63	37	63
Hungary	100	0	100	0	100	0
Ireland	100	0	100	0	100	0
Italy	75	25	71	29	92	8
Latvia	100	0	100	0	100	0
Lithuania	100	0	100	0	100	0
Luxembourg	100	0	100	0	100	0
Netherlands	100	0	100	0	100	0
Poland	100	0	100	0	100	0
Portugal	16	84	19	81	9	91
Romania	100	0	100	0	100	0
Slovakia	100	0	100	0	100	0
Slovenia	100	0	100	0	100	0
Spain	58	42	58	42	57	43
Sweden	100	0	100	0	100	0
United Kingdom	100	0	100	0	100	0
EU25	**90**	**10**	**90**	**10**	**91**	**9**

The comparison of the data with information obtained from the national greenhouse gas inventory reports (Table 6.40) reveals substantial differences for several countries.

France. France is almost entirely in the cool climate zone (with the exception of the extra-territorial area), for both CAPRI and national data.

Greece. Greece allocates 100% of manure in the temperate climate zone (Ministry of Environment Energy and Climate Change, 2012), while CAPRI-MARS data suggest that more than one third of the livestock units are in the cool climate zone.

Italy. Both the national inventory (ISPRA, 2012) and CAPRI-MARS give a very high share of monogastric animals for the cool climate zone, while there is some disagreement for ruminants, with a higher share of ruminants in the temperate climate zone (29%) in the CAPRI-MARS data than in the national inventory data (range 7%-41%). Also, the aggregation method might play a role, on the basis of the data submitted in 2013, the average allocation of cattle, sheep and goat to the cool climate zone is 79%, 86% or 88%, depending on whether animal numbers, N excretion, or VS excretion was used. The aggregation on the basis of animal numbers appears to be quite in agreement with the CAPRI-MARS data, considering considerable uncertainty in the downscaling process.

Portugal. According to the National Inventory Report of Portugal, the distribution of poultry and swine is very different with 42% of poultry being in the cool climate zone, but only 19% of swine. Both values are considerably higher than the CAPRI-MARS estimate of only 9%. Such a large difference is astonishing as – in contrast to most of the other countries – in Portugal not only coastal areas are classified as ‘temperate’ and thus the downscaling of CAPRI-NUTS2 data to the pixel scale (which is most uncertain) is less relevant. A similar difference between the two estimates is found for ruminants, at higher shares in the cool climate zone in both data sets.

Spain. While the CAPRI-MARS data estimate about the same share of ruminants and monogastric animals in the cool (almost 60%) and temperate climate (about 40%) zones, the share of animals in the cool climate zone on the basis of national data is higher for ruminants (18%-78%), depending on animal type, with lowest share for goats, than for monogastric animals (46%).

Differences between the CAPRI analysis and national data are caused by differences in the methodology (e.g. aggregation method) and data sources used. Available information on the national methodologies are summarized in Table 6.41.

Livestock data are obtained from statistical sources at high resolution; this is in contrast to the CAPRI data which were available only at NUTS2 level and were dis-aggregated to the pixel scale. In several countries, the temperate climate zone is located in coastal areas, such as in Italy, France, and Eastern Spain, and also Greece (see Figure 6.17). These are often narrow stripes, which adds considerable uncertainty of the spatial distribution of animals within NUTS2 regions. However, often this is overlaid with a gradient across different NUTS2 such as for example in Italy (intensive production systems concentrated in Northern Italy, higher share of extensive systems in Southern Italy) and France (concentration of animal production systems in a few regions).

Depending on the methodology used by the MS, the time series of the allocation to climate region reflects weather conditions or only shifts in animal population.

Table 6.40: Comparison between the allocation of livestock to the cool and temperate climate zones as reported in the National Inventory Reports (EEA, 2012) and as calculated on the basis of CAPRI dis-aggregated livestock data (Britz & Witzke, 2012; Leip et al., 2008) and MARS meteorological data (AGRI4CAST, 2012)

	France		Greece		Italy		Portugal		Spain	
	Cool	Temp.	Cool	Temp.	Cool	Temp.	Cool	Temp.	Cool	Temp.
Allocation of manure as reported in National Inventory Reports										
Dairy cattle	100%	0.0%	0%	100%	93%	7%	44%	56%	78%	22%
Non-dairy cattle	99%	0.0%	0%	100%	89%	11%	28%	72%	63%	37%
Sheep	100%	0.0%	0%	100%	72%	28%	30%	70%	52%	48%
Goats	94%	0.0%	0%	100%	59%	41%	49%	51%	18%	82%
Swine	99%	0.0%	0%	100%	97%	3%	19%	81%	47%	53%
Poultry	99%	0.0%	0%	100%	96%	4%	42%	58%	45%	55%
Allocation of livestock units as calculated from CAPRI and MARS data										
Total livestock	99%	1%	37%	63%	75%	25%	16%	84%	58%	42%
Ruminants	99%	1%	37%	63%	71%	29%	19%	81%	58%	42%
Monogastrics	100%	0%	37%	63%	92%	8%	9%	91%	57%	43%

Table 6.41: Available background information regarding animal allocation to climate regions

Member State	***Emission Factors and other parameters***
Greece	*The selection of EFs for our emission calculations are based on the 100% allocation of animals to the "temperate" zone. This consideration is based on annual mean temperature (MAT) values provided by the Greek Meteorological Service, measured at meteorological stations around Greece.* *According to the 5th national communication, for the high majority of Greece, MAT is higher than 15 C, with some small exceptions, like Ioannina and Tripoli, where MAT was measured to be around 14 C. Moreover, in regions like Thessaly (Larisa) and Alexandroupoli, where the highest percentage of animals (cows, sheep etc) is located, MAT is measured to be higher than 16 C.* *Based on measured MAT values provided by the Greek Meteo Service and geographical allocation of animal's data from Hellenic Statistical Authority, we will re-examine the allocation to climate zones and reported associated emissions. However, the effect of possible recalculations on total emissions is*

Member State	Emission Factors and other parameters
	expected to be minor, given that this is not a key category for Greece. For example, if we conclude to similar results as the JRC assessment, the impact to total GHG emissions will be less than 0.05 %.
Portugal	*Portugal estimates the allocation to climate regions in 5 steps. Climate data refer to the climatological normals for the period 1931-60 referring to the average values of annual air temperature. The network of climatological stations was constituted by 52 stations complemented by 93 other climatological stations with more than 10 years but less than 30 years of observations. The interpolation was done based on data from the referred 145 monitoring stations using physiographic factors. The equivalent scale is 1:1000000. Additional information can be obtained here* **http://sniamb.apambiente.pt/webatlas/** *Step 1: For each Concelho territorial area in mainland Portugal and Madeira archipelago the percentage of land area above and below 15ºC was determined using the annual average air temperature map. All area in Azores islands were considered to be in temperate region. This information was obtained cross-referencing Concelho areas with the average air temperature map in a GIS software.* *Step 2: Using data from INE (national statistics) 1999 Agriculture Census, which has information at Concelho level, we determine the number of animals, for each animal type, that are managed in cool or temperate conditions. With this information we can characterize the management condition for 1999.* *Step 3: We then aggregate this information into NUTs II and determine the shares, for each animal type, of animals in cool or temperate condition. This procedure is needed because livestock numbers for years not covered by the census are given by INE aggregated in NUTSII level. We used the 1999 NUTSII shares to characterize temperature condition for all time series (we assume equal).* *Step 4: With the shares for each animal type and year we now applied those values to the yearly livestock numbers given by INE (at NUTSII level).* *Step 5: VS values are determined for each animal type according to the methodologies discussed in the NIR. We assume these values are representative of 1998. For most animal types we use weight at slaughter (from INE) to propagate VS from 1998 to other years.* *Following recommendations made by the 2012UNFCCC in-country review team, in future inventories we will try to update livestock information concerning number of animals by Concelho with new information gathered by the 2009 Agriculture census. We will also try to implement a new system that incorporated more recent temperature data.*
Spain	*The Spanish Inventory does not use directly IPCC climate regions (see Table 6.28). The Spanish Inventory is performed at regional level (NUTS3), comprising 50 provinces. In some regions, annual mean temperature is close to 15ºC. Therefore, slight interannual changes in temperature would lead to large differences in emission estimates, as these regions may be assigned to different climate regions depending on the year. Additionally, the IPCC climate division of the provinces by climate region would give rise to substantial differences among provinces with similar climate conditions, which would be assigned to different climate regions. In order to avoid these distortions, it was decided to smooth the stepped function shown in the IPCC Reference Manual (pp. 4.36 and 4.37)53.* *Climate data: 6-hourly data provided by meteorological stations and synoptic reports of the National Weather Institute (AEMET). The possible gaps in these data are filled using temperature curves, specifically fitted for each station based on available data. After that, these temperatures are aggregated to estimate an annual mean. Provincial annual mean temperature is estimated using every weather station available and applying a lapse rate (0.6ºC / 100 m altitude) to correct for altitude variations. It is assumed that the provincial mean altitude is the mean altitude of the weather stations.* *Livestock data: Livestock numbers are gathered from the National Annual Directory of the Ministry of Agriculture, Food and Environment. The information is provided annually at regional level and comprises different subcategories within each type of livestock. This sub-categorization is further disaggregated into the Inventory animal categories (currently around 80)* *Aggregation: Information required in table 4.B(a) for each animal aggregate categories that are not very similar, such as suckling pigs and hogs within Swine. A weighted mean was calculated using N excretion as weighting parameter. Therefore, numbers reported in table 4.B(a) are obtained, for each year, using: i) mean annual provincial temperatures; ii) number of heads by category for each province; and, iii) N excretion by category.* *Smoothing of the MCF and default emission factors: Smoothed functions take the temperatures 10ºC, 20ºC and 28ºC as the class mark for each climate region. For each class mark, the default MCF provided by IPCC is taken and the linear function thus obtained is smoothed to provide the above-mentioned values. The smoothed function proposed by the Inventory Working Party is as follows:* $Factor(t) = Factor(10) + b \cdot (10 - t)^m$ *where:* *Factor(t) = Emission factor at temperature t.* *Factor(10) = Emission factor at a temperature of 10ºC (known).* *b, m = Parameters depending on the manure management system.* *The following table shows the functions for each of the management systems:*

[53] This revision deemed sound according to IGES-IPCC communication (September 2001).

Member State	Emission Factors and other parameters	
	System	***MCF_{jK}***
	Pasture/Range/Paddock	*MCF=1.000+0.033x(Tª-10)1.179*
	Daily spreading	*MCF=0.100+0.017x(Tª-10)1.380*
	Solid Storage	*MCF=1.000+0.033x(Tª-10)1.179*
	Liquid/Slurry	*MCF crust=39+0.008x(Tª-10)2.900*
		MCF no crust=39+0.008x(Tª-10)2.900
	Pit storage below animal confinements	*Two step function:* *Si Tª <20ºC. MCF <1 month=0* *Si Tª ≥20ªC. MCF <1 month=1.000x(Tª-20)1.636* *MCF >1 month=39+0.008x(Tª-10)2.900*
	Anaerobic digester	*MCF=0*
	Cattle and swine deep litter	*Same as Pit storage below animal confinements*
	Compost – Static stack	*MCF=0.5*
	Intensive compost	*MCF=0.5*
	Poultry manure with bedding	*MCF=1.5*
	Poultry manure without bedding	*MCF=1.5*
	Aerobic treatment	*MCF=0.1*
	For Tier 1 animals, IPCC also takes into account the climatic region they belong to and varies the default emission factor appropriately. Analogously to the actions carried out with the MCFs in Tier 1, functions that are continuous with temperature have been obtained from the default values of the emission factor provided by the IPCC.	

Trends

Shifts in emission factors are partly explained by the increasing milk yield for dairy cows and by changes in the use of manure management systems. For example, in Denmark, an increasing IEF for dairy cattle results from an increasing milk yield and a shift to liquid manure systems. For pigs, there has been a similar development with a move from solid manure to slurry-based systems. For non-dairy cattle, the opposite development has taken place; an increasing proportion of bull-calves is raised in stables with deep litter, where the MCF is lower than for liquid manure. A similar effect is seen for Finland. The fluctuations underlying the general increase in emissions in Finland are related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture. In the Netherlands, liquid manure systems were replaced for poultry by solid manure systems which explain the decreasing emissions for poultry.

Figure 6.19: through Figure 6.24 show the trend of the development of animal productivity in terms of volatile solid excretion for dairy and non-dairy cattle and swine, and the IEF for CH_4 emissions from manure management. These figures show how the different development of the animal sectors in the various countries affects the average characteristics at EU level. Spain is the country with the largest increase in the swine population and also the country which estimates the highest estimated volatile solid excretion rate. Thus the trend observed at EU-15 level (steepest increase in volatile solid excretion) can entirely be explained by a shift of the weight towards Spanish conditions.

Table 6.42 gives additional information on the trend in category 4B(a) as reported in the national inventory reports.

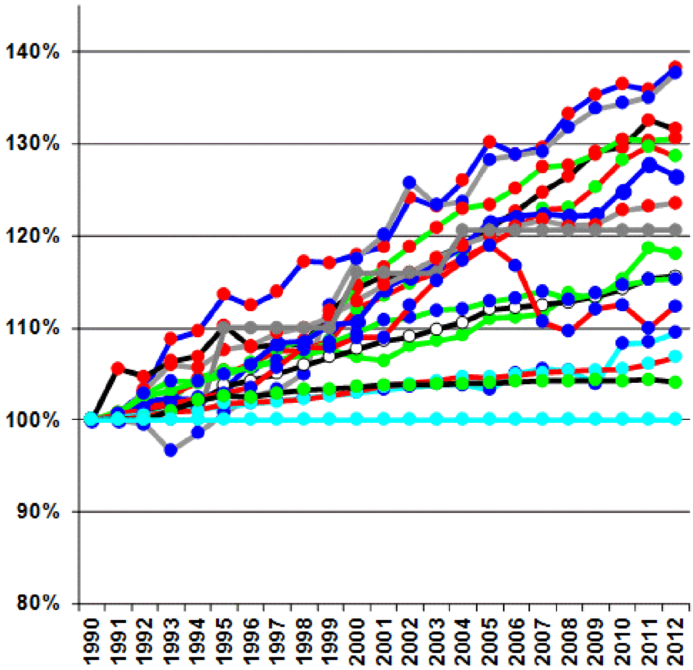
Table 6.42: Available background information on the trend for CH_4 emissions in category 4.B(a).

Member State	Trend in category 4B(a)
Denmark	*The emission from manure management has increased due to a change towards greater use of slurry-based stable systems, which have a higher emission factor than systems with solid manure. By coincidence, the decrease and the increase almost balance each other out and the total CH_4 emission from 1990 to 2007 decreased by 5%. For pigs, there has been a similar development as for dairy cattle with a*

Member State	Trend in category 4B(a)
	move from solid manure to slurry-based systems. Updated stable type data for 2007 shows fewer animals on slurry systems than previous estimated by the expert judgement from the Danish Agricultural Advisory Centre. An increase of the EF for swine has been observed between 2007 and 2008 (6%). This is due to changes in the allocation between the subcategories sows, slaughter pigs and piglets. Looking at the time series for EF similar changes is seen, for example between 1993 and 1994 (increase by 7%), 2000-2001 (decrease by 5%) and 2004-2005 (decrease by 6%).
Finland	*Some inter-annual variation between the years can be noticed from the time series but overall there is an increase in the emissions since 1990. This is mainly caused by fluctuation in activity data between the years because of changes in animal numbers, for example, which is largely affected by agricultural policy and subsidies. Manure management is affected by the fluctuation in animal numbers as well as the proportion of manure managed in different manure management systems which vary depending on animal species. The number of animals kept in a slurry-based system is increasing.*
Germany	*Between 1993 and 1994 there was a shift in German dairy cattle housing systems from straw based systems to slurry based systems (1993: 33 % straw based systems, 1994: 19 % straw based systems). As the MCFs for slurry systems (10 and 17 %) are much higher than the MCF for solid systems (2 %), this leads to a comparably high increase of overall methane EF. (TI - Claus Roesemann)*
Ireland	*A decrease of the IEF for non-dairy cattle between 2005 and 2006 (by 5%) is explained by the strong increase of recovery of biogas from the animal waste storage for energy purposes in 2006.*
Italy	*Strong increase in biogas recovery in affected significantly CH_4 emissions from manure management. This caused a decrease by 22% and 19% in the period 2010/2011 and 2011/2012 for the IEF in the methane emissions estimation of swine in manure management as well as a decrease in the IEFs for dairy and non-dairy cattle by 25%*
Luxembourg	*Methane emissions from manure management increased by more than 22% for the period 1990-2006. Animals who did contribute the most of these emissions are cattle, swine and chicken. Beside livestock population developments, the methane emission increase is mainly driven by the changes in the AWMS for cattle: the liquid system share in AWMS went from 23% to about 38% for dairy cattle and from 18.9% to 28.9% for non-dairy cattle. As liquid systems have the highest methane conversion factor, this explains why, despite a decreasing cattle population, related CH_4 emissions did rise over the period 1990-2006.*
Netherlands	*The interannual increase of methane emissions is 13% and methane IEF for dairy cattle in 2008/2009 is 11%. This is not due to shorter grazing periods but the result of a shift from day and night grazing towards during the daytime only. Methane emissions from the stable are far higher than during grazing thus explaining the difference. Lower values are seen for pigs and horses, and higher for rose veal (as a part of young stock) and fur-bearing animals (as part of other animals). In poultry three effects lead to lower emissions, i.e. decrease in organic matter content of broiler manure, less laying hens kept and the on-going shift to solid manure within the latter category.*
Spain	*Increase of methane emissions from manure management in the period 1990-2011 due to the increase of number of heads of non-dairy cattle and, above all, of swine. (The interannual increase of CH_4 emissions for swine 2005/2006 by 11% was due to several factors: a) an increase of 5% in the numbers of animals that superimposes to an increase in the per animal weight, and b) to an increase of the annual average temperatures (based on annual meteorological - not climatic - data for temperature). There is also an increase of emissions from poultry, but this has a lower impact in the total.*

Figure 6.19: Trend of volatile solid excretion for dairy cattle

Dairy cattle: Volatide solid excretion (kg dm/head/year)

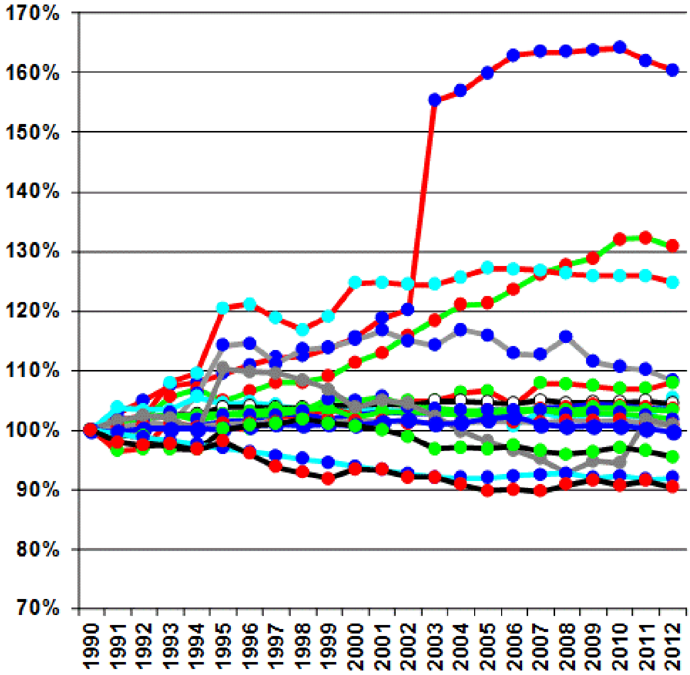


	1990	2012	Trend (%) 1990-2012
Greece	3.5	4.8	138%
Portugal	3.5	4.8	138%
Spain	3.9	5.1	132%
Finland	3.8	4.9	131%
Belgium	3.2	4.1	129%
United Kingdom	2.8	3.6	126%
Luxembourg	3.7	4.6	124%
Netherlands	3.8	4.6	121%
France	3.5	4.1	118%
EU-15	3.8	4.4	116%
Germany	3.5	4.0	115%
Denmark	5.5	6.2	112%
Ireland	2.8	3.0	109%
Austria	4.0	4.3	107%
Sweden	5.4	5.6	104%
Italy	6.4	6.4	100%

15.05.2014 - AL - file: EC-IR.TREND..4Ba.VS.DAIR

Figure 6.20: Trend of volatile solid excretion for non-dairy cattle

Non-dairy cattle: Volatide solid excretion (kg dm/head/year)

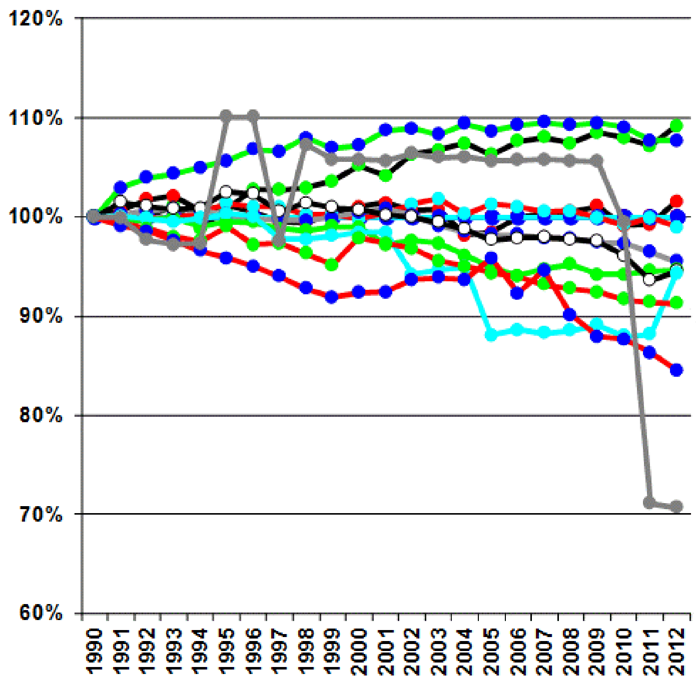


	1990	2012	Trend (%) 1990-2012
Denmark	1.7	2.7	160%
Finland	1.3	1.7	131%
Austria	1.5	1.9	125%
Portugal	2.6	2.8	108%
Belgium	1.4	1.5	108%
Italy	2.8	2.9	105%
EU-15	1.9	1.9	104%
Greece	2.1	2.2	103%
France	1.9	2.0	103%
Germany	1.4	1.5	102%
Luxembourg	1.9	1.9	101%
Netherlands	1.2	1.2	101%
United Kingdom	2.3	2.3	100%
Sweden	1.6	1.5	95%
Ireland	1.4	1.3	92%
Spain	2.5	2.3	90%

15.05.2014 - AL - file: EC-IR.TREND..4Ba.VS.NDAI

Figure 6.21: Trend of volatile solid excretion for swine

Swine: Volatide solid excretion (kg dm/head/year)

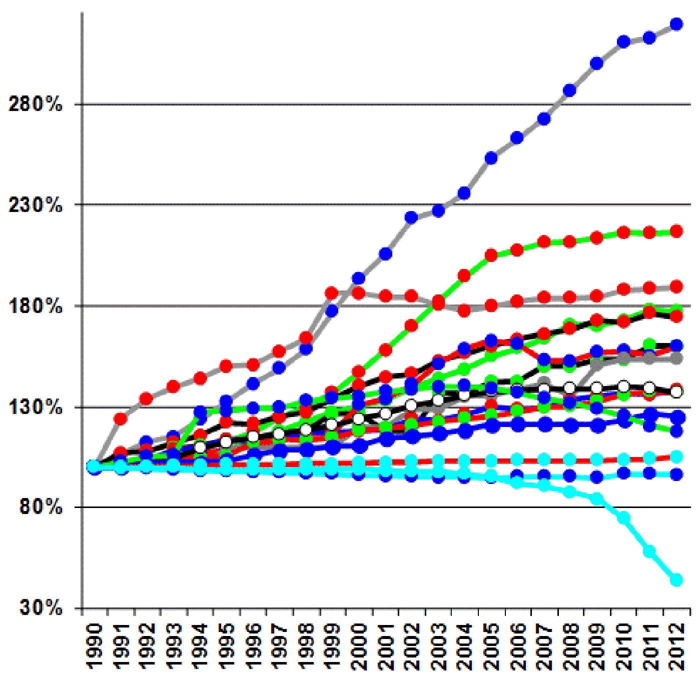


	1990	2012	Trend (%) 1990-2012
Sweden	0.3	0.4	109%
Germany	0.2	0.3	108%
Spain	0.3	0.3	102%
Finland	0.5	0.5	100%
Luxembourg	0.5	0.5	100%
United Kingdom	0.5	0.5	100%
Ireland	0.3	0.3	100%
Austria	0.3	0.3	99%
Portugal	0.5	0.5	95%
France	0.3	0.3	95%
EU-15	0.3	0.3	95%
Italy	0.4	0.3	94%
Belgium	0.4	0.4	91%
Denmark	0.2	0.2	85%
Netherlands	0.2	0.2	71%
Greece			

15.05.2014 - AL - file: EC-IR.TREND..4Ba.VS.SWIN

Figure 6.22: Trend of IEF for CH_4 emissions from category 4B(a) for dairy cattle

Dairy cattle: CH4 from manure management (kg CH4/head/yr)

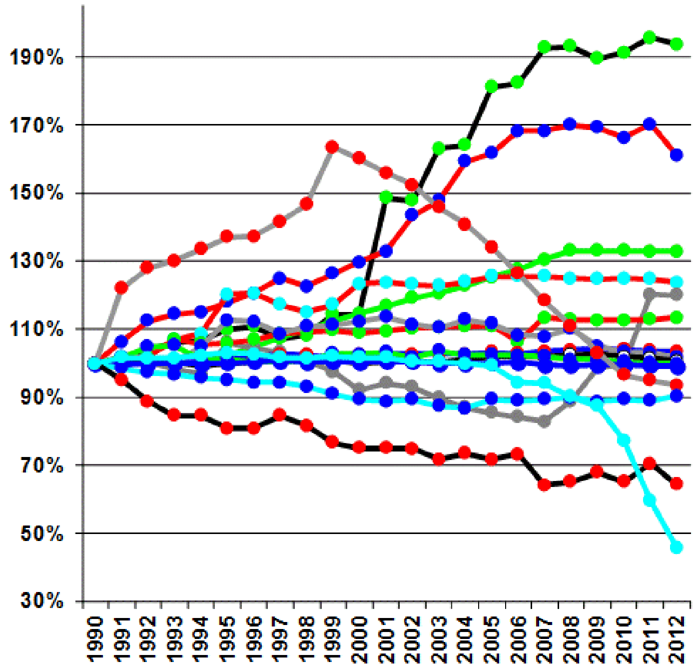


	1990	2012	Trend (%) 1990-2012
Portugal	1.7	5.3	319%
Finland	7.0	15.2	216%
Luxembourg	21.1	40.0	189%
France	22.5	39.8	177%
Spain	41.7	72.7	174%
Sweden	5.9	9.4	160%
Denmark	21.1	33.6	160%
Netherlands	28.0	43.1	154%
Greece	7.9	11.0	138%
Belgium	12.7	17.4	137%
EU-15	21.2	29.0	137%
United Kingdom	34.2	42.9	125%
Germany	16.7	19.6	118%
Austria	8.7	9.2	105%
Ireland	21.6	20.8	96%
Italy	15.0	6.6	44%

15.05.2014 - AL - file: EC-IR.TREND..4Ba.IEF.4BA.DAIR

Figure 6.23: Trend of IEF for CH_4 emissions from category 4B(a) for non-dairy cattle

Non-dairy cattle: CH4 from manure management (kg CH4/head/yr)

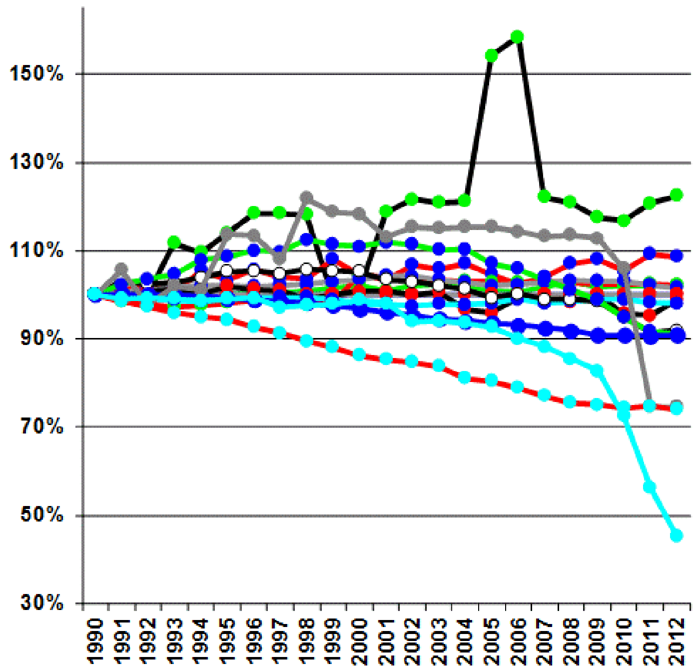


	1990	2012	Trend (%) 1990-2012
Sweden	3.3	6.4	194%
Denmark	5.7	9.2	161%
France	6.4	8.5	133%
Austria	3.3	4.1	124%
Netherlands	7.6	9.1	120%
Belgium	2.5	2.8	113%
Greece	1.3	1.3	103%
Portugal	1.4	1.4	102%
EU-15	8.1	8.1	101%
Germany	8.3	8.3	100%
United Kingdom	15.1	15.0	99%
Luxembourg	6.4	6.0	94%
Ireland	11.1	10.1	90%
Spain	4.2	2.7	64%
Italy	7.5	3.4	46%
Finland			

15.05.2014 - AL - file: EC-IR.TREND..4Ba.IEF.4BA.NDAI

Figure 6.24: Trend of IEF for CH_4 emissions from category 4B(a) for swine

Swine: CH4 from manure management (kg CH4/head/yr)



	1990	2012	Trend (%) 1990-2012
Sweden	1.3	1.6	122%
Denmark	2.1	2.3	109%
France	12.6	12.9	102%
Belgium	7.6	7.7	102%
Portugal	20.4	20.8	102%
Greece	7.0	7.0	100%
Luxembourg	19.5	19.5	100%
Spain	9.5	9.4	99%
Ireland	13.0	12.7	98%
EU-15	7.5	6.9	92%
Germany	3.6	3.3	91%
United Kingdom	21.0	19.0	91%
Netherlands	3.9	2.9	75%
Austria	1.6	1.2	74%
Italy	8.1	3.7	45%
Finland			

15.05.2014 - AL - file: EC-IR.TREND..4Ba.IEF.4BA.SWIN

6.3.2.3 Uncertainty and time series consistency

As for enteric fermentation, the activity data in the category 4B(a) are considered to be relatively certain with uncertainty estimates around 10%. Highest uncertainty for the activity data are estimated by Italy (20%). Portugal assigns a high uncertainty to the population data of several animal types.

The uncertainty estimate for the emission factors is higher and ranges between 8% (Spain) and 100% (Italy).

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.43 and Table 6.44. An overview of uncertainty estimates for agriculture at country and EU-15 levels will be given in section 6.4

Table 6.45 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from manure management. The table lists only information on activity-data uncertainty that is not covered in category 4A.

Table 6.43: Relative uncertainty estimates for activity data in category 4B(a)

Member State	**Total**	**Cattle**	**Dairy Cattle**	**Non-Dairy Cattle**	**Buffalo**	**Swine**	**Poultry**	**Other**
Austria		10						
Belgium	10		10	10		10		
Denmark	5							
Finland	12							
France	5							
Germany		6			5	3		
Greece	5							
Ireland			1	1				1
Italy	20							
Luxembourg		2						
Netherlands		10				10	10	10
Portugal	8							
Spain	3							
Sweden	7							
United Kingdom	0.1							

Table 6.44: Relative uncertainty estimates for implied emission factors in category 4B(a)

Member State	**Total**	**Cattle**	**Dairy Cattle**	**Non-Dairy Cattle**	**Buffalo**	**Swine**	**Poultry**	**Other**
Austria		50						
Belgium	40		40	40		40		
Denmark	20							
Finland								
France	30							
Germany		64			19	29		
Greece	50							
Ireland			15	15				30
Italy	100							
Luxembourg		70						
Netherlands		100				100	100	100
Portugal	75							
Spain	8							
Sweden	18							
United Kingdom	30							

Table 6.45: Available background information for uncertainty estimates in category 4.B(a)

Member State	***Background information to uncertainty estimates***
Austria	*Emission Factor: AWMS distribution for the years 1989–1992 could be estimated with low uncertainty (± 10%) due to the survey of (Konrad 1995). It must be assumed that AWMS distribution changed after 1992. Uncertainty increases the longer the time lag between the survey and the respective inventory year. Uncertainty of AWMS distribution in 2001 was estimated at 30%. TIHALO (Amon et al 2007) carried out a comprehensive survey on AWMS distribution on representative Austrian farms. The inventory revision integrated TIHALO data into the emission estimates. Uncertainty of AWMS distribution has therefore been reduced again to ± 10%. Following the uncertainties of N_2O emission factors, we estimate MCF values to be –50 to +100% uncertain. The country specific MCFs reflect the agricultural practice and the climate conditions in Austria better than the default values. Thus, uncertainties could be reduced to ± 20% (Amon and Hoertenhuber 2010). Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 50%(expert judgement Barbara Amon, spring 2010), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000.*
Belgium	*Activity Data: The activity data are the livestock census, but also the type of animal housing. The type of housing is more difficult to assess than the number of animals. Consequently the uncertainty on the activity data is estimated at 10 %.* *Emission Factor: The CH_4 emission factors are based on a regional-specific study. However, given that many assumptions were necessary to calculate these emission factors, the uncertainty on these emission factors is estimated to be similar to the uncertainty on enteric fermentation emission factor.*
Denmark	*Emission Factor: The emission factor for CH_4 from manure management is 10%. This figure may be underestimated and the uncertainty is, therefore, increased to 100 % until further investigations reveal new data.*
Finland	*Emission Factor: The uncertainty estimate of the CH_4 emission factor for manure management for all species (±30%) was based on uncertainty estimates of other countries, i.e. Norway, the Netherlands, the USA (Rypdal & Winiwarter 2001) and the UK (Charles et al. 1998), complemented with expert judgement. Uncertainty could be reduced by collecting more information about the distribution of manure management systems and by gathering data from gas flux measurements in order to study the suitability of IPCC default to Finnish boreal climate.*
France	*30% uncertainty, lower than in previous reports, because the preliminary results of the MONDFERENT project have allowed a more accurate estimation of VS values for cattle (responsible of 57% of total CH_4 emissions from manure management)*
Germany	*Emission Factor: Figures for N_2O, NO and N2 are taken from IPCC (2006).*
Netherlands	*Activity Data: The uncertainty in the annual CH_4 and N_2O emissions from manure management from cattle and swine is estimated to be approximately 100%. The uncertainty in the amount of animal manure (10%) is based on a 5% uncertainty in animal numbers and a 5–10% uncertainty in excretion per animal. The resulting uncertainty of 7–11% was rounded off to 10%.* *Emission Factor: The uncertainty in the CH_4 emission factors for Manure management, based on the judgments of experts, is estimated to be 100% (Olivier et al.,2009). Of the three factors that together make up the emission factor (emission per amount of manure), MCF (Methane Conversion Factor) is the most uncertain. The factor captures for instance assumptions on temperature (temperature is important to the rate of methane production) on technology of manure systems (e.g., sometimes methane (biogas) is collected and used) and on the actual management (e.g. whether a tank is directly cleaned after its use). The microbiology of methane formation itself is relatively well known. Most of the uncertainty is created by the assumptions about 'average' manure management (Olsthoorn and Pielaat, 2003)*
Portugal	*Emission Factor: The total uncertainty in the emission factors was determined on the basis of estimated uncertainty of VS (20%), the allocation of manure fo reach manure management system, B_0 and from the allocation to climate regions., considering the use of an enhanced livestock characterization.*
Spain	*For animals where tier 1 is used, default IPCC uncertainty values are taken. For sheep, 10% is considered (based on the assumption that the use of national specific parameters will reduced the IPCC default for tier 2). Fo cattle, swine and poultry, the uncertainty is assumed to be reduced because of the use of a tier 3 approach, so 8% is taken.*
Sweden	*Emissions from manure management have an estimated error of about 50 %.*
UK	

The following issues for time-series consistency have been identified:

- *Activity data, Sweden*

  Information on waste management systems is collected from the surveys published in the biannual statistical report on the use of fertilisers and animal manure in agriculture and the interpolated values are used for the intermediate years. National estimates of stable periods for cattle are collected from the statistical report on use of fertilisers and animal manure in agriculture. This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990.

6.3.3 Manure Management N_2O (CRF source category 4.B(b))

6.3.3.1 Source category description

During storage and management of manure, N_2O can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term 'manure' is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. As for methane emissions, source category 4.B(b) excludes emissions that originate from burning of manure. Also excluded are emissions from manure deposited on pastures by grazing animals, which are reported under category 4.D2.

Direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure, and depend on the availability of nitrogen and carbon. As nitrification requires the presence of oxygen, N_2O emissions are favoured by aerobic conditions, which are favoured in solid manure storage and treatment systems. Denitrification is an anaerobic process and yields molecular nitrogen next to N_2O. Under conditions of reduced moisture, high nitrate concentrations and acidic medium, the emissions of N_2O relative to N_2 increase. Losses of other forms of nitrogen (NH_3, NO_X) are possible and will potentially lead to N_2O emissions once they re-deposit on the surface. These 'indirect' N_2O emissions are reported in source category 4.D3.

Generally, GHG emissions (in CO_2-equivalents) from manure management are predominantly as CH_4 rather than as N_2O. At the EU-15 level, this ratio is at about a factor of 1.9, ranging from 0.4 (Austria) to 4.8 (Ireland). Values close or smaller to unity are found for example for Greece (0.7).

The differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors.

Table 6.46 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value and that only small changes in the IEF occurred in the time between 1990 and 2012 with an -1% change of the IEF for solid systems and of -7% for liquid systems.

Table 6.46: Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-15 level for the years 1990 and 2012

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0.03	7	67
Total Nitrogen excreted [Gg N]	21	2,711	2,391
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.18%	1.80%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2012		
Total Emissions of N_2O [Gg N_2O-N]	0.03	6	52
Total Nitrogen excreted [Gg N]	20	2,485	1,866
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.16%	1.77%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2012 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	97%	85%	77%
Total Nitrogen excreted [Gg N]	97%	92%	78%
Implied Emission Factor [kg N2O-N / kg N]	100%	93%	99%

6.3.3.2 Methodological Issues

Methods

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems; the percentage of emissions from solid storage systems thus varies between 18% in Denmark and 99% in Greece.

Table 6.47 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that 'solid storage' is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. This is done by most Member States at a higher disaggregation level than categories that are reported in the CRF. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.

The quality of the emission estimates is calculated from the Nex factor for the each manure management system (assigning Tier 1 or Tier 2 when comparing to IPCC default), combined with the MEAN-rule (see section 6.4.1.5, Table 6.91 through Table 6.94) and then further combined with the Tier level of the emission factor for the manure storage system by using the MEDIAN rule with weighting factors for Nex and the IEF being 2/3 and 1/3 (for details see Section 6.4.1.3).

As most countries use country-specific nitrogen excretion rates for most animals but use default emission factors, the level of Tier 1.8 is assigned. The combined uncertainty of solid, liquid, and other systems (14% of total emissions) range between Tier 1.1 and Tier 2.0. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used.

For EU-15, the overall Tier level is Tier 1.8 (78% of emissions estimated using country-specific information). This value is somewhat lower for solid systems (Tier 1.7) than for liquid systems (Tier 1.9). A compilation of national methodologies for the estimation of nitrogen excretion can be found in

Table 6.53; most data are based on country-specific information. This is important if we assess the uncertainty of the EU-15 emission estimate: given that nitrogen excretion is largely controlling N_2O emissions from manure management, the error of the estimates of the different countries can be assumed to be largely independent one from another. Only two countries are relying on IPCC default values, i.e. Greece using values reported for the Mediterranean region and France (for dairy cattle) using the value for Western Europe.

Additional background information on the methodology, if available, is summarised in Table 6.48.

Table 6.47: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems. Data for the year 2012.

2012	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Austria	917	Tier 1.8	74%	Tier 1.7	y	3%	Tier 1.7
Belgium	766	Tier 1.7	92%	Tier 1.7	y	1%	Tier 1.7
Denmark	391	Tier 1.9	18%	Tier 1.7	y	20%	Tier 1.9
Finland	416	Tier 1.1	78%	Tier 1.8	y	4%	Tier 0.9
France	4,972	Tier 1.7	96%	Tier 1.7	y	4%	Tier 1.7
Germany	2,788	Tier 2.0	59%	Tier 2.0	y	41%	Tier 2.0
Greece	594	Tier 1.7	99%	Tier 1.5	y	1%	Tier 1.7
Ireland	464	Tier 1.7	86%	Tier 1.7	y	14%	Tier 1.7
Italy	3,742	Tier 1.7	89%	Tier 1.6	y	4%	Tier 1.7
Luxembourg	32	Tier 2.0	94%	Tier 2.0	y	5%	Tier 2.0
Netherlands	1,007	Tier 1.7	84%	Tier 1.7	y	16%	Tier 1.7
Portugal	293	Tier 1.7	93%	Tier 1.6	y	4%	Tier 1.7
Spain	1,521	Tier 1.8	20%	Tier 1.1	y	0%	Tier 1.0
Sweden	442	Tier 1.7	70%	Tier 1.7	y	5%	Tier 1.7
United Kingdom	2,660	Tier 1.8	70%	Tier 1.7	y	2%	Tier 1.7
EU-15	**21,005**	**Tier 1.8**	**77%**	**Tier 1.7**	**y**	**9%**	**Tier 1.9**
EU-15: Tier 1	22%		27%			11%	
EU-15: Tier 2	78%		73%			89%	

a Contribution to N_2O emissions from manure management; b Quality level (between Tier 1 and Tier 2); c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 6.48: Available background information on the methodology for estimating N_2O emissions in category 4.B(b)

Member State	***Methods***
Austria	*For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. For the calculation of the losses of gaseous N species (NH_3-N and NO_X-N) the mass-flow procedure pursuant to EMEP/CORINAIR (EEA 2007) has been applied. In 2009 new data on agri-cultural practice in Austria (Amon et al. 2007) has been integrated to the ammonia emission model (Amon and Hoertenhuber 2008).*
Belgium	*The method used in the three regions is fully in compliance with the IPCC GPG 2000. N_2O emissions from manure produced by grazing animals are not taken into account into category 4.B but are included in the category 4.D, agricultural soils.*
Denmark	*Emissions from manure management are calculated in with the model IDA. Investigation indicates a lower N_2O emission from biogas treated slurry compared to untreated slurry (Sommer et al., 2001 and Sommer et al., 2004). The lower emission is a result of displacement in allocation between the fraction of degradable and non-degradable VS. Biogas treated slurry increase the fraction of non-degradable VS, which promote the oxygen content in soil. These conditions will reduce the potential risk for N_2O emission, because N_2O emission takes place in environments without oxygen or with very low concentrations of oxygen (Sommer et al., 2001). In practice this effect of a lower N_2O emission will takes place in the manure applied on soil. However, it is chosen, in the inventory, to incorporate the lower N_2O-emission as a subtracting from the manure management emission. The biogas treatment is accomplished before the slurry is applied to soil. It is assumed that the lower emission of biogas treated slurry compared to untreated slurry is 64% for cattle slurry and 59% for pig slurry (Sommer et al., 2001).*
Finland	*N_2O emissions from manure management are calculated with a national calculation model (Gronroos et al. 2009). The nitrogen mass flow model takes into account the volatilisation of ammonia in each step of manure management (animal shelter, filling storage, storing) and the effect of possible abatement measures to volatilisation. This enables to calculate indirect nitrous oxide emissions from AWMS. Urine stored separately is a small adjustment to solid storage emissions (and has EF of liquid). Direct N_2O*

Member State	Methods
	emissions from manure managements are calculated in the model using the IPCC methodology, with default EF.
France	
Germany	*Calculation of N-excretion is calculated with the GAS-EM model and based on the concept of nitrogen-flow in agriculture which considers all nitrogen losses including molecular nitrogen (EMEP, 2003; Daemmgen and Hutchings, 2005; Daemmgen et al., 2007). It considers a differentiation between organic nitrogen and easily decomposable nitrogen (total ammoniacal nitrogen, TAN). TAN is present in the urine of mammals, while poultry excrete uric acid nitrogen (UAN), which is considered as TAN in the calculations. In a first step, both the excretion of total nitrogen and of total ammoniacal nitrogen (TAN) is estimated. Consistently with the definition of the EFs,emissions of NH_3 are calculated in proportion to the TAN content, while N_2O, NO, and N2 emissions are proportional to the total N content, weighted by the share of TAN and organic N. Emissions of all N-gases on pasture, range and paddock occur simultaneously, while volatilization in housing systems are subtracted from available TAN for the calculation of emissions from manure management systems. For solid storage systems, the N in bedding material is considered with a N-content of 0.58% of dry weight straw. All calculations are done on the district level using the agricultural model RAUMIS.*
Greece	*Default*
Ireland	*Tier 1*
Italy	*For sheep and goat, a detailed analysis has been carried out with information from ASSONAPA, the National Association for Sheep Farming. For slurry and solid manure production parameters, specifically for the cattle and buffalo category, updated data have been incorporated, according to new country specific data available.*
Luxembourg	
Netherlands	*Activity data are collected in compliance with a Tier 2 method. The method used is fully in compliance with the IPCC Good Practice Guidance (IPCC, 2001). The N-flows from animal production are assessed by the National Emission Model for Ammonia (NEMA). Results include emissions of ammonia (NH_3), nitric oxide (NO), laughing gas (N_2O) and nitrogen gas (N2) from stable and storage. IPCC 2000 methodology with country specific parameters.*
Portugal	
Spain	*IPCC 2000 methodology with country specific parameters.*
Sweden	*The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.*
United Kingdom	*It is assumed that 20% of the total N emitted by livestock volatilises as NO_X and NH_3 and does not contribute to N_2O emissions. This is because in the absence of a more detailed split of NH_3 losses at the different stages of the manure handling process it has been assumed that NH_3 loss occurs prior to major N_2O losses. Emission estimates are made with 20% smaller Nex factors than those reported in the CRF. The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.*

Activity Data

In EU-15, a total of 7,869 Gg N was managed in manure management systems or excreted on pasture range and paddock in 2012. The largest share of this manure-nitrogen was excreted by grazing animals, followed by manure managed in liquid and solid storage systems. Compared with 1990, this was a decrease of manure-nitrogen by 12%. The decreases were similar for the different manure management systems with a smallest decrease for liquid systems (8%). The decrease of nitrogen was particularly pronounced in the Netherlands, where total nitrogen decreased by 33%. At the same time, the manure managed on solid storage systems decreased by 12% indicating a strong shift from pasture to solid systems in the Netherlands. This is a consequence of the increase of the time period dairy cattle are kept indoors. Firstly this is done to increase cost-effectiveness of milk production and secondly to increase the efficiency of manure application as an effect of Dutch manure-policy.

The nitrogen managed in the various manure management systems in 2012 is given in Table 6.49. Background information on the allocation to manure management systems is given in Table 6.31. Nitrogen excretion data per head will be discussed below.

Table 6.49: Member State's nitrogen managed in the manure managed systems anaerobic lagoon, liquid systems, daily spread, and other systems, manure excreted on pasture range and paddock, and total nitrogen excreted in 2012 [Gg N yr^{-1}]

Member State 2012	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Austria		55		70	31	10	165
Belgium		19	2	73	86	77	257
Denmark		198		7	32	22	258
Finland		37		41	8	19	105
France		422		489		839	1,750
Germany		763		369		135	1,267
Greece		15	1	60		152	228
Ireland		134		41		276	451
Italy		313		343	25	146	828
Luxembourg		4		3	1	5	13
Netherlands		321		89		65	476
Portugal	20	22		28		83	154
Spain		2	3	30	429	298	764
Sw eden		48		32	11	45	136
United Kingdor		131	10	190	90	597	1,018
EU-15	20	2,485	16	1,866	712	2,769	7,869

Information source: CRF Table 4.B(b) for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

As most countries are using IPCC default values for the IEF or values that are close to it, these numbers apply also for the EC-N_2O inventory for manure management. An overview of the implied emission factors is given in Table 6.50. In the German inventory, the IEF for the category solid storage and dry lot is country specific and higher than default. Nitrogen in bedding material is considered when calculating N_2O emissions from solid manure. The IEF is therefore higher than each partial EF by management system.

Table 6.50: Implied Emission factors for N_2O emissions from manure management used in Member State's inventory 2012

Member State	Implied EF (kg N_2O-N / kg N)			
2012	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Austria	NO	0.10%	2.0%	1.4%
Belgium	NO	0.10%	2.0%	0.1%
Denmark	NO	0.08%	2.0%	1.6%
Finland	NO	0.10%	1.6%	2.0%
France	NA	0.10%	2.0%	NA
Germany	NO	0.31%	0.9%	NO
Greece	NA	0.10%	2.0%	NA
Ireland	NO	0.10%	2.0%	NO
Italy	NO	0.10%	2.0%	2.0%
Luxembourg	NO	0.10%	2.0%	0.1%
Netherlands	NO	0.10%	2.0%	NO
Portugal	0.10%	0.10%	2.0%	NO
Spain	NO	0.10%	2.0%	0.6%
Sweden	NO	0.10%	2.0%	2.0%
United Kingdom	NO	0.10%	2.0%	1.7%
EU-15	0.10%	0.16%	1.8%	0.8%

Information source: CRF Table 4.B(b) for 2012, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

An important parameter in the calculation of N_2O emissions from manure management is the nitrogen excretion rate per head and year, which is given in Table 6.51 for EU-15-countries and for the main animal types. The table shows a range by a factor of up to 3.3 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range of about 40 kg N head^{-1} y^{-1} from 100 (Ireland) to 138 kg N head^{-1} y^{-1} (Denmark). Large ranges are found for non-dairy cattle with values between 40 (Netherlands) and 58 kg N head^{-1} y^{-1} (France) and sheep with values between 5.1 kg N head^{-1} y^{-1} (Spain) and 17.0 kg N head^{-1} y^{-1} (Luxembourg and Denmark).

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 6.52. Additional background information on the calculation of nitrogen excretion rates is summarised in Table 6.53.

Table 6.51: *Total Nitrogen excretion by AWMS [kg N head^{-1} yr^{-1}] for dairy and non-dairy cattle, sheep, swine, and poultry in 2012*

Member State 2012	Dairy	Non-Dairy	Sheep	Swine	Poultry
Austria	100	46	13	9	0.5
Belgium	118	55	8	10	0.6
Denmark	138	43	17	8	0.5
Finland	130	51	10	IE	0.6
France	115	58	17	7	0.5
Germany	117	44	8	11	0.8
Greece	103	46	11	16	0.6
Ireland	100	50	7	8	0.5
Italy	116	52	16	13	0.5
Luxembourg	102	46	17	11	0.8
Netherlands	122	40	7	9	0.6
Portugal	117	50	8	9	0.6
Spain	110	43	5	9	0.5
Sweden	124	42	6	9	0.4
United Kingdom	123	54	5	10	0.6
EU-15	117	50	8	9	0.6

Information source: CRF Table 4.B(b) for 2012, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.52: *Available background information on the emission factor for calculation of N_2O emissions in category 4.B(b)*

Member State	***Emission Factors***
Austria	*Default with exception of 'deep litter' for which IPCC (2006) is taken. In the IPCC guidelines no emission factor for yard is available. It is assumed, that the storage of the yard manure equals the average waste management systems distribution in Austria. Thus, the implied N_2O emission factor of all systems (except pasture) has been used. Scientific background: N_2O emissions result from the interaction of manure N with organic carbon that is present in soils and in straw. This explains higher EF for pasture, solid systems or composting compared to liquid systems. In yards, there is neither soil-C nor straw-C.*
Belgium	*In Belgium, the local excretion factors are more or less comparable to the IPCC 1996 default value, especially if the principle of table 4.14 of the IPCC GPG 2000 is taken into account.*
Denmark	
Finland	*IPCC default. For dung and deep litter, EF is the same as for solid storage, and urine's is the same as for slurry*
France	
Germany	*Liquid slurry - the higher EF from IPCC (2006) is used as a conservative estimate. For artificial cover the EF for natural crust is used (0.5%) instead of the EF of 0% following a 'worst-case' assumption; however, these artificial covers are not significant in Germany. For anaerobic digesters IPCC (2000) is used. A differentiation between deep litter and solid storage is made. EF for solid storage is 1.3% (Vandre et al., 2012), for deep litter the EF from IPCC (2006) had to be used, similar to poultry litter, for which no EF is available from IPCC (1996). Studies from Denmark (Sommer, 2001) and UK (Sneath et al., 1997) show that EFs from IPCC (2006) do not lead to an underestimation of emissions. Emissions of NO and N2 are linked to N_2O emissions, using an EF for NO of 10% and for N2 of 300% of the N_2O-EF.*
Greece	*Default*
Ireland	*Default*
Italy	*Liquid system, solid storage and other management systems (chicken-dung drying process system) are considered according to their significance and major distribution in Italy*
Luxembourg	
Netherlands	*IPCC default.*
Portugal	*IPCC 1996 defaults*
Spain	*IPCC 2000 defaults*
Sweden	*Default values from the IPCC Guidelines. IEFs may change over the years, depending on the relative size of the respective subgroups aggregated. IPCC 1996 defaults*
United Kingdom	*Calculations were performed with the N_2O Inventory of Farmed Livestock to compare housing and storage phases (Sneath et al. 1997). For pigs and poultry, the emission factor for housing is the same as or greater than that of storage. For dairy and non-dairy cattle, the emission factor for the housing phase is around*

Member State	*Emission Factors*
	10% of the storage phase, so the non-stored FYM has been split between SSD and DS to account for this. Emissions from the combustion of poultry litter for electricity generation are reported under power stations. Emissions occurring during storage of poultry litter that will later be used for energy generation are included in the agricultural inventory.IPCC 2000 defaults

Table 6.53: Available background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions in category 4.B(b)

Member State	*Nitrogen excretion rates*
Austria	*N-excretion data are calculated following the guidelines of the European Commissions according to the requirements of the European Nitrate Directive based on feed rations which are estimated on the basis of the following parameters:* *Cattle: Feed rations represent data of commercial farms consulting representatives of the working groups "Dairy production". These groups are managed by well-trained advisors. Their members, i.e. farmers, regularly exchange their knowledge and experience. Forage quality is based on field studies, carried out in representative grassland and dairy farm areas. The calculations depend on feeding ration, gain of weight, nitrogenand energy uptake, efficiency, duration of livestock keeping etc.* *Sheep and goats:life weight, daily gain of weight, degreeof pregnancy or lactating, feeding rations.* *Pigs: breeding pigs, piglets, boars, fattening pigs: number and weight of piglets, daily gain of weight, energy content of feeding, energy and nitrogen uptake, N-reduced feeding.* *Poultry: feeding ration, duration of keeping, nitrogen uptake, nitrogen efficiency.* *Horses: feeding ration per horse category, weight of horses.*
Belgium	*In Wallonia N-excretion factors were first determined for the implementation of the CE Nitrates Directive 91/676 (see annexes of the decree downloadable on http://www.nitrawal.be/upload_files/3.1.1%20PGDA/AGW%20PGDA%2031%2003%2011.pdf) but were representing the nitrogen after deduction of the atmospheric losses, so new factors were calculated on this basis for the purposes of estimating atmospheric emissions. For Flanders, nitrogen excretion factors are from the Manure Bank of the Flemish Land Agency (www.vlm.be) and are based on the regional situation. The N-excretion factors of cattle, sheep, goats, horses, mules and rabbits used are described in the manure decree of December 2006 (or MAP3): http://www.vlm.be/SiteCollectionDocuments/Publicaties/mestbank/bemestingsnormen_2013.pdf. For dairy cows, in MAP3, these N-excretion factors depend on the average milk production per cow. Till 2006 the N-excretion factors of the manure action plan (MAP2bis) is used. For the N-excretion factors of swine and poultry, a farmer can choose to use the standard excretion factors. Or they can choose (or in some cases are obliged) to use the other systems (regression, animal feed covenant, input-output balance).*
Denmark	*N-excretion (kg N/head/yr) is weighted values from the following categorisation: Non-dairy cattle: Calves, Bulls, Heifers and Suckling Cattle, Sheep, Goats, Swine: Piglets, Slaughtering pigs, Fur animals, Poultry: Broilers, Hens, Ducks, etc. The variations in N-excretion in the time-series reflect changes in feed intake, fodder efficiency and allocation of subcategories. The Danish N-excretion levels are generally lower than IPCC default values. This is due to the highly skilled, professional and trained farmers in Denmark, with access to a highly competent advisory system.*
Finland	*Annual N excretion per animal for cattle, sheep, swine, horses, poultry and fur animals has been calculated by animal nutrition experts of MTT Agrifood Research Finland (Nousiainen, J. pers.comm.). Values for annual N excretion (Nex) are based on calculations on N intake-N retention for typical animal species in typical forage system. Annual nitrogen excretion per animal and in the case when animals are kept less than one year in farms (swine, poultry), replacement of animals with new ones has been taken account in the calculations. For reindeer, values for goats have been used. N-excretion for Fur animals is average of two sub-categories: Minks and Fitches and Fox and Racoon.*
France	*Data related to manure management systems based on national studies. Country-specific excretion factors but IPCC default volatilisation factors. (For cattle, N-excretion is calculated on the basis of animal physiology, milk production, and feed consumption. While feed consumption of dairy cattle is known, it has been estimated for non-dairy cattle. For swine, N-excretion has been calculated from animal physiology data and the share of swine under phase-feeding. N-excretion factors for poultry are available for 78 animal types, which have been aggregated to the 10 animal types in the national statistics based on data obtained on the survey on animal housing systems from 2008. N-excretion for goats are from Schmideley et al. (2002). N-excretion data is from expert judgement (Rosset).*
Germany	*Dairy cattle: N-excretion factors are calculated on the basis of milk productivity, protein content of the milk, the weight, number of births and the composition of the rations. Non-dairy cattle: feed composition, daily weight gain and live weight. Swine and hens: N-excretion is calculated on the basis of productivity (number of births or weight gain), the weight and the feed composition. For Dairy cattle and national data for other animals. Country-specific data for other animal categories. Values for the content of total ammoniacal nitrogen (TAN) were estimated for Cattle, Swine, Sheep, Horses, and Poultry. Other parameter required for the estimation of N_2O emission (the effective surface area, the ventilation conditions and the temperature during storage) are not available. N-excretion for other livestock are taken from national studies (see Roesemann et al., 2013). For the detailed calculation the mean N-content in feed is checked with national feeding recommendations. N-excretion is obtained by subtracting N-retention, N-export in products (milk/eggs/offspring) from N-intake.*
Greece	*N excretion for dairy cattle value referring to West Europe countries was used taking into account that the*

Member State	Nitrogen excretion rates
	dairy milk production in Greece has increased to levels similar to those of Western Europe. Moreover, for other cattle and buffalo N excretion values for dairy cattle referring to West Europe countries were used. For the rest of the animals N excretion value referring to Mediterranean countries was used. Finally, for the estimation of other cattle and sheep N excretion, the adjustment factors for young animals proposed by IPCC guidelines (Table 4.14, IPCC 1997) were used.
Ireland	*For Cattle, the excretion rates are consistent with the nitrogen content of cattle feeds and the quantities excreted by the animal, as analysed in conjunction with the determination of Tier 2 CH_4 emission factors for Cattle. The published nitrogen excretion rates are used along with the information on the allocation of animal manures to each applicable animal waste management system from the Farm Facility Survey.*
Italy	*Since 2006 submission, with results obtained from the Nitrogen Balance Inter-regional Project, country-specific annual nitrogen excretion rates have been incorporated. This project involved Emilia Romagna, Lombardia, Piemonte and Veneto regions, where animal breeding is concentrated. The nitrogen balance methodology was followed, as suggested by IPCC. N-excretion rates are time-dependent for cattle, buffalo, and pigs.*
Luxembourg	*The nitrogen excretion per AWMS cannot be calculated since the nitrogen excretion per head of animal is not yet estimated for Luxembourg. The default factors suggested for Western Europe in the IPCC Guidelines have to be further investigated to decide whether or not they might be applied to Luxembourg's situation as regards manure management of animals.*
Netherlands	*Standard factors for manure production and manure N-excretion per animal per animal category and per manure management system are calculated by the Netherlands Statistics and decided on by WUM (Working group for Uniform calculations on Manure- and minerals) annually, based on specific data such as milk yield. More specified data on manure management are based on statistical information on management systems and is documented (Van der Hoek, 2006). http://www.greenhousegases.nl/documents/4B_N2O_manure.pdf*
Portugal	*Country-specific nitrogen excretion factors. The nitrogen excretion rates result from expert information provided by the Ministry of Agriculture. The pattern used allows different rates according to age and sex. After 2009 reports' review, N excretion rates were revised, in coordination with the Ministry of Agriculture, including: analysis of new nitrogen excretion rates proposed in the revision of the Agricultural Good Practice Code (CBPA), compliance of nitrogen excretion rates from CBPA with livestock information used in the inventory, and resort to expert guesses when animal types are not covered in CBPA by comparing with similar animal types. Results are considered to be more representative of the national conditions than those formerly submitted. For dairy cattle, CBPA defines nitrogen excretion rate as a function of milk production.*
Spain	*National N-excretion factors for cattle, sheep, swine and poultry. For the other animal types IPCC facotr for the "Near East & Mediterranean" climate region and applying age-related correction factors.*
Sweden	*The Swedish Board of Agriculture publishes data on manure production from most of the animal subgroups included in the inventory. The given values are according to the STANK model, which is the official model for input/output accounting on farm level (Linder, 2001). They are a function e. g. of milk productivity for dairy cattle, age and number of production cycles for pigs etc.*
United Kingdom	*Country-specific values for nitrogen excretion per head for the different livestock types were derived from the report of Defra project WT0715NVZ (Defra, 2006) with interpretation by Cottrill and Smith (ADAS) .*

Trends

The decreases in total N_2O emissions of 17% (total; 15% in liquid systems and 23% for solid systems) are mainly due to decreases in nitrogen excretion. For liquid systems, the implied emission factor decreases by 7% (a decrease by 19%, 14% and 4% is estimated for Denmark, the Netherlands and Germany, respectively). For solid systems, a change in the IEF between 1990 and 2012 has been reported for Finland (increase of 9%), Germany (decrease of 14%), and the Netherlands (increase of 2%).

Figure 6.25 through Figure 6.31 show the trend of the nitrogen excretion rate per head and the nitrogen managed in solid storage and dry lot systems. The trend in emissions is driven by animal numbers, animal performance (nitrogen excretion) and the distribution of manure over the manure management systems, which have been discussed above. The effect of the AWMS is contrary to that observed for the methane emissions.

The category “other“ animal waste management systems for Italy is reported for the years 1995 onwards only in the Italian inventory. This nitrogen excretion refers to poultry manure that is undergoing a drying-process. This system has been widely used from 1995 (CRPA, 2000).

Nitrogen excretion for buffalo is reported for Germany (occurring from 1996 onwards), Italy and Greece only. While Greece and Germany use a constant excretion factor of 70.0 and 82.0 kg N head^{-1} year-1, respectively, the N excretion of buffalo varies significantly in time in Italy with values between

91 and 107 kg N head[-1] year-1. The N-excretion values result from the weighted average of cow buffalo and other buffaloes and the variability is due to the interannual variation of the proportion of the two livestock number as published by the National Institute of statistics. Cow buffaloes have a higher N excretion, comparable with dairy cows, because they are prevalently bred for milk production (mozzarella di bufala).

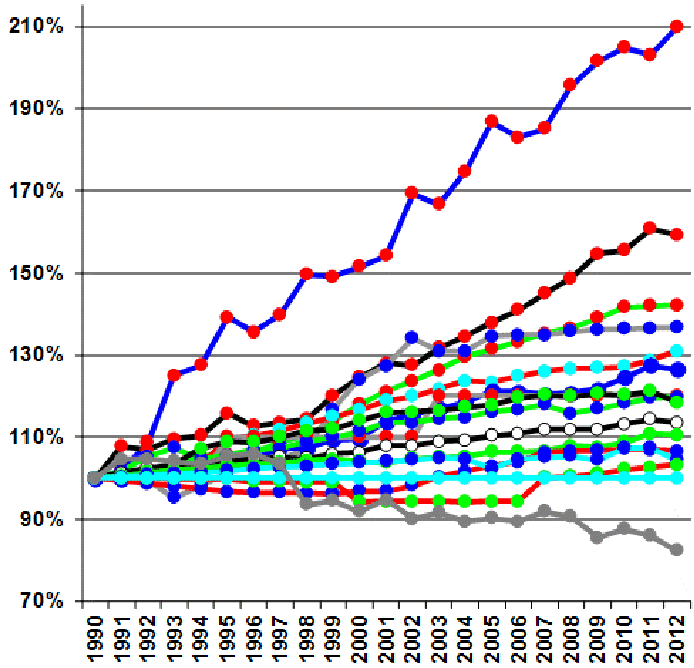
Table 6.54 gives additional information on the trend in category 4B(b) as reported in the national inventory reports.

Table 6.54: Available background information on the trend for N_2O emissions in category 4B(b).

Member State	**Trend in category 4B(b)**
Austria	Emissions of cattle dominate the trend. The reduction of dairy cows is partly counterbalanced by an increase in emissions per animal (because of the increasing gross energy intake, milk production and N excretion of dairy cattle since 1990).
Belgium	
Denmark	Reduction in the total amount of nitrogen in manure despite the increasing production of pigs and poultry, particularly due to an improvement in fodder efficiency, especially for slaughter pigs. An increase of the EF for swine has been observed between 2007 and 2008 (6%). This is due to changes in the allocation between the subcategories sows, slaughter pigs and piglets. Looking at the time series for EF similar changes is seen, for example between 1993 and 1994 (increase by 7%), 2000-2001 (decrease by 5%) and 2004-2005 (decrease by 6%).
Finland	The fluctuation in N_2O emissions is related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture.
France	
Germany	
Greece	
Ireland	
Italy	N-excretion in the category Other has been not reported in 1990-1994. The chicken-dung drying process system has been widely used only since 1995 onwards.
Luxembourg	
Netherlands	Relatively large decrease in N_2O emissions of solid manure in 2003 is a direct result of the decrease in poultry animal manure. This decrease was due to the reduction in the number of poultry animals that followed the avian flu epidemic. In 2004 and 2005, N_2O emissions increased once again following the recovery of poultry animal numbers, while in 2006 the emission decreased as a consequence of lower poultry numbers. In 2007 emissions increased as a result of increasing animal population and higher N excretion per animal. The slightly increase N_2O emissions from manure management over the whole time series is explained by a higher IEF partly counteracted by a decrease in N excretion in the stable. The interannual decrease of N-excretion in 2008/2009 was 6%. Technical information on the composition of rations and their mineral content are taken into consideration, and therefore N-excretion can vary from year to year. In 2009 considerably more maize silage was available, filling in almost equal energy requirements replacing grass (which has more than double the N-content of maize). Anticipating a ban on battery cage systems for laying hens effective from 2012, farmers started changing their management towards ground housing or the aviary system in 2011. In the process they switch from solid manure without bedding on which birds do not walk, to solid manure with bedding on which birds do walk. Following the GPG 2000, emission factor increases from 0.5 to 2% in this case, thus explaining the overall increase.
Portugal	
Spain	
Sweden	The N_2O emissions have decreased since 1990, mainly because of a change from solid manure management to slurry management in dairy and pork production. An increase in the production cycles per year from 2.5 to 3 for pigs for meat production causes an increase in the nitrogen excretion for swine in 2001-2002 by 16%.
United Kingdom	

Figure 6.25: Trend of nitrogen excretion rates for dairy cattle

Dairy cattle: Nitrogen excretion (kg N/head/yr)



	1990	2012	Trend (%) 1990-2012
Greece	49	103	210%
Spain	69	110	159%
Finland	91	130	142%
Portugal	86	117	137%
Austria	77	100	131%
United Kingdom	97	123	127%
Luxembourg	85	102	120%
Germany	98	117	120%
Sweden	105	124	118%
EU-15	103	117	113%
France	104	115	110%
Denmark	129	138	107%
Ireland	96	100	104%
Belgium	114	118	103%
Italy	116	116	100%
Netherlands	149	122	82%

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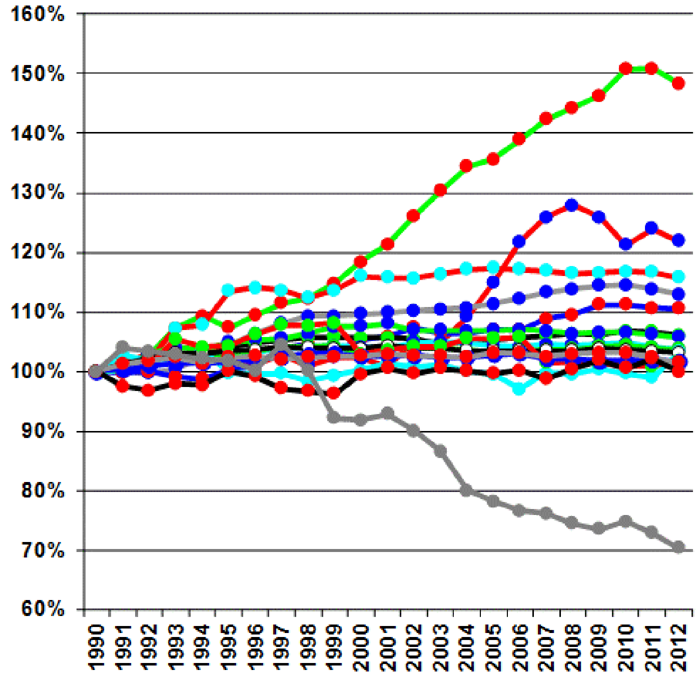
Figure 6.26: Trend of nitrogen excretion rates for non-dairy cattle:

Non-dairy cattle: Nitrogen excretion (kg N/head/yr)



	1990	2012	Trend (%) 1990-2012
Finland	34	51	148%
Denmark	36	43	122%
Austria	40	46	116%
Portugal	44	50	113%
Greece	42	46	110%
Sweden	39	42	106%
Germany	42	44	106%
Ireland	49	50	104%
France	56	58	104%
Italy	50	52	103%
EU-15	48	50	103%
Belgium	54	55	102%
United Kingdom	53	54	102%
Luxembourg	46	46	101%
Spain	43	43	100%
Netherlands	57	40	70%

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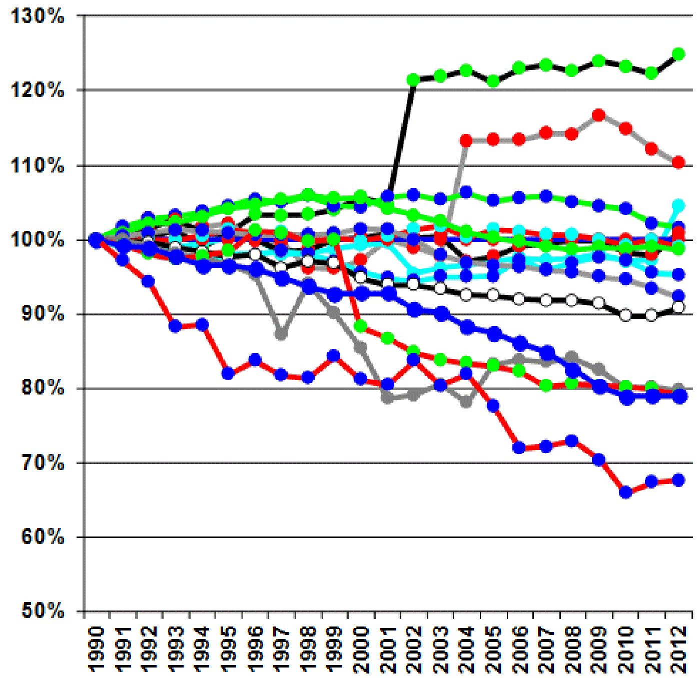
Figure 6.27: Trend of nitrogen excretion rates for swine

Swine: Nitrogen excretion (kg N/head/yr)



	1990	2012	Trend (%) 1990-2012
Sweden	7.4	9.2	125%
Luxembourg	10.2	11.2	110%
Italy	12.0	12.5	104%
Germany	11.1	11.3	102%
Spain	9.3	9.3	101%
Greece	16.0	16.0	100%
Austria	9.6	9.5	99%
France	7.0	7.0	99%
Ireland	8.8	8.4	95%
Portugal	10.3	9.5	92%
EU-15	10.4	9.5	91%
Netherlands	10.8	8.6	80%
Belgium	12.5	9.9	79%
United Kingdom	13.2	10.4	79%
Denmark	11.8	8.0	68%
Finland			

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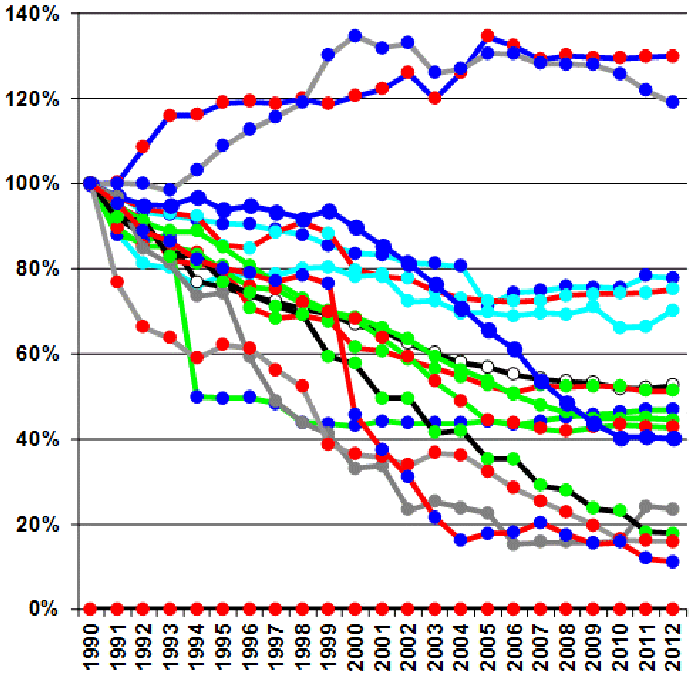
- Remark Sweden: Due to more intense swine production the nitrogen production for sows and pigs for meat production were updated in 2002. This led to an increase in N-excretion of 16% between 2001 and 2002.

- Remark Luxembourg: Nex is calculated as a population-weighted average of constant Nex values for 4 swine sub-categories: pigs < 20kg- pigs from 20 to 50 kg- fattening pigs > 50 kg and breeding pigs. From 2004 onwards the two first sub-categories were changed to pigs < 10 kg and pigs from 10 to 50 kg. Unfortunately the published table does not record these changes as a footnote but they are clearly visible in the series. Since this modification increases the Nex it was not corrected because it does not lead to an underestimation of the emissions for the `Kyoto` years.

Figure 6.28: Trend of N managed in solid storage and dry lot, dairy cattle

Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)

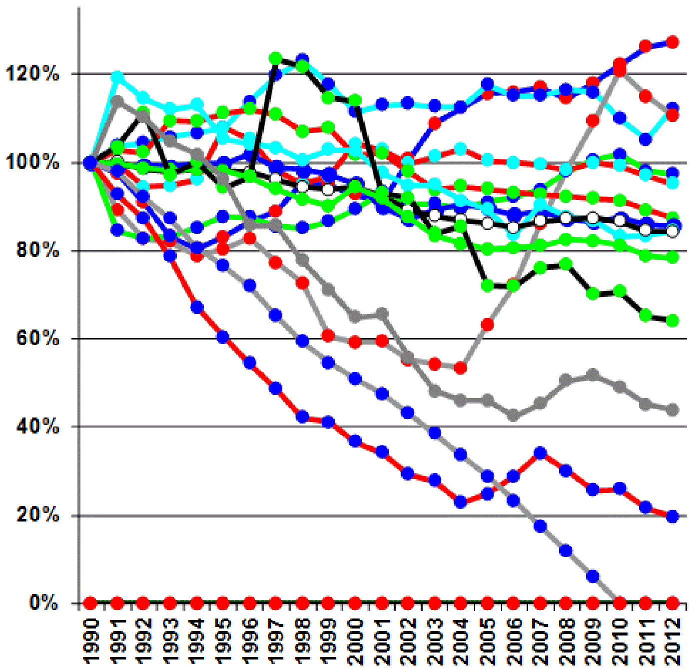


	1990	2012	Trend (%) 1990-2012
Greece	7	10	130%
Portugal	12	14	119%
Ireland	3	2	78%
Austria	34	26	75%
Italy	175	123	70%
EU-15	720	379	53%
Belgium	26	13	51%
Germany	166	78	47%
France	163	72	45%
Finland	23	10	43%
United Kingdom	51	21	40%
Netherlands	14	3	24%
Sweden	31	6	18%
Luxembourg	2	0	16%
Denmark	13	1	11%
Spain			

15.05.2014 - AL - file: EC-IR.TREND..4Bb.SOL.DAIR

Figure 6.29: Trend of N managed in solid storage and dry lot, non-dairy cattle

Non-dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	2012	Trend (%) 1990-2012
Greece	13	16	127%
Ireland	25	28	112%
Luxembourg	2	3	111%
Germany	144	141	97%
Austria	30	28	95%
Belgium	48	42	87%
United Kingdom	160	138	86%
Italy	102	86	85%
EU-15	850	716	84%
France	272	213	78%
Sweden	15	10	64%
Netherlands	27	12	44%
Denmark	2	0	20%
Portugal	10	0	0%
Finland			
Spain			

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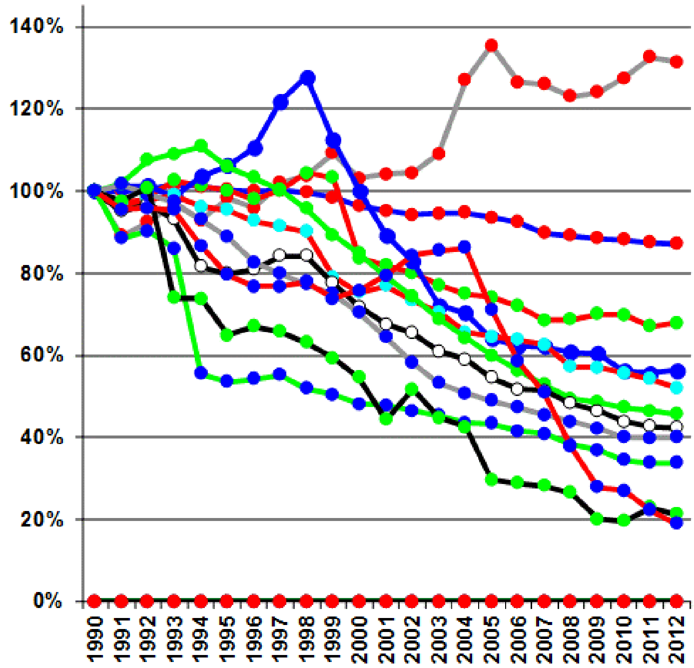
Figure 6.30: *Trend of N managed in solid storage and dry lot, swine*

Swine: Nitrogen managed in solid storage systems (Gg N/yr)

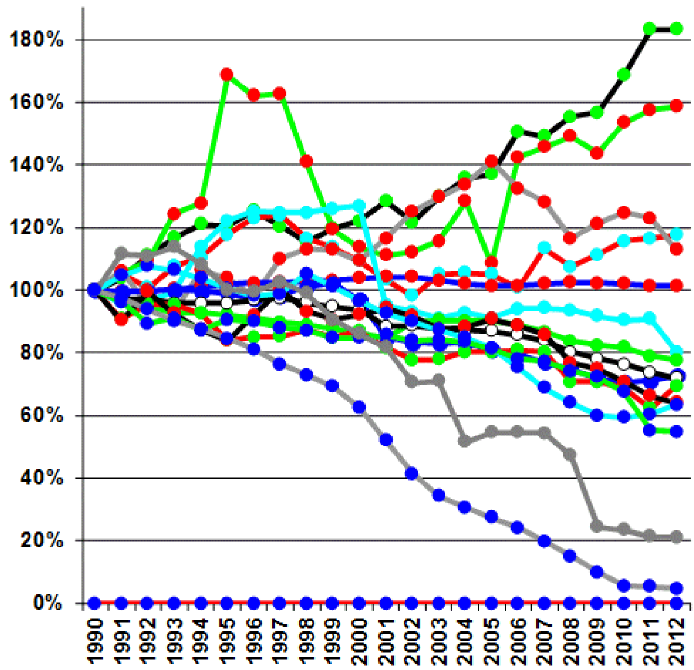


	1990	2012	Trend (%) 1990-2012
Luxembourg	0	0	131%
Greece	2	1	87%
Belgium	5	4	68%
United Kingdom	43	24	56%
Austria	4	2	52%
France	15	7	46%
EU-15	151	64	42%
Portugal	1	0	40%
Germany	61	20	34%
Sweden	9	2	21%
Denmark	12	2	19%
Ireland			
Italy			
Netherlands			
Finland			
Spain			

15.05.2014 - AL - file: EC-IR.TREND..4Bb.SOL.SWIN

Figure 6.31: *Trend of N managed in solid storage and dry lot, sheep*

Sheep: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	2012	Trend (%) 1990-2012
Sweden	1.1	1.9	183%
Finland	0.1	0.1	159%
Austria	2.0	2.4	118%
Luxembourg	0.0	0.1	113%
Greece	9.3	9.4	101%
Italy	14.2	11.4	80%
France	49.1	38.1	78%
United Kingdom	9.8	7.1	73%
EU-15	131.2	94.4	72%
Belgium	0.3	0.2	69%
Spain	22.1	14.2	64%
Ireland	3.9	2.5	63%
Germany	11.4	6.2	55%
Netherlands	3.1	0.7	21%
Portugal	5.1	0.2	5%
Denmark			

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6.3.3.3 Uncertainty and time series consistency

Activity data used for the estimation of N_2O emissions from manure management are generally analogous to those used for the estimation of CH_4 emissions, and consequently also the uncertainty estimates are similar. The uncertainty of the emission factor is much higher than the uncertainty of the activity data, and only Sweden has estimated an uncertainty lower than 50%. Generally an uncertainty of 100% is assumed, the United Kingdom assume high uncertainty with a 414% value.

Nevertheless, N_2O emissions from manure management are representing only a small fraction in most inventories, so that the contribution to the overall uncertainty remains in most cases small, i.e. 0.5% of total emissions or less. Only Austria and United Kingdom report a higher contribution of N_2O emissions from manure management to the overall uncertainty with 1.1% and 1.2% of total emissions, respectively.

An overview of the uncertainty estimates for activity data and emission factors is given in Table 6.55. An overview of uncertainty estimates for agriculture at country and EU-15 levels will be given in section 6.4

Table 6.56 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from manure management.

Table 6.55: Relative uncertainty estimates for activity data and implied emission factors in category 4B(b)

Member State	**AD**	**EF**
Austria	10	100
Belgium	10	90
Denmark	22	50
Finland	67	
France	5	50
Germany	4	102
Greece	50	100
Ireland	11	100
Italy	20	100
Luxembourg		
Netherlands	10	100
Portugal	37	93
Spain	16	100
Sw eden	15	37
United Kingdom	1	414

Table 6.56: Available background information for uncertainty estimates in category 4.B(b)

	Background information to uncertainty estimates
Austria	*Emission Factor: Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 70% (Amon et al. 2002), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000.*
Belgium	*Emission Factor: The IPCC emission factors are used to calculate the emissions of N_2O. Consequently, the IPCC uncertainty in combination with information of the Finnish emission inventory, are used in the uncertainty calculation.*
Denmark	*Activity Data: The normative figures (Poulsen et al. 2001) are arithmetic means. Based on the feeding plans, the standard deviation in N-excretion rates between farms can be estimated to ±20 % for all animal types (Hanne D. Poulsen, FAS, pers. comm).*
Finland	*Activity Data: Uncertainty in nitrogen excretion values varies between animal species, from 2 to 15%, except for reindeer and poultry (25%). The amount of N excreted annually by the reindeer is very uncertain. Currently, because of lack of data, the value for goats has been used.* *Emission Factor: The uncertainty estimate for N_2O emissions from manure management used a negatively skewed distribution based on different studies (Amon et al., 2001; Huether, 1999). The uncertainty of the N_2O emission factor could probably be reduced by gathering more national data from gas flux measurements. Uncertainties in manure management are estimated using Tier 2 Monte Carlo simulaiton to the emission calculation models. For nitrous oxide from manure management, it has been estimated at -43...+66%. For direct nitrous oxide emission factors, it's -60...+100%, in line with the IPCC 2006*

	Background information to uncertainty estimates
	uncertainty range
Portugal	*Activity Data: The uncertainty in N-excretion rate was set at 37.5 per cent, considering an intermediate situation between the uncertainty values recommended by GPG for default N-excretion rates (50 per cent) and the lower uncertainty when country-specific values are based on accurate national statistics (25 per cent).* *Emission Factor: The uncertainty in N_2O emission factors was set in accordance with the maximum values, 100 per cent for all MMS.*

6.3.4 Rice Cultivation

6.3.4.1 Source category description

Anaerobic decomposition of organic material in flooded rice fields produces methane (CH_4), which escapes to the atmosphere primarily by transport through the rice plants. The annual amount emitted from an area of rice acreage is a function of rice cultivar, number and duration of crops grown, soil type and temperature, water management practices, and the use of fertilisers and other organic and inorganic amendments.

Rice cultivation is occurring in five EU-15 countries: France, Greece, Italy, Portugal, and Spain. All these countries but Italy and Portugal are reporting rice production under a continuously flooding regime, while in Italy and Portugal the practice of multiple aeration is predominant. In Italy rice paddies are flooded with 15-25 cm of water usually from April-May to August. During this field submersion time two or three water drainage periods, of 2 to 4 days each, can happen in 85% of rice paddies, a clearly uninterrupted submersion in 13-14% and about one month delayed submersion in 1-2%.

At EU-15 level, the implied emission factors amounts to 13 g m^{-2} in 2012 for continuous flooded rice fields, which represents an increase in the implied emission factor by 3% since 1990 (see Table 6.57). The implied emission factors for intermittently flooded field are stemming from the Italian and Portuguese inventories only. Emissions are smaller than the emissions from continuously flooded fields. At the EU-15 level and with the given choices of emission factors by the different countries, however, the average emission from continuous flooded fields appears to be only half of those from single-aerated rice fields.

Table 6.57: Total CH_4 emissions, area harvested and implied Emission Factor for category 4C at EU-15 level for 2012 and 1990.

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	1990		
Total Emissions of CH4 [Gg CH4]	19	8	74
Total Area harvested [10^9 m^2 y^{-1}]	1.5	0.4	2.1
Implied Emission Factor [g CH4 / m^2]	12	21	35

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2012		
Total Emissions of CH4 [Gg CH4]	25	25	57
Total Area harvested [10^9 m^2 y^{-1}]	2.0	1.0	1.7
Implied Emission Factor [g CH4 / m^2]	13	26	34

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2012 value in percent of 1990		
Total Emissions of CH4 [Gg CH4]	134%	327%	76%
Total Area harvested [10^9 m^2 y^{-1}]	130%	270%	79%
Implied Emission Factor [g CH4 / m^2]	103%	121%	96%

6.3.4.2 Methodological Issues

Methods

A summary of the methodologies used for the calculation of CH_4 emissions from rice cultivation is given in Table 6.58. More detailed data are given in the section on the emission factors.

Table 6.58: Additional information in the methodology used for the calculation of CH_4 emissions in category 4.C in 2012

Member State	***Method***
France	*Default EF, as it is not a key source, IPCC methodology. Statistic from the Ministry of Agriculture.*
Greece	*Continuously flooded fields and the default methodology suggested by the IPCC Good Practice Guidance was followed. The cultivated areas provided by the NSSG and the default emission factor (20 g CH_4 / m^2) were used for the emissions calculation. Rice cultivated in Greece is grown in continuously flooded fields without the use of organic amendments and one cropping period is considered annually.*
Italy	*In Italy, three types of rice cultivation are distinguished: Wet-seeded "classic" cultivation, Wet-seeded "red rice control" cultivation and dry-seeded with delayed flooding. The wet-seeded cultivation methods fall into the IPCC category of 'multiple aeration' while the dry-seeded cultivation method is intermittently aerated one once. A detailed description of the management is given in the national inventory report. Estimated only for an irrigated regime. Expert group on rice cultivation together with the C.R.A. – Experimental Institute of Cereal Research – Rice Research Section of Vercelli was established to improve methodology. The quality of the Italian rice emission inventory was verified with the Denitrification Decomposition model (DNDC) model. Initial results have found a high correspondence between the EFs used for the Italian inventory and those simulated with DNDC model (Leip and Bocchi, 2007). Methane emission factor has been adjusted with the following parameters: daily integrated emission factor for continuously flooded fields without organic fertilisers, scaling factor to account for the differences in water regime in the rice growing season (SFw), scaling factor to account for the differences in water regime in the preseason status (SFp) and scaling factor which varies for both types and amount of amendment applied (SFo) (Yan et al., 2005). Following national circumstances: cultivation period of rice (days) and annual harvested area under specific conditions. In Italy, rice is sown from mid-April to the end of May and harvested from mid-September to the end of October; the only practised system is the controlled flooding system, with variations in water regimes (Tossato and Regis, 2002; Mannini, 2004; Confalonieri and bocchi, 2005; Regione Emilia Romagna ,2005)*
Portugal	*Methane emissions from rice production were estimated following the GPG, but simplified because there are no appreciable differentiation in Portugal in what concerns water management regimes or any other conditions that are known to affect emissions from this source sector. A regional specific seasonally integrated emission factor for continuously flooded fields without organic amendments (Efc) of 31.9 g/m^2/yr was used, based on Schutz (1989). Rice culture in Portugal is almost homogeneous, in what concerns hydrologic management regime and characterized by cultivation being done under irrigated continuous flooded areas (SFw is set to 1). Traditionally, stubbles and straw were burnt between crops, the use of rice straw as fodder or bedding is not significant (Portuguese Ministry of Agriculture). More recently the agricultural practices have changed. It became more common to left the straw on ground and incorporate it into soil by ploughing. This is the only procedure allowed for rice cultivation subject to the "Techniques of Integrated Production and Protection"), which occupied about 60 per cent of rice paddies in 2004. A time series for the scaling factor reflecting organic amendments S0 was developed assuming that, in 1990, 100% of rice paddies were burnt and no organic amendments were added to soil. In 2008 the area subjected to burning was reduced to only about 33 per cent.*
Spain	*Rice cultivation is not key source, EFs: IPCC default, default methodology.*

Activity Data

Italy is by far the largest producer of rice in Europe, with 2351 km^2 of rice cultivation, followed by Spain with an area of 1221 km^2 (2012 data). The other three countries have rice producing areas of 1106 km^2, as shown in Table 6.59 for the rice cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aerations.

Table 6.59: Rice Harvested Area in the Member States in 2012 and 1990

Member State 2012	Harvested area [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.5	NO	NO
Greece	0.3	NO	NO
Italy	NO	0.7	1.7
Portugal	NO	0.3	NO
Spain	1.2	NO	NO
EU-15	**2.0**	**1.0**	**1.7**

Member State 1990	Harvested area [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.5	NO	NO
Greece	0.2	NO	NO
Italy	NO	0.0	2.1
Portugal	NO	0.3	NO
Spain	0.9	NO	NO
EU-15	**1.5**	**0.4**	**2.1**

Information source: CRF Table 4.C for 2012 and 1990, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

A summary of the implied emission factors used by these countries is given in Table 6.60. France and Greece are using IPCC default emission factors presented in the IPCC *Good Practice Guidance*. This value is the arithmetic mean of the seasonally integrated emission factors presented in Table 4-13 of the IPCC *Guidelines*. In this Table, a value from Schuetz et al (1989) is also presented (36 g m^{-2}, range 17-54 g m^{-2}, representing a seasonally averaged emission factor). In Italy, a daily integrated emission factor for continuously flooded fields without organic fertiliser (Schuetz et al., 1989; Leip et al., 2002) have been adjusted to account for differences for three different cultivation types (see Table 6.58) Spain uses a seasonal emission factor of 12 g m^{-2}, which has been obtained from Table 4-9 of the IPCC *Guidelines* reporting a study carried out in Spain (Seiler et al., 1984).

Table 6.60: Implied Emission factors for CH_4 emissions from rice cultivation used in Member State's inventory. Data for the year 2012.

Member State 2012	Implied EF (g CH_4 · m^{-2})		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	10	NO	NO
Greece	20	NO	NO
Italy	NO	25	34
Portugal	NO	28	NO
Spain	12	NO	NO
EU-15	**13**	**26**	**34**

Member State 1990	Implied EF (g CH_4 · m^{-2})		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	10	NO	NO
Greece	20	NO	NO
Italy	NO	27	35
Portugal	NO	21	NO
Spain	12	NO	NO
EU-15	**12**	**21**	**35**

Information source: CRF Table 4.C for 2012 and 1990, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trend

The trend in rice growing areas in these countries is divers: while in Italy, the area cultivated with rice fluctuated since 1990, its level in 2012 was 9% larger than in 1990. The harvested area in Spain increased from 1990 to 2012 by 35%, but around 1993-1995 rice production was only half of the area reported in 1990; also Greece increased its rice production since 1990 by 70%. The trend in France with peaks in rice production during 1993-1995 and in 2012 the level was about 8% higher than in 1990. Finally, Portugal saw a decline in rice production by 8% since 1990.

There was an increase in the implied emission factor used by Portugal from 21 g CH_4 m^{-2} yr^{-1} in 1990 to 28 g CH_4 m^{-2} yr^{-1} in 2012. The reason is the increase of organic amendment to rice paddies in this time period. In 1990 it can be assumed that 100% of the rice paddies were burned and no organic amendment was added to the soils. However, the "Techniques of Integrated Production and Protection" allow only incorporating the straw by ploughing. In 2004, 60% of the rice cultivation area was subject to these "Techniques".

Figure 6.32 through Figure 6.37 show the area harvested and the implied emission factors for the different rice management systems.

Figure 6.32: Trend of continuous flooded rice cultivation – area harvested

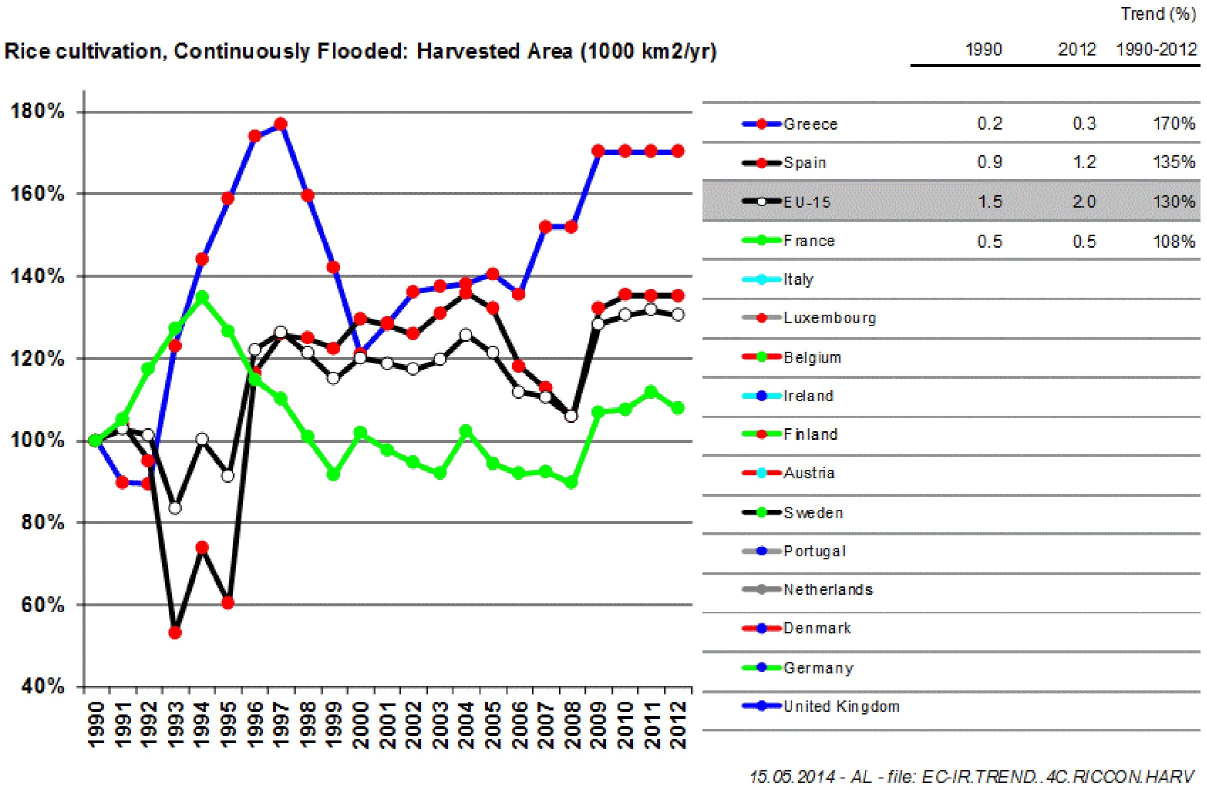


Figure 6.33: Trend of intermittently flooded (single aeration) rice cultivation – area harvested

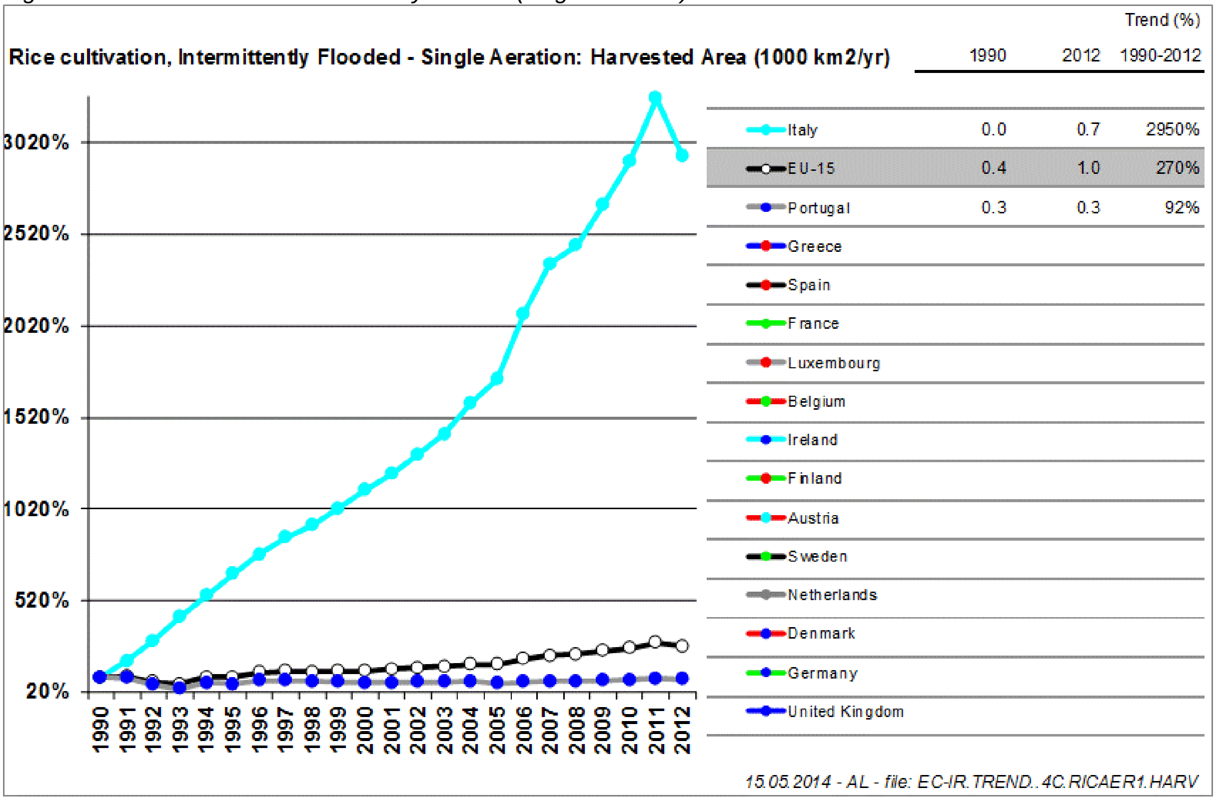


Figure 6.34: Trend of intermittently flooded (multiple aeration) rice cultivation – area harvested

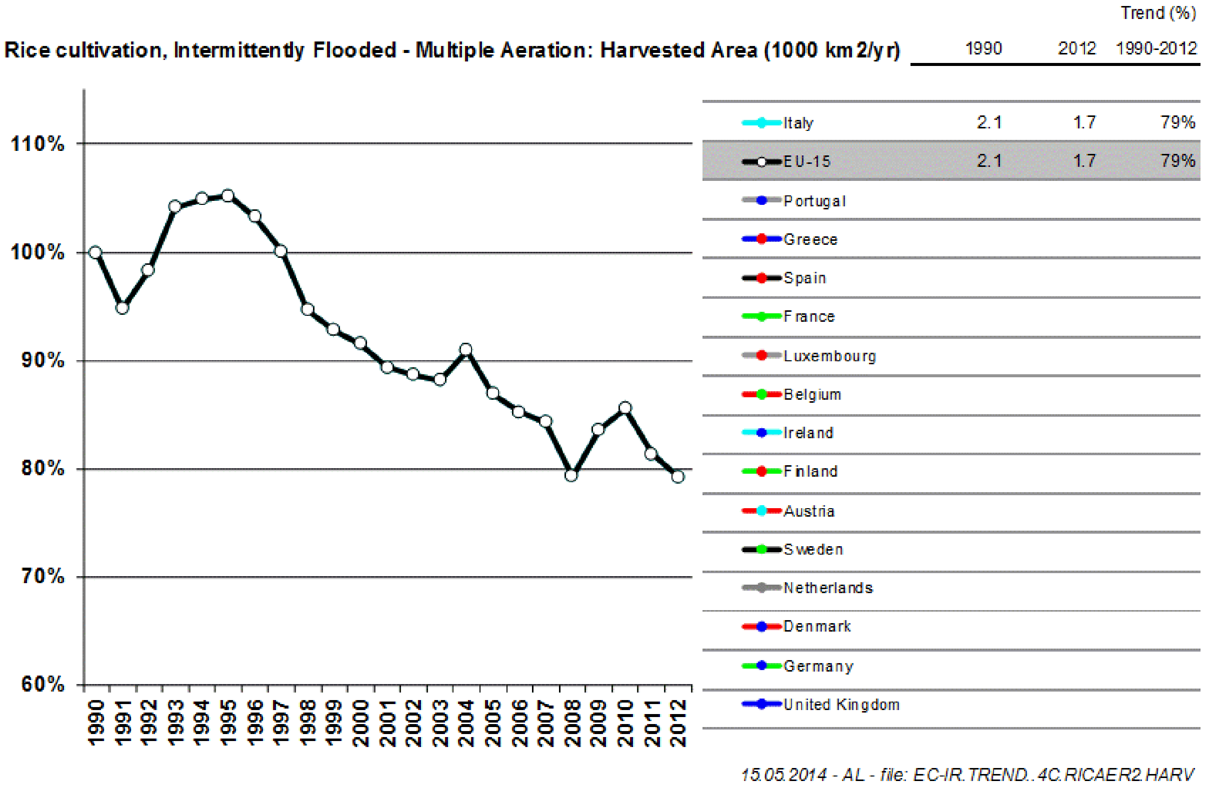


Figure 6.35: Trend of continuous flooded rice cultivation – implied emission factor

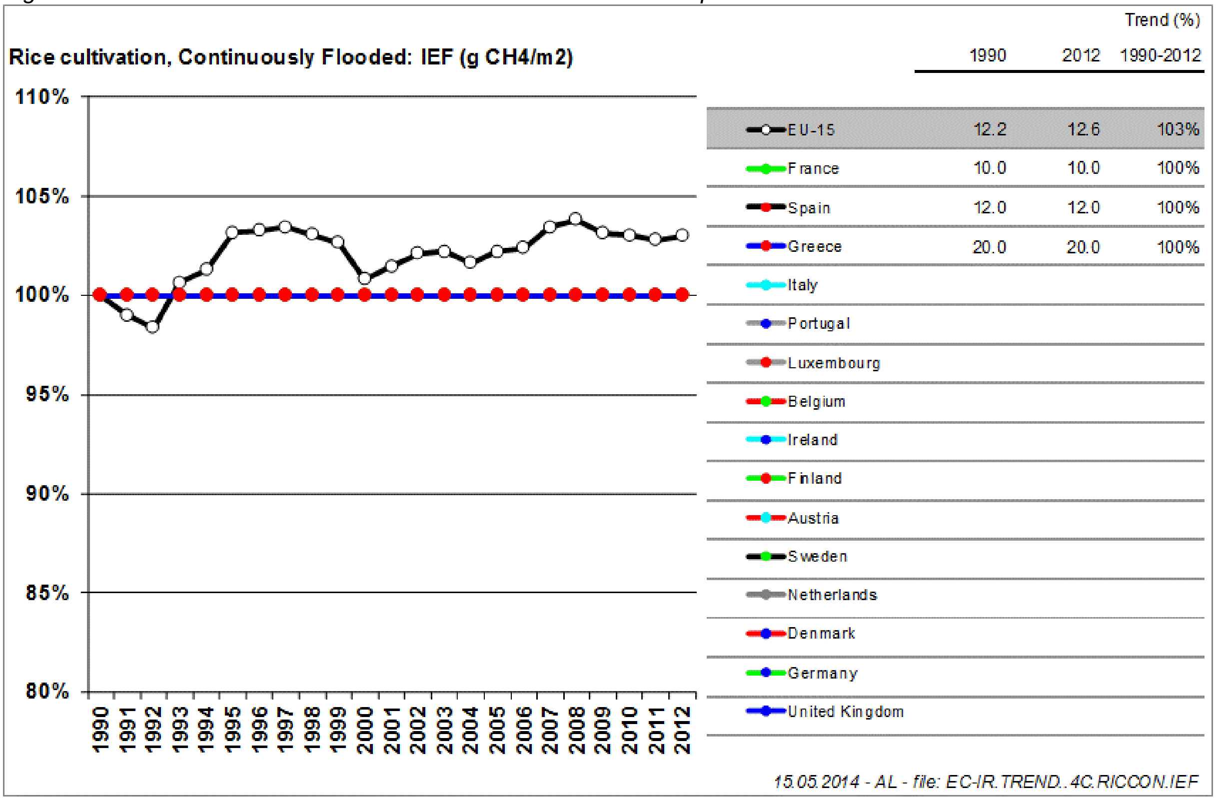


Figure 6.36: *Trend of intermittently flooded (single aeration) rice cultivation – implied emission factor*

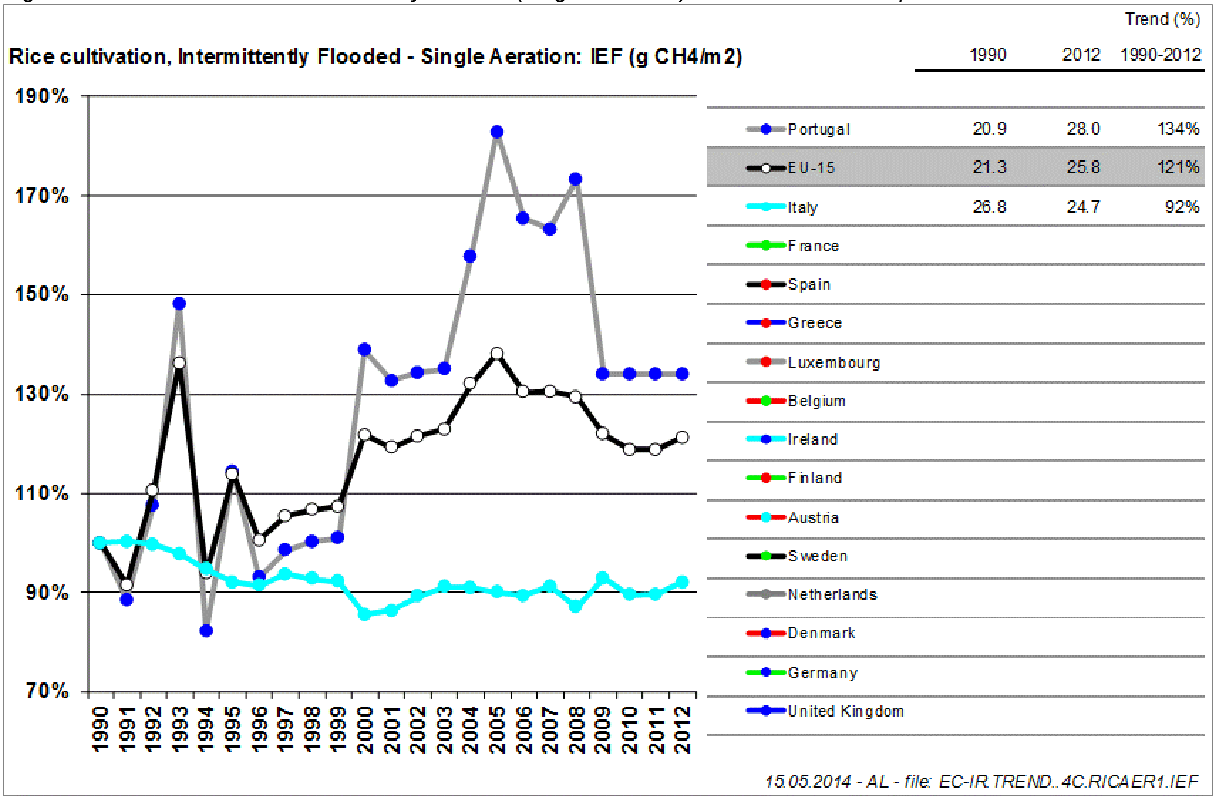
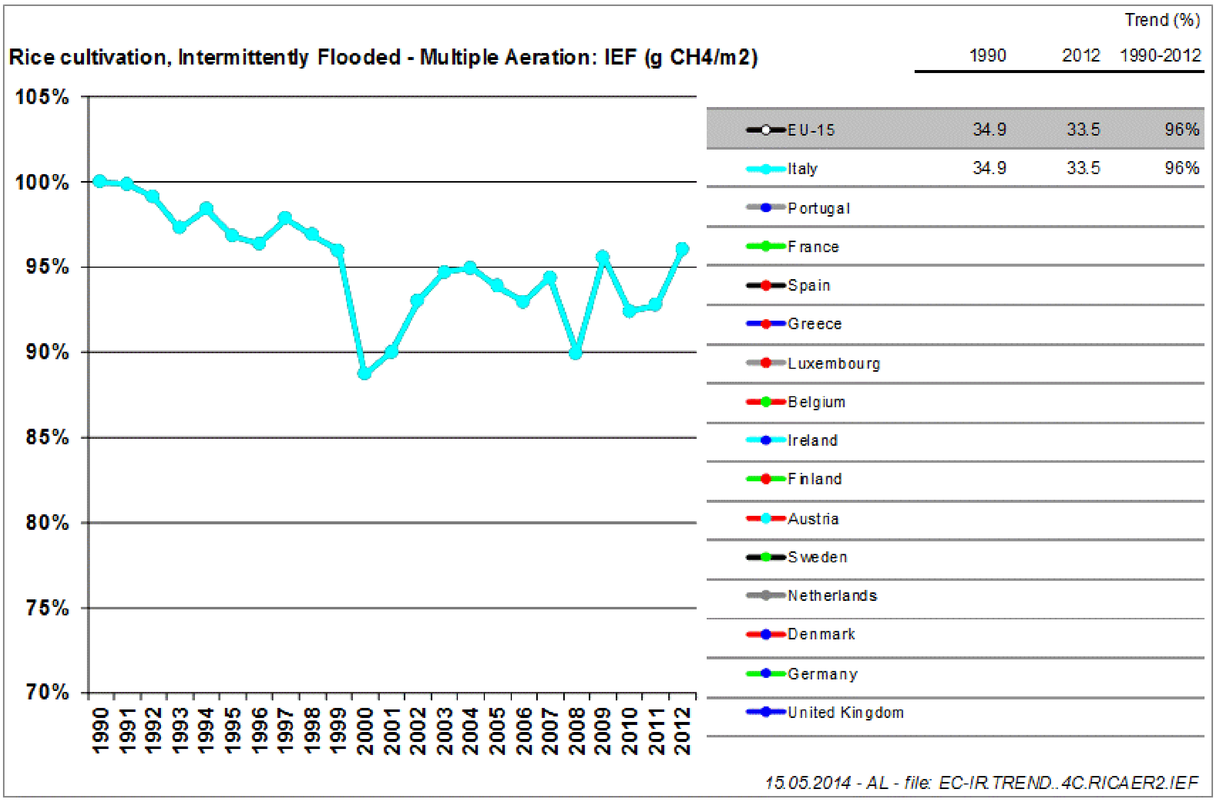


Figure 6.37: *Trend of intermittently flooded (multiple aeration) rice cultivation – implied emission factor*



6.3.4.3 Uncertainty and time series consistency

Uncertainty estimates for CH_4 emissions from rice cultivation are reported by three countries (Greece, Italy, and Portugal). The area used for the cultivation of rice is generally well known, only Portugal reports an uncertainty of 33.6% for this variable. The uncertainty of the implied emission factor is 40%, except for Italy, which uses a national methodology and estimates an uncertainty of 20%. An overview of the estimates is given in Table 6.61.

Table 6.62 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from rice cultivation.

Table 6.61: Relative uncertainty estimates for activity data and implied emission factors in category 4C if reported

Member State 2012	AD	IEF
France		
Greece	2	40
Italy	3	20
Portugal	34	40
Spain		

Table 6.62: Available background information for uncertainty estimates in category 4.C

Member State	***Background information to uncertainty estimates***
France	*No information available*
Greece	*No information available*
Italy	*Uncertainty of emissions from rice cultivation has been estimated equal to 20% as a combination of 3% and 20% for activity data and emissions factor, respectively.*
Portugal	*The uncertainty in the adjusted seasonally integrated emission factor was considered to be 40 per cent, according to the range proposed in table 4.22 of the GPG. For activity data, the standard deviation of inter-annual area under rice cultivation was considered, also 40 per cent.*
Spain	*No information available*

6.3.5 Agricultural Soils - N_2O (Source category 4.D)

6.3.5.1 Source category description

Nitrous oxide is produced naturally in soils through the processes of nitrification and denitrification. Nitrification is the aerobic microbial oxidation of ammonium to nitrate, and denitrification is the anaerobic microbial reduction of nitrate to nitrogen gas (N2). Nitrous oxide is a gaseous intermediate in the reaction sequence of denitrification and a by-product of nitrification that leaks from microbial cells into the soil and ultimately into the atmosphere. One of the main controlling factors in this reaction is the availability of inorganic N in the soil. Therefore, N_2O emissions are reported separately for the main anthropogenic input pathways of nitrogen to the soil, i.e., application of mineral nitrogen fertiliser nitrogen or nitrogen contained in applied manure, biological nitrogen fixation and nitrogen returned to the soil by the process of mineralization of crop residues. Additionally, the emissions of N_2O from manure deposited by grazing animals on pasture, range and paddock are reported here. The emissions of N_2O that result from anthropogenic N inputs or N mineralisation occur through both a direct pathway (i.e., directly from the soils to which the N is added/released), and through two indirect pathways: (i) following volatilisation of NH_3 and NO_X from manure management and managed soils, and the subsequent redeposition of these gases and their products NH4+ and NO3- to soils and waters; and (ii) after leaching and runoff of N, mainly as NO3-, from managed soils.

For EU-15, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.63). This was most significant for direct emissions from the application of synthetic fertiliser (-28%), followed by volatilization of NH_3 and NO_X and indirect emissions from leaching and run-off (-

19%) and volatilisation of NH_3+NO_X (-23%). In the latter two cases, the reduction of emissions can be explained by a reduction of nitrogen input, as the implied emission factor was not or, in the case of leaching+runoff, only slightly changing during the reporting period. The reduction of animal manure applied to soils more than counterbalanced the increase in the implied emission factor for animal wastes application so that emission decreased by 6%.

At the aggregated EU-15 level, the implied emission factor for N_2O emissions from the application of manure increased by 5%, caused by strong increase by 117% of the implied emission factor for this source in the Netherlands during 1990 to 2012. This increase is explained by a shift from surface spreading of manure to the incorporation of manure into the soil. In the inventory of the Netherlands, incorporation of manure into soils is accounted for with a higher emission factor of N_2O. Incorporation into the soil reduces NH_3 emissions.

The decrease in the input of nitrogen to agricultural soils was significant for all sub-categories and was 28% for synthetic fertiliser application, 10% for application of manure, 2% (on average) of the area of cultivated histosols and 15% for nitrogen excreted by grazing animals. This was translated to a reduction of volatilized and re-deposited nitrogen by 23% and of the amount of nitrogen leached by 19%.

Table 6.63: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-15 level in 2012 and 1990 and relative changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	197	75	29	106	48	211
Total Nitrogen input [Gg N]	10,101	4,034	23,987	3,258	3,076	5,444
Implied Emission Factor [kg N_2O-N / kg N]	1.24%	1.19%	7.6	2.08%	1.00%	2.47%

2012	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	142	71	29	88	37	171
Total Nitrogen input [Gg N]	7,256	3,627	23,610	2,769	2,367	4,384
Implied Emission Factor [kg N_2O-N / kg N]	1.24%	1.24%	7.8	2.03%	1.00%	2.48%

2012 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O	72%	94%	100%	83%	77%	81%
Total Nitrogen input	72%	90%	98%	85%	77%	81%
Implied Emission Factor	100%	105%	102%	98%	100%	101%

Source of information: Tables 4.D for 1990 and 2012, submitted in 2014

[1)] Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

6.3.5.2 Methodological Issues

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). For other parameters used in the calculation of N_2O emissions from agricultural soils, however, many Member States use country-specific methodologies, linking the N_2O inventory with the CORINAIR NH_3 inventory or using simulation models. A more specific discussion of emission factors and parameters used is presented below.

Table 6.64 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. For direct N_2O emissions from the application of fertiliser and for emissions from animal production activity data are multiplied by the emission factor, which is for most countries the IPCC default factor. Thus, the vast majority of the emissions are calculated with the Tier 1 approach for the emission from synthetic fertiliser. However, emissions depend also the fraction of nitrogen that volatilises is subtracted from the applied nitrogen for the calculation of N_2O emissions and – for manure applied – also from the method that is used to estimate nitrogen excretion, which has already been discussed above. Additionally, nitrogen in crop residues and nitrogen fixed by biological nitrogen fixation might be estimated using country-specific data.

For each single sub-category we calculated a 'Tier-level' scoring between 1 and 2 according to the methodology described in 6.4.1.5 (Table 6.95 through Table 6.98, for details see section 6.4.1.5).

- The Tier level for direct N_2O emissions is calculated from the Tier level for emissions from mineral fertiliser input, manure application, crop residues and N-fixing crops on the basis of the MEAN rule. The Tier level for the estimation of N_2O emissions from mineral fertiliser is done by comparing the IEF with the IPCC default value. For emissions from manure applications, the Tier level of the nitrogen excretion rates estimated for N_2O emissions from manure management are combined with the Tier level of the IEF using the MEDIAN rule. The Tier level for N_2O emissions from crop residues and N-fixing crops are combined from the quality level of the emission factor used and the Tier level of the N-input, which is done by expert judgement on the basis of the information contained in the national inventory reports (see Table 6.72 and Table 6.73). A "Tier 2" level has been assigned only if country-specific data have been used; the use of Tier 1b with default IPCC parameters counted as Tier 1 level. An analogue approach is followed to determine the Tier level for N_2O emissions from the cultivation of histosols.
- The Tier level of N_2O emissions from grazing animals is derived from the quality of N excretion factors, the implied emission factor, and a factor based on the information given in the national inventory report on the fraction of manure deposited to grazing land. The share of nitrogen that is deposited on pasture/range and paddock was only considered to be "Tier 2" if the estimate is based on a more is based on a more elaborate approach than purely the length of the grazing season.
- The Tier level for indirect N_2O emissions is a combination of the Tier levels for N_2O emissions from volatilised NH_3+NO_X and from leached/run-off nitrogen. In either case the Tier level is derived from the emission factor used and the respective fraction of nitrogen with weighing factors being 1/3 and 2/3. In the case of N-volatilization the Tier level of the amount of nitrogen is derived from both volatilization of mineral nitrogen and manure nitrogen (MEAN rule), whereby the quality of the latter is obtained from $Frac_{GASM}$ and from nitrogen excretion factors (equal weights) using the MEDIAN rule.

As a result, we estimate that a minimum of 31% of the emissions reported in category 4D are estimated with country-specific information. Highest quality was obtained for emissions from volatilised nitrogen (33%), which reflects the direct impact of the calculation of N-excretion rates and the fact that several countries link this calculation to the NH_3 inventory, where fertiliser-specific volatilisation fractions are given.

A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.65. Note however, that most information will be summarized in specific tables on the emission factors and parameters used.

Table 6.64: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year 2012.

2012	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Austria	3,055	Tier 1.3	59%	Tier 1.3	y	3%	Tier 1.4	y	38%	Tier 1.2	y	8%	Tier 1.6	30%	Tier 1.1
Belgium	3,529	Tier 1.4	56%	Tier 1.2	y	21%	Tier 1.4	y	23%	Tier 2.0	y	7%	Tier 2.0	16%	Tier 2.0
Denmark	5,004	Tier 1.6	61%	Tier 1.4	y	4%	Tier 1.4	y	34%	Tier 1.9	y	6%	Tier 1.6	29%	Tier 2.0
Finland	3,497	Tier 1.5	78%	Tier 1.5	y	5%	Tier 1.3	y	17%	Tier 1.5	y	4%	Tier 1.6	13%	Tier 1.5
France	45,853	Tier 1.2	46%	Tier 1.1	y	18%	Tier 1.7	y	36%	Tier 1.1	y	6%	Tier 1.0	30%	Tier 1.1
Germany	40,916	Tier 1.4	63%	Tier 1.4	y	3%	Tier 1.7	y	34%	Tier 1.3	y	5%	Tier 1.6	28%	Tier 1.2
Greece	4,798	Tier 1.2	32%	Tier 1.1	y	31%	Tier 1.4	y	37%	Tier 1.1	y	6%	Tier 1.0	31%	Tier 1.1
Ireland	6,454	Tier 1.3	39%	Tier 1.1	y	42%	Tier 1.4	y	19%	Tier 1.6	y	6%	Tier 1.6	13%	Tier 1.6
Italy	16,624	Tier 1.2	48%	Tier 1.3	y	9%	Tier 1.4	y	43%	Tier 1.2	y	9%	Tier 1.3	33%	Tier 1.1
Luxembourg	309	Tier 1.2	44%	Tier 1.2	y	17%	Tier 1.4	y	39%	Tier 1.2	y	6%	Tier 1.0	33%	Tier 1.2
Netherlands	5,714	Tier 1.9	57%	Tier 2.0	y	18%	Tier 1.7	y	25%	Tier 2.0	y	8%	Tier 2.0	17%	Tier 2.0
Portugal	2,941	Tier 1.4	36%	Tier 1.1	y	28%	Tier 1.4	y	37%	Tier 1.6	y	6%	Tier 1.6	31%	Tier 1.6
Spain	18,167	Tier 1.2	47%	Tier 1.2	y	16%	Tier 1.4	y	37%	Tier 1.2	y	5%	Tier 1.6	31%	Tier 1.1
Sweden	4,347	Tier 1.7	55%	Tier 1.8	y	10%	Tier 1.7	y	19%	Tier 1.6	y	4%	Tier 1.6	15%	Tier 1.6
United Kingdom	27,086	Tier 1.2	42%	Tier 1.1	y	21%	Tier 1.4	y	35%	Tier 1.1	y	6%	Tier 1.0	29%	Tier 1.1
EU-15	**188,293**	**Tier 1.3**	**51%**	**Tier 1.3**	**y**	**15%**	**Tier 1.5**	**y**	**34%**	**Tier 1.2**	**y**	**6%**	**Tier 1.3**	**28%**	**Tier 1.2**
EU-15: Tier 1	69%		71%			46%			77%			67%		78%	
EU-15: Tier 2	31%		29%			54%			23%			33%		22%	

a Contribution to N2O emissions from agricultural soils

b Tier 1: default methodology; Tier 2: country-specific methodology

c Source category is key in the Member State's inventory (y/n)

Table 6.65: Available background information for the calculation of N_2O emissions in category 4.D

Member State	***Methods***
Austria	*Emissions are estimated within an N-flow model for agriculture. The IPCC Tier 1a and – where applicable – Tier 1b with Austria specific consideration of nitrogen losses (NH_3-N, NO_X-N, N_2O-N). These losses are subtracted from the amount of mineral fertiliser N sales in the CRF table.*
Belgium	*The direct N_2O emissions are calculated according to the Tier 1a methodology as described in the IPCC GPG 2000, using country or region specific data when available. The same methodology is used in all 3 regions.*
Denmark	*The IPCC Tier 1b. Emissions of N_2O are closely related to the nitrogen balance. Indirect emissions from atmospheric deposition includes all emission sources of ammonia, i.e., livestock manure, use of synthetic fertiliser, crops, ammonia-treated straw used as feed, field burning of crop residues and sewage sludge and sludge from industrial production applied to agricultural soils. Emission factor for NH_3 from synthetic fertilisers is based on updated EEA/EMEP guidebook (2013)_.*
Finland	*Tier 1 approach for all N_2O emissions from soils, except for cultivation of organic soils (Tier 2). Emissions are estimated within a mass-flow approach in order to avoid double-counting. The nitrogen mass flow model (except for N-fixing, crop residue and sewage sludge) accounts for nitrogen losses as ammonia and nitrous oxide emissions during manure management in animal houses, during storage and application; for NH_3 volatilisation of pasture manure, urine and dung volatilisation are now taken into account separately; for synthetic fertilisers fertiliser type field type and placement fertilisation are considered; atmospheric deposition from manure is calculated from the ammonia volatilised during the whole management/application process. Activity data are national, mainly from the annual agricultural statistics of the Ministry of Agriculture and Forestry; other data from the Finnish Environment Institute and Finish Forest Research Institute. Emission factors are IPCC default, except for organic soils, for which it is calculated based on national data.*
Germany	*Nitrogen emissions are calculated with the mass-flow approach. A national approach is used for calculating N_2O emissions from atmospheric deposition of NH_3+NO_X taking into consideration total volatilization fluxes of NH_3 and NO_X, including those from mineral fertiliser, applied and deposited manure and NH_3 emissions from leguminous crops. As there is a small net export of manure, this has been ignored following a conservative approach. Emission factors of NH_3 are taken from EMEP. NO emissions from housing and manure storage are assumed to be 10% of N_2O emissions.*
Greece	*Tier 1, 1a, 1b*
Ireland	*Direct Soil Emissions: calculated in a Tier 1 approach take into account the nitrogen inputs from all these sources, except that due to the cultivation of organic soils. For N_2O emissions from manure application, also N_2O emissions during housing and storage are subtracted from the N-input.*
Italy	*IPCC default Tier 1 methodology.*
Luxembourg	*Nitrous oxide emissions from agricultural soils are estimated by using emission factors in relation with the mass of fertilisers used. For fallows (cultures without fertiliser use) an area-based emission factor is used in relation with the respective agricultural surface areas.*

Member State	Methods
Netherlands	*Full description of the methodologies is provided in Van der Hoek et al. (2007), with more details in Kroeze (1994). An IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions from soil from animal production. An IPCC Tier 1 method is used to estimate indirect N_2O emissions from atmospheric deposition. Since 2010 calculations are made on gross instead of net nitrogen flows in order to make them more transparent. At the same time, emission factors were updated based on laboratory and field experiments towards the effect of manure application technique on N_2O emission (Velthof et al., 2010; Velthof en Mosquera, 2011; Van Schijndel en Van der Sluis, 2011). For a description of the methodologies and data sources used, see the monitoring protocols on www.nlagency.nl/nie. In the calculation of emissions from animal manure, the use of air scrubbers as an abatement technology is considered, as it produces a reallocation of the ammonia. A level of compliance based on observations is considered for the implementation of such mitigation measure.*
Portugal	*Manure managed as liquid systems and solid storage is fully applied to agricultural soil as a fertiliser, irrespective of the animal species considered, whereas only 80% of manure handled in anaerobic lagoons is placed in soil (Bicudo & Albuquerque, 1995). The remaining 20 per cent wastewater flow and nitrogen is rejected directly to water systems. This fraction, however, is included in the determination of N_2O indirect emissions from agricultural soils. For the estimation of N_2O emissions from agricultural soils other than animal production, Tier 1a approach is used, with the same emission factor for all nitrogen sources (EF1 IPCC default, equal to 0.0125). For indirect N_2O emissions from soils, Tier 1a with default emission factors.*
Spain	*Tier 1 with national parameters. The activity data for applied organic nitrogen is obtained after subtracting not only NH_3 and NO_X volatilization from housing and manure management systems, but also N_2O emissions in manure management systems. Sources of information: "Anuario de Estadistica" (MAGRAMA) for mineral fertiliser applied and crop production (surface and yield per crop, by year and province). Grazing time calculated according to the "Saturday Paper".*
Sweden	*Background emissions from agricultural soils are reported both for organic and mineral soils in the Swedish inventory. For mineral soils, a national emission factor has been developed (Kasimir-Klemedtsson, 2001), considering 0.5 kg N_2O/ha. N_2O emissions from animal manure applied to soils are calculated using default IPCC methodology with national estimates of N content in manure. In the calculation of emissions from crop residues, the activity data is based on actual yearly yield. For indirect emissions, default emission factors from IPCC 2000 are used, but values for losses of nitrogen as ammonia and nitrogen leakage are national.*
United Kingdom	*IPCC default Tier 1 methodology.*

Activity Data

Activity data for category 4.D are given in Table 6.66. Additional background information on the source of the data used in the Member States’s inventories is given in Table 6.67.

Table 6.66: Member State's activity data to calculate direct and indirect N_2O emissions in category 4D. Data for the year 2012.

Member States	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Sewage Sludge (Gg N)	Atmosph. Deposition (Gg N)	N- Leaching and run-off (Gg N)
2012	Direct							Indirect	
Austria	103	110	23	60	NO	10	1.3	49	75
Belgium	136	125	4	55	25	77	0.6	50	47
Denmark	181	191	42	51	509	22	6	60	149
Finland	137	59	0.7	24	3,385	19	0	28	37
France	1,820	745	224	516	2,013	839	17	560	1,144
Germany	1,567	771	78	1,013	12,190	135	27	454	952
Greece	158	61	0.8	28	67	152	0.2	63	121
Ireland	290	111	0.5	9	NO	276	1.9	85	69
Italy	613	437	140	106	247	146	10	324	457
Luxembourg	13	6	0.1	3	NO	5	0.2	4	8
Netherlands	218	284	4	25	2,230	65	0.8	98	78
Portugal	93	43	10	26	NO	83	0.9	36	74
Spain	769	298	172	128	NO	298	36	195	468
Sweden	147	61	35	50	1,444	45	2	36	53
United Kingdom	1,011	326	19	410	1,500	597	37	323	652
EU-15	7,256	3,627	753	2,505	23,610	2,769	141	2,367	4,384

Source of information: Tables 4.D for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviatio

Table 6.67: Available background information on the activity data used for the calculation of N_2O emissions in category 4.D. Data for the year 2012.

Member State	***Activity data***
Austria	*Mineral fertiliser consumption: Grüne Berichte (BMLFUW); urea application in Austria: expert judgement based on sales data (RWA). Detailed data about the use of different kind of fertilisers are available until 1994, because until then, a fertiliser tax („Düngemittelabgabe") had been collected. Data about the total mineral fertiliser consumption are available for amounts (but not for fertiliser types) from the statistical office (Statistik Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). Annual sales figures about urea are available for the years 1994 onwards from a leading fertiliser trading firm (RWA). These sources were used to get a time series of annual fertiliser application distinguishing urea fertilisers and otherN-fertilisers ("mineral fertilisers"). High inter-annual variations in N_2O emissions of sector 4.D mineral fertiliser use. These variations are caused by the effect of storage: fertilisers have a high elasticity to prices. Sales data are changing very rapidly due to changing market prices. Not the whole amount purchased is applied in the year of purchase. The fertiliser tax intensified this effect at the beginning of the 1990s. Considering this effect, the arithmetic average of each two years is used as fertiliser application data. Cropped area legume production and harvested amount of agricultural crops: (BMLFUW). Agriculturally applied sewage sludge data were taken from Water Quality Report, 2000 (Philippitsch, 2001), For 2001 to 2006 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used.*
Belgium	*Data of crop production (area and yield) originate from 'Statistics Belgium'. The cultivated area for each crop originates from the agriculture census of the 1st of May. Data of crop production (area and yield) originate from 'Statistics Belgium'. The cultivated area for each crop originates from the agriculture census of the 1st of May. The crop production originates from an additional survey performed in December.*
Denmark	*The amount of nitrogen (N) applied on soil by use of synthetic fertiliser is estimated from sale estimates by the Danish AgriFish Agency, which is source to the FAO database. The use of synthetic fertiliser includes fertiliser used in parks, golf courses and private gardens. 1 % of the synthetic fertiliser can be related to these uses outside the agricultural area. Data for crop yield is based on Statistics Denmark. For nitrogen content in the plants the data is taken from Danish feed stuff tables (Danish Agricultural Advisory Centre).*
Finland	*The amount of synthetic fertilisers sold annually has been received from the annual agricultural statistics of the Ministry of the Agriculture and Forestry. The amount of sewage sludge applied annually has been received from the VAHTI database of Finland's environmental administration. Area of cultivated organic soils are from MTT Agrifood Research Finland. Crop yields of cultivated plants have been received from agricultural statistics.*
France	*National statistics of fertiliser consumption are from UNIFA. Crop production statistics are obtained from the Ministry of agriculture (SCEES/ AGRESTE). For animal production, the difference between table 4.D and table 4B(b) is due to the overseas territories that are accounted separately in table 4D.*
Greece	*Confirmed data for the quantities of synthetic fertilisers applied in soils derive for the first time from the Pan-Hellenic Association of Professional fertilisers Producers & Dealers (PHAPFPD). Agricultural*

Member State	Activity data
	production data were derived from the Hellenic Statistical Authority (ELSTAT).
Ireland	*The annual statistics on nitrogen fertiliser use (Nfert) are obtained from the Department of Agriculture, Food and the Marine.*
Italy	*Italian fertiliser Association (AIF) the use of fertilisers is determined by their cost and particularly by the price of agricultural products. In the last years, prices have decreased and, as a result, farmers need to save costs, consequently, less fertilisers is being used (Perelli, 2007; De Corso 2008). The Italian National Statistical System (SISTAN) revises every year the National Statistical Plan that covers three years and includes, among others, the system of agricultural statistics. In this framework, the Agriculture, Forestry and Fishing Quality Panel has been established under coordination of the Agriculture service of ISTAT where those who produce and use agricultural statistics (mainly public institutions) meet every year in order to monitor and improve national statistics. Information of the cultivated surface is collected 100% from rice farmers. Every year, data are collected on time by the National Rice Institute (ENR, 2011[b]).*
Luxembourg	*AD from national statistical data (Statistical Yearbook, tables C.2100 and C.2104) and ASTA (Administration des Services Techniques de l'Agriculture)*
Portugal	*No available statistics on annual quantity of N used for agricultural soils, not even on sales of synthetic fertilisers. The National Statistical Institute, in collaboration with Laboratorio Quimico Agricola Rebelo da Silva and ADP (main fertiliser producer), produced a methodology that estimates the Apparent Consumption of fertilisers in the Agriculture activity (ACFA) by a simple mass balance, from sales and international market information data not accounting for losses and stock changes. The data are compared to the more complete time-series that is available at FAO (http://faostat.fao.org), with sales information for "Nitrogenous fertilisers" from 1961 up to 2002. However, and although its completeness, the Ministry of Agriculture and the National Statistical Institute, shown concerns about the origin of the information behind the final time series, and consider that it did not reflect clearly the situation that existed in Portugal in the period. Nevertheless, both series agree quite well near the base year, although the values in this series appear to be over-estimating the rate of decrease of synthetic fertilisers in Portugal.*
Spain	*Mineral fertiliser statistics are obtained from 'Anuario de Estadistica Agroalimentario' (MARM)*
Sweden	*Sales of fertilisers, recalculated into nitrogen quantities, are published annually by Statistics Sweden and the national estimates are considered to be accurate, according to the quality declaration in the statistical report. The fertiliser sales values are however a bit higher than the estimated use of fertilisers, which is estimated from telephone interviews with farmers. The difference can partly be explained by the use of fertiliser in other sectors such as in horticulture. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in the current submission of the GHG inventory. Estimated standard yields for different crops are published annually by the Swedish Board of Agriculture/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years.* *The area of arable land in the agricultural sector is taken from the National Forest Inventory to harmonize the Swedish National Forest Inventory with the agricultural sector.*
United Kingdom	*Annual consumption of synthetic fertiliser is estimated based on crop areas from the England and the Devolved Administrations.* *Production data of crops are provided by Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI*

Emission Factors and other parameters

Table 6.68 and Table 6.69 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2012. As discussed already above, emission factors are largely IPCC default, while other parameters are more frequently country-specific. In addition, while the emission factors are static in the time series, some parameters are dynamically calculated on the basis of national input data, for example the mix of mineral fertiliser types with different volatilization fractions associated.

In the following, country-specific elements in the calculation of N_2O emissions from agricultural soils as reported in the National Inventory Reports are given in Table 6.71 for direct N_2O emissions from fertiliser application, Table 6.72 and Table 6.73 for N_2O emissions from N-fixing crops and crop residues, Table 6.74 for the N_2O emissions from animal production and Table 6.75 for N_2O emissions from cultivated histosols.

Furthermore, background information on the development of national parameters is given in Table 6.76 for $Frac_{GASF}$, Table 6.77 for $Frac_{GASM}$ and Table 6.78 for $Frac_{LEACH}$.

Table 6.68: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in 2012.

Member States 2012	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
	Direct						Indirect	
Austria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Belgium	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Denmark	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.0%
Finland	1.25%	1.25%	1.25%	1.25%	8.4	2.0%	1.0%	2.5%
France	1.25%	1.25%	1.25%	1.25%	8.1	2.0%	1.0%	2.5%
Germany	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Greece	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Ireland	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Italy	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Luxembourg	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Netherlands	1.30%	0.87%	1.00%	1.00%	4.7	3.3%	1.0%	2.5%
Portugal	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Spain	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Sweden	0.8%	2.50%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
United Kingdom	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
EU-15	1.24%	1.24%	1.25%	1.25%	7.8	2.0%	1.0%	2.5%

Source of information: Tables 4.D for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.69: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2012

Member States 2012	$Frac_{BURN}$	$Frac_{FUEL}$	$Frac_{GASF}$	$Frac_{GASM}$	$Frac_{GRAZ}$	$Frac_{LEACH}$	$Frac_{NCRBF}$	$Frac_{NCR0}$	$Frac_{R}$
Austria	0.1%		4.0%	27%	6%	30%	2.6%	0.9%	34%
Belgium	NO	NO	3.8%	21%	30%	13%	2.0%	0.9%	50%
Denmark	0.9%	NO	3.1%	19%	8%	33%	3.9%	1.7%	87%
Finland	0.2%	NA	1.5%	25%	18%	15%	NA	0.5%	NA
France	0.5%	NO	10%	20%	44%	30%	3.0%	0.8%	NA
Germany	NO	NO	4.5%	29%	11%	30%	4.4%	2.4%	65%
Greece	10%		10%	20%	67%	30%	1.4%	0.5%	52%
Ireland	NO	NO	2.1%	18%	61%	10%	1.4%	1.1%	NO
Italy	10%	NO	10.3%	30%	18%	30%	3.0%	1.5%	45%
Luxembourg	NO	NO	10%	20%	45%	30%	3.0%	1.5%	50%
Netherlands	NO	NO	6.7%	17%	14%	12%	NE	NE	NE
Portugal	6%	NO	5.7%	19%	54%	32%	2.4%	1.3%	67%
Spain	19%	NO	8.8%	16%	39%	30%	2.4%	0.5%	NA
Sweden	NO	NO	0.9%	33%	33%	21%	1.3%	1.0%	64%
United Kingdom		1.27%	10%	20%	59%	30%	3.0%	1.5%	52%
EU-15[1)]	NA	NA	6.1%	22%	34%	25%	2.6%	1.2%	57%

Source of information: Tables 4.D for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbre

[1)] Arithmetic average over the MS that reported.

Direct emissions from N-application

Only few countries use country-specific emission factors to estimate N_2O emissions caused by the application of mineral fertiliser. The reason is the extreme high spatial and temporal variability of this emission source, which makes the generation of a robust database with observations, based on which national emission factors can be derived, extremely difficult.

A differentiation between organic and inorganic fertiliser has been made by the Netherlands (see Table 6.70) and by Sweden.

The Swedish EF for synthetic fertiliser is lower than the IPCC default and is based on a study on N_2O emissions in Sweden and other countries of northern Europe and Canada (Kasimir-Klemedtsson, 2001). This study is supported by another study carried out in Norway, suggesting a lower emission factor for emitted fertiliser N than the IPCC default value (Laegreid and Aastveit, 2002). The EF for applied manure is higher than IPCC default and is a country specific EF derived from a literature study requested by the Swedish EPA (Klemedtsson, 2001).

The Netherlands distinguish between mineral fertiliser application on mineral soils and on organic soils, with the EFs being twice as high for the application on organic soils. For the application of manure, differentiation is made between surface spreading and incorporation of the fertiliser. As more nitrogen is locally available if the fertiliser is incorporated into the soil, this application system is assumed to result in higher emissions of N_2O in mineral soils. For organic soils, the same, higher EF is applied for both application systems.

Additional background information on the emission factors used is given in Table 6.71.

All countries are reporting N_2O emissions from manure excreted by animals during grazing and the implied EF is the default factor of 2% N_2O-N per kg N excreted and year, except of the emission inventories of the Netherlands, which use an EF of 3.3%.

National methodologies are summarized in Table 6.71. Table 6.72 through Table 6.74 give additional information on the methodologies used to estimate N_2O emissions from crop residues, biological N-fixation, and animal production.

Table 6.70: N_2O emission factors for agricultural soils used in Netherlands' inventory (from the NL protocol for direct N_2O emissions; www.greenhousegases.nl)

Supply source	EF (kg N_2O–N per kg N supply)		Reference
	Mineral soil	Organic soil	
Using fertiliser			
- ammonia-retaining (no nitrate)	0.005	0.01	2
- other types of fertiliser	0.01	0.02	1
Using animal manure			
- above-ground usage	0.01	0.02	1
- low-emission use	0.02	0.02	1
Grazing agricultural pets			
- faeces	0.01	0.01	1
- urine	0.02	0.02	1
Nitrogen fixation	0.01		1
Remaining crop residues	0.01		2
Agricultural use of histosols		0.02	2

references: 1= Kroeze, 1994; 2= Van der Hoek et al., 2005

Table 6.71: Available background information for the calculation of N_2O emissions from the application of fertiliser in category 4.D

Member State	***Direct emissions from fertiliser application***
Austria	*IPCC default*
Belgium	*IPCC default*
Denmakr	*IPCC default*
Finland	*IPCC default with the exception of emission factors for organic soils on grass and other crops which are based on national data (Monni et al. 2007) (cereals 11.08 kg N_2O-N ha^{-1} y^{-1}, grass 5.7 kg N_2O-N ha^{-1} y^{-1}).*
France	*IPCC default*
Germany	*IPCC default. For emissions from leaching, default factor from IPCC 2006. The IPCC 1996 factor represents poor knowledge available at the time. The new data set used for the development for the IPCC 2006 guidelines agrees with the German situation (Weymann et al., 2008).*
Greece	*IPCC default*
Ireland	*IPCC default*

Member State	Direct emissions from fertiliser application
Italy	*IPCC default*
Luxembourg	*IPCC default*
Netherlands	*Distinction is made between fertiliser type (ammonia-retaining-no-nitrate fertiliser and other fertiliser), application to mineral or organic soils, and manure incorporation. The country specific emission factors for mineral soils are lower than IPCC defaults and for organic soils they are higher. A fixed distribution of the total amount of nitrogen in fertiliser and animal manure is used over the Netherlands areas of mineral and organic agricultural soils. For fertiliser use, 90% is attributed to mineral soils, and 10% to organic soils; for animal manures this is 87% and 13% respectively (Kroeze, 1994). For incorporation into soil also a higher emission factor than the IPCC default is used. A recent survey on N_2O emission factors for the field-scale application of animal manure (Kuikman et al., 2006) showed that on the basis of available data it was not possible to make an update of the N_2O emission factors applied in the past (Kroeze et al., 1994). Very few comparative trials between surface spreading and incorporation have been carried out in The Netherlands to date, resulting in very low emission rates for both techniques. Field-scale comparative experiments carried out in other countries show that, in most cases, N_2O emissions increased and seldom were lower in comparison with surface application. However, it was not possible to deduce long-term average N_2O emission factor from these findings and to translate these to the Dutch circumstances. Therefore, it was not possible to underpin an update of the N_2O emission factor for the application of animal manure. More research is needed in order to be able to take the specific circumstances of The Netherlands into account.*
Portugal	*IPCC default*
Spain	*IPCC default*
Sweden	*National emission factor for direct emissions based on a study by (Klemedtsson, 2001). For nitrogen supply from fertilisers, a national emission factor, 0.8% N_2O-N of N-supply, is used. For nitrogen supply from manure, a national emission factor of 2.5% emissions of N-supply is used. The background emissions from the cultivation of mineral soils have also been included in the inventory with the national emission factor of 0.5 kg N_2O-N ha-1. For other direct soil emissions, default values from the IPCC Guidelines are used. The background emissions from organic soils vary with different crops. They are considered to be higher from ploughed soils than from pasture or lay lands and the suggested emission factors are 1 and 6 kg N_2O-N ha-1, respectively. The IPCC guidelines' default value is implemented in the inventory since a Swedish/Finnish research group concluded that not enough data exists to generate different emission factors for different management and soil types (Klemedsson et al., 1999).IPCC default*
United Kingdom	*IPCC default*

Table 6.72: Available background information for the calculation of N_2O emissions from crop residues in category 4.D

Member State	Direct emissions from crop residues
Austria	*Country-specific data for average crop residues/crop products ratio, dry matter fraction, N in crop residues (Goetz, 1998) and fraction of crop residues removed (Loehr 1990). Emissions from field burning have been calculated on a crop by crop basis.*
Belgium	*The dry matter content of the crops in Flanders is region specific.*
Denmark	*Tier 1b. N_2O emissions from crop residues are calculated as the total above-ground amount of crop residues returned to soil. For cereals the aboveground residues are calculated as the amount of straw plus stubble and husks. The total amount of straw is given in the annual census and reduced with the amount used for feeding, bedding and biofuel in power plants. Straw for feeding and bedding is subtracted in the calculation because this amount of removed nitrogen returns to the soil via manure. Data for nitrogen content in stubble and husks are provided by the Danish Institute of Agricultural Sciences (Djurhuusand Hansen, 2003). Burning of plant residues has been prohibited since 1990 and may only take place in connection with continuous cultivation of seed grass. It is assumed that the emissions are insignificant. The fractions FracNCRO, $Frac_{NCRBF}$ and FracR are calculated for all years by using the definitions given in the IPCC Reference Manual. A higher $Frac_{NCRBF}$ could be explained that Denmark includes fields with clover grass, which has a high N-content. The higher national FracNCRO could be a consequence of the relatively large part of straw that is harvested and used for feeding, bedding and fuel. The national FracR is significantly higher than the IPCC default. The national value express, that 84 % to 87 % of the total N in crops above ground is re-moved from the field. The remaining is the N-content in straw and tops from beets and potatoes, which are left on the field. Since 1990 the FracR increased as a consequence of a fall in cultivated area of feeding beets.*
Finland	*IPCC default values for residue/crop ratio, dry matter fraction and nitrogen fraction for each crop species. Where ther is no default, expert judgement has been used.*
France	*N-input from crop residues is calculated using data on harvest indices and other parameters, obtained from the survey on crop production practices.*
Germany	*Germany makes use of statistically available nitrogen contents in crop residues from the Duengerverorndung (DuV, 2007) and IGZ (2007). Factors used in the Tier 2 calculation for emissions from crop residues is given in (Daemmgen et al., 2007).*
Italy	*Country-specific methodology; N-content in crop residues calculated using the protein content in dry matter, and dividing by the factor 6.25. The FCR parameter is obtained by adding the nitrogen content of cultivars crop residues.*

Member State	Direct emissions from crop residues
Netherlands	A fixed country specific value in kg N per hectare is used for the nitrogen content of the above-ground crop residues (Velthof and Kuikman, 2000). Country-specific values for removal of crop residues show that during the period 1990-2003, only grains and corn were removed (90%) from the fields (Van der Hoek et al., 2005).
Portugal	Tier 1b approach from IPCC 2000. Crop residues returned to soils include all crops (N fixing and non N fixing crops, and also including permanent crops). Calculations similar to N-fixing crops; N added to soil is estimated from the ration residue/crop mass, fraction of dry matter in product and fraction of N in dry matter. Values for the estimation of N in residues for leguminous are the same as for N fixed by crops. For non-leguminous, IPCC defaults. For the estimation of FCR, FracFUEL, FracCNST and FracFOD were set to zero for all crops, because those uses are negligible in Portugal.
Spain	Regulations on burning of cereal residues vary between regions (zones A and B). Data are listed by year, crop category and zone. Calculation of emissions from crop residues following IPCC 2000 default methodology (considering FracFUEL-CR, FracCNST-CR and FracFOD equal to zero, because these uses do not take place in Spain).
Sweden	Methodology recommended in IPCC 2000 is followed, combined with national activity data on removed residues and other parameters. Emission factors used are the default. N-content in crop residues from cereals is based on national measurement data (Mattson, 2005). For other crops, a combination of national factors and IPCC default values was used (Swedish EPA/SMED, 2005).
United Kingdom	Production data of crops are provided by Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI.

Table 6.73: Available background information for the calculation of N_2O emissions from N-fixing crops in category 4.D

Member State	Direct emissions from N-fixing crops
Austria	Values for biological fixation for peas, soya beans and horse/field beans (120 kg N/ha) and clover-hey (160 kg N/ha) are country-specific (Goetz, 1998); these values are constant over the time series.
Denmark	Tier 1b. The estimates for the amount of fixed nitrogen in crops are estimated by Danish Institute of Agricultural Science (Swedish Board of Agriculture, 2005) from literature (Kristensen, 2003; Høgh-Jensen et al, 1998; Kyllingsbæk, 2000). Emissions from clover-grass are included (not mentioned in IPCC). Area with grass and clover cover now 20% of the total agricultural area and represent thus a significant part of N-fixing crops emissions.
Finland	Vegetables grown in the open have been included into the emission estimate of crop residues for the first time in 2005 submission. Vegetable yields have been received from literature (Yearbook of Farm Statistics, 2006). Values for the residue/product fraction, dry matter content and nitrogen fraction are IPCC with amendments where appropriate values were missing (turnip rape/rape; sugar beet; clover seed) or where more values based on expert judgement were used (N-fraction for peas of 3.5%; DM and residue/product fraction from sugar beet used for vegetables).
Germany	The quantity of N fixes by leguminous crops is estimated on the basis of cultivated area and national average N-fixing rates of 250 kg N ha-1 (pulses), 300 kg N ha-1 (alfalfa), and 200 kg N ha-1 (mixed alfalfa, clover; improved grassland) (Daemmgen et al., 2007).
Greece	Tier1b. The cereal production of Greece consists mainly of wheat (36 per cent of cereal production) and maize (52 per cent of cereal production) crops, whose FracNCRO is significant lower than IPCC default, 0.0028 of wheat and 0.0081 of maize.
Ireland	Tier1b
Italy	Nitrogen input from N-fixing crops (FBN, kg N yr^{-1}) is calculated with a country-specific methodology. Peculiarities that are present in Italy were considered: N-fixing crops and legumes forage. FBN is calculated with two parameters: cultivated surface and nitrogen fixed per hectare (Erdamn 1959 in Giardini, 1983).
Netherlands	For emissions from crop residues and N-fixing crops, only crops from arable farming and horticulture in the full soil (not in tubs) are included. Country-specific value for nitrogen fixation per hectare (Mineralen Boekhouding, 1993) (Lucerne: 422 kg N per hectare; Green peas (harvested dry) and field peas, marrowfat peas en grey peas, brown beans, peas (harvested green): 164 kg N per hectare; Field beans: 325 kg N per hectare; Stem beans (harvested green), scarlet runner-/salad-/common beans: 75 kg N per hectare; Broad beans: 164 kg N per hectare.
Portugal	Tier 1b approach of IPCC 2000: use of crop-specific residue to product ratio and dry matter content. Quantity of N fixation estimated from INE data on crop production (regional level), including permanent crops. N fixed is estimated from the ration residue/crop product mass, the fraction of dry matter in product and the fraction of N in dry biomass. These parameters are calculated by crop, using default IPCC values.
Spain	Two methods are used: a specific national methodology to calculate non-cultivated agricultural land, and IPCC methodology with national parameters for cultivated land. A literature review was made to obtain N-fixing parameters relevant for cultures grown in Spain. This resulted in a detailed list containing data on crop residue/yield fraction, dry matter, carbon and nitrogen content for more than 100 crop types.
Sweden	To estimate nitrogen fixation from the atmosphere, a model according to Høgh-Jensen has been used since submission 2006 The model covers fixation from root and stubble as well as transmission to other plants. It has been adapted to Swedish conditions (Frankow-Lindberg, 2005). According to the model, the amount of fixed nitrogen is estimated as a part of the total amount of N in the plant's biomass, which varies

Member State	Direct emissions from N-fixing crops
	depending on the kind of leguminous plant, the age of the pasture, the number of harvests and, to some extent, the amount of fertiliser applied.
United Kingdom	*Crop production data were provided by Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI.*

Table 6.74: Available background information for the calculation of N_2O emissions from animal production in category 4.D

Member State	Grazing animals
Austria	*During the summer months, 14.1% of Austrian Dairy cows and Suckling cows are on alpine pastures 24 hours a day. 43.6 % are on pasture for 4 hours a day and 42.3 % stay in the housing for the whole year (Konrad, 1995).*
Belgium	*The nitrogen from grazing is estimated, taking into account the number of days in pasture and the nitrogen excreted by each animal category. Available nitrogen is the difference between the manure nitrogen content and the manure nitrogen volatilisation in NH_3 and NO form.*
Denmark	*$Frac_{GRAZ}$. The amount of nitrogen deposited on grass is based on estimations from the NH_3 inventory. Grazing days is based on expert judgement from the Danish Agricultural Advisory Centre.*
Finland	*Calculating manure excreted on pasture requires data of length of pasture season and time spent outside. For dairy cattle, it has been estimated that 25% of cows spend nights inside (14h) during pasture season. The length of pasture season is 140 days for suckler cows, heifers, horses and ponies, 125 days for dairy cows, 100 for calves, 130-140 for sheep and goats, 365 for reindeer and 0 for bulls, swine, poultry and fur animals.*
France	*Surveys on the distribution of national animal housing systems have been carried out in 1994, 2001, and 2008 including the time the animal spent within the housing and outside (pasture or yard) as well as the share of solid and liquid systems. As only days which were spent entirely in the housing systems were counted, 4 hours/day during the grazing period were added for dairy cattle to account for time they spent in the housings. For sheep and goat, time grazing was obtained from PMPOA 1 et 2. Data for poultry are based on N excretion data which that excreted in housing systems.For horses, it is assumed that the animals spend 5 month/yr in housing systems.*
Germany	*Grazing animals: N input calculated with the mass-flow approach taking into consideration all relevant housing systems occurring in Germany and is based on the length of the grazing period, the average time per day spent grazing and in milking yards. The share of grazing varies with subcategory, region, and time.*
Greece	*Surveys on the distribution of national animal housing systems have been carried out in 1994, 2001, and 2008 including the time the animal spent within the housing and outside (pasture or yard) as well as the share of solid and liquid systems. As only days which were spent entirely in the housing systems were counted, 4 hours/day during the grazing period were added for dairy cattle to account for time they spent in the housings. For sheep and goat, time grazing was obtained from PMPOA 1 et 2. Data for poultry are based on N excretion data which that excreted in housing systems.For horses, it is assumed that the animals spend 5 month/yr in housing systems.*
Ireland	*Default*
Italy	
Netherlands	*National emission factor. A distinction is made between nitrogen in urine and in faeces. The distribution of nitrogen over faeces and urine depends on the nitrogen content in the meadow grass, and in turn this depends on the fertilisation level. For the period 1990-1999 a distribution of 30/70 was assumed, and for the period from 2000 onwards, a ratio of 35/65 is used (calculated on the basis of Valk et al., 2002). For the calculation of N_2O emissions, the nitrogen excreted is corrected for NH_3 volatilization.*
Portugal	*Surveys on the distribution of national animal housing systems have been carried out in 1994, 2001, and 2008 including the time the animal spent within the housing and outside (pasture or yard) as well as the share of solid and liquid systems. As only days which were spent entirely in the housing systems were counted, 4 hours/day during the grazing period were added for dairy cattle to account for time they spent in the housings. For sheep and goat, time grazing was obtained from PMPOA 1 et 2. Data for poultry are based on N excretion data which that excreted in housing systems.For horses, it is assumed that the animals spend 5 month/yr in housing systems.*
Spain	
Sweden	*2% default emission factor for all animal groups (although it is probably an overestimation of emissions in a cold climate, but no better empiric information is available)*
United Kingdom	*The fraction of livestock N excreted and deposited onto soil during grazing in UK is much larger (0.54) than the IPCC default value (0.23), as cattle in particular spend more time grazing at pasture in the UK than is the case in many other countries.*

Direct emissions from the cultivation of histosols.

N_2O emissions from the cultivation of histosols reported as not occurring in Austria, France, and Spain, and as not estimated in Portugal. Additionally, no emissions from the cultivation of histosols are reported by Ireland, because tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the middle and western part of the country. Consequently, nitrogen inputs due to the cultivation of organic soils have been taken as negligible.

The cultivation of histosols represents the biggest share of emissions from agricultural soils in Finland (40%), and a substantial source for N_2O emissions in Sweden (15%), Germany (12% - almost as large as emission from application of manure) and the Netherlands (9%). The emission factor proposed in the IPCC GPG of 8 kg N_2O-N per hectare and year (IPCC, 2000) is used in most countries. The Netherlands uses 4.7 kg N_2O-N ha^{-1}; national emission factors are further used in France (8.1 kg N_2O-N ha^{-1}), Denmark (8.0 kg N_2O-N ha^{-1}) and Finland (8.4 kg N_2O-N ha^{-1}).

On absolute terms, the estimated emissions of N_2O from the cultivation of histosols are largest for Germany (15.3 Gg N_2O), followed by Finland (4.5 Gg N_2O), France (2.6 Gg N_2O), UK (1.9 Gg N_2O) and Sweden (1.8 Gg N_2O).

Table 6.75: Available background information for the calculation of N_2O emissions from the cultivation of histosols in category 4.D

Member State	***Histosols***
Austria	*Cultivation of Histosols is not occurring in Austria. There are no annually cultivated organic soils in the Austrian grassland area.*
Belgium	*The cultivation of organic soils only represents Flanders. The area of histosols in Flanders has been estimated using region specific data based on an intersection between the CORINE Land Cover Geo dataset from 1990 and the Belgian 'Soil association map'. The area of cultivated organic soils is obtained by the University of Leuven (KUL). Given the slow pace of change the area is taken constant over the entire time series.*
Denmark	
Finland	*The area of cultivated organic soils has been received from MTT Agrifood Research Finland and has been updated for the 2006 submission on the basis of (Myllys, 2004; Kähäri, 1987). The area of cultivated organic soils is poorly known in Finland. Current area estimate is based on the results of soil analysis. The emission factors for organic soils on grass and other crops are based on national data (Monni et al. 2007). The emission factors were calculated on the basis of published results on annual fluxes measured with flux chambers on five different peat fields.*
Germany	*Estimation of the area of cultivated histosols consistent with estimates from the LULUCF sector. It includes the classes arable land and grassland (not woody grassland) whereby un-drained grassland is subtracted.*
Greece	*Data for the areas of organic soils cultivated area (6.7 kHa, constant for the entire period examined in North Greece) derive from a relevant research conducted by the Soil Science Institute of Athens (SSIA, 2001).*
Ireland	*Following discussion with the respective experts in agricultural practices and GIS analysis, it was agreed, pending the results of proposed research, to assume that no cultivation of histosols occurs. Therefore cropland organic soils are designated as "not occurring", i.e. "NO" in the CRF tables.*
Italy	*The area of organic soils cultivated annually (histosols) is estimated to be 9,000 hectares for the whole time series (CRPA, 1997[b]). The data for surface area, reproduced in the national soil map of the year 1961, were supplied by the Experimental Institute for the study and protection of soil in Florence (ISSDS). These values have been verified with related data for Emilia Romagna region, where this type of soil is most prevalent.*
Netherlands	*A fixed country-specific emission factor of 0.02 kg N_2O-N per hectare is used for this calculation (largely taken from Dutch research projects conducted in the first half of the 1990s and reported in Kroeze, 1994).*
Portugal	*Considering climate conditions, and the long period since when soils have been subjected to agriculture in Portugal, histosols are not present in Portugal and N_2O emissions from histosols may be reported as not occurring. This is also supported by data available from the European Soil Data Centre (ESDAC, see http://eusoils.jrc.ec.europa.eu/wrb/) which show no presence of peat in Portugal.*
Spain	
Sweden	*The area of organic soils has only been estimated intermittently. The latest survey in 2009 concluded that approximately 5 % of the total area of arable land consists of organic soils (Berglund, Berglund & Sohlenius, 2009). That fraction has then been used for all years.*
United Kingdom	*The area of cultivated histosols is estimated at 1500 km^2. It is assumed to be equal to that of eutric organic soils in the UK and is based on a FAO soil map figure supplied by SSLRC (now NSRI).*

Indirect emissions.

All Member States report indirect emissions of nitrous oxide induced by the atmospheric deposition of NH_3 and NO_X volatilised and nitrate leached to the groundwater using the default IPCC emission factors. Only Denmark uses a smaller emission factor for N_2O from nitrogen leached or run-off (2.0%).

The EMEP/EEA Emission Inventory Guidebook (EMEP/EEA, 2013) gives in the section '4.D Crop production and agricultural soils' the emission factors for NH_3 volatilization from mineral fertilisers if the Tier 2 'technology specific approach' can be used (Table 3-2). The method considers soil pH and as a factor influencing the magnitude of NH_3 volatilizations. For example, the application of ammonium sulphate on soils with a pH≤7 would lead to a NH_3 volatilization of 0.013 or 1.3%, which is considerably lower than the IPCC default factor, but to a NH_3 volatilization of 0.27 or 27% on soils with a high pH. Emission of other fertiliser types are independent from soil pH, such as for example ammonium nitrate (3.7%) or urea (24.3%). Volatilizations higher than the IPCC default factor of 10% are only achieved when using this methodology for the application of urea, ammonium solutions, or urea ammonium sulphates. Accordingly, the estimates volatilization fraction of NH_3 and NO_X from the application of mineral fertiliser is considered by all Member States to be lower as the IPCC default values (range of national factors 1.5% to 10.3%, with 4 countries using the default value of 10%).

In contrast, most of the Member States with country-specific volatilisation rates for organic fertiliser are estimating larger losses of NH_3 + NO_X than proposed by the IPCC (range 21% to 33%) with 4 countries using the default $Frac_{GASM}$ of 20% and the lowest volatilization fraction used being 17.5%.

Also, model-based estimations for the fraction of nitrogen volatilised from applied animal wastes have been used. The fraction of nitrogen lost by leaching ranges from 13.5% to 33% with 8 countries using the default FracLEACH of 30% and 6 countries using a smaller value. They are in some cases based on a nitrogen-leaching model (e.g., Denmark, Sweden) and in some cases based on national studies (e.g., Finland, Ireland).

Table 6.76: Available background information on the fraction of NH_3 and NO_X volatilized from applied mineral fertiliser, $Frac_{GASF}$ for the calculation of N_2O emissions in category 4.D

Member State	***$Frac_{GASF}$***
Austria	*$Frac_{GASF}$ NH_3 emissions are 2% for mineral fertilisers and 15% for urea fertilisers; NO_X emissions 0.3% (CORINAIR)*
Belgium	*$Frac_{GASF}$ 2.3% in Wallonia (recommended by IIASA for different fertiliser types); in Flanders an average rate for NH_3 volatilisation is calculated by the model that estimates the NH_3 emissions from synthetic fertiliser as developed by ILVO. The rate for NO volatilisation in Flanders is 1.5%.*
Denmark	*The Danish value for the $Frac_{GASF}$ is an average of national estimates of NH_3 emissions from each fertiliser type (Sommer and Christensen, 1992; Sommer and Jensen, 1994; Sommer and Ersbøll, 1996) in accordance with the CLRTAP guidebook. The major part of the Danish emission is related to the use of calcium ammonium nitrate and NPK fertiliser, where the emission factor is 0.01 kg NH_3-N/kg N. The low Danish $Frac_{GASF}$ is also probably due to a small consumption of urea (<1%), which has a high emission factor.*
Finland	*Nitrogen volatilised as NH_3-N and NO_X-N from synthetic fertilisers ($Frac_{GASF}$) is calculated and used for calculating indirect emissions from atmospheric deposition and subtracted from the amount of N remaining which is used for calculating direct emissions form synthetic fertiliser application.*
Germany	*$Frac_{GASF}$ dynamically calculated using default emission factors for the application of mineral fertilisers (EMEP/CORINAIR, 2003).*
Ireland	*The volatilization rates for Ireland are however determined from an elaborate new NH_3 inventory for agriculture and it is assumed that nitrogen lost as NO_X is negligible in comparison to NH_3.*
Italy	*$FRAC_{GASF}$ parameter is estimated for the whole time series, following the IPCC definition*
Netherlands	*Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions. The extent of the NO_X emission as a result of fertiliser and animal manure is estimated at 15% of the ammonia emission (De Vries et al., 2003). The supply source, deposits of NO_X as a result of using fertiliser and animal manure, is not (yet) included in the annual calculations under the framework of the Emission Registration, and is therefore not included when determining the nitrogen balance.*
Portugal	*Country specific, determined from an estimate of the share of N synthetic fertilisers used in Portugal, based on statistical information from INE on exports, imports and national production of each individual fertiliser. Values vary between 0.053 and 0.064 kg NH_3-N/kgN, almost half the default IPCC value*
Spain	*$Frac_{GASF}$ from national inventories, calculated according to the EMEP/CORINAIR methodology.*

Member State	$Frac_{GASF}$
Sweden	*The proportions of emitted N-content of fertilisers sold in different years vary because of changes in the sold quantities of different types of fertilisers. Values for ammonia emission fractions from EMEP/EEA emission inventory guidebook 2009 and calculated using the mean spring temperature of 5.9 Celsius degrees.*

Table 6.77: *Available background information on the fraction of NH_3 and NO_X volatilized from applied manure, $Frac_{GASM}$ for the calculation of N_2O emissions in category 4.D*

Member State	$Frac_{GASM}$
Austria	The amount of manure left for spreading was calculated within source category 4B (Amon et al., 2002). With regard to a comprehensive treatment of the nitrogen budget, the emission inventory of N_2O is linked with the Austrian inventory of NH_3. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{GASM}$. Nitrogen left for spreading is calculated subtracting the following losses: N-excreted during grazing, NH_3-N losses from housing, NH_3-N losses during manure storage and N_2O-N losses from manure management. NH_3 emissions from housing: according to CORINAIR using EFs for Switzerland where similar management strategies and geographic structure between the countries, or default EFs for Germany if no Swiss factor is available; NH_3 emissions from manure management: TAN content according to Schlechtner 1991 (cattle and pigs) + emissions factors default CORINAIR; correction factors are applied for different manure treatment systems from the Swiss inventory model DYNAMO (Menzi et al., 2003; Reidy et al., 2007;2009); for example composted solid manure has a correction factor of 1.2 with respect to uncomposted solid manure, and covered liquid systems have correction factors between 0.2 (solid cover) to 1.1 (aerated open tank) compared to uncovered tank. Other animals CORINAIR simple methodology; NH_3 emissions during manure application: CORINAIR default factors; NO_X-emissions during manure application: a conservative emission factor for NO_X-N of 1% was used (Freibauer & Kaltschmitt, 2001).
Belgium	*In Wallonia and Flanders no animal manure is burned. In Flanders the animal manure nitrogen used as fertiliser is also corrected for the amount of manure transported outside Flanders or to a fertiliser processing company.*
Denmark	*Emissions of NH_3 are linked to the national NH_3 emission inventory (Mikkelsen et al. 2011). The $Frac_{GASM}$ is estimated as the total N-excretion (N ab animal) minus the ammonia emission in stables, storage and application. They are based on national estimations and are calculated in the ammonia emission inventory. The $Frac_{GASM}$ has decreased since 1990 as a result of an active strategy to improve the utilization of the nitrogen in manure. It is assumed that 1.9% of the N-input from sewage sludge or industrial sludge applied to soil volatilises as ammonia.*
Finland	*The amount of N volatilised as NH_3-N from total manure N ($Frac_{GASM}$) is calculated in the N calculation model for the whole manure management chain and is used for calculating indirect N_2O emissions from atmospheric deposition.*
Germany	*$Frac_{GASM}$ is calculated considering also the input of nitrogen with straw. Therefore, it is not possible to deduce $Frac_{GASM}$ on the basis of the data available in the CRF.*
Ireland	*The volatilization rates for Ireland are determined from an elaborate NH_3 inventory for agriculture (Duffy et al. 2012). It is assumed that nitrogen lost as NO_X is negligible in comparison to NH_3. In addition, $Frac_{GASM}$ is split into $Frac_{GASM}1$ and $Frac_{GASM}^2$ with $Frac_{GASM}1$ referring to NH_3-N losses from animal manures in housing, storage and land spreading and $Frac_{GASM}^2$ being the proportion of nitrogen excreted at pasture that is volatilised as NH_3. These modifications have been made to achieve more accurate accounting of nitrogen and to maintain consistency with Ireland's inventory of NH_3. There is no contribution to N_2Oindirect-dep from FS, the nitrogen input from sludge spreading, but FS increases N_2Oindirect-leach through its inclusion in FAM.*
Italy	*$Frac_{GASM}$ country-specific, FAM ($t\ yr^{-1}$) value is estimated by summing the FAM for each livestock category*
Netherlands	*Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions (estimated at a tier 3 level; LEI-MAM).*

Member State	$Frac_{GASM}$
Portugal	*$Frac_{GASM}$ equals the sum of $EFNH_3(i,s)$ and $EFNH_3SD$. The use of emission factors of ammonia volatilisation from EMEP/UNECE results, therefore, in obtaining a value for $Frac_{GASM}$ that is different and slightly higher than the default value for $Frac_{GASM}$. The resultant implied $Frac_{GASM}$ oscillates between 0.22 to 0.23 kg N-NH_3 + N-NO_X/ kg of N excreted.*
Spain	*$Frac_{GASM}$ from national inventories, calculated according to the EMEP/CORINAIR methodology.*
Sweden	*The estimates of the fraction of nitrogen supply in emitted as ammonium-N are model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage. $Frac_{GASM}$ varies from year to year.*

Table 6.78: Available background information on the fraction of nitrogen input leached or run-off, $Frac_{LEACH}$ for the calculation of N_2O emissions in category 4.D

Member State	FracLEACH and EF5
Austria	*Default value applied to nitrogen inputs from synthetic fertiliser use, livestock excretion, and sewage sludge application.*
Belgium	*FracLEACH is estimated from local studies (Pauwelyn, 1997) and falls into the IPCC range (0.17 kg N / kg N available). In Flanders, the nitrogen leaching (N_2O model) comes from the SENTWA model (System for the Evaluation of Nutrient Transport to Water) that is yearly updated.*
Denmark	*The calculation of N to the groundwater is based on two different models– SKEP/Daisy and N-LES (Børgesen & Grant, 2003) carried out by DJF and NERI. SKEP/DAISY is a dynamical crop growth model taking into account the growth factors, whereas N-LES is an empirical leaching model based on more than 1500 leaching studies performed in Denmark during the last 15 years. The models produce rather similar results for nitrogen leaching on a national basis (Waagepetersen et al., 2008). Data concerning the N-leaching to rivers and estuaries is based on data from NOVANA (National Monitoring program of the Water Environment and Nature) received from NERI the department of Freshwater Ecology. NOVANA is a monitoring program which includes monitoring of the ecologic, physic and chemical condition of water areas and transport of water and a range of substances, including N, to lakes and the sea (Wiberg-Larsen et al., 2010). These studies include measurements from 223 monitoring stations in all parts of Denmark and have been going on from the early 1990'ies.*
Finland	*It is estimated that nitrogen leaching is less than IPCC default value in Finnish conditions (Rekolainen, 1993) value is 15% and this has been used in the inventory).*
Germany	*For the calculation of indirect emissions from leaching, the following sources of N are considered: (i) fertiliser application, net of losses as NH_3, NO, and N2; (ii) sewage sludge application, net of emissions of N_2O only; (iii) N-fixation, net of losses of N_2O, NH_3 and N2; crop residues, net of emissions of N_2O and N2. Estimation of N2 losses according to Roesemann et al. (2013). FracLEACH default.*
Ireland	*Estimates of the nitrogen loads in Irish rivers reported under the OSPAR Convention (NEUT, 1999) suggest that approximately 10 percent of all applied nitrogen in Irish agriculture is lost through leaching. More recent research (Ryan et al., 2006; Del Prado et al., 2006 and Richards et al., 2009) also suggest an average value of 10%. The value of 0.1 is considered to be a more realistic estimate of FracLEACH than the default value of 0.3.*
Netherlands	*Tier 3 approach (Velthof and Mosquera, 2011) has been adopted, while keeping the IPCC default EF of 0.025 in place. Specific characteristics of the Netherlands' agricultural soils, with relatively high water tables. A model (STONE) was adopted to assess this fraction as described in Velthof and Mosquera (2011).*
Portugal	*Default FracLEACH for nitrogen applied to soil. For 20% of manure managed in anaerobic lagoons, which are directly discharged to the wastewater system, with agreement of the ERT, the N_2O emissions are calculated directly from the total amount of manure discharged, without considering volatilization losses are a leaching fraction, and using the default IPCC emission factor.*
Sweden	*The national estimates of nitrogen leaching are calculated from the SOILNDB model , which is a part of the SOIL/SOILN model (Johnsson, 1990; Swedish EPA, 2002). The simulation model SOIL/SOILN was developed during the 1980s in order to describe nitrogen processes in agricultural soils. Since then the model has been developed and tested on data from controlled leaching experiments, and these tests show that the model estimates leaching from soils with good precision (Swedish EPA, 2002b). By using national data on crops, yields, soil, use of fertiliser/manure and spreading time, the leaching is estimated for 22 regions. These regions are based on similarities in agricultural production. For calculating nitrogen leaching in the inventory, the average N leaching per hectare, calculated by the SOILNDB model, is multiplied by the total Swedish area of agricultural soil. To estimate the implied FracLEACH, the leached nitrogen, according to the national model, is divided by the sum of nitrogen in fertilisers and animal production. This quotient varies between 0.2 and 0.25.*
United Kingdom	*Indirect emissions of N_2O from leaching and runoff are estimated according the IPCC methodology but with corrections for N_2O emissions to avoid double counting N. The sources of nitrogen considered, are synthetic fertiliser application and animal manures applied as fertiliser.*

N_2O emissions from other sources.

All EU-15 countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in most cases the IPCC default factor for direct N_2O emissions, only France and the Netherland used a different value. An overview of the emissions from sewage sludge and the specified other 'other' sources in category 4D is given in Table 6.79. These emissions are reported either under 4.D.1.6 or under 4.D.4. Furthermore, other N_2O emissions are reported but the Netherlands, Portugal and the United Kingdom. Note that for better overview, the activity data on sewage sludge application are also included in Table 6.66.

Table 6.79: Member State's emissions from "other" sources in category 4D. Data for the year 2012.

Member States		Value	IEF	EM	Value	IEF	EM
	Description		kg N2O-N /	N2O		kg N2O-N /	N2O
2012		kg N/yr	kg N	(Gg)	kg N/yr	kg N	(Gg)
			1990			2011	
Austria	Sewage Sludge Spreading	1,034,480	0.0125	0.020	1,326,702	0.0125	0.026
Belgium	Sludge Spreading	NO	NO	NO	555,136	0.0125	0.011
Denmark	Industrial waste used as fertilizer	1,528,720	0.0125	0.030	3,942,000	0.0125	0.077
Denmark	Use of sewage sludge as fertilizers	3,056,918	0.0125	0.060	2,423,688	0.0125	0.048
Finland	Municipal sewage sludge applied to soils	1,644,748	0.0125	0.032	110,865	0.0125	0.002
France	4.D.1.6.1 Sewage Sludge Spreading	15,411,141	0.0111	0.269	16,907,616	0.0111	0.295
Germany	Sewage sludge on agricultural fields	27,415,232	0.0125	0.539	26,734,825	0.0125	0.525
Greece	Other non-specified	NO	NO	NO	224,640	0.0125	0.004
Ireland	Sewage Sludge	102,732	0.0125	0.002	1,940,680	0.0125	0.038
Italy	Sewage sludge applied to soils	4,057,125	0.0125	0.080	10,290,850	0.0125	0.202
Luxembourg	Sewage Sludge Spreading	377,061	0.0125	0.007	247,642	0.0125	0.005
Netherlands	Sludge application on land	5,000,000	0.0100	0.079	800,000	0.0100	0.013
Portugal	Sewage sludge spreading on agric. land	255,552	0.0125	0.005	865,629	0.0125	0.017
Spain	Domestic Wastewater Sludge	8,296,042	0.0125	0.163	35,733,383	0.0125	0.702
Sweden	Use of sewage sludge as fertilizers	826,000	0.0125	0.016	1,608,905	0.0125	0.032
United Kingdom	Municipal sewage sludge applied to fields	14,371,200	0.0125	0.282	37,098,272	0.0125	0.729
EU15	**Total sewage sluge application**	**83,376,949**	**0.0121**	**1.584**	**140,810,832**	**0.0123**	**2.726**
France	4.D.1.6.2 Compost Spreading	21,033	0.0125	0.000	182,527	0.0125	0.004
Spain	Municipal Solid Wastes Compost	8,480,979	0.0125	0.167	12,932,395	0.0125	0.254
EU15	**Total compost application**	**8,502,011**	**0.0125**	**0.167**	**13,114,922**	**0.0125**	**0.258**
Sweden	Cultivation of mineral soils	2,947,000	0.4999	2.315	2,808,000	0.4999	2.206
United Kingdom	Improved Grassland	29,005,584	0.0125	0.570	29,178,684	0.0125	0.573

Additional information on N_2O emissions estimated from the application of sewage sludge it given in Table 6.80.

Table 6.80: Available background information on N_2O emissions estimated under the category 'other' in category 4.D

Member State	
Austria	*Country-specific data on N-content (Scharf et al., 1997).*
Belgium	*In Wallonia, the data on sludge spreading on agricultural soils are available on the website of DGARNE (http://www.environnement.wallonie.be/). It is considered a fixed contribution of 0,1kg N/ha/yr and an emission factor equal to 0,0125 kg N_2O-N/kg N from sludge is used. In Flanders, the use of sewage sludge on agricultural soils is forbidden. This is described in the manure decree. In Brussels sludge spreading does not take place.*
Denmark	*The category, "Other", includes emission from sewage sludge and sludge from the industrial production applied to agricultural soils as fertiliser. Information about industrial waste, sewage sludge applied on agricultural soil and the content of nitrogen is provided by the Danish Environmental Protection Agency.*
Finland	
France	
Germany	*Data on sewage sludge application is from Umweltbundesamt and since 2009 from the Statistical Office.*
Greece	*N_2O direct emissions from the sewage sludge used in agriculture, the default emission factor of 1.25% N_2O-N per kg N was applied while the annual amount of sewage sludge used in agriculture in Greece was provided by the Waste Management Sector of the Ministry of Environment, Energy and Climate Change (MEECC). Since 2004 and it remains limited, mainly in the frame of research projects and pilot studies. The N content of sewage sludge (dry matter) used in agriculture is assumed to be 3.0%. This value was obtained from the report 'Disposal and recycling routes for sewage sludge Part 3 – Scientific and technical report', Table 3, Page 24, European Commission, 2001.*

Member State	
Ireland	*Published estimates of sludge production (Monaghan eta l. 2009) and the proportion applied on agricultural lands are used to estimate FS on the basis of 3 percent nitrogen content in sewage sludge with typical dry solids content of 25 percent (Fehily Timoney, 1985). The estimate of FS is included in N_2Odirect without deduction for volatilisation and the value is added to FAM for reporting purposes.*
Italy	*Published estimates of sludge production (Monaghan eta l. 2009) and the proportion applied on agricultural lands are used to estimate FS on the basis of 3 percent nitrogen content in sewage sludge with typical dry solids content of 25 percent (Fehily Timoney, 1985). The estimate of FS is included in N_2Odirect without deduction for volatilisation and the value is added to FAM for reporting purposes.*
Luxembourg	
Netherlands	
Portugal	
Spain	*28% increase of emissions from sewage, compared to 1990, due to the increase in the sewage activity and to the spread of wastewater treatment. Data on the application of sewage sludge are available for the years 1989, 1993 and 1997. For the other years these data are linearly interpolated.*
Sweden	*N_2O from sewage sludge used as fertiliser is a part of the N_2O emissions from agricultural soils and may be reported, according to the IPCC Good Practice Guidance, if sufficient information is available. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in submission 2006 of the GHG inventory.*
United Kingdom	*Data sources for the annual production of sewage sludge (as dry matter) were obtained from OFWAT, the Water Commissioner for Scotland and the Northern Ireland regulator, UREGNI. The amounts for the missing years were derived by interpolation/extrapolation of the available data.*

Trends

Trends in N_2O emissions from agricultural soils are consistent with the decrease of animal numbers in Europe and with the decrease of nitrogen in manure (see above). The input of nitrogen to agricultural soils also decreased considerably between 1990 and 2012, as shown in Table 6.63. The input of manure decreased by 10%, and the input of mineral fertiliser decreased even more, by 28%. Accordingly, also the amount of nitrogen volatilized or leached decreased by 15% and , respectively.

Figure 6.38 through Figure 6.51 show the trend of direct N_2O emissions from the source categories mineral and organic fertiliser application and indirect emissions from atmospheric deposition and nitrogen leaching and run-off.

In several countries the fraction of mineral fertiliser that volatilises as NH_3 or NO_X is showing considerable fluctuation (see for example Sweden and Ireland). This is a direct consequence of the varying composition of the types of mineral fertiliser used and the NH_3 emission factors taken from the more detailed ammonia-inventory.

The fraction of livestock N excretion that volatilises as NH_3 or NO_X is reported to be more stable. A decreasing trend can be observed for Denmark and Belgium.

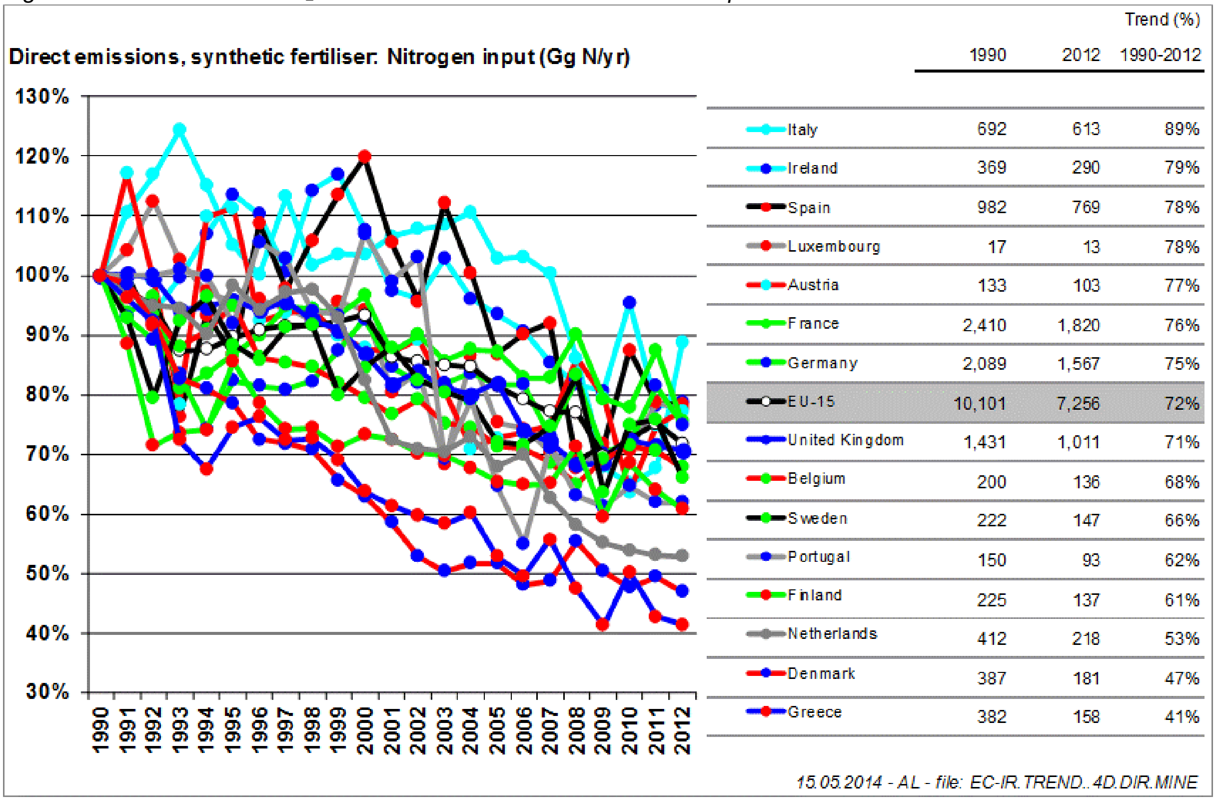
General observations include:

- Denmark: Reduction of total N_2O emissions since 1990 is due to a proactive national environmental policy over the last twenty years to prevent loss of nitrogen from agricultural soil to the aquatic environment. These measures includes among other things a ban on manure application during autumn and winter, increasing area with winter-green fields to catch nitrogen, a maximum number of animals per hectare (ha) and maximum nitrogen application rates for agricultural crops. Due to the combination of these increasing environmental requirements and the efforts to obtain economic advantage, the farmers have been forced to improve the utilisation of nitrogen in manure. The improvement of feed efficiency has been one of the most important drivers to reach those objectives. This has led to a halving of nitrogen use in synthetic fertiliser and to a decrease of emission per produced kg of meat, all of which has reduced the overall GHG emission. The national emission from crop residues has decreased as result of a decrease in the cultivated area of beetroot for feeding, which has been replaced by the cultivation of forage maize.
- Finland: N_2O emissions from agricultural soils have decreased since 1990, mainly due to the decrease in animal numbers. Annual changes in some parameters, like crop annual yield and crop residues, cause the fluctuation in the time series, but the share of these emissions is minor

compared to total emissions and it does not affect much the overall trend. Since Finland joined the EU, there has been a reduction in the use of nitrogen fertilisers and an improvement in manure management resulting from agri-environmental programmes. However, the number of cultivated organic soils has increased, leading to an increase in N_2O emissions.

Additional information on the trend in category 4D as reported in the national inventory reports are given below the respective figures.

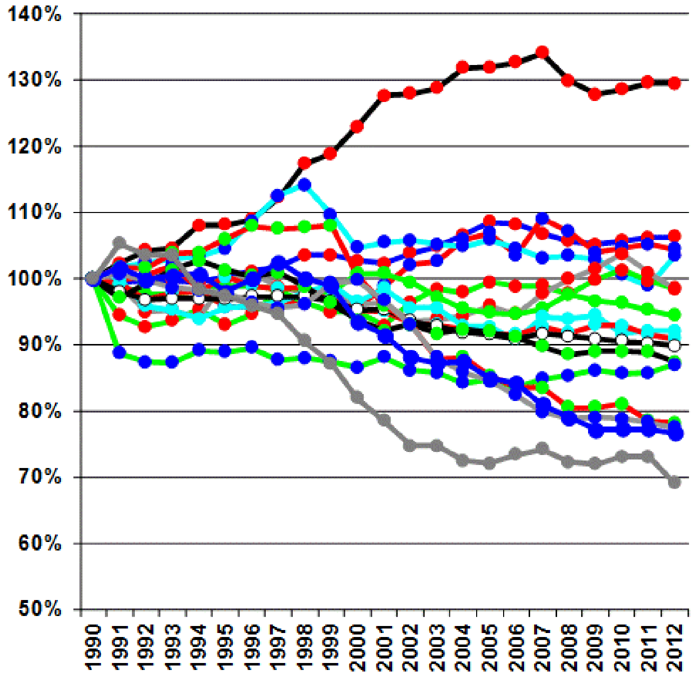
Figure 6.38: Trend of N_2O emissions for mineral fertiliser – N-input



- Austria: High inter-annual variations in N_2O emissions are caused by fluctuations in mineral fertiliser sales. These variations are caused by the effect of storage. As fertilisers have a high elasticity to prices, sales data are changing due to changing market prices very rapidly. Not the whole amount purchased is applied in the year of purchase. The fertiliser tax intensified this effect at the beginning of the 1990s. In the in-country review 2007 it was recommended to consider revising the time series by determining actual fertiliser use in accordance with the IPCC good practice guidance. Investigations showed that data on the actual fertiliser use are not available in Austria. Therefore it has been decided to continue to use the official fertiliser sales data as input data for the emission inventory.
- Greece: The steep decrease observed for the years 1993 and 1994 is due to the cut backs in public incentives for the use of synthetic fertilisers. The decrease in the use of synthetic nitrogen fertilisers could probably be attributed to an increase in organic farming, the price of fertiliser and the impact of initiatives to promote good practice in fertiliser use.
- Portugal: Time series shows an abrupt decrease until 1992 and thereafter a lighter reduction: total synthetic nitrogen fertiliser use in 2003 is 22% less than in 1990. Nitrogen in fertilisers is the first source of nitrogen to soils in Portugal just above nitrogen in animal manure applied to soil. Interannual changes of emissions (2002/2003 16%, 2003/2004 6%, 2004/2005 8%, 2005/2006 11%, fluctuation from 2003) can be explained from variations of emissions from N applied as synthetic fertilisers. During this period a severe drought occurred which caused reduction in the sales and use of fertilisers.

Figure 6.39: Trend of N_2O emissions for organic fertiliser – N-input

Direct emissions, manure application: Nitrogen input (Gg N/yr)



	1990	2012	Trend (%) 1990-2012
Spain	230	298	129%
Greece	57	61	106%
Denmark	183	191	104%
Ireland	107	111	103%
Finland	60	59	99%
Luxembourg	6	6	98%
France	788	745	94%
Italy	475	437	92%
Austria	120	110	91%
EU-15	4,034	3,627	90%
Sweden	70	61	87%
Germany	886	771	87%
Belgium	160	125	78%
Portugal	56	43	77%
United Kingdom	426	326	77%
Netherlands	410	284	69%

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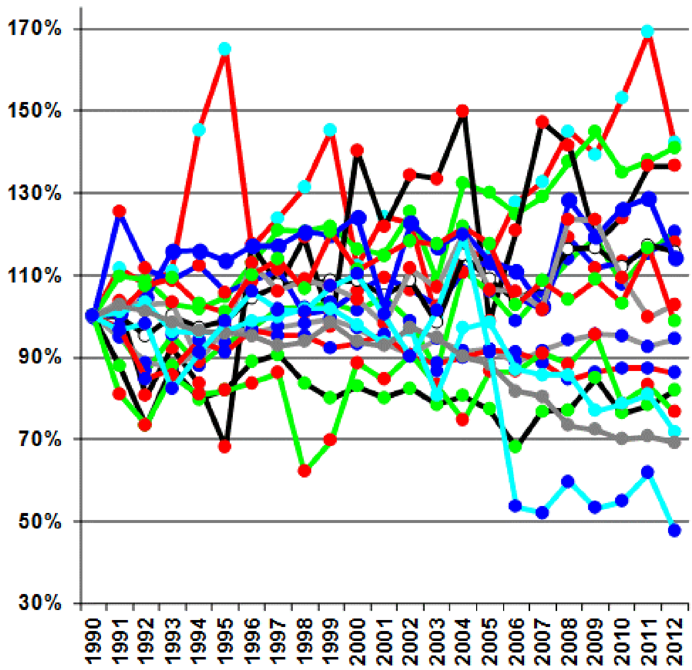
Figure 6.40: Trend of N_2O emissions from crop residues – N-input

Crop residues: Nitrogen input (Gg N/yr)



	1990	2012	Trend (%) 1990-2012
Austria	42	60	142%
France	366	516	141%
Spain	93	128	137%
Germany	840	1,013	121%
Greece	24	28	118%
EU-15	2,166	2,505	116%
United Kingdom	360	410	114%
Luxembourg	3	3	103%
Belgium	56	55	99%
Portugal	28	26	94%
Denmark	59	51	86%
Sweden	61	50	82%
Finland	31	24	77%
Italy	148	106	72%
Netherlands	36	25	69%
Ireland	20	9	48%

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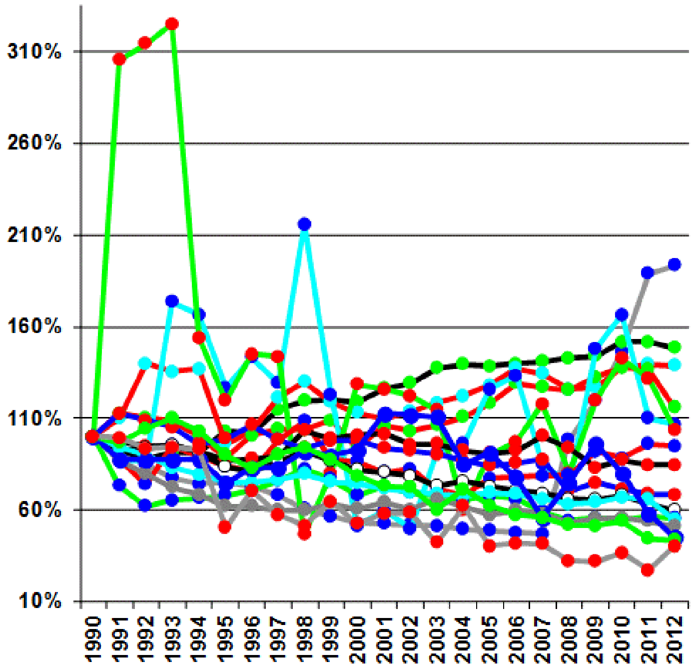
Figure 6.41: Trend of N_2O emissions from N-fixing crops – N-input

N-fixing crops: Nitrogen input (Gg N/yr)



	1990	2012	Trend (%) 1990-2012
Portugal	5	10	193%
Sweden	24	35	149%
Austria	17	23	139%
Belgium	3	4	116%
Ireland	1	1	107%
Finland	1	1	104%
Denmark	44	42	95%
Spain	203	172	85%
Greece	1	1	68%
EU-15	1,261	753	60%
Germany	140	78	55%
Italy	255	140	55%
Netherlands	8	4	51%
United Kingdom	43	19	45%
France	516	224	44%
Luxembourg	0	0	40%

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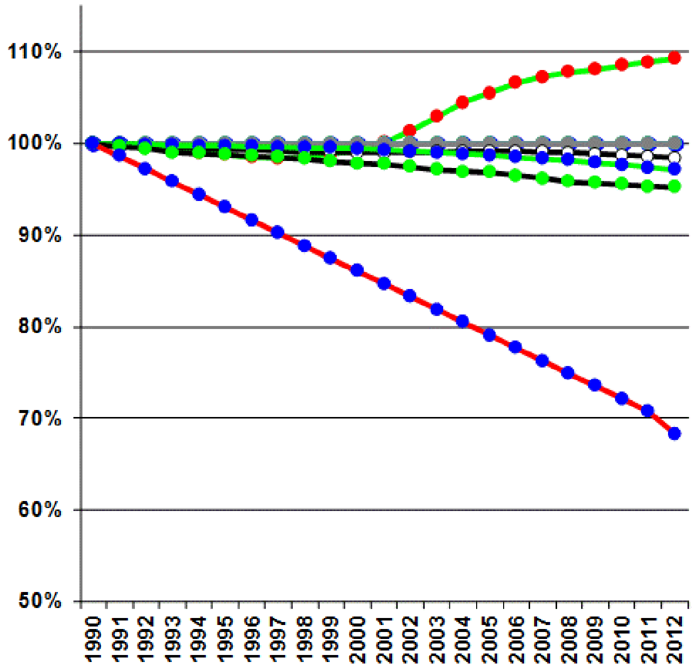
- Finland: Some parameters, such as the annual crop yields affecting the amount of crop residues produced, cause the fluctuation in the time series but this fluctuation does not have much effect on the overall N_2O emissions trend.

Figure 6.42: *Trend of N_2O emissions from cultivated histosols – Cultivated area*

Cultivation of histosols: Cultivated area (km2/yr)

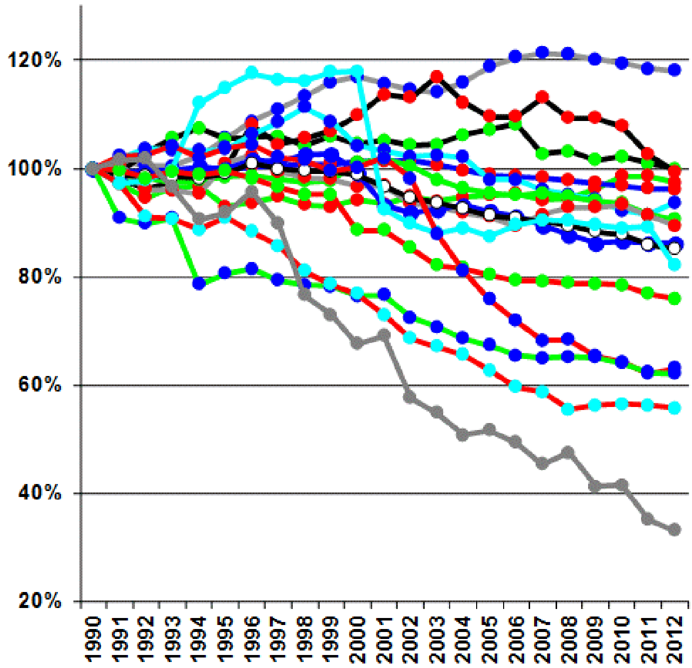


	1990	2012	Trend (%) 1990-2012
Finland	3,099	3,385	109%
France	2,013	2,013	100%
Greece	67	67	100%
United Kingdom	1,500	1,500	100%
Belgium	25	25	100%
Italy	247	247	100%
Netherlands	2,230	2,230	100%
EU-15	23,987	23,610	98%
Germany	12,545	12,190	97%
Sweden	1,516	1,444	95%
Denmark	745	509	68%
Austria			
Spain			
Luxembourg			
Portugal			
Ireland			

15.05.2014 - AL - file: EC-IR.TREND..4D.DIR.HIST

Figure 6.43: *Trend of N_2O emissions from pasture, range, and paddock – N-input*

Nitrogen deposited during grazing: Nitrogen input (Gg N/yr)



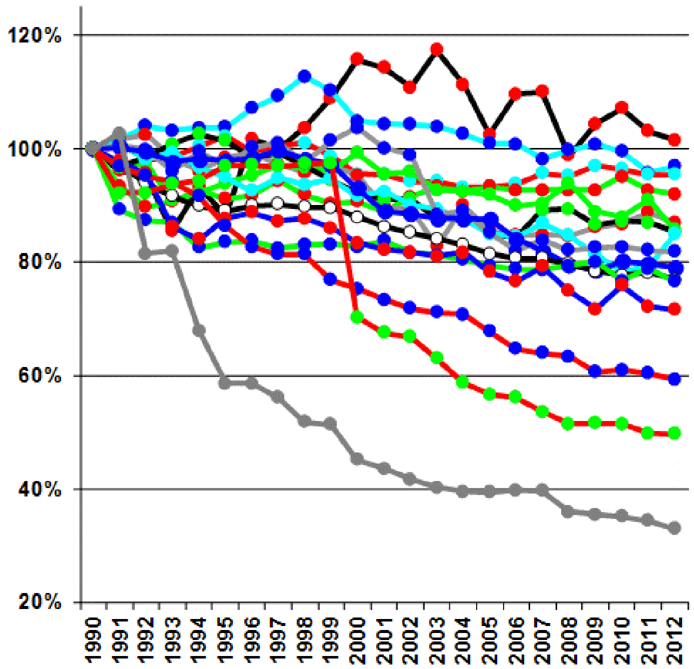
	1990	2012	Trend (%) 1990-2012
Portugal	71	83	118%
Sweden	45	45	100%
Spain	300	298	99%
Finland	20	19	97%
Greece	158	152	96%
Ireland	294	276	94%
France	927	839	91%
Luxembourg	6	5	90%
United Kingdom	693	597	86%
EU-15	3,258	2,769	85%
Italy	178	146	82%
Belgium	102	77	76%
Denmark	34	22	63%
Germany	217	135	62%
Austria	17	10	56%
Netherlands	196	65	33%

15.05.2014 - AL - file: EC-IR.TREND..4D.DIR.GRAZ

- Netherlands: The decrease of N_2O emissions from meadow is caused by a relatively high decrease in N-input to soil (from manure and chemical fertiliser application and animal production in the meadow) partly counteracted by the increased IEF in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil as a result of ammonia policy driving a shift from surface spreading of manure to the incorporation of manure into the soil. The decrease in indirect N_2O emissions is fully explained by the decrease in N lost by atmospheric deposition and by leaching and run-off. Tendency is to keep grazing animals indoors more, thus decreasing the amount of manure excreted in the meadow. Emissions therefore shift towards category 4B Manure management, but increase there only partially offsets the decrease here, as associated EFs are lower (for CH_4 the opposite is true).

Figure 6.44: Trend of N_2O emissions for atmospheric deposition – N-input

Nitrogen volatilised as NH3+NOx: Nitrogen input (Gg N/yr)

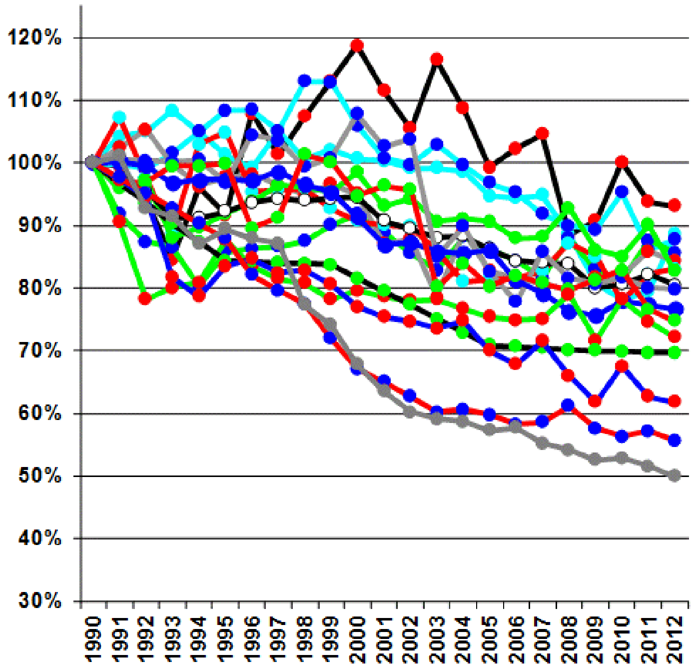


	1990	2012	Trend (%) 1990-2012
Spain	192	195	102%
Ireland	88	85	97%
Austria	52	49	95%
Finland	31	28	92%
Luxembourg	5	4	87%
France	654	560	86%
Sweden	42	36	85%
Italy	381	324	85%
Portugal	44	36	82%
United Kingdom	408	323	79%
EU-15	3,076	2,367	77%
Germany	593	454	77%
Greece	88	63	72%
Denmark	102	60	59%
Belgium	100	50	50%
Netherlands	297	98	33%

15.05.2014 - AL - file: EC-IR.TREND..4D.IND.ATM

Figure 6.45: Trend of N_2O emissions for nitrogen leaching and run-off – N-input

Nitrogen leached/run-off: Nitrogen input (Gg N/yr)

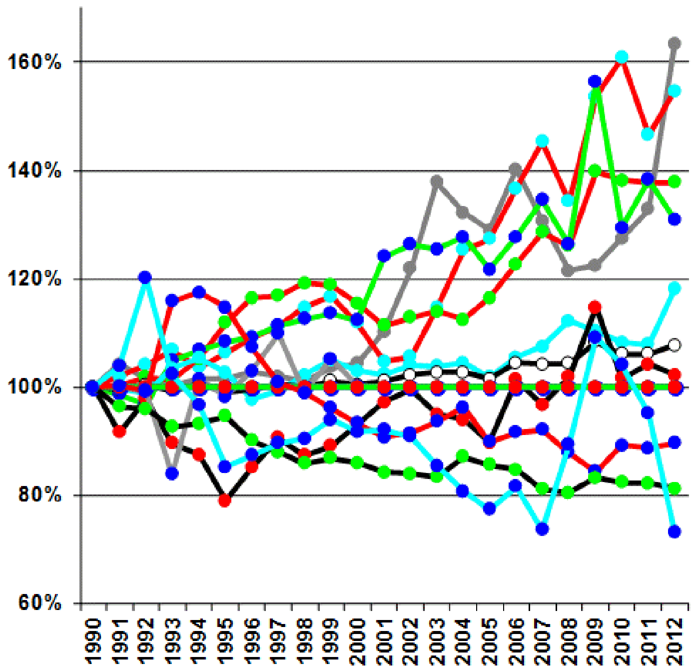


	1990	2012	Trend (%) 1990-2012
Spain	502	468	93%
Italy	516	457	89%
Ireland	78	69	88%
Germany	1,112	952	86%
Luxembourg	10	8	84%
Austria	90	75	83%
France	1,383	1,144	83%
EU-15	5,444	4,384	81%
Portugal	93	74	80%
United Kingdom	850	652	77%
Belgium	62	47	75%
Finland	51	37	72%
Sweden	76	53	70%
Greece	196	121	62%
Denmark	267	149	56%
Netherlands	157	78	50%

15.05.2014 - AL - file: EC-IR.TREND..4D.IND.LEA

Figure 6.46: Trend of $Frac_{GASF}$

Indirect emissions: FracGASF (%)

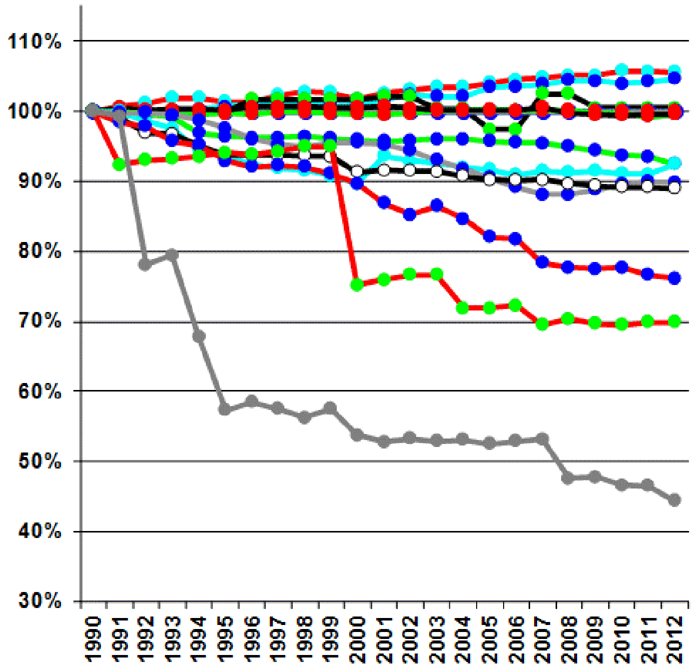


	1990	2012	Trend (%) 1990-2012
Netherlands	0.041	0.067	163%
Austria	0.026	0.040	155%
Belgium	0.028	0.038	138%
Germany	0.034	0.045	131%
Italy	0.087	0.103	118%
EU-15	0.057	0.061	108%
Spain	0.086	0.088	102%
Greece	0.100	0.100	100%
Portugal	0.057	0.057	100%
France	0.100	0.100	100%
United Kingdom	0.100	0.100	100%
Luxembourg	0.100	0.100	100%
Finland	0.015	0.015	100%
Denmark	0.035	0.031	90%
Sweden	0.011	0.009	81%
Ireland	0.028	0.021	73%

15.05.2014 - AL - file: EC-IR.TREND..4D.FracGASF

Figure 6.47: Trend of $Frac_{GASM}$

Indirect emissions: FracGASM (%)



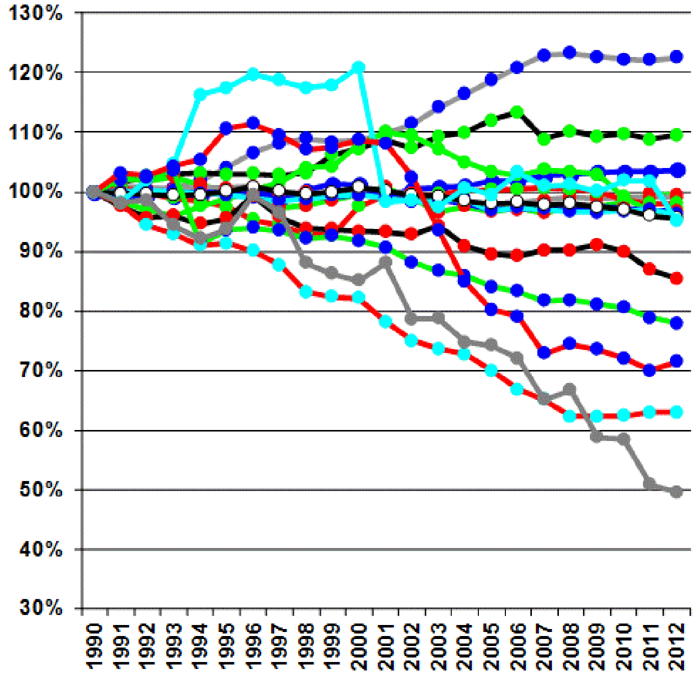
	1990	2012	Trend (%) 1990-2012
Austria	0.26	0.27	106%
Ireland	0.17	0.18	105%
Sweden	0.33	0.33	100%
Greece	0.20	0.20	100%
France	0.20	0.20	100%
United Kingdom	0.20	0.20	100%
Luxembourg	0.20	0.20	100%
Finland	0.25	0.25	100%
Spain	0.16	0.16	100%
Germany	0.32	0.29	92%
Italy	0.32	0.30	92%
Portugal	0.22	0.19	90%
EU-15	0.25	0.22	89%
Denmark	0.25	0.19	76%
Belgium	0.30	0.21	70%
Netherlands	0.39	0.17	44%

15.05.2014 - AL - file: EC-IR TREND..4D.FracGASM

- Belgium: The fraction volatilised as NH_3 and NO in Flanders ($Frac_{GASM}$) decreased considerably since 1990. The reason for this strong reduction of $Frac_{GASM}$ is due to a strong reduction of the NH_3 emission which is calculated in the NH_3-inventory in Flanders. The reason for this strong reduction of NH_3 emission can be found in the implementation of the different successive Manure Action Plans (MAP) in Flanders.
- Sweden: The fraction of nitrogen supply emitted as ammonium-N is model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage.

Figure 6.48: *Trend of $Frac_{GRAZ}$*

Pasture, range and paddock: FracGRAZ (%)

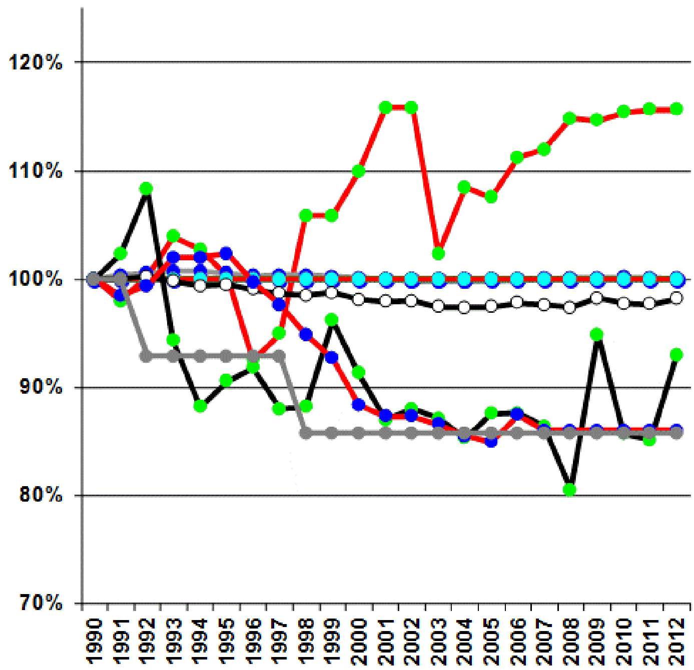


	1990	2012	Trend (%) 1990-2012
Portugal	0.44	0.54	122%
Sweden	0.30	0.33	109%
United Kingdom	0.57	0.59	104%
Finland	0.18	0.18	100%
Luxembourg	0.45	0.45	99%
Belgium	0.31	0.30	98%
France	0.45	0.44	97%
Greece	0.69	0.67	97%
Ireland	0.64	0.61	96%
EU-15	0.35	0.34	96%
Italy	0.19	0.18	95%
Spain	0.46	0.39	85%
Germany	0.14	0.11	78%
Denmark	0.12	0.08	71%
Austria	0.09	0.06	63%
Netherlands	0.28	0.14	50%

15.05.2014 - AL - file: EC-IR.TREND..4D.FracGRAZ

Figure 6.49: *Trend of $Frac_{LEACH}$*

Indirect emissions: FracLEACH (%)



	1990	2012	Trend (%) 1990-2012
Belgium	0.12	0.13	116%
Portugal	0.32	0.32	100%
United Kingdom	0.30	0.30	100%
Finland	0.15	0.15	100%
Luxembourg	0.30	0.30	100%
France	0.30	0.30	100%
Greece	0.30	0.30	100%
Ireland	0.10	0.10	100%
Italy	0.30	0.30	100%
Spain	0.30	0.30	100%
Germany	0.30	0.30	100%
Austria	0.30	0.30	100%
EU-15	0.26	0.25	98%
Sweden	0.23	0.21	93%
Denmark	0.38	0.33	86%
Netherlands	0.14	0.12	86%

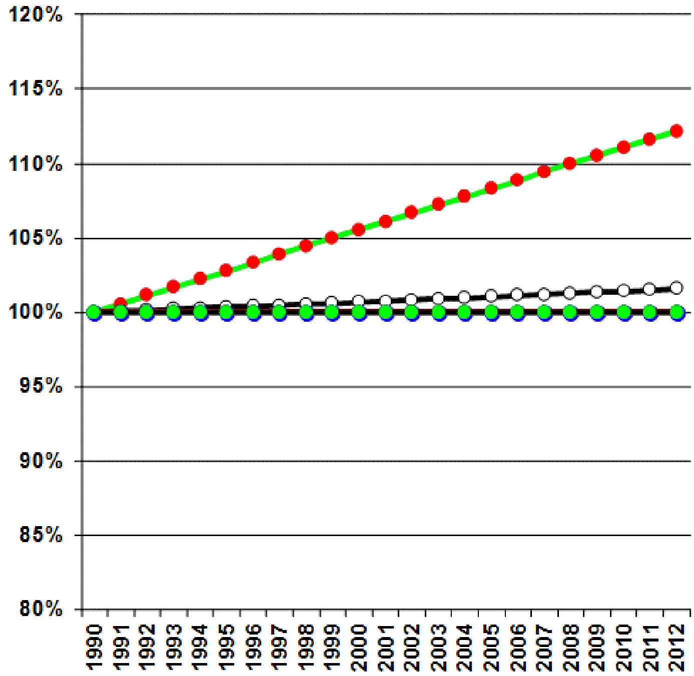
15.05.2014 - AL - file: EC-IR.TREND..4D.FracLEACH

- Denmark: FracLEACH is decreasing since the 1990s, when manure was often applied in autumn. The decrease in FracLEACH over time is caused by sharpened environmental requirements, including banning manure application after harvest. The major part of manure application is made in spring and summer, where there is a precipitation deficit. This is due to a decrease in the emission from leaching and run off, which is decreased because of a decrease in N-input mainly from synthetic fertiliser. The annual fluctuating is due to climatic changes and especially the precipitation conditions.

- Sweden: The fraction of nitrogen supply emitted as ammonium-N is model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage.

Figure 6.50: Trend of direct emissions from the cultivation of histosols - IEF

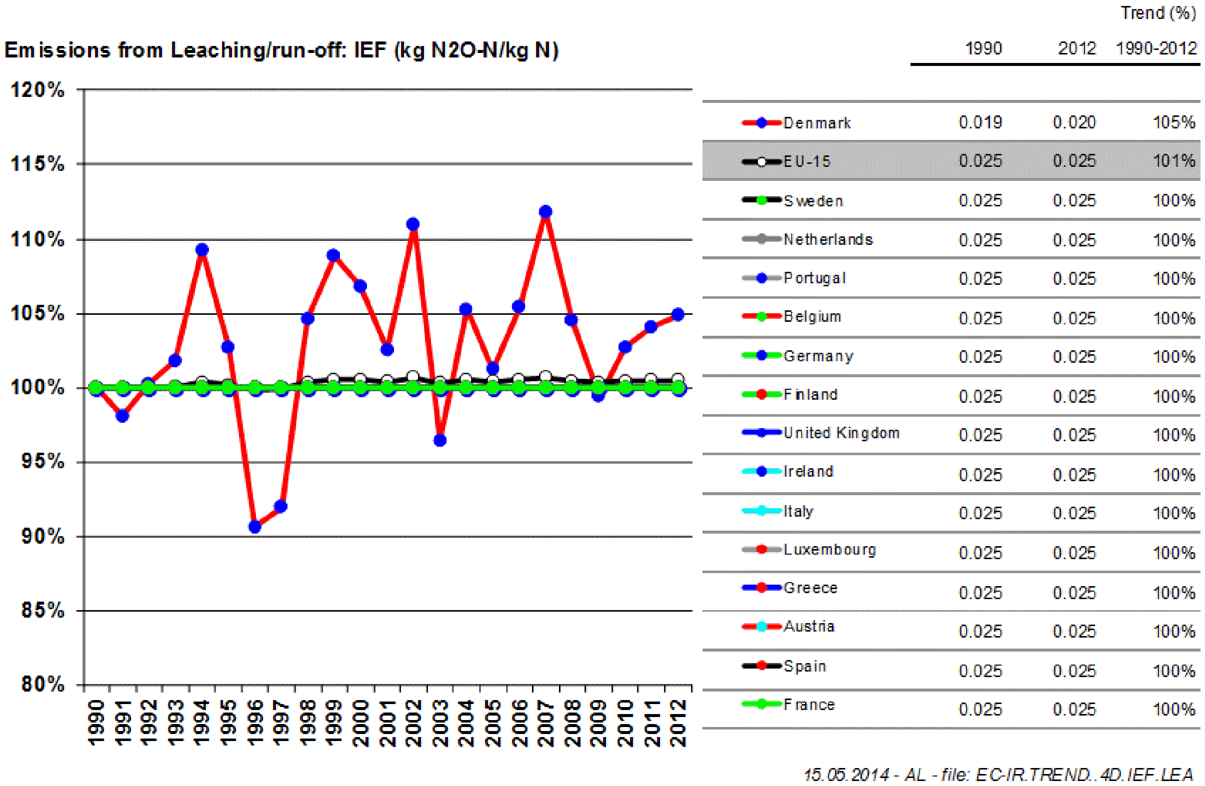
Cultivation of histosols: IEF (kg N2O-N/ha)



	1990	2012	Trend (%) 1990-2012
Finland	7.5	8.4	112%
EU-15	7.6	7.8	102%
Germany	8.0	8.0	100%
United Kingdom	8.0	8.0	100%
Italy	8.0	8.0	100%
Greece	8.0	8.0	100%
Belgium	8.0	8.0	100%
France	8.1	8.1	100%
Netherlands	4.7	4.7	100%
Denmark	8.0	8.0	100%
Sweden	8.0	8.0	100%
Portugal			
Ireland			
Luxembourg			
Spain			
Austria			

15.05.2014 - AL - file: EC-IR.TREND..4D.IEF.HIST

Figure 6.51: Trend of indirect emissions from leaching/run-off - IEF



6.3.5.3 Uncertainty and time series consistency

As described above, N_2O emissions from agricultural soils are among the most uncertain source categories of national GHG inventories. For direct N_2O emissions, the highest uncertainty is attributed to the emission factor, which ranges up to 400% relative uncertainty in Greece and Spain (expressed in 2•standard_deviation). For indirect emissions, both the activity data and the emission factors are considered equally uncertain, which stems from the fact that a most uncertain parameter, the fraction of nitrogen leached, must be applied to determine the activity data. Thus, uncertainties of indirect N_2O emissions are estimated as up to more than 200%.

This large difference of the uncertainty estimates does not reflect real differences in the uncertainties of the emission estimates. Rather, the differences are caused by different interpretation of the available data:

- In the United Kingdom, the uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA.
- The estimate of Portugal is based on the Good Practice Guidance that presents a possible variation from one-fifth to 5 times the default emission factor of 1.25 per cent. From that range an uncertainty of 500 per cent was assumed in uncertainty analysis.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.81 and Table 6.82. An overview of uncertainty estimates for agriculture at country and EU-15 levels will be given in section 6.4

Table 6.83 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from agricultural soils.

Table 6.81: Relative uncertainty estimates for activity data in category 4D

Member State	**Total**	**Direct**	**Animal Production**	**Indirect**
Austria	5			
Belgium		30	30	30
Denmark			25	
Finland		117	200	302
France		15	20	120
Germany		16	20	143
Greece		20	50	20
Ireland		11	11	11
Italy		20	20	20
Luxembourg		10	10	20
Netherlands		10	10	50
Portugal	20			
Spain		18	16	190
Sw eden		15	35	29
United Kingdom	1			

Table 6.82: Relative uncertainty estimates for implied emission factors in category 4D

Member State	**Total**	**Direct**	**Animal Production**	**Indirect**
Austria	150			
Belgium		250	250	250
Denmark			100	
Finland				
France		140	200	430
Germany		53	200	319
Greece		400	100	50
Ireland		100	100	50
Italy		100	100	100
Luxembourg		150	150	150
Netherlands		60	100	200
Portugal	177			
Spain		400	100	50
Sw eden		65	150	122
United Kingdom	259			

Table 6.83: Available background information for uncertainty estimates in category 4.D

Member State	*Background information to uncertainty estimates*
Austria	*Mineral Soils – EF: Revision of the uncertainty estimate of N_2O from soils. A detailed investigation revealed that the source of the 48% uncertainty presented was a statement in an IPCC report (2000) referring to a measurement uncertainty. Here we have to deal with an emission factor uncertainty, which is estimated much higher, at an order of magnitude (IPCC, 2006). This higher number is still much smaller than the two orders of magnitude recommended by IPCC (2000). The latter was considered in part systematic uncertainty, however (the random uncertainty was considered smaller than the range now used) - this is still in part true, but only reflects our lack of knowledge on soil processes. Choosing to apply a quasi-standardized value conforms to the claim of (Winiwarter, 2007) that application of similar parameters between countries allows for a smaller error in an inter-comparison, even if the difference to a "true value" might be larger. In the latest Austrian study (WINIWARTER 2008) for the emission factor of N_2O from soils an uncertainty of 150% was applied. Uncertainty contributions of the activity (combined from agricultural area and average N-fertiliser input) at about 5% is almost negligible in this context. It is virtually N_2O alone that determines the uncertainty. Uncertainties of emission factors of indirect emissions are not significantly different from those of direct emissions, and the underlying processes (microbial nitrification/denitrification) are identical. Thus it was decided to treat the uncertainties of direct and indirect emissions as being correlated.*
Belgium	*Mineral soils - AD: N_2O emissions from soils involves the use of more AD (mineral fertilisers, atm. deposition and runoff, manure application, ...) Consequently the uncertainty on AD is estimated at 30% , which seems in line with the values applied by other parties.* *Mineral soils – EF: The uncertainty of N_2O from agricultural soils is crucial for the determination of the*

Member State	Background information to uncertainty estimates
	*overall uncertainty. Although most countries use the IPCC default values, the uncertainty on emission factors varies widely : 2 orders of magnitude (Norway), 509 % (UK, in IPCC Good Practice Guidance), 200 % (France and the Netherlands, NIR 2003), 100 % (Ireland, NIR 2003), 75 % (Finland, overall uncertainty for AD*EF, [40]), 24 % (Austria, NIR 2003). For the time being, a more or less average value of 250 % is used for this uncertainty calculation.*
Denmark	*Mineral soils – AD: Both farmers and suppliers of mineral fertilisers are obliged to report to the Plant Directorate. The total sold to farmers is very close to the amount imported by the suppliers, corrected by storage. The total amount of mineral fertiliser in Denmark is, therefore, a very precise estimate for the mineral fertiliser consumed. This is also valid for N-excretion in animal manure.*
Finland	*The uncertainty estimate for N_2O emissions from agricultural soils is very high due to both lack of knowledge of emissions generating process and high natural variability and was estimated at -60 to +170% (direct) and -60 to +240% (indirect). For the 2005 inventory submission, uncertainty estimates were revised based on measurements data. The range of annual average emission factors obtained from different soils reveal that uncertainty may be larger than previously estimated.* *Mineral soils - AD: Uncertainties in N_2O emissions from agricultural soils are estimated by applying Tier 2 Monte Carlo simulation to the emission calculation models. The most effective way to reduce uncertainty would be case D, i.e., the use of the climate-specific emission factors for N_2O from agricultural soils (Monni et al., 2007). On the basis of this study, at this stage the national field data does not enable the development of a reliable national emission factor for mineral soils. The national emission factor for N_2O emission from cultivated organic soils would be 7.9 kg ha-1 a-1 with an uncertainty of -114 to +187%, which is very close to the IPCC default value... These results from the field monitoring indicated that even if large national measurement campaigns are introduced, this source will still remain very uncertain. (Monni et al., 2007)* *Mineral soils – EF: Uncertainty in direct N_2O emission factor for agricultural soils was updated from the las inventory submission. Based on IPCC 2006, the new uncertainty range is -76…+140%; for manure in pasture, -65…+200% (IPCC 2006); for histosols -100…+210% (Moni et al. 2009); for indirect N_2O emission factor for atmospheric deposition, -90...+400% (IPCC 2006); and for indirect N_2O emission factor for leaching -94...+380% (not changed).* *Organic soils: The accuracy of the emission estimate for organic soils could be further improved by adopting separate emission factors for grass and cereals since emissions from grass fields are consistently lower due to less frequent tillage of the soil and a longer period of nitrogen uptake of the grass compared to cereals (Monni et al., 2007)*
France	*Tier 2 approach for the estimation of uncertainties for emissions from agricultural soils, based on Monte Carlo simulations (ICPP 2000). These give an average uncertainty value of 180% for N_2O emissions from soils.*
Germany	*The detailed discussion in this source indicates that the error for relevant areas is on the order of 10 % and that the error for emissions is on the order of 50%.*
Greece	*Uncertainty given by NSSG for the crop production and the Pan-Hellenic Association of Professional fertilisers Producers & Dealers for the synthetic fertilisers consumed in the country.*
Ireland	*Large uncertainties still remain in relation to the N_2O emissions from the agricultural sector. These uncertainties are the main determinant behind uncertainty in total national emissions*
Italy	*Monte Carlo analysis was also applied to estimate uncertainty of the two key categories Direct N_2O emissions from agricultural soils and Indirect N_2O emissions from nitrogen used in agriculture. Normal and lognormal distributions have been assumed for the parameters; at the same time, whenever assumptions or constraints on variables were known this information has been appropriately reflected on the range of distribution values.*
Luxembourg	*Arable land crops, used to estimate soil emissions, are on the high end at 10%, just the "fallows" (which is the basis for calculating indirect soil emissions) is considered statistically dependent, but twice as high. Most similar analyses of uncertainties of national GHG inventories have already shown previously that N_2O emissions from soils are poorly understood and are the highest priority for methodological improvement.* *Mineral soils – EF: Manure application emission factor follow a 70% uncertainty for CH_4 and a range from 50% to 200 % (lognormal distribution) for N_2O. The CH_4 emission factor for soil emissions is considered uncertain by +/-100%, the N_2O emission factor is within a factor of 10 (lognormal distribution, from 30% to 300% of the best estimate) following IPCC (2006).*
Netherlands	*The uncertainty in direct N_2O emissions from Agricultural soils is estimated to be approximately 60%. The uncertainty in indirect N_2O emissions from N used in agriculture is estimated to be more than a factor of 2 (Olivier et al.,2009).*
Portugal	*Mineral soils – AD: Comparing the values of nitrogen in synthetic fertilisers form these independent data sources between 1995 and 2000 a maximum uncertainty value of 17 per cent was obtained.*
Sweden	*Nitrogen applied to soils with mineral fertilisers is related to the amount of nitrogen in sold fertilisers (estimated by sales statistics, collected annually) and to nitrogen used in fertilisers (estimated from interviews with farmers, performed every two years). These two series of data should coincide, but sales statistics give higher values, maybe due to storage or maybe due to errors in the estimation methods. Sales statistics are the ones used because they give better estimates for the total use and are updated annually.* *Mineral soils – EF: The disaggregating of direct emissions from manure and mineral fertilisers, respectively, in the Swedish inventory may reduce some of the variability but direct emissions from*

Member State	*Background information to uncertainty estimates*
	agricultural soils are still one of the most uncertain in the inventory.
United Kingdom	*Emissions from agricultural soils were correlated. The uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (pers. comm.).* *Mineral soils – EF: The overall uncertainty quoted is calculated using the first method in order that uncertainties should not be underestimated in sectors showing a skewed distribution such as agricultural soils and N_2O as a whole.*

6.3.6 Agricultural Soils – CH_4

CH_4 fluxes from agricultural soils are reported only by Austria. In Austria, CH_4 emissions from Agricultural Soils originate from sewage sludge spreading on agricultural soils. They contribute only a negligible part of Austria's total methane emissions. The average carbon content of sewage sludge amounts to 300 kg C/t (Detzel et al., 2003; Schaefer 2002), 52% of the carbon is emitted to the air from which 5% as methane. Emissions of 0.42 Gg CH_4 yr^{-1} are calculated.

In Germany, fluxes of CH_4 from agricultural soils are not considered for the first time in the inventory for the year 2008. CH_4 is taken up in aerobic soils, and N-application reduces this sink for CH_4. In former inventories, the estimation was based on the approach of Boeckx and Van Cleemput (2001), compiling the available observations in Europe, differentiating emissions from grassland ($EFCH_4$ = -2,5 kg ha-1 a-1CH_4) and from cropland ($EFCH_4$ = - 1,5 kg ha-1 a-1 CH_4). In the course of the development of the IPCC(2006) guidelines, however, no consensus could be found how this CH_4 sink in agricultural soil could be considered (A. Freibauer, pers. comm.).

6.3.7 Prescribed Burning of Savannas– CH_4 and N_2O (CRF source category 4.E)

Savannas are not present in the countries that are part of the EU inventory.

6.3.8 Field burning of crop residues – CH_4 and N_2O (CRF source category 4.F)

Burning of crop residues on the field gives rise to emissions of various compounds, including aerosols and trace gases. Field burning of crop residues is forbidden in Europe. Most countries therefore do not report CH_4 and N_2O emissions from this source category. Also at European level, this source category contributes only insignificantly to total emissions from agriculture. We therefore present only limited information, including total CH_4 and N_2O emissions and emissions from the two most important crop groups (cereals and 'other') (Table 6.84) and methodological information as described in the national GHG inventory reports (Table 6.85). The trend of CH_4 and N_2O emissions from field burning of crop residues is shown in Figure 6.52 and Figure 6.53. In many countries, field burning of crop residues has become illegal since 1990 so that the emissions show a significant decline by almost one order of magnitude. Only Greece and Italy report stable emissions from this source category.

Table 6.84: CH_4 and N_2O Emission from burning of crop residues in 2012

2012	Total Gg CO2-eq		Cereals Gg CO2-		Other Gg CO2-eq	
	CH4	N2o	CH4	N2o	CH4	N2o
Austria	1	0	1	0	0	0
Belgium	NO	NO	NO	NO	NO	NO
Denmark	3	0	0	0	2	0
Finland	1	0	1	0	NO	NO
France	20	1	17	0	2	0
Germany	NO	NO	NO	NO	NO	NO
Greece	27	1	26	1	NO	NO
Ireland	NO	NO	NO	NO	NO	NO
Italy	14	0	14	0	NA	NA
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	NO	NO	NO	NO	NO	NO
Portugal	20	1	5	0	15	1
Spain	368	5	NO	NO	368	5
Sw eden	NO	NO	NO	NO	NO	NO
United Kingdom	NA,NO	NA,NO	NO	NO	NA	NA
EU-15	**454**	**7**	**63**	**2**	**388**	**6**

Table 6.85: Methodologies used to calculate CH_4 and N_2O Emission from field burning of crop residues in 2012$^{\$}$

Member States	
Austria	*Burning agricultural residues on open fields in Austria is legally restricted by provincial law and since 1993 additionally by federal law and is only occasionally permitted on a very small scale.*
Denmark	*Field burning of agricultural residues has in Denmark been prohibited since 1990 and may only take place in connection with production of grass seeds on fields with repeated production and in cases of wet or broken bales of straw. The amount of burnt straw from the grass seed production is estimated as 15 % of the total amount produced. The amount of burnt bales of or wet straw is estimated as 0.1 % of total amount of straw. Both estimates are based on an expert judgement by the Danish Agricultural Advisory Service. The total amounts are based on data from Statistics Denmark. The fraction value FracBURN is calculated by using the definitions as given in IPCC Reference Manual.*
Finland	*Default. The share of straw burned in 2007 (0.25%) is an estimate made by several experts on crop cultivation in different parts of Finland. The trend of residue burning is assumed to follow the trend of rye crop yield as rye is the most common straw burned on fields. The share of burned residue from total cereal residue on the fields for the years 1990-2006 is estimated on the basis of the annual rye yield.*
France	*IPCC default*
Greece	*The fraction of residues that is burned on-site in fields, which needs to be subtracted, was assumed to be 10%.*
Italy	*Country-specific methodology is used for estimating emissions from field burning of agriculture residues. Emissions from fixed residues, stubble (stoppie), burnt on open fields, are reported in this category (4F) while emissions from removable residues (asportabili) burnt off-site, are reported under the waste sector. The following data are used: (a) annual crop production, removable residues/product ratio, and "fixed" residue/removable residues ratio; (b) dry matter fraction; (c) fraction of the field where "fixed" residues are burned, and fraction of residues oxidized during burning; (d) fraction of carbon and nitrogen from the dry matter of residues; (e) default emissions rates for C-CH_4 and N-N_2O.*
Netherlands	*Open fires/burning in the field is prohibited by law and therefore negligible in practice.*
Spain	*Despite the new regulations prohibiting the burning agricultural residues for most crops, these regulations are not the main reason for changes in this category of emissions. The main driver for trends in the emissions from burning of agricultural residues is the burning of rests of pruning of olive trees and vines, which have not been reduced.*
Portugal	*Default IPCC value for methante emissions from rice cultivation, with a scaling factor of 0.7. In-site burning of agricultural residues is still practiced nowadays in Portugal, being however forbidden by law-decree during the Forest Fire Season from May to September. Burning of residues from vineyards and olive oil are the most significant sources. Methodology according to IPCC, except for the fact that residue biomass is not estimated from crop production but from residue production quantities by cultivated area. Quantity of residues and actually burnt fraction from expert opinion from the Agriculture Ministry (Seixas et al., 2000). Only for rice a detailed and time-series could be developed following the information received from the agriculture experts from the Portuguese Ministry of Agriculture: (i) traditionally, stubbles and straw were burnt between crops, as the use of rice straw as fodder or bedding is not significant, and is not removed from field; (ii) more recently the agricultural practices have changed. It became more common to left the straw on ground and incorporate it into soil by ploughing (only procedure allowed in the area subject to the "Techniques of Integrated Production and Protection", which is about 50 per cent of rice paddies in 2004). It may be assumed that, in 1990, 100 per cent of rice paddies were burnt and no organic amendments were added to soil. Today the area subjected to burning is between 30 and 40%.*

Member States	
United Kingdom	*Field burning has largely ceased in the UK since 1993. For years prior to 1993, field-burning data were taken from the annual MAFF Straw Disposal Survey (MAFF, 1995). The estimates of the masses of residue burnt of barley, oats, wheat and linseed are based on crop production data (Tom Johnson, DEFRA (England & Wales), Gregor Berry, The Scottish Government and Conor McCormack, DARDNI) and data on the fraction of crop residues burnt (MAFF, 1995; ADAS, 1995). Field burning ceased in 1993 in England and Wales. Burning in Scotland and Northern Ireland is considered negligible, so no estimates are reported from 1993 onwards. The carbon dioxide emissions are not estimated because these are part of the annual carbon cycle.*

$^{\$}$ ***In countries not listed in this table field burning of crop residues does not occur***

Figure 6.52: Trend of CH_4 emissions from field burning of crop residues

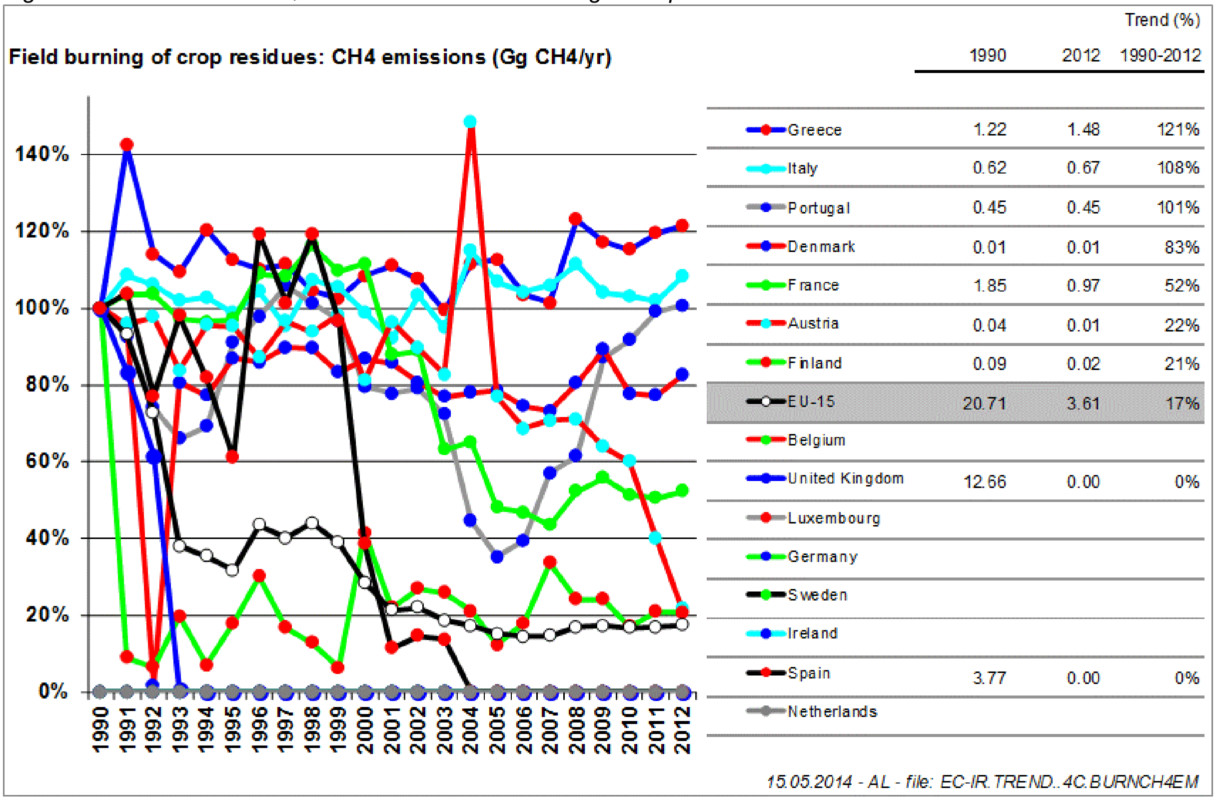
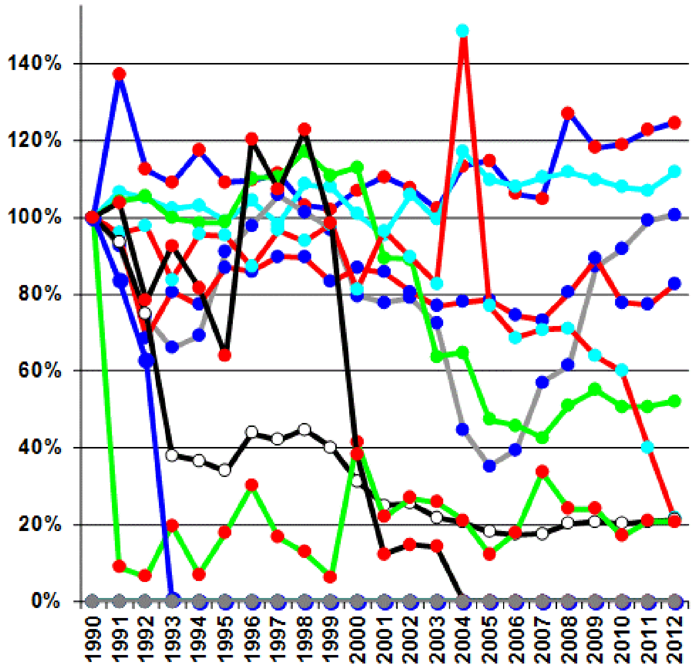


Figure 6.53: Trend of N_2O emissions from field burning of crop residues

Field burning of crop residues: N2O emissions (Gg N2O/yr)



	1990	2012	Trend (%) 1990-2012
Greece	0.031	0.038	125%
Italy	0.013	0.015	112%
Portugal	0.012	0.012	101%
Denmark	0.000	0.000	83%
France	0.046	0.024	52%
Austria	0.001	0.000	22%
EU-15	0.422	0.090	21%
Finland	0.002	0.000	21%
Belgium			
United Kingdom	0.256	0.000	0%
Luxembourg			
Germany			
Sweden			
Ireland			
Spain	0.062	0.000	0%
Netherlands			

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6.4 Harmonized estimation of Tier level and uncertainty of emissions in sector 4 - agriculture

The following sections describe a methodology to estimate the uncertainty of Member States and the EC's emission estimates in the sector agriculture. The method involves several additions to the approaches described in the IPCC guidelines (IPCC 2000, 2006). This includes:

1. a quantitative assessment of the Tier level of the emission estimate based on the individual factors and parameters used for all member states and for the EU;
2. consistent aggregation of the available uncertainty information to the level of the categories including gap filling where necessary. This is done using both Tier 1 and Tier 2 methodology for both level and trend uncertainty;
3. aggregation of categorical uncertainty estimates to the EU level using quantitative information on the level of independence. As a proxy for the level of independence, the Tier level is used and is defined as follows: Tier 1 if only default IPCC data are used in the estimation equation and Tier 2 if the emissions estimate is based on country-specific data. Through the aggregation of emission data by categories and countries, intermediate values between Tier 1 and Tier 2 become possible.

The methodology has been published in the Journal Climatic Change in the year 2010 (open access: http://dx.doi.org/10.1007/s10584-010-9915-5).

The following section describe the methodology and updates the tables to the last inventory year of 2012.

6.4.1 Determination of the Tier level

The IPCC methodology estimates emissions Es from a certain source category s as

$E_s = IEF_s \cdot AD_s$ (1)

where ADs are the activity data for the source category s and IEFs is the implied emission factor for this category. There are three levels for estimating the emissions, called Tier 1, Tier 2, and Tier 3, moving from the use of default values over the inclusion of national information to the application of modelling tools. In order to define an EU-wide Tier level per source category and sector, two criteria must be met:

- For each source category and Member State a Tier level must be assigned.
- To assess the Tier level of aggregated emissions derived at different quality, the Tier levels must be measured on an interval scale, allowing 'intermediate' Tier levels.

To do so, we developed standard procedures for each source category. These are based on the following principles:

(i) The flow of nutrients in agriculture implies that the emission in one category can serve as activity level in another. For example, nitrogen excretion can be regarded as an emission of nitrogen in livestock production systems. According to the IPCC the amount of nitrogen excreted is an activity data for estimating N_2O emissions from manure management. Thus, in contrast to the IPCC definitions, we define as activity data only this information that must be obtained using statistical surveys (e.g., population data, distribution of animal manure systems etc.) and regard everything else as parameters (emission factors and other factors).

(ii) A Tier level is assessed for each parameter by comparing the IPCC default value with the value used by the countries. If the default IPCC value is used, the Tier level is set to Tier 1 and otherwise the Tier level is set to Tier 2. Caution must be taken if country-specific data are identical to the default values.

(iii) An appropriate estimation of the basic activity data (animal numbers, mineral fertiliser consumption, allocation of manure to the manure management systems) is regarded as basic requirement for the estimation of the source strength and is not considered in the calculation of the overall Tier level.

Note however, that Tier levels are aggregated applying different aggregation rules:

1. The MEDIAN-rule should be applied where the Tier level of a product of different parameters Pi is to be evaluated. For example the emission factor for CH_4 emissions from manure management is calculated from the CH_4 production potential, the methane conversion factor, and the volatile solid excretion. The aggregation of the Tier level of these parameters to estimate the level of quality of the emission factor should follow the following principles. (i) If parameters with very different quality are multiplied, the higher quality should get more weight; (ii) if parameters with different uncertainty are multiplied, it should be good practice to estimate the parameter which is associated with the higher uncertainty at a higher Tier level. Thus, the aggregation rule should reward if efforts have been made to improve uncertain parameters. However, with the lack of a comprehensive set of relative uncertainty estimates for the individual parameters, in the following equation an arbitrary weighting factors $w_{p,j}$ has been introduced, based on expert judgment.

$$\lfloor \qquad \rfloor \quad (2)$$

with i and j indicating the individual parameters to be multiplied. The term ($3-Q_i$) assures that a higher weight is given to the parameter estimated with the higher Tier.

In some cases, when there is clear domination of one multiplicative parameter, the median rule simplified and the Tier level of the product is approximated with that Tier level. This simplified rule has been applied to estimate the Tier level of CH_4 emissions from enteric fermentation, which is in many cases based or validated with direct measurements.

2. The MEAN-rule if an emission estimate is calculated as the sum of two or more sub-categories. In this case, the Tier levels of the individual estimates are aggregated using an emission-weighted average. E.g., the Tier level of indirect N_2O emissions from agriculture Q4D3 is calculated from the Tier levels calculated for indirect emissions through volatilization of nitrogen gases Q4D3a and leaching/run-off of nitrate Q4Db according to:

$$\sqsubset_{A+B} \qquad (3)$$

It must be noted, however, that a higher Tier-level does not automatically mean that also the emission estimate is more accurate. The relationship only holds, if (i) inherent links between processes are reflected in the methodology; (ii) parameters are based on statistically representative sample of measurements or carefully with experimental data validated models.

6.4.1.1 CH_4 emissions from enteric fermentation

The Tier level for CH_4 emissions from enteric fermentation is determined by comparison of the Implied Emission Factor with the IPCC default emission factors. The Tier level for cattle, sheep, goats, swine, and reindeer is shown in Table 6.86

Table 6.86: Tier level of IEFs for CH_4 emissions from enteric fermentations in 2012.

2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Reindeer
Austria[1)]	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Belgium	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	
Greece	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Italy	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Netherlands	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Portugal[1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.5	Tier 1.0	Tier 1.0	
EU-15	**Tier 2.0**	**Tier 1.9**	**Tier 1.7**	**Tier 1.3**	**Tier 1.6**	**Tier 2.0**

1) Dairy-cattle for Spain and Non-dairy cattle for Austria and Portugal: IEF equals default IPCC EF, how ever Tier 2 has been used according to the national inventory reports.

6.4.1.2 CH_4 emissions from manure management

The determination of the Tier level for the estimation of CH_4 emissions from manure management is done in four steps

3. "Default" CH_4 conversion factors for each manure management system are calculated on the basis of the allocation of manure to the different AWMS

4. The results are compared with the used MCF and a Tier 2 level assigned if the two numbers differ (see Table 6.87).

5. The final Tier level is obtained using the MEDIAN rule from the Tier levels of MCF, B_0, and VS, using the following weights: w_{MCF}=0.13; wB_0=0.13; w_{VS}=0.75 (see Table 6.88, Table 6.89,

and Table 6.90). The highest weight is given to the Volatile solid excretion factor because it can and should be based on the detailed characterization of the animal performance.

Table 6.87: Tier level of MCF for CH_4 emissions from manure management in 2012.

2012 MCF	Dairy	Non-dairy	Sheep	Goats	Swine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Denmark	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg [1)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Portugal	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sweden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
EU-15	**Tier 1.5**	**Tier 1.6**	**Tier 1.0**	**Tier 1.0**	**Tier 1.5**	**Tier 1.0**

Sheep and goats get Tier 1 for MCF!

The data used for B_0 and VS are compared with IPCC default values.

Table 6.88: Tier level of B_0 for CH_4 emissions from manure management in 2012.

2012 B0	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Finland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sweden	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.3**	**Tier 1.5**	**Tier 1.0**	**Tier 1.1**	**Tier 1.2**	**Tier 1.1**

Table 6.89: Tier level of VS for CH_4 emissions from manure management in 2012.

2012 VS	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0
Sweden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 1.5**	**Tier 1.4**	**Tier 1.9**	**Tier 1.1**

Table 6.90: Tier level of the IEFs for CH_4 emissions from manure management in 2012.

2012 IEF	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.9	Tier 1.0
Belgium	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Denmark	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Finland	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.8
France	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.9	Tier 2.0	Tier 1.9
Greece	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Spain	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.8	Tier 1.8
Sweden	Tier 1.9	Tier 1.9	Tier 1.2	Tier 1.9	Tier 1.9	Tier 1.9
United Kingdom	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
EU-15	**Tier 1.9**	**Tier 1.9**	**Tier 1.4**	**Tier 1.4**	**Tier 1.8**	**Tier 1.1**

[1)] Netherlands does not give background data in Table 4B(a), however according to the national inventory report a Tier 2 methodology is used.

6.4.1.3 N_2O emissions from manure management

The determination of the Tier level of the estimate of N_2O emissions from manure management is done in four steps

6. The comparison of the N-excretion rates used with the IPCC default values (see Table 6.91)
7. The determination of the Tier level of manure allocated to the manure management systems based on the Tier level of the N-excretion rate by animal type and the allocation of manure-nitrogen to the manure management systems reported in Table 4B(b) (see Table 6.92)
8. The comparison of the N_2O emission factor used with the IPCC default values (see Table 6.93)

9. The calculation of the overall Tier level on the basis of the MEDIAN rule by using the Tier level of the IEF (with a weight of 0.33) and the Tier level of the allocated manure nitrogen to the manure management systems (with a weight of 0.67).

Table 6.91: Tier level of the N-excretion rates for N_2O emissions from manure management in 2012.

2012 Nex	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Austria	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0		Tier 2.0	Tier 2.0	
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Italy	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 1.0	Tier 1.0
Sweden	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**

Table 6.92: Tier level of the allocation of manure-nitrogen to the manure management systems for N_2O emissions from manure management in 2012.

Member State	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 1.8		Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 2.1		Tier 1.7	Tier 1.8	Tier 1.9
France	Tier 2.0		Tier 2.0	Tier 2.0	
Germany	Tier 2.0		Tier 2.0	Tier 2.0	
Greece	Tier 2.0	Tier 2.0	Tier 1.7	Tier 2.0	
Ireland	Tier 2.0		Tier 2.0	Tier 2.0	
Italy	Tier 2.0		Tier 1.9	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands	Tier 2.0		Tier 2.0	Tier 2.0	
Portugal	Tier 2.0		Tier 1.8	Tier 2.0	
Spain	Tier 1.0	Tier 1.0	Tier 1.2	Tier 2.0	Tier 2.0
Sweden	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
EU15	**Tier 2.0**	**Tier 2.0**	**Tier 1.9**	Tier 2.0	**Tier 2.0**

[1)] including anaerobic lagoon

Table 6.93: Tier level of the IEFs for N_2O emissions from manure management in 2012.

2012	Liquid system[1)]	Solid storage and dry lot	Other
Austria	Tier 1.0	Tier 1.0	Tier 2.0
Belgium	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 2.0	Tier 1.0	Tier 2.0
Finland	Tier 1.0	Tier 2.0	Tier 1.0
France	Tier 1.0	Tier 1.0	NA
Germany	Tier 2.0	Tier 2.0	NO
Greece	Tier 1.0	Tier 1.0	NA
Ireland	Tier 1.0	Tier 1.0	NO
Italy	Tier 1.0	Tier 1.0	Tier 1.0
Luxembourg			Tier 1.0
Netherlands	Tier 1.0	Tier 1.0	NO
Portugal	Tier 1.0	Tier 1.0	NO
Spain	Tier 1.0	Tier 1.0	Tier 2.0
Sweden	Tier 1.0	Tier 1.0	Tier 1.0
United Kingdom	Tier 1.0	Tier 1.0	Tier 2.0
EU15	**Tier 1.1**	**Tier 1.6**	**Tier 1.8**

Table 6.94: Tier level of the estimation of N_2O emissions from manure management in 2012.

2012	Liquid system[1)]	Solid storage and dry lot	Other	Total
Austria	Tier 1.7	Tier 1.7	Tier 2.0	Tier 1.8
Belgium	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
Denmark	Tier 1.9	Tier 1.7	Tier 2.0	Tier 1.9
Finland	Tier 0.9	Tier 1.8	Tier 1.6	Tier 1.1
France	Tier 1.7	Tier 1.7	NA	Tier 1.7
Germany	Tier 2.0	Tier 2.0	NO	Tier 2.0
Greece	Tier 1.7	Tier 1.5	NA	Tier 1.7
Ireland	Tier 1.7	Tier 1.7	NO	Tier 1.7
Italy	Tier 1.7	Tier 1.6	Tier 1.7	Tier 1.7
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.7	Tier 2.0
Netherlands	Tier 1.7	Tier 1.7	NO	Tier 1.7
Portugal	Tier 1.7	Tier 1.6	NO	Tier 1.7
Spain	Tier 1.0	Tier 1.1	Tier 2.0	Tier 1.8
Sweden	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
United Kingdom	Tier 1.7	Tier 1.7	Tier 2.0	Tier 1.8
EU15	**Tier 1.9**	**Tier 1.7**	**Tier 2.0**	**Tier 1.8**

[1)] including anaerobic lagoon

6.4.1.4 CH_4 emissions from rice cultivation

No combination of information is required.

6.4.1.5 N_2O emissions from agricultural soils

The determination of the Tier level of N_2O emissions from agricultural soils is done in three steps:

10. The comparison of the used emission factors (for direct N_2O emissions induced by the application of synthetic fertiliser, animal wastes, nitrogen from crop residues and N-fixing crops and by the cultivation of histosols; for N_2O emissions from manure deposited by grazing animals; for indirect N_2O emissions induced by volatilization of NH_3+NO_X from synthetic fertiliser and from applied manure, and induced by leaching/run-off of nitrogen from the fields) with the respective IPCC default values.

11. With the exception of direct N_2O emissions induced by the application of mineral fertiliser, a Tier level has been considered for the nitrogen input data.

For the application of animal waste the Tier levels of N allocation to liquid systems (incl. anaerobic lagoons), solid storage and dry lot, and other systems have been combined using the MEAN rule.

For N-fixing crop, crop residues and cultivated area of histosols, the Tier level has been estimated from the information reported in the national inventory reports

For nitrogen deposited by grazing animals, the Tier level calculated under category 4B(b) for pasture, range, and paddock is used.

12. The Tier level of the N_2O emission estimate is calculated on the basis of the above-obtained information:

Application of synthetic fertiliser the Tier level of the emission factor is used

Direct emissions from other nitrogen sources using the MEDIAN rule with equal weights for the Tier level of the nitrogen input and the emission factor

N_2O emissions from grazing animals using the MEDIAN rule for N-input, $Frac_{GRAZ}$, and the emission factor using equal weights. The Tier level for $Frac_{Graz}$ has been determined on the basis of the information given in the national inventory reports

N_2O emissions from volatilised nitrogen using the MEDIAN rule for the amount of volatilised nitrogen, which is calculated from the Tier levels for volatilised synthetic fertiliser and manure nitrogen using the MEAN rule, and the emission factor using equal weights. The Tier level for volatilised synthetic fertiliser is obtained by comparing $Frac_{GASF}$ with the IPCC default value. The Tier level for volatilised manure nitrogen is obtained using the MEDIAN rule on the basis of $Frac_{GASM}$ (comparing with the IPCC default value) and the Tier level of applied nitrogen manure using equal weights.

N_2O emissions from leached/run-off nitrogen using the MEDIAN rule for N-input, FracLEACH and the emission factor giving higher weight to FracLEACH and the emission factor (0.43 each) than to the N-input (0.14)

Table 6.95: Tier level of the estimation of direct N_2O emissions from agricultural soils in 2012.

Member States	Synthetic fertilizer	Animal Wastes appl.			N-fixing crops			Crop Residues			Cultivation of Histosols		
	N2O emis.	N input	EF	N2O emis.	N input	EF	N2O emis.	N input	EF	N2O emis.	N input	EF	N2O emis.
Austria	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	NO	NO
Belgium	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 0.0	Tier 2.0	Tier 2.0
Denmark	Tier 1.0	Tier 1.9	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
Finland	Tier 1.0	Tier 1.1	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
France	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Germany	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Ireland	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Italy	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Netherlands	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Spain	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Sweden	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
United Kingdom	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
EU-15	**Tier 1.0**			**Tier 1.5**			**Tier 1.4**			**Tier 1.3**			**Tier 1.9**

Table 6.96: Tier level of the estimation of N_2O emissions from pasture, range and paddock in 2012.

Member States	Animal Production			
	N-input	FracGRAZ	EF	N2O emissions
Austria	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.4
Belgium	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Denmark	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Finland	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.3
France	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.7
Greece	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Ireland	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Italy	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Netherlands	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Spain	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Sweden	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.7
United Kingdom	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
EU-15				**Tier 1.5**

Table 6.97: Tier level of the estimation of indirect N_2O emissions from nitrogen volatilised from agricultural soils in 2012.

Member States	$Frac_{GASF}$	Manure application	$Frac_{GASM}$	Volatilized Manure	Volatili-zation	Emission Factor	N2O emissions from volatilised nitrogen
Austria	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Belgium	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Denmark	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Finland	Tier 2.0	Tier 1.1	Tier 2.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6
France	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Italy	Tier 1.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 1.5	Tier 1.0	Tier 1.3
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Portugal	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Spain	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Sweden	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
United Kingdom	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 1.0	Tier 1.0	Tier 1.0
EU-15							**Tier 1.3**

Table 6.98: Tier level of the estimation of indirect N_2O emissions from nitrogen leached/run-off from agricultural soils in 2012.

Member States	N input	$Frac_{LEACH}$	Emission factor
Austria	Tier 1.8	Tier 1.0	Tier 1.0
Belgium	Tier 1.7	Tier 2.0	Tier 1.0
Denmark	Tier 1.9	Tier 2.0	Tier 2.0
Finland	Tier 1.1	Tier 2.0	Tier 1.0
France	Tier 1.7	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 1.0	Tier 1.0
Greece	Tier 1.7	Tier 1.0	Tier 1.0
Ireland	Tier 1.7	Tier 2.0	Tier 1.0
Italy	Tier 1.7	Tier 1.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0
Netherlands	Tier 1.7	Tier 2.0	Tier 1.0
Portugal	Tier 1.7	Tier 2.0	Tier 1.0
Spain	Tier 1.8	Tier 1.0	Tier 1.0
Sweden	Tier 1.7	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.8	Tier 1.0	Tier 1.0
EU-15			

6.4.2 Uncertainty

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.104. These data are calculated from the information on the uncertainty of activity data and implied emission factors (see sections above and Table 6.100 through Table 6.102 summarizing all categories in agriculture) and the emissions data. For several countries, N_2O emissions from agricultural soils are by far dominating the uncertainty of national inventory. The uncertainty estimate for this source category of the submission in 2014 ranges from 1.9% of total national GHG emissions from agriculture (Netherlands) to 16.7% (France). Overall, the estimate for the uncertainty range is relatively stable since the last years (see Table 6.99).

Table 6.99: Range of contribution of category 4D to overall GHG uncertainty. Minimum and maximum values since 2005 submission

	Minimum uncertainty	***Maximum uncertainty***
2005	*0.7% (Austria)*	*20.9% (France)*
2006	*1.5% (Austria)*	*17.6% (France)*
2007	*1.9% (Denmark)*	*19.9% (France)*
2008	*1.7% (Denmark)*	*20.1% (France)*
2009	*2.0% (Denmark)*	*17.9% (France)*
2011	*2.4% (Netherlands)*	*18.7% (United Kingdom)*
2012	*1.2% (Portugal)*	*19.0% (United Kingdom)*
2013	*1.9% (Netherlands)*	*20.7% (United Kingdom)*
2014	*1.9% (Netherlands)*	*16.7% (France)*

The contribution of the whole agricultural sector to the overall uncertainty is very similar to the contribution of agricultural soils (2.2% to 16.7%), highlighting again the dominance of this category.

Some countries allocate the biggest contribution to the direct emissions and others to the indirect emissions of N_2O. For example, the uncertainty of direct N_2O emissions is estimated in the Greece inventory of being ±400% (5.6% of the national total) versus ±54% (0.8% of the national total) of the indirect emissions. On the other hand, the Netherlands estimate an uncertainty of ±61% and ±206% for direct and indirect N_2O emissions agricultural soils, respectively (corresponding to 1.0% and 1.5% of the national total uncertainty, respectively).

CH_4 emissions from enteric fermentation are less uncertain (2.4% to 10.5% of total national GHG emissions from agriculture or 0.3% to 1.7% from total national HGG emissions) and manure management contributes with less than 13.0% of national GHG emissions from agriculture uncertainty.

Table 6.104 gives an overview of: (1) the estimated total GHG uncertainty, carried out with the Tier 1 methodology, and (2) the contribution of the agricultural sector to the overall uncertainty, calculated from reported relative uncertainties for activity data and emission factors and from reported emissions. The corresponding uncertainties for activity data and emission factors are given in Table 6.100 and Table 6.101, and the combined uncertainty (Tier 1 approach) is given in Table 6.102. The data for the combined uncertainty are “gap-filled” at the category-level, if required, to allow a meaningful comparison of the uncertainty estimates at EU-level, using information reported at the level below the categories.

A table summarizing background information on the uncertainty estimates is given in Table 6.103.

It is interesting to note that combined relative uncertainty of agriculture in some cases is higher than the overall uncertainty of the greenhouse gas inventory (for example in Austria and Spain). This is due to the fact that the combined uncertainty is calculated neglecting any other contribution to the uncertainty. As uncertainties are assumed to be uncorrelated between the different sectors, the consideration of more sectors can thus lead to the partial compensation of the individual uncertainties.

Some countries have carried out also a Monte Carlo uncertainty assessment. In most cases, both the input data and also the results do not deviate much from the Tier 1 analysis. Main differences between both methods are (i) the possibility to assess emission sources where the distribution of the uncertainty is non-normal and (ii) the consideration of correlation between source categories, which tends to reduce the compensation effect.

Table 6.100: Member States' uncertainty estimates for Activity Data used in the agriculture sector [%] in 2012

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	**CH_4**	**N_2O**	**N_2O**	**N_2O**	**N_2O**	**N_2O**
Austria	*(1)	*(7)	10	5			
Belgium	*(2)	*(8)	10		30	30	30
Denmark	2	5	22			25	
Finland		12	66		117	200	302
France	5	5	5		15	20	120
Germany	*(3)	*(9)	4		16	20	143
Greece	5	5	50		20	50	20
Ireland	*(4)	*(10)	11		11	11	11
Italy	20	20	20		20	20	20
Luxembourg	*(5)	*(11)			10	10	20
Netherlands	*(6)	*(12)	10		10	10	50
Portugal	6	8	36	20			
Spain	3	3	16		18	16	190
Sweden	2	7	15		15	35	29
United Kingdom	0	0	1	1			

*(1)- AT: all animal types: 10%

*(2)- BE: all animal types: 5%

*(3)- DE: Dairy cattle 4% and non-dairy cattle 2%. Buffalo 4%

*(4)- IE: Dairy and non-dairy cattle and other animals: 1%

*(5)- LU: Cattle: 2%, sheep, horses, poultry: 10%

*(6)- NL: Dairy and non-dairy cattle, swine and other animals: 5%

*(7)- Cattle and swine: 10%

*(8)- BE: all animal types: 10%

*(9)- DE: Dairy cattle 0% and swine 3%. Buffalo 5%

*(10)- IE: Dairy and non-dairy cattle and other animals: 1%

*(11)- LU: Cattle: 2%, sheep, horses, poultry: 10%

*(12)- NL: Cattle, swine and other animals: 10%

Table 6.101: Member States' uncertainty estimates for Emission Factors used in the agriculture sector [%] in 2012

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	**CH_4**	**N_2O**	**N_2O**	**N_2O**	**N_2O**	**N_2O**
Austria	*(1)	*(7)	100	150	0		
Belgium	*(2)	*(8)	90		250	250	250
Denmark	20	20	100		0	100	
Finland	25		0		0		
France	15	30	50		140	200	430
Germany	*(3)	*(9)	103		53	200	319
Greece	30	50	100		400	100	50
Ireland	*(4)	*(10)	100		100	100	50
Italy	20	100	100		100	100	100
Luxembourg	*(5)	*(11)			150	150	150
Netherlands	*(6)	*(12)	100		60	100	200
Portugal	12	75	93	177	0		
Spain	8	8	100		400	100	50
Sweden	11	18	37		65	150	122
United Kingdom	20	30	254	259	0		

*(1)- AT: Cattle and sheep: 20%; Goats, Horses, Swine, Poultry and other animals:30%

*(2)- BE: all animal types: 20%

*(3)- DE: Dairy cattle 40% and non-dairy cattle 25%. Buffalo 25%

*(4)- IE: Dairy and non-dairy cattle 15, other animals: 30%

*(5)- LU: Cattle: 20%

*(6)- NL: Dairy cattle 15%, non-dairy cattle 20%, swine 50%and other animals: 30%

*(7)- AT: All animal types: 50%

*(8)- BE: all animal types: 40%

*(9)- DE: Cattle 0% and swine 29%. Buffalo 19%

*(10)- IE: Dairy and non-dairy cattle 15, other animals: 30%

*(11)- LU: Cattle: 70%

*(12)- NL: Cattle, swine and other animals: 100%

Table 6.102: Member States' uncertainty estimates for agriculture (combined uncertainty calculated from the given uncertainty of AD and EF) [%]in 2012

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	**CH_4**	**N_2O**	**N_2O**	**N_2O**	**N_2O**	**N_2O**
Austria	21	37	100	150	0		
Belgium	14	34	91	161	252	252	252
Denmark	20	21	102	103		103	
Finland	25	12	66	105	117	200	302
France	16	30	50	178	141	201	446
Germany	26	23	103	123	55	201	350
Greece	30	50	112	134	400	112	54
Ireland	11	11	101	58	101	101	51
Italy	28	102	102	67	102	102	102
Luxembourg	20	41	0	92	150	150	151
Netherlands	12	75	100	65	61	100	206
Portugal	14	76	100	178			
Spain	9	9	101	204	400	101	196
Sw eden	12	19	40	55	66	154	125
United Kingdom	20	30	254	259			

Table 6.103: Available background information on the uncertainty estimates in the sector of agriculture

Member State	*Uncertainties*
Austria	*Separate uncertainty calculations, albeit with the same (as much as possible) input information was performed using a spread sheet prepared specifically according to the Tier 1 approach (IPCC 2000), and with a Monte Carlo approach fully considering statistical dependence of detailed input data (Tier 2). Since the first detailed uncertainty analysis (Winiwarter and Rypdal, 2001) the Austrian inventory compilers have spent considerable effort to also obtain uncertainties from individual contributors to the inventory. Studies on methane emissions reported also uncertainty in emission factors (Amon et al. 2002, Gebetsroither et al. 2002).*
Belgium	*In Flanders, a complete study of the uncertainty was conducted in 2004 by an independent consultant, Det Norske Veritas, both on Tier 1 and Tier 2 level. The uncertainties were determined for the emission level 2001 and for the 1990-2001 trend in emissions for all source categories comprising emissions of CO_2, CH_4 and N_2O. These results are available in the technical report 'Quantification of Uncertainties – Emission Inventory of Greenhouse Gases of the Flemish Region of June 2004'.*
Denmark	*The uncertainty estimates are based on the Tier 1 methodology in the IPCC Good Practice Guidance (GPG) (IPCC, 2000). Uncertainty estimates for the all sectors are included in the current year. The estimated uncertainties for some of the emission sources, based on expert judgement (Olesen et al. 2001, Gyldenkærne, pers. comm., 2005). The uncertainties for the number of animals and the number of hectares with different crops under cultivation are very small.*
Finland	*Uncertainty is quantified with a Tier 2 approach (KASPER model, developed by VTT Technical Research Centre of Finland). A simulation model was constructed for uncertainty analysis using Monte Carlo simulation and sensitivity analysis using an extended version of Fourier Amplitude Sensitivity Test (FAST, Saltelli et al. 2005). In agriculture, an uncertainty estimate was given for each calculation parameter of the calculation model at a detailed level. A detailed description of the uncertainty analysis has been presented in Monni & Syri (2003), Monni (2004) and Monni et al. (2007).*
France	*Uncertainty calculation according to Tier 1 methodology. Strongest impact on total uncertainty arises from the category of N_2O emissions from agricultural soils.*
Ireland	*Tier 1 method. In some of the most important emissions sources in Agriculture (such as enteric fermentation and agricultural soils) and Waste (solid waste disposal, for example) the activity data or emission factors ultimately used are determined by several specific component inputs, which are all subject to varying degrees of uncertainty. The uncertainty estimates used for both activity data and emission factor for these sources have been derived by assigning uncertainties to the key component parameters and combining them at the level of activity data or emission factors, as appropriate, for each activity for input to the Tier 1 uncertainty assessment.*
Italy	*Tier 1 approach. In addition, a Tier 2 approach, corresponding to the application of Monte Carlo analysis, has been applied to specific categories of the inventory but the results show that, with the information available at present, applying methods higher than the Tier 1 does not make a significant difference in figures. For N_2O emissions from agricultural soils, a Monte Carlo analysis was applied assuming a normal distribution for activity data and two tests one with a lognormal and the other with a normal for emission factors; the results with the normal distribution calculated an uncertainty figure equal to 32.44, lower than the uncertainty by the Tier 1 approach which was 102; in the case of the lognormal distribution there were*

Member State	*Uncertainties*
	problems caused by the formula specified in the IPCC guidelines which is affected by the unit and needs further study before a throughout application.
Luxembourg	*In December 2007, the Environment Agency contracted Austrian Research Centres GmbH - ARC28 for performing a detailed uncertainty analysis of Luxembourg's GHG inventory. Monte-Carlo approach was used to calculate overall uncertainty. Within this project, we use the software "@RISK" from Palisade Co. (www.palisade.com).*
Netherlands	*Tier 1 method for base year and last reported year – for both the annual emissions and the emission trend for the Netherlands. All uncertainty figures should be interpreted as corresponding to a confidence interval of 2 standard deviations (2?), or 95%. In cases where asymmetric uncertainty ranges were assumed, the largest percentage was used in the calculation. Furthermore, a Tier 2 uncertainty assessment was carried out in 2006 (Ramirez, 2006). The study used the same uncertainty assumption as the Tier 1 study but accounted for correlations and non-Gaussian distributions. Results are at the same order of magnitude for the level assessment, although a higher uncertainty is found for the trend analysis. As part of the above mentioned study, the expert judgments and assumptions made for uncertainty ranges in emission factors and activity data for the Netherlands have been compared to the uncertainty assumptions (and their underpinnings) used in Tier 2 studies carried out by other European countries.*
Sweden	*During 2005, a SMED study was carried out to improve transparency and quality in the uncertainty estimates of the Swedish National Greenhouse gas inventory (Gustafsson, 2005). Although much activity data in the agricultural sector is estimated from extensive surveys, with high quality estimates at national level, the sector contributes to a large part of the total estimated uncertainty.*
United Kingdom	*Both the Tier 1 and Tier 2 uncertainty estimates. The Tier 2 approach provides estimates according to GHG (1990, base year and latest reporting year) and has now been extended to provide emissions by IPCC sector and is based on a background paper (Eggleston et al., 1998). An internal review was completed of the Monte Carlo analysis was completed in 2006 (Abbott et al., 2006). The uncertainty of the majority of the sectors was assumed to be normally distributed; for certain sectors where data are highly correlated or the distributions non-normal, custom correlations or functions have been used (landfill, sewage sludge distributions calculated from a known data series; agricultural soils lognormal distribution with the 97.5%il being 100 times the 2.5%il). Calculations are carried out using the @RISK software.*

The uncertainty estimates are combined to the EU-15 level for source categories in the agriculture sector. For the sector as a whole, uncertainties are combined with a Tier 1 approach considering an assumed degree of dependence between each pair of countries. The quantitative assessment of the quality-levels outlined above helps to derive a reasonable estimate for the correlation coefficient ρ_{XY} between two countries X and Y. To this purpose, the Tier levels Q_X and Q_Y are transformed with the following equation:

$$\rho_{X,Y} = \sqrt{(2 - Q_X)\cdot(2 - Q_Y)} \qquad (4)$$

Equation (4) leads to the situation of no correlation $(\rho_{X,Y} = 0)$ for two countries with a Tier 2 approach and full correlation $(\rho_{X,Y} = 1)$ if both countries used a Tier 1 approach. A correlation coefficient can be calculated for any intermediate situation. This information is further processed within the standard IPCC Tier 1 method for both level and trend uncertainty.

Table 6.104: Member States' uncertainty estimates for agriculture expressed in percent of total GHG emissions in 2012. The table shows three "scenarios" for the uncertainty at EU-15 level, i.e., (i) with the correlation between MS uncertainty estimates as quantified with equation (4); (ii) under the assumption of no correlation and (iii) under the assumption of full correlation between the uncertainty estimates of MS. Scenario (i) is considered to be the most realistic case, and scenarios (ii) and (iii) are giving the range of uncertainty at EU-15 level.

Member State	Total agriculture	Enteric ferment. (4A)	Manure Managem. (4B)		Rice Cultivation (4C)	Agricultural soils (4D)				
		CH_4	CH_4	N_2O	CH_4	total CH_4	total N_2O	direct N_2O	animal prod. N_2O	indirect N_2O
	uncertainties expressed as % of total GHG emissions from agriculture									
Austria	5.7	0.8	0.1	1.1		0.0	5.5			
Belgium	4.8	0.4	0.4	0.6			4.7	4.1	1.6	1.7
Denmark	9.2	1.0	0.5	0.7			9.1		0.4	
Finland	5.5	0.6	0.0	0.4			5.5	4.8	0.6	2.6
France	16.7	0.9	0.6	0.5			16.7	6.0	3.4	15.2
Germany	5.5	0.6	0.1	0.3			5.4	1.5	0.3	5.2
Greece	5.7	0.8	0.2	0.6	0.0		5.6	5.4	1.4	0.8
Ireland	6.8	1.7	0.4	0.8			6.6	4.4	4.7	1.1
Italy	2.5	0.6	0.4	0.8	0.1		2.3	1.7	0.3	1.5
Luxembourg	2.5	0.4	0.3				2.3	1.7	0.7	1.5
Netherlands	2.2	0.4	1.0	0.5			1.9	1.0	0.5	1.5
Portugal	7.7	0.5	1.1	0.4	0.1		7.6			
Spain	10.8	0.3	0.2	0.4			10.7	10.0	0.8	3.8
Sweden	4.0	0.5	0.1	0.3			3.9	2.6	1.1	1.7
United Kingdom	12.5	0.5	0.4	1.2			12.5			
EU15	**5.9**	**0.3**	**0.2**	**0.3**	**0.0**	**0.0**	**7.0**			
EU15 no corr	**3.5**	**0.2**	**0.1**	**0.2**	**0.0**	**0.0**	**3.4**			
EU15 full corr	**8.0**	**0.6**	**0.3**	**0.6**	**0.0**	**0.0**	**8.0**			

Uncertainties calculated from information contained in NIR on uncertainty of activity data and emission factors, and emission data, using the Tier 1 approach.

6.5 Sector-specific quality assurance and quality control

QA/QC procedure for the agriclture sector of the EU GHG inventory are documented in detail in a prezi-presentation given during the ICR on October 2nd, 2013. The presentation can be freely accessed at the following link:

http://prezi.com/f1d3elxzd4qn/?utm_campaign=share&utm_medium=copy&rc=ex0share

The following section gives a brief summary of the main points; for additional details the number of the slides (or views) in the prezi presentation is given.

The QA/QC procedures for the agricultural sector have five main elements:

- Quality checks
- Calculation of EU background data and preparing of relevant tables
- Calculation of EU data level uncertainty (see section 6.4.2)
- Cooperation with Member Countries (workshops, bilateral discussion, etc.)
- Participation in EU-wide activities to improve availability of data and development of methods (see section 6.6.3)

6.5.1 Quality checks

The quality checks made are explained in the prezi-presentation in slides #81-93.

The following tasks are performed:

Completeness check

- Comparison of the CRF tables in terms of identifying emply cells nan not reported categories
- Check of notation keys use: includes all cases where less than seven MS report "NE"
- Check on proper use of "NO" or "NA" and all other MS report emissions

Outlier checks

- IEF outlier check and documentation, comparison of IEF with previous submission
- Comparison with oher MS. Check trend/low/high outliers
- Check plausibility of trends and consistency in time series
- Special focus is laid on the change of the year x-3/x-2 and the relevance of MS emission trends for EU-15 and EU28
- Identification of inconsistnecies between the NIRs and the CRF Tables.

Specific quality checks for agriculture

The following gives a list of specific quality checks for agriculture and their purpose:

- Check on Ym: Average CH_4 conversion rate in CRF Table 4A is expressed in fraction instead of . Output: values < 1.
- Check on correct unit for VS excretions: Volitile solids daily excretion in CRF Table 4B(a)s1 is probably provided per year; it should be provided per day (kg dm/head/day). Output VS>100
- Check on correct unit for allocation to AWMS: The percent allocation to each individual animal waste management system in CRF Table 4B(a)s2 should not be above 100%. Possible error: summed-up per climate region
- Check correct unit for MCF: Volitile solids daily excretion in CRF Table 4B(a)s1 is probably provided per year; it should be provided per day (kg dm/head/day). Output: values > 99 and non-zero values < 0.5
- Check AWMS allocation: The sum of percent allocation to animal waste management systems in CRF Table 4B(a)s2 for each animal population should be 100%. Output all values different from 100 and 0
- Check on N-excretion: (a) Total nitrogen excretion calculated from CRF Table 4B(b) as follows: animal population size multiplied by nitrogen excretion per head (kg N); (b) Total nitrogen excretion calculated from CRF Table 4B(b) as follows: Sum of nitrogen excretion in all animal waste management systemskg N. Output: differences > 1%
- Check on grazing manure: (a) Fraction of livestock N excreted and deposited onto soil during grazing calculated on basis of information provided in CRF Table 4B(b): Nitrogen excretion from pasture range and paddock divided by the sum of nitrogen excretion of all animal waste systems; (b) Fraction GRAZ taken from CRF Table 4Ds2. Output: differences > 1%
- Check of consistency of the sum of AD and emissions calculated for EU-15
- Check of consistency of animal population data across the tables 4A, 4B(a), and 4B(b)
- Check correct assessment of 'other animal types' not included in the EU-CRF tables, but reported in the NIR. The data are tabulated for 1990 and the last reporting year. Total Nexcretion in Table

4B(b) is compared to the sum of N-excertion in Table 4B(b) for EU-15 + sum of N-excretion from 'other animals'.

Initial issues are identified and entered into the web-tool requesting clarification from MS and followed up subsequently.

6.5.2 Calculation of EU background data

The quality checks made are explained in the prezi-presentation in slides #50-80.

The file EC14_template.xls contains all macros (Visual Basic for Applications) and procedures such that no step can be omitted and all tasks (manual file preparation, updating of links, etc.) are explained.

The file contains also the information on previous 'problems' found in the national submissions (such as a mistake in the unit used for a background number). The problems include no background information given; wrong unit for milk yield, VS excretion, AD value for crop residues and N-fixing crops, or mistake in the use of fraction vs. percent value; share of climate regions not calculated properly.

Even though such mistakes have no effect on the estimates of GHG emissions done by the countries it is important to detect them. For example, in the past some countries reported milk yield per cow and year instead in per cow and day as requested. Without correction, it would not be possible to estimate a meaningful milk yield for EU-15 or EU28 countries.

Once all mistakes are identified and corrected, the EU-15 and EU28 data are calculated. For some numbers, it is sufficient to calculate the sum (as for activity data and emissions). For most others, a weighted average is required. For example, the EU-15 milk yields depends in the national estimates for the milk yield but also on the share of dairy cattle in a country relative to total EU-15 dairy cattle numbers. Some values need more complex calculations, such as the share of animals over climate regions. Finally, for some numbers a direct average is used.

The template used defines in a transparent way which method is used for which number and what kind of corrections were needed.

Specific attention is given to information on 'other' sub-categories (e.g. animal types, N-sources) that are not processed in the files distributed. The data are obtained in a separate file and processed such that the EU GHG inventory report gives complete data for all source categories.

6.5.3 Compilation of the chapter agriculture for the EU-GHG inventory report

The compilation of the chapter agriculture is explained in the prezi-presentation in slides #98-132.

Most importantly, the compilation of the agriculture chapter is highly automated.

- The word document which is used to edit the chapter is linked with a series of excel file containing the relevant information
    - All quantitative tables and values in the text referring to national or EU-wide GHG data are linked with a series of excel files (20xx.EC-IR.4-files, with 20xx being the last year of the current submission) which are directly linked to the files distributed by UBA-V and processed as explained above.
    - All methodological tables are linked to excel files in which the information is stored in a transparent way such that update is quickly and easily possible whenever a change in a national methodology occurs
    - Macros of the word document make sure that the latest versions of the trend-figures are used.

6.6 Sector-specific planned improvements

This section lists activities on improvements oft he EU-IR and the national IR. In section 6.6.1 improvements of the EU inventory are described; while section 6.6.2 gives an overview on issues raised during recent UNFCC reviews and how this has been addressed in the current submission (Table 6.105) and compiles review items and responses by EU countries (Table 6.109).

Section 6.6.3 reports on more general activities on improving the quality of the agricultural GHG inventory in Europe.

6.6.1 Improvements since last submission

A major revision of the present chapter on methodological issues and uncertainty in the sector agriculture was done for the submission in 2006. The chapter gives now a complete overview of all relevant parameters required for the estimation of GHG emissions in this sector. This has been done in parallel to the calculation of all background parameter in the CRF tables for agriculture.

The changes were partly due to a “natural evolution” of the inventory generation over the years and partly motivated by recommendations made by the UNFCCC review team on the occasion of the in-country review in 2005. The main issues raised by the Expert Review Team in 2005 and the major changes include (i) more transparent overview tables on methodological issues; (ii) better presentation of trend development; (iii) streamlining information contained in CRF and NIR; (iv) continuous working with Member States in order to improve the inventory and allowing the quantification of all background data; (v) including a summary of workshops.

For the submission in 2007, few improvements were added, mainly regarding the calculation of the quality of the EU estimate. Several errors that were identified in the background tables of the Member States could be eliminated, such as the inconsistent use of units or implied emission factors. These corrections did not have an impact on the calculated emissions, but made the aggregation of background information difficult and the comparison impossible.

For the submission in 2008, based on recommendations by the Expert Review Team of the in-country review in 2007, several improvements were implemented, including higher transparency in describing the aggregation of animal numbers presented under Option B into Option A (which is used at EU level), time series consistencies and trends (including epidemic diseases and issues raised by the ERT, such as the buffalo population in Germany and the goat population in Luxembourg, manure managed in ‘other’ systems in Italy, or $Frac_{GASM}$ used in Sweden), and outliers. A discussion on the main policies driving the level of GHG emissions in Europe was introduced.

Further a novel approach to calculate uncertainties at the EU level including the assessment of the quality of the emission estimates at MS and EU level has been implemented and described in the NIR. This method was presented during the in-country-review in 2007 and its implementation in the EC-IR was suggested by the ERT. This has been complemented by a series of tables giving background information for the estimates of the uncertainty levels for activity data and emission factors.

For the submissions in 2008 through 2014, background information was further developed, in particular with regard to the general development and policy drivers in the countries. A new section was introduced giving most important information on the source category ‘Field Burning of Agricultural Residues’ and information on the methodology and trends of emissions in this category has been added. For the submission in 2011, a new section was added summarizing the findings of the GGELS project (Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS). In 2014, a comparison between submissions and data from the FAO GHG database has been included. Also, the section on sector-specific recalculations was completely ‘re-designed’ and the description of sector-specific quality assurance and quality control was improved.

For the submission 2013, the discussion of the share of manure excretion by IPCC climate zones was extended and amended with an independent Europe-wide estimation of shares, together with additional background-information on the methodologies used by the MS. This project is of high relevance also for the submission of the EU GHG inventories, because

- The project might help identifying data gaps which will be discussed in the Working Group on Agri-environmental indicators at EUROSTAT and could lead to improvements of data collection, such as the Survey on Agricultural Production Methods (SAPM) which was carried out in 2010[54]
- The project aims at enhancing cooperation between countries and for various reporting obligations. The EUROSTAT/OECD methodology and handbook on Nutrient Budgets explicitly mentions the link to GHG inventory systems.

Continuous work with MS helps to identify and correct errors; and justifications for un-documented national emission factors have been requested (for example, for the use of IPC2006 default values) and are now also included in national inventory reports (Germany). Even though **the number of errors could be significantly reduced with regard to previous submissions,** a few errors remain and have been requested to be corrected by the MS, such as for example a few (remaining) mistakes in the units reported.

The MS CRF tables are carefully checked on these errors and corrected before calculating the background data for the European Union.

The generation of the chapter on agriculture is now highly automated in order to reduce the risk of inconsistencies between NIR and CRF.

6.6.2 Reviews

Table 6.105 gives an overview on issues raised during recent UNFCC reviews and how this has been addressed in the current submission or will be addressed in future submissions of the EU GHG inventory.

Table 6.109 compiles recommendations made for country-reviews and lists countries' responses as available from the national IRs.

Table 6.105: Recommendations from Expert Reviews with regard to the agriculture sector of the EU GHG inventory and comments

Refer ences	***Source Issues***	***Reccommendation/ improvements planned***	***Comment***
ICR 2013		*ERT encouragement: use the NIR structure as it is included in the Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol.*	*New structure will be implemented for submission 2015*
ARR 2013		*para 67. The ERT commends the Party for the increased use of higher-tier approaches in comparison to the 2012 annual submission (e.g. for manure management, the percentage of emissions estimated based on a country-specific methodology increased from approximately 63 per cent in the 2012 annual submission to 86 per cent in 2013). The ERT recommends that the European Union further support and encourage member States to develop country-specific AD and EFs in order to allow for increased use of higher-tier approaches.*	*The European Union is organizing a workshop to discuss with countries the development of country-specific methods; information on this activity has been included in the submission 2014.*

[54] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Survey_on_agricultural_production_methods_%28SAPM%29

Refer ences	*Source Issues*	*Reccommendation/ improvements planned*	*Comment*
ICR 2013	*Consist .*	*• Several inconsistencies within the NIR, for example: o in Tables 6.14 and 6.86 a Tier 1 method is specified as used by Greece for Non -Dairy Cattle, while in Table 6.15 a Tier 2 method is presented; o in Table 6.23 only the value of uncertainty associated with the Cattle livestock number in Austria in presented, in Table 6.24 only the value for Cattle related EF is included, while in Table 6.25 containing background information from the MSs NIRs, values are included for all livestock. • ERT recommendations: o improve the implementation of QC activities; o update the algorithm of inclusion of MSs data and information into the EU inventory .*	*Greece problem solved by checking and correcting the algorithm for estimating the Tier level (rounding problem); Problem with AT-uncertainties will be checked for the 2014 re-submission in May; a full review of the chapter will be done after the April submission.*
ARR 2012	*Transp.*	*In addition, the ERT identified some transparency issues linked to the reporting of the tier method used to estimate CH_4 emissions from enteric fermentation in tables 6.2, 6.14 and 6.15 of the NIR for sheep and cattle for some member States. During the review, the Party explained that the aforementioned three tables have different sources: table 6.2 was obtained from the officially submitted CRF tables of the European Union member States; table 6.15 comprises quotations from the member States' NIRs, with the level of detail and nature of the information depending on each NIR; and table 6.14 provides a quantification of the tier level according to the approach from Leip (2010).9 The ERT recommends that, in the next annual submission, the Party improve the transparency of the reported information. The ERT welcomes the information provided by the Party on the thorough update of the tables on the basis of the data in the NIRs for the next annual submission. (para 74)*	*Transparency with respect to the reporting of the Tier levels has been improved in the NIR2014 by omitting the table providing country estimates and focussing on the presentation/discussion of the Tier levels estimated with the EU-wide approach as explained in the sectoral chapter.*
ARR 2012	*Consist .*	*The ERT noted some inconsistencies within the NIR, within the CRF tables and between the CRF tables and the NIR concerning the reporting of some data and methods. For example: a tier 1 method for estimating emissions from enteric fermentation is reported for France in table 6.15 for sheep, whereas a tier 2 method is reported in table 6.14 and a tier 3 method in table 6.3;*	*With regard to inconsistencies of Tier level reporting see above.*
ARR 2012	*Consist .*	*the summation of the allocation per animal waste management system for swine is lower than 100 per cent in table 6.29 (74 per cent) and table 6.30 (80 per cent) of the NIR; and reference is made to a non-existent CRF table 7s2 in section 6.3 of the NIR. The ERT also noted that data on the weight reported for different livestock differ from CRF table 4.A to CRF table 4.B(a); and that the numbers of dairy cattle and non-dairy cattle are reported as 17,525,000 and 58,515,000, respectively, in table 6.13 of the NIR and CRF table 4.A, and these values are different from those reported in table 6.16 of the NIR for dairy cattle (19,045,000) and non-dairy cattle (61,169,000). In response to questions raised by the ERT during the review, the Party attributed the inconsistencies related to the population size of dairy cattle and non-dairy cattle within the NIR and between the NIR and the CRF tables to unintentional double counting of the number of cattle that were reported using option B. The ERT recommends that, in the next annual submission, the European Union improve its QC activities to ensure the consistency of the reporting within the NIR, within the CRF tables and between the CRF tables and the NIR. (para 75)*	*Problems related to the reporting of animal heads (instead of 1000 heads) and consequently inconsistent data in the CRF (not corrected from country-submission) and the NIR (corrected in order to have comparable information) have been resolved already in the 2013 submission, as well as the error with regard to the reporting of animal number under Option A and Option B. Also the allocation of manure to 'other' system has already been provided in the 2013 submission ensuring that the numbers add up to 100%.*
ARR2 013	*Transp.*	*68. Recalculations were performed for the entire time series (see table 9 below) and are documented in the NIR at the sectoral level. However, only the reasons for recalculations by categories for some member States are included, and it is not clear whether all the reasons for recalculations are reported. In addition,*	*For the NIR 2014, the section on recalculation (chapter 6.8) has been completely revised. It contains now a direct link to the data reported in the CRF tables in form of summary graphics, showing the impact of the recalculations from 1990 to the last year before the current last*

Refer ences	*Source Issues*	*Reccommendation/ improvements planned*	*Comment*
		no numerical information by member State on the impact of recalculations per category is included (CRF table 8(b) only refers to member States which performed recalculations). Furthermore, there are inconsistencies in how recalculations are presented in the NIR. For example, a section on the recalculations of CH_4 emissions from field burning of agricultural residues is not included in the NIR, but a section on the recalculations of CH_4 emissions from agricultural soils is (although it includes primarily a discussion on rice cultivation). The ERT reiterates the recommendation made in the previous review report that the Party include in the NIR information on recalculations for all member States that conducted recalculations, including numerical information per member State, and include the rationale and impact of the recalculations on the category. The ERT encourages the European Union to include a specific section in the NIR on the recalculations performed for CH_4 emissions from field burning of agricultural residues and recommends that the Party resolve the error described above in the section on agricultural soils.	*reporting year as well as the contribution of countries to total EU-15 changes due to recalculation. For each source category, a table giving details on the recalculations as described in the national IRs is given.*
ARR 2012	*Transp.*	*However, the ERT noted some issues relating to a lack of transparency, as background information related to data and methods is not provided for all member States (e.g. tables of background information on AD and EFs related to CH_4 from manure management covered 11 and 14 member States, respectively; background information on methods and EFs related to N_2O from manure management was provided for nine and six members States, respectively; and the background information on agricultural soils, including methods, data and parameters, such as $Frac_{GRAZ}$, $Frac_{GASF}$, $Frac_{GASM}$ and FracLEACH, also did not cover all member States). The ERT reiterates the recommendation made in the previous review report that the European Union provide complete background tables with information for all member States in its next annual submission. (para 73)*	*The methodological background tables in Chapter 6 of the NIR compile information that is useful for understanding national data/approaches in addition to other information already provided. For example, if a country used defaul FracLEACH there is no addtional background information that would be to add to this table. This has been made clear for the submission 2013 by modifying the header of the table now saying "Available background information ...".*
ICR20 13	*Uncerta inty assess ment*	*Include in the NIR uncertainty data for all member States and for the European Union at the category level, as well as category-specific planned improvements*	*Complete information on uncertainty estimates will be attempted to obtain and included in the re-submission in May 2014. A thorough re-structuration of the agriculture chapter is foreseen for the submission 2015.*
ARR2 013	*4A*	*para 69. The ERT noted that sheep and swine population numbers reported in the CRF tables are below the values included by the Food and Agriculture Organization of the United Nations (FAO) (0.6 per cent and 3.5 per cent difference, respectively). In response to a question raised by the ERT during the review, the European Union identified which member States are mainly responsible for the differences (for sheep, Ireland and Portugal are responsible for approximately 80 per cent of the difference and in the case of swine, Germany and Portugal are responsible for over 90 per cent) and provided the rationale for them. The ERT encourages the European Union, in the context of implementing its verification activities, to include in the NIR the results of the comparison of livestock population data used in the inventory with similar data reported to FAO and Eurostat, together with the description of the potential reasons for differences.*	*A brief section on comparing relavant actity data reported with data from FAO and CAPRI has been included in the submission 2014.*

Refer ences	*Source Issues*	*Reccommendation/ improvements planned*	*Comment*
ARR2 013	*4A - Trans*	*para 70. The ERT noted that in table 6.20 of the NIR some additional background information on milk production (kg milk/head/day) associated with the CH_4 emissions for dairy cattle are reported as "NA" for the Netherlands, while data which allow their derivation (milk production expressed as kg milk/head/year) are available in the respective member States' NIRs. The ERT recommends that the Party continues its efforts to achieve the completeness and comparability of reported data.*	*Missing background data are identified and countries have been asked to provide the data using the EU-QA/AC web tool.*
ARR2 013	*4B*	*para 72. The ERT commends the Party for the inclusion in the NIR of a distinct section on the distribution of livestock by IPCC climate regions, including the comparison of data reported by member States with an independent estimate elaborated by JRC. During the review, the Party presented the need to further assess, perhaps in a workshop setting, the conclusions of the previously presented analysis considering also the uncertainty associated with the model used. The ERT welcomes the Party's initiative to consider further these conclusions, including through workshop(s) and through Working Group 1 under the Climate Change Committee. The ERT recommends that the Party continue the analysis through the collaboration between the JRC, member States, DG CLIMA and EEA, focusing on the differences revealed. In addition, the ERT recommends that the Party, as appropriate, update the member States' livestock allocation to climate regions and associated parameters and report in the NIR on the status and results of any further analysis.*	*A dedicated report on this issue has been provided to Member States early 2013 and been included in the NIR2013. Consistency in the reporting of climate regions has been improved for the NIR2014.*
ARR2 013	*4B - Cons.*	*71. During the review, the Party described a pilot project implemented by Eurostat and member States (in cooperation with JRC) related to animal waste management systems (AWMS). The ERT commends the Party for the extensive discussions held at the European Union level with the goal of developing country-specific parameters for AWMS and housing, as well as the implementation of the pilot project and use by member States of the results. The ERT welcomes the European Union efforts and recommends that the Party continue efforts to develop and implement country-specific data. The ERT encourages the European Union to consider further opportunities to coordinate EU-wide data collection and inventory improvements, including through Working Group 1 under the Climate Change Committee. In addition, the ERT recommends that the European Union report in the NIR on the status and results of further progress in collecting farm-level data.*	*Cooperation with EUROSTAT on data collection (SAPM) and methodological issues with high relevance for GHG emissions estimation (RegNiBal project, LiveDate project) is ongoing. A brief section on this topic will be included in the NIR 2014.*
ARR2 013	*4C - trans*	*para 66. The ERT found several areas where there was lack of transparency in the NIR. For example, table 6.61 on relative uncertainty estimates for AD and EFs for rice cultivation includes data only for Greece, Italy and Portugal, although the activity occurs also in France and Spain. In addition, the NIR does not include a section on category-specific planned improvements. The ERT encourages the European Union to use the NIR structure as it is included in the annotated outline of the NIR. The ERT recommends that the Party include in the NIR uncertainty data for all member States and for the European Union at the category level, as well as category-specific planned improvements.*	*No information on the uncertainty estimates from France and Spain was available from the national IRs. This information has been added for the NIR2014. Category-specific planned improvements, as available from the national IRs are included.*
ARR2 013	*4D*	*para 73. According to table 6.75 in the NIR, N_2O emissions from the cultivation of histosols for Portugal and Ireland were regarded as negligible although in CRF table 4.D the AD and emissions were reported as "NO". In response to a question raised by the ERT during the review, the Party responded that in relation to Portugal the NIR already*	*Portugal added additional information in the NIR (page 6-62) saying "Considering climate conditions, and the long period since when soils have been subjected to agriculture in Portugal, histosols are not present in Portugal and N_2O emissions from histosols may be reported as not occurring. This is also supported by data*

References	***Source Issues***	***Reccommendation/ improvements planned***	***Comment***
		describes that histosols are at most negligible, which is supported by data available at European Soil Data Centre. Regarding Ireland, the Party responded that based on discussions with experts on agricultural practices and geographic information system analysis, cultivated organic soils are designated as not occurring, that non-permanent grassland is accounted for under cropland, consistent with the definition of arable land temporarily used for forage crops or grazing (page 3.69 of the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (hereinafter referred to as the IPCC good practice guidance for LULUCF)). The Party also indicated that, in its understanding, the term "cultivated" refers to soil disturbance by ploughing, and that discussions on the term were included within the KP-LULUCF workshop organized by JRC in November 2013. Additionally, the Party responded that data from FAO on the existence of cultivated organic soils for agricultural purposes might reflect that sometimes countries report data on the drained areas. The ERT recommends that the Party resolve the inconsistencies between the NIR and CRF tables, clarifying whether emissions arise from cultivation of histosols. The ERT commends the Party for the inclusion of a discussion on the meaning of "cultivated" in the JRC KP-LULUCF workshop in November 2013, believing that the term includes more than ploughing, and recommends that the European Union include in the NIR the clarifications provided to the ERT during the review, together with the results of the workshop discussion.	*available from the European Soil Data Centre (ESDAC, see http://eusoils.jrc.ec.europa.eu/wrb/) which show no presence of peat in Portugal.".* *For Ireland, cultivated organic soils are designated as "not occurring", i.e. "NO" in the CRF tables for Ireland, in agreement and on the basis of discussions with the respective experts in agricultural practices and GIS analysis, pending the results of proposed research (due to start shortly). (see IR-IR, page 189) Emissions from carbon stock changes on organic soils are reported in the LULUCF sector, which could be seen as inconsistency between the sectors. However, as a reply to the ERT, Ireland notes that "The Inventory Agency considered this comment, however it is not clear what is at issue. The grasslands areas for which carbon losses are reported are drained organic soils. They are not cultivated in a conventional cropland sense. The emission are reported under LULUCF as they are due to the land use activity (i.e. drainage) and would occur regardless of whether the grassland is used for agricultural production or not. "* *A comparison of the area of cultivated organic soils as reported by the NIRs, the FAO and a calculation made by JRC is provided in the EU-IR2014.*
ICR2013	*4A, 4B, and 4D - Cons.*	*Several inconsistencies between the NIR and CRF tables, for example:* *o in page 499 of the NIR reindeer, deer, fur farming, rabbits and other poultry livestock are presented as characterized by several MSs while in the CRF tables 4.A, 4.B(a)s1 and 4.B(b) NE has been assigned to the population data. ERT recommendations: strengthen the QC activities; update the algorithm of extracting MSs CRF data and filling of the EU CRF. (partly re-iteration of para 82 from ARR 2012)*	*Efforts will be undertaken in improving the reporting of sewage sludge as part of the EU-CRF tables rather than only in the NIR. For animal types, this problem will be solved in the transition to new IPCC2006 CRF reporter*
ARR2013	*4D*	*para 74. The ERT noted a large inter-annual change in the fraction of livestock nitrogen excreted and deposited onto soil during grazing (FracPRP) between 2010 (0.3512) and 2011 (0.3315), the 2011 value being 5.6 per cent lower than 2010. In response to a question raised by the ERT during the review, the European Union indicated that this is due to a mistake resulting from the use of a zero in the FracPRP to reflect the non-reporting by the United Kingdom. The Party added that the correct value for 2011 is 0.3475, resulting in a 1 per cent decrease. The ERT notes that this error does not lead to an underestimate of emissions, but recommends that the Party include the correct value and improve the implementation of QC procedures in order to prevent such errors.*	*The data series have been checked on completeness of the time series as part of the improved QA/QC procedures.*
ARR2013	*4E*	*para 64. Prescribed burning of savannas is reported as "NA, NO" in CRF table 4.E but no information is included in the NIR. The ERT recommends that the European Union provide information in the NIR on the occurrence of this category within the Party*	*Savanna does not occur in Europe. This information has been added for the NIR2014*

Refer ences	Source Issues	Reccommendation/ improvements planned	Comment
ICR2013	*4F*	*• The Agriculture Sector is complete, but several elements were not included in the NIR, for example: o in Table 6.84 on CH_4 and N_2O emissions from IPCC 4F category, the activity has not been characterized for Belgium, Germany, Ireland, Luxemburg, Netherlands, Sweden and United Kingdom of Great Britain and North Ireland; o in Table 6.85 on methodologies used to estimate CH_4 and N_2O emissions associated to the IPCC 4F category, no methodological element but a general description was included while for Greece, except the fraction of residues burned on field, no AD, EFs and estimation method were presented. • ERT recommendations: o strengthen the QC activities; o update the algorithm of filling the EU NIR from the data and information provided by MSs; o strengthen the collaboration between EU and MSs in order that complete data and information be included in the MSs NIRs, for example, in the context of the Working Group 1 under the Climate Change Committee and/or dedicated workshop(s)*	*Field burning of agricultural residues is not occurring in some countries. With regard to the characterization of small contributors to total emissions of a specific emission category, care has to be taken to not overload the report with information of little relevance in view that data from many countries have to be covered.*

Table 6.106: Compilation of recommendations from Expert Reviews for EU countries with regard to the agriculture sector and comments as available in the national IRs 2014

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Austria	
Para 49: The ERT recommends that all country-specific data be presented in the NIR in the tables for all reporting years, briefly indicating the sources of such data.	As requested, a table is included giving overview of country specific data related to emissions from manure management and sources from which the information is taken (Chapter 6.1.3., table 154). Tables with the distribution of manure in AWMS for all animal categories is provided (Annex 6). Additional information on the derivation of the share of manure digested in biogas plants is included (Chapter 6.3.2).
Para 50: The ERT recommends to improve the transparency and accuracy of the information provided in the CRF tables and report data on AWMS for all animal categories and corrected data on weight for dairy cattle in its annual submission.	*Additional information on the derivation of the share of manure digested in biogas plants is provided. Regarding the different weights reported for dairy cattle in the CRF tables and the weight used in the model which calculates CH_4 emissions (where a constant weight of 700 kg is used), an explanation is included in the NIR (Chapter 6.2.2.1).*
Para 51 (Direct soil emissions) and 52 (Indirect soil emissions): Reviewers requested additional explanation on the N-flow model used for the calculation of emissions from agricultural soils.	Additional explanation has been included (annex 6).
Para 53: the ERT recommended to investigate the revised data from 2009 and the results of the agricultural survey carried out in 2010 and improve AWMS distribution for sheep, goats, horses and other animals.	*This has not been addressed*
Para 54: Reviewers recommended to review the use of the notation "IE" and "NO" in the CRF tables for mules and asses (reported under horses category).	*This has been changed, replacing "IE" by "NO" for all AWMS not relevant for horses, mules and asses.*
Bulgaria	

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Para 56: Incorporate information on the rationale for recalculations made between 2012 and 2013 submissions into the NIR for each category where recalculations occur.	
Para 57, 58, 59: Several inconsistencies found between data in the CRF and in the NIR, different places in the NIR or between text and figures. The ERT recommends to correct errors and improve the QA/QC	
Para 60: The ERT recommends to include in the NIR detailed information on how emissions from enteric fermentation for young cattle were recalculated.	*Animal weight value has been changed (chapter 6.4.5)*
Para 61: The ERT recommends to justify the use of a MCF of 90% for anaerobic lagoon, which seems too high, and encourages Bulgaria to make efforts to develop a country-specific value.	*Not yet addressed*
Para 62: Details on the sources of country-specific data on manure production and N content of swine and cattle.	*Not yet addressed*
Para 63: The ERT strongly recommends that Bulgaria verify and document the country-specific manure Nex values used in the inventory for dairy cows with well-documented and detailed values. This should include analysis of manure production, dry matter content, VS content and N content for a number of animals housed in different stable types and with different productivity and for all cattle categories. If this was not possible, then the recommendation is to use the default Western European Nex value.	*Not yet addressed*
Para 64: Regarding the Nex for poultry, the calculation was not clear. The ERT recommends to improve the QA/QC procedures to reduce inconsistencies between NIR and CRF tables and to include detailed information in the NIR.	*Nitrogen excretion for poultry has been changed (chapter 6.4.5)*
Para 65: Bulgaria was recommended to develop country-specific values for VS for cattle and sheep. The study is on-going, and the ERT recommends to report on progress on the review of the VS estimates in the NIR.	*Not yet addressed*
Para 67: Given the availability of detailed data on ammonia volatilization form the CLRTAP, the ERT recommends to use country-specific parameters to estimate N_2O emissions from ammonia volatilization and report them under the indirect oil emissions category.	*Not yet addressed*
Para 68: The ERT encourages the Party to check whether the selection of the emission factor for rice cultivation is consistent with the organic amendment practice in the country, and preferably to develop a country-specific EF based on field measurements.	*Not yet addressed*
Para 69: The ERT recommends that Bulgaria either provide a justification for the values used in the CRF tables for agricultural field burning or correct these values using the IPCC GPG default values.	*Not yet addressed*
Croatia	
Para 46: Croatia applies tier 1 methods for the estimation of CH_4 emissions from enteric fermentation for all animals except for cattle and uses default EFs for developing countries until 2007, and for developed countries from 2008. The ERT recommends to use default EF for developed countries for all years in accordance with the IPCCC GPG.	*Included in the improvement plan for 2015 submission.*
Para 47: Croatia uses the notation "NO" for reporting CH_4 emissions from agricultural soils in CRF table 4; the ERT considers that "NA" is more appropriate and recommends to replace "NE" by "NA" for parameters not applied in the calculations when using a tier 1 method.	*Included in the improvement plan for 2015 submission.*
Para 48: Improvement of transparency, including background information on the evaluation of AD compiled, information on how time-series consistency is ensured, data sources and information on representativeness of yearly average milk yields and clear references to equations, parameters and EFs.	*Included in the improvement plan for 2015 submission.*
Para 49: ERT recommends to apply results of on-going studies on country-specific EFs and AWMS distribution as soon as they are available.	*Included in the improvement plan for 2015 submission.*
Para 50: Report all relevant parameters and fractions related to the AD and the calculation of N_2O emissions from N-fixing crops and crop residues in CRF table 4F.	*Included in the improvement plan for next year for 2015 submission.*
Para 51: Some errors were identified in the reporting of milk yield, table CRF table 4.A. ERT recommends to improve the sector-specific	*Included in the improvement plan for next year for 2015 submission.*

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
routine QC procedures.	
Para 52: Update the list of sector-specific improvements and implement the improvement on schedule.	*Included in the improvement plan for next year for 2015 submission.*
Para 53: Recommend to apply tier 2 method in CH_4 emission estimations, reflecting the result of the on-going projects launched with that purpose.	*Included in the improvement plan for next year for 2015 submission.*
Para 55: The ERT recommends to start the planned work to develop country specific EFs from manure management and AWMS distribution, in order to include the refined estimates in the next submission.	*Included in the improvement plan for next year for 2015 submission.*
Para 57: Inconsistency was found between reported swine population, Nex/head and total N excreted in all AWMS. The ERT recommends to correct the error.	*Included in the improvement plan for next year for 2015 submission.*
Para 61: the ERT recommends to include additional explanation on the absence of data on N_2O emissions from sewage sludge prior to 2005.	*Included in the improvement plan for next year for 2015 submission.*
Estonia	
Para 42: The ERT identified several small discrepancies without impacts on the calculations but due to incorrect reporting in the CRF tables (e.g. incorrect copy and paste). The ERT encourages Estonia to identify the actual reasons for this type of error in its reporting and encourages the Party to enhance its QC checks.	*The omissions have been corrected. Efforts are being made to avoid similar errors during the next submissions.*
Para 43: Uncertainty estimates have been implemented according to the tier 1 method presented in the IPCC good practice guidance. Although tier 2 methods are used for the calculation of emissions from most of the key categories related to livestock, default uncertainty values have been used for most parameters. The ERT encourages Estonia to investigate the possibility of using more country-specific data for the uncertainty estimates in relation to the calculations that are actually implemented.	*Estonia has taken notice of the encouragement to investigate the possibility of using more country specific data for the uncertainty estimates and is considering to look into the matter in the following submissions.*
Para 44: Estonia reported CH_4 emissions from enteric fermentation for poultry as "NE". The ERT encourages Estonia to estimate the emissions.	*To date Estonia is not actively weighing the possibility to start reporting CH_4 emissions from enteric fermentation for poultry as no methodology in the Revised 1996 IPCC Guidelines or in the IPCC good practice guidance is available.*
Para 45: For fur-bearing animals, Estonia has used an EF from Norway. The ERT reiterates previous encouragement of developing country-specific EFs, although considers it a minor issue that could be resolved by comparing the types of animals that were used to develop the Norwegian EF with the fur-bearing animals that are bred in Estonia.	*The EFs were received from a Finnish expert in the agriculture sector. The same factors are used in Finnish GHG emission inventory. Since, Estonian conditions are close to Finnish, it was decided to implement the EFs in the estimations of the emissions. However, due to a negligible contribution of emissions occurred due to fur-animals breading (less than 0.05% to the total CO_2 eq emissions occurred in the agriculture sector) and due to the lack of resource, the encouragement given by the ERT was not implemented in the present submission.*
Para 49: An omission was identified in the reporting of the allocation structure of manure management systems for swine in CRF table 4.B(a). The ERT recommends that Estonia amend this incorrect reporting.	*The recommendation was implemented in the 2014 submission; the omission has been corrected (CRF table 4B, not in the NIR because the correction did not affect the calculation of emissions)*
Para 50: A copy and paste omission was identified in the reporting of the N excretion values for dairy cattle and furbearing animals in CRF table 4.B(b). The ERT recommends that Estonia amend this incorrect reporting.	*The recommendation was implemented in the 2014 submission; the omission has been corrected (NIR sub-section 6.4.2.7)*
Para 51: Regarding a sharp increase in N excretion for dairy cattle between 2007 and 2008, Estonia explained that this trend is due to the combined effect of the sharp increase in the milk yield between 2007 and 2008 and the use of milk yield dependent values for the N content in cattle feed. The N content in food values is based on an Estonian publication (Kaasik et al., 2002). *The ERT considers that this explanation is satisfactory and commends Estonia for using a dynamic value for the N content in cattle feed, which is reliable information. However, the ERT also encourages Estonia to investigate the possibility of smoothing this effect, which appears to be a threshold effect and may not be in line with good*	*The recommendation of increasing the transparency by explaining the trend of N excretion for dairy cattle in the NIR has been implemented in the 2014 submission. The encouragement made by the ERT for Estonia to investigate the possibility of smoothing the sharp increase in N excretion for dairy cattle between 2007 and 2008 has been taken under consideration (NIR Appendix A3.3_V).*

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
practice. The ERT recommends that the Party increase the transparency of this issue by explaining the trend of N excretion for dairy cattle in the NIR. The ERT also recommends that Estonia report the fact there is dynamic N content in the feed of dairy cattle, which is not currently the case, in appendix A.3.3_V of the NIR.	
Para 52: An omission was identified in the reporting of AD for pasture in CRF table 4.D for 2011. The ERT recommends that Estonia amends this incorrect reporting.	*The recommendation has been implemented in the 2014 submission; the omission has been corrected (NIR Subsection 6.6.4).*
Para 53: Estonia plans to develop a more accurate value for the parameter fraction of total above-ground crop biomass that is removed from the field as a crop product (FracR). The ERT recommends that Estonia revise its estimate of FracR on the basis of national studies.	*The work for developing a more accurate value for the parameter fraction of total above-ground crop biomass that is removed from the field as a crop product is in progress.*
Finland	
Para 52: Based on the recommendations made in the previous review report, Finland made a series of changes for which the ERT recommends now to improve the documentation in the NIR, so as to improve transparency.	*The descriptions have been improved in the present report (sections 6.4.2.2, 6.2.4, 6.3.4 and 6.4.4)*
Para 53: The ERT recommends to clearly document the external review QA/QC and verification procedures carried out for the agriculture methodology.	
Para 54: The ERT recommends to improve transparency in the QA/QC and verification sections of the NIR, where the country refers to "comparing emission factors with national data" but these national data are not provided.	*As these data are not published, it the references to the comparisons were removed (sections 6.2.4, 6.3.4 and 6.4.4).*
Para 57: Finland reported that a weight gain of zero was used in calculations of enteric fermentation for dairy cows and suckler cows, which did not correspond with live weights reported in table 6.2.5 of the NIR or with weights used in the N budget model.	*Finland corrected the data used for the calculation of enteric fermentation and it matches now the data in the N model (Section 6.2.5).*
Para 59: The ERT recommended to report in the NIR the ratio used to divide N between urine and dung, with a reference to the source of information (Section 6.3.2.1).	*It has not been completed, but the description will be improved and the reference included in the next submission.*
Para 60: The ERT requested more information on the calculation of N excretion used (Grönroos et al., 2009).	*A new appendix has been added (Appendix 6b).*
Para 62: The ERT recommended further explanations on the changes in crop areas.	*More text on the trend variations was added (Section 6.1.1).*
Para 63: In CR table 4.D, Finland reported the value for $Frac_{NCRBF}$ *as "NA", while it had been reported as a value in previous submissions. The ERT recommends to add the value to the tables in the form of weighted average of the N fraction in N-fixing plants.*	*Weighted averages were now reported (Table 6.5-2).*
Para 65: The ERT recommends to review national data on fertiliser use and provide in the NIR a description of the distribution of fertiliser types used in Finland and document the source of information.	*A table on fertilisers was added (Table 6.4-8).*
Para 66: The ERT recommends to produce an report in the NIR country-specific information or data that justify the choice of an EF that is lower than the default EF for CH_4 *emissions from manure management in liquid storage systems.*	*Conditions in Finland and Sweden are similar and thus the reference to Swedish studies is considered suitable for Finland (Section 6.3.2.3)*
Germany	
Para 52: Include as part of the annual submission a separate report and Excel files describing the inventory calculations for the agriculture sector (as was done in the 2012 annual submission), or provide the parameters and EFs by subcategory, as well as information on the process to aggregate data, to improve transparency	
Para 53: Ensure time-series consistency of sheep population data and report on this in a transparent manner	
Para 54: Include the updated table on gross energy intake in the NIR	
Para 55: Provide a description of the data from which the percentage of slurry manure digested in biogas plants is derived, as well as a	

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
description of how the leakage rate is determined	
Para 56: Summarize in the NIR the information provided in the report on the development of an N_2O EF for solid manure	
Para 57: Improve transparency by including the explanation on fertiliser data used in the NIR	
Greece	
Para 41: Greece has not made recalculations for the agriculture sector between 2012 and 2013. Last year, recalculations were avoided due to the use of three-year average for AD. The ERT recommends Greece for this improvement.	
Para 42. The inventory for the agriculture sector is complete and includes estimates of all gases and for all categories for the whole time series, but the ERT considers that the transparency of the NIR requires further improvements (see paras. 47 and 51 below)	*Done, please see NIR section 6.2.2.*
Para 44: Greece has used provisional estimated data for some AD, including dairy cattle population and milk and yield data due to a delay in data delivery by EL.STAT. The ERT recommends to obtain actual statistical data, especially for the key categories, for all years of the time series for use in the calculation of the emission estimates. If that is not possible, the ERT recommends to provide a more detailed explanation of the provisional estimations.	
Para 46. For the estimation of CH_4 emissions from enteric fermentation for dairy cattle, Greece uses the tier 2 method, applying default Ym value from IPCC and default DE value for Mediterranean conditions. The ERT considers this value too low, given the level of milk production in Greece. The ERT strongly recommends that Greece investigate the national feeding conditions and develop country specific values for the next submission.	*Done, please see NIR section 6.2.2.*
Para 47. CH_4 emissions from enteric fermentation for sheep are based on the tier 2 method, using official annual statistics of total milk production of sheep. The ERT strongly recommends that Greece provide a better explanation of the AD used for the inventory in order to improve transparency, and a more appropriate explanation of the use of different mil production data, the generation of AD for the nomadic and domestic sheep populations and the input data used for the emission calculations, with clear references for data sources.	*The only available official data for milk production provided by EL.STAT. were used. Please see NIR section 6.2.2.*
Para 49. Greece provides in the NIR AD on the consumption of mineral fertilisers provided by the Pan-Hellenic Association of Professional Fertilisers Producers & Dealers (PHAPFDP). ERT noted that the data should be supported by documentation on how the data have been collected, estimates for sales and purchases from non-members of PHAPFDP, and local unregistered imports. The ERT strongly recommends that Greece document in the NIR the completeness of the AD and encourages to strengthen arrangements with data providers.	*Please see NIR section 6.5.2 for a reply on this recommendation*
Para 51. Greece applies country-specific AWMS distribution for cattle and swine. To calculate AWMS distribution, assumptions were made based on expert opinion which is not clearly explained. The ERT recommends the Party to continue its efforts to further refine the appropriate parameters for the entire time series, to investigate the AWMS for all animal types in detail and to update the information in the next annual submission.	
Para 52. Within the liquid management system for dairy cattle, the separation of solids is common practice in Greece. The fraction of VS managed according to liquid practices has been calculated according to management practices applied. The ERT recommends to include the shares of VS excretion per AWMS, as provided in CRF table 4.b(a), in the NIR of its next annual submission to improve the description of the method and justify expert judgement.	
Para 53. The ERT noted that Greece has reported in CRF table 4.B(a) the AWMS distribution data for 2011 only. The MCF for cattle, swine and sheep has been reported as "NA", "NE" or 0.0 for 2011. For the other years of the time series, 0.0 has been reported. Greece explained this must be due to a software problem. The ERT recommends to identify the cause of the error and report the correct data for the entire time series in the next submission.	
Para 54. In Greece's inventory, manure separation in dairy cattle	

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
husbandry results in different allocations to liquid and solid systems and is therefore reported in CRF table 4.B(a) under CH_4 emissions and in CRF table 4.B(b) under N_2O emissions from manure management. To improve transparency, the ERT strongly recommends to improve the description of the method used to derive the AWMS fractions (liquid and solid systems) from manure separation for the estimation of emissions in the relevant subcategories under manure management in the NIR.	
Italy	
Para 43: To improve transparency the ERT recommends that Italy document the methods used to estimate the 8.0 per cent emission reduction in the next NIR submission, including information on the share of covered/uncovered storage and the emissions rate for covered storage systems. The ERT also observed that, there has been a rapid increase in biogas recovery in recent years which is likely to have increased the share of covered storage, reducing the accuracy of the 8.0 per cent value. The ERT recommends that Italy review and revise this value, as appropriate, to take into consideration changes in waste management through the time-series.	*Additional information has been supplied in the NIR (chapter 6.3.2 Methane emissions (swine)). The collection of additional information on the share of covered/uncovered storage, the emissions rate for covered storage systems and the review of the percentage emission reduction is in progress, in collaboration with the CRPA and the ISTAT*
Para 44: The ERT recommends that Italy, in its next annual submission, include information about each crop production type and appropriate parameters for relevant crop production categories which are used for emission calculation to improve transparency.	*Additional information has been supplied in the NIR (chapter 6.5.2 Methodological issues (see Crop residues (FCR)) and in the Annex 7, A7.3 Agricultural soils)*
Para 45: The ERT recommends that Italy corrects the identification of the methodology used for field burning of agricultural residues in the NIR and in CRF table summary 3 in the next submission (IPCC methodology instead of CS methodology).	*The identification of the methodology has been corrected in the NIR and in CRF.*
Luxemburg	
Malta	
Para 54: Improve transparency, completing parameters missing in the CRF tables 4.A, 4.B(a), 4.B(b) and 4.D.	
Para 55: The ERT strongly recommends to develop and implement QA/QC procedures for the agriculture sector and provide information on uncertainty.	
Para 56: The time series for the population of all animal types are inconsistent. Data should be reviewed and should report on any recalculations.	
Para 57: Malta applies a country-specific EF from Italy for CH_4 emissions from enteric fermentation for rabbit. Malta should justify the applicability of that EF to national circumstances in the country.	
Para 58: Enteric fermentation has been identified as key category but tier 1 method is used. The ERT recommends to change to a tier 2 method.	*Included in the improvement plan.*
Para 59: The ERT recommends to split cattle population before 2000 in dairy and non-dairy cattle using an appropriate technique.	*The population has been split into dairy and non-dairy cattle (but not explained)*
Para 60: In the calculation of CH_4 emissions from manure management, Malta uses default EFs from EMEP/CORINAIR; they should refer to IPCC default EFs instead. The ERT also recommends, given the lack of data on AWMS, to assess the applicability of tier 1 default EFs and, if necessary, implement a higher tier method.	*References to EMEP/CORINAR have been replaced by IPCC, 1996.* *Efforts will be dedicated to get the necessary data to apply a tier 2 approach.*
Para 61: The ERT strongly recommends to replace the notation keys with figures in CRF table 4.B(b) and ensure that the information in the NIR and in the CRF tables is consistent.	
Para 62: The ERT recommends to compare the country-specific N excretion values for all animal types with the IPCC defaults and explain the differences.	
Para 63: Estimate N excretion rates and N_2O emissions from manure management for sheep, goats, horses and rabbits.	
Para 64: Information should be provided in the NIR regarding assumptions for the calculation of Nex from swine, and also additional explanation regarding the underlying data for the country-specific values presented in table 6.4.	
Para 65: Include estimations on emissions from crop residues and N-fixing crops.	*Emissions from N-fixing crops and crop residues have been incorporated for the whole time series.*
Para 66: Review the consistency of the time series of the use of	*Data on fertiliser inputs for 2010 and 2011 has been*

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
synthetic fertiliser and explain the trend in the NIR. Investigate the quality of the statistical data reported on N content of the imported fertilisers and describe corrections made to the statistical data in the NIR.	*revises and emissions recalculated.*
Para 68: The ERT recommends to improve the methodological description in the NIR, including a listing of all parameters used in the calculation and the values used for emissions from manure applied to soils.	
Para 69: Provide more information about the 90% swine slurry not applied to soils, including details on storage conditions.	
Netherlands	
Para 48: More information on models and gross energy intake.	*Reference included (www.cbs.nl) and improved Text (Chapters 6.2.3, 6.4.4 and 6.4.8)*
Para 49: Transparency of methods and parameters.	*Reference (Bannink, 2010) included (Chapter 6.2.3)*
Para 50 and 54: Buffalo's Notation keys	*We now use NO instead of NE (Improved CRF tables 4s1 and 4A)*
Para 51 and 55: Maintain consistency in the notation keys used to report emissions from buffalo, and mules and asses	*Emissions from mules are now included (Chapter 6.1 and improved CRF tables)*
Para 52: Consistency between N_2O and CH_4	*Has been identified as area for possible improvement*
Para 56: Include in the NIR detailed information justifying changes in the values for $Frac_{GASM}$, in order to increase transparency	
Para 57: Give more detail on cattle outdoor	*The decrease in N_2O emissions from animal manure produced on pasture land is also entirely reflected in the decrease in N input to soil by this source. (Chapter 6.4.4)*
Other modifications, responding to previous review (ARR 2012)	*(ARR2012, Para 71) The notation keys were reviewed an corrected (Improved CRF tables)* *(ARR 2012, para 72) The explanation of the model used to determine the value of the methane conversion factor for cattle has been improved (Chapter 6.2.3)* *(ARR 2012, para 73) We completed the CRF table 4.A to the extent possible within the Dutch methodology (Improved CRF table 4A)* *(ARR 2012, para 74) Other animals is comprised of rabbits and fur-bearing animals, producing solid and liquid manure respectively. Resulting IEF for this category is therefore very dependent on the ratio between both species in a given year (Chapter 6.3.3)* *(ARR 2012, para 76) Improved text and explanatory tables 6.7 and 6.8, justifying the changes in nitrogen flows (Chapters 6.4.4 and 6.4.8)* *(ARR 2012, para 77) "NE" has been used in CRF table 4 due to the fact that there are no IPCC estimation methods Available (Improved CRF table) A reference was included for data on the use of sludge in agriculture (Van der Hoek et al., 2007) (Chapter 6.4.4)* *(ARR 2012, para 78) In order to comply with the requirements set by the Farm Accountancy Data Network (FADN) of the European Union, from 2010 on a new definition for farms has been used. Before, the criterion for inclusion in the agricultural census was three Dutch size units (nge); this has been changed into 3,000 Standard Output (SO). The influence on measured population has been minimalized by setting the new criterion to a value that matches 3 nge.(Chapters 6.2.5, 6.3.5 and 6.4.6)*
Para 64: Implement pending recommendations from previous review to improve transparency, in particular regarding the STANK model.	*Information on the STANK model now included in the NIR (Chapter 6.3.2)* *Other improvements following 2012 review:* *QC procedures improved to ensure consistency of the information provided in the NIR and in the CRF*

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	tables (para 74 and 81) *The ERT recommended to include the values of the average gross energy intake and average CH_4 conversion rate for cattle for the entire time series (para 76). When these two variables are not actually used as input data in the calculations, Sweden has chosen to not include them in the NIR. The data are, however, included in the CRF-tables (Table 4.A) and are therefore easy assessable. All data needed to calculate the emissions are already included in the NIR.* *The ERT recommended to include information on the definition of AWMS in the relevant chapter in the NIR (para 79). Now the text in the NIR and the equation in chapter 6.3.2.2 satisfyingly describe how the PRP-manure is include in calculations* *Mismatching values for N excretion were presented in CRF tables 4.B(b) and 4.D (para 83). The amount of nitrogen in CRF table 4.D was not correct and has now been corrected.*
Para 66: Inter-annual changes in CH_4 IEFs for non-dairy cattle are significant. The ERT recommends that Sweden include in the NIR additional information explaining the reasons for those fluctuations.	
Para 67: Standard yield was used for estimating N_2O emissions from N-fixing crops and crop residues. This could result in an under estimation. Emission for the KP years will be resubmitted for both subcategories. The ERT strongly recommends that all time series for CRF tables 4.D.1.3 and 4.D.1.4 are to be estimated using actual yield data for all crops in the 2014 submission.	*All the crop yield activity data for the complete time series are now changed from standard yield to actual yield in submission 2014.*
Para 68: Sweden uses country-specific EF for N_2O emissions from animal manure applied to soils, which differ significantly from IPCC default values. The ERT recommends to include detailed information on the EF used.	
Selection of activity data from various sources is not sufficiently justified; i.e. AD for horses and chickens differs from Farm Statistics compared to other sources (low or too high). Detailed information as delivered is to be included in the 2014 NIR.	*See the clarifications in the end of paragraph "6.1 Overview of sector" in the NIR.*
Spain	
Para 49: The ERT recommends to revise and improve the GHG emission estimates by developing country-specific methodologies based on studies coordinated by the Ministry of Agriculture and Environment.	*Studies are on-going; some results have been incorporated for cattle, swine and poultry, also planned for sheep and goat.*
Para 50: The ERT recommends to include a summary table providing details of references used to develop the country-specific methodologies and parameters (for Tier 2).	
Para 51: Required ecplanation for key drivers of trends for the whole agriculture sector and by category.	
Para 53, 54: Improve transparency by incorporating detailed explanations of the data and assumptios used for the emission estimates, particularly when country-specific parameters are used, and a table containing information such as the EFs for the key categories and the relevant parameters uses in Tier 2 approaches.	
Para 56, 57: Include more detailed explanation on the manure management practices considered under 'other' category and provide additional information on the AWMS and the share of AWMS that are specific to Spain, focusing on differences with those described in IPCC guidelines.	
Para 59: There is an underestimation of N_2O emissions from pastures, as volatilization substracted from Nex prior to the calculation of direct N_2O emissions. The ERT strongly recommends to revise the estimates of N_2O emissions from pasture, range and paddock manure for the whole time series to be in line with the IPCC good practice guidance.	*The methodology for the estimation of N_2O emissions from manure deposited on pastures has been revised and adapted to the 'Saturday paper', substracting volatilization losses after the calculation of N_2O emissions.*

Issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Para 61: Spain reports negligible area of cultivated histosols. The ERT recommends to check it and report corresponding emissions if appropriate.	
Para 62, 63: The ERT recommends to include in the NIR a separate chapter on field burning of agricultural residues and another separate section on emissions from rice cultivation.	*Still not done, both categories of emissions are under the section "other, non key sources"*
Slovenia	
Para 48: The ERT recommends to provide correct values in CRF table 4.B(a) for all years of the time series and to strengthen the QC of the data entry in the CRF Reporter from the database.	*The errors have been corrected.*
Para 49: Provide more transparent documentation with additional information on the methodologies and parameters used to estimate emissions from AWMS, including a table on AWMS by livestock category.	*Additional information has been included (Annex 3 of the NIR)*
Para 51: Apply the available pasture data for 2010 and interpolate the pasture data for the years 2001–2009, accordingly.	
Para 52: Provide additional information in order to clarify how the time series of Nex values for non-dairy cattle was obtained and to improve the description of the development of the Nex values for swine, in order to improve the transparency of the inventory.	*A sub-chapter has been added with long explanations on the selection of Nex for cattle and swine and their comparison with IPCC default.*

6.6.3 Workshops and activities to improve the quality of the inventory in agriculture

6.6.3.1 Workshop on "Inventories and Projections of Greenhouse Gas Emissions from Agriculture" (2003)

As a first activity to assure the quality of the inventory by Member States, a workshop on "Inventories and Projections of Greenhouse Gas Emissions from Agriculture" was held at the European Environment Agency in February 2003. The workshop focused on the emissions of methane (CH_4) and nitrous oxide (N_2O) induced by activities in the agricultural sector, not considering changes of carbon stocks in agricultural soils, but including emissions of ammonia (NH_3). The consideration of ammonia emissions allows the validation of the N_2O emission sources and it further strengthens the link between greenhouse gas and air pollutant emission inventories reported under the UNFCCC, the EC Climate Change Committee, the UNECE Long-Range Transboundary Air Pollution Convention, and the EU national emission ceiling directive. Objectives of the workshop were to compare the Member States' methodologies and to identify and explain the main differences. The longer term objective is to further improve the methods used for inventories and projections in the different Member States and to identify how national and common agricultural policies could be integrated in EU-wide emission scenarios.

Information on the workshop and the recommendations can be downloaded at the following website: **http://ccupeople.jrc.ec.europa.eu/leip/expmeetcat4d_2004/recommendations.htm**

6.6.3.2 Survey on agricultural production methods (SAPM 2010)

The **Survey on agricultural production methods**, abbreviated as **SAPM**, is a once-only survey carried out in 2010 to collect data at farm level on agri-environmental measures. EU Member States could choose whether to carry out the SAPM as a sample survey or as a census survey. Data were collected on tillage methods, soil conservation, landscape features, animal grazing, animal housing, manure application, manure storage and treatment facilities and irrigation. With reference to irrigation, Member States were asked to provide estimation (possibly by means of models) of the volume of water used for irrigation on the agricultural holding.

The characteristics that were collected are given in the REGULATION (EC) No 1166/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on farm structure surveys and the survey on agricultural production methods[55] and further defined in the COMMISSION REGULATION (EC) No 1200/2009 of 30 November 2009 implementing Regulation (EC) No 1166/2008 of the European Parliament and of the Council on farm[56].

A list of characteristics of potential relevance for the quantification of GHG emissions is given in Table 6.107.

[55] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R1166&qid=1396776467775&from=EN

[56] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009R1200&qid=1396776467775&from=EN

Table 6.107: Selected characteristics included in the 'Survey on agricultural production methods' (SAPM)

Animal grazing	Grazing on the holding	Area grazed during the last year	ha
		Amount of time when animals are outdoors on pasture	Months per year
	Common land grazing:	Total number of animals grazing on common land	Head
		Amount of time when animals are grazing on common land	Months per year
Animal housing	Cattle:	Stanchion-tied stable — with solid dung and liquid manure	Places
		Stanchion-tied stable — with slurry	Places
		Loose housing — with solid dung and liquid manure	Places
		Loose housing — with slurry	Places
		Other	Places
	Pigs:	On partially slatted floors	Places
		On completely slatted floors	Places
		On straw beds (deep litter-loose housing)	Places
		Other	Places
	Laying hens:	On straw beds (deep litter-loose housing)	Places
		Battery cage (all types)	Places
		Battery cage with manure belt	Places
		Battery cage with deep pit	Places
		Battery cage with stilt house	Places
		Other	Places

Manure application	Utilised agricultural area on which solid/farmyard manure is applied	Total		UAA % band (2)
		With immediate incorporation		UAA % band (2)
	Utilised agricultural area on which slurry is applied	Total		UAA % band (2)
		With immediate incorporation or injection		UAA % band (2)
	Percentage of the total produced manure exported from the holding			Percentage band (3)
Manure storage and treatment facilities	Storage facilities for:	Solid dung		Yes/No
		Liquid manure		Yes/No
		Slurry	Slurry tank	Yes/No
			Lagoon	Yes/No
	Are the storage facilities covered?	Solid dung		Yes/No
		Liquid manure		Yes/No
		Slurry		Yes/No

6.6.3.3 The LiveDate project on Nitrogen Excretion factors

The key indicator "Gross Nutrient Balance" (GNB) is part of the set of agri-environmental indicators defined in the Commission Communication on the "Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy"[57]. The Eurostat/OECD Methodology and Handbook on Nutrient Budgets has been updated and amended in 2013[58]. Nitrogen excretion coefficients have been identified of a major source of uncertainty for the estimation of the GNB, with high relevance for other reporting obligations, including the nitrate directive, reporting of ammonia emissions under the CLRTAP and the NEC directive, as well (and importantly) for the quantification of N_2O emissions from manure management and agricultural soils. An expert workshop was therefore organized on 28/03/2014 at Eurostat to discuss the possibility to improve the quality of N-excretion data by using a common improved methodology. A recommendation on such a common methodology served of the basis for discussion. The workshop was co-organized by JRC under the WG on Annual GHG inventories under the EU Climate Change Committee and was attended by agricultural experts of the EU GHG inventory system.

The following gives some information on the project that prepared the recommendations, as extracted from the report OENEMA, O., SEBEK, L., KROS, H., LESSCHEN, J.P., VAN KRIMPEN, M., BIKKER, P., VAN VUUREN, A., VELTHOF, G. (2014). Methodological studies in the field of Agro-Environmental Indicators. Lot 1 excretion factors. Guidelines for a common methodology. Eurostat, Luxembourg.

The report is available here:

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[57] http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/introduction

[58] http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/documents/Nutrient_Budgets_Handbook_%28CPSA_AE_109%29_corrected3.pdf

https://circabc.europa.eu/sd/a/49003437-db12-44ad-9105-6e264d08399e/Workshop%20main%20report%20February%202014.docx

The general objective of the study "Nitrogen and phosphorus excretion coefficients for livestock; Methodological studies in the field of Agro-Environmental Indicators; Lot1" (2012/S 87-142068) is "to bring clarity into the issue of excretion coefficients so that a recommendation on a single, common methodology to calculate N and P excretion coefficients can be identified. The recommendation for a uniform and standard methodology for estimating N and P excretion coefficients must be based on a thorough analysis of the strength and weaknesses of the existing methodologies and on the data availability and quality in the Member States.

The specific objectives of the study were:

- To create an overview of the different methodologies used in Europe to calculate excretion factors for N and P, and analyse their strengths and weaknesses;
- To set up a database with the excretion factors presently used in different reporting systems and describe the main factors that cause distortion within a country and across the EU;
- To provide guidelines for a coherent methodology, consistent with IPCC and CLTRP guidelines, for calculating N and P excretion factors, and taking into consideration the animal balance and taking into account different methodologies identifies under the first bullet point;
- To create default P-excretion factors that can be used by the countries who do not have yet own factors calculated;

The following (draft) recommendations are put forward. They will be subject of further discussion and refinement in 2014:

Draft Recommendations from the LiveDate project:

- It is recommended to use the mass balance as a common and universally applicable method to estimate N and P excretion coefficients per animal category across EU-28:

  $N_{excretion} = N_{intake} – N_{retention}$.

  $P_{excretion} = P_{intake} – P_{retention}$

- It is recommended to use a 3-Tier approach for the collection of data and information needed to estimate N and P excretion coefficients, so as to address differences between countries in livestock production and data collecting/processing infrastructure, and to economize on data collection/processing efforts. The three Tiers differ in the origin, scale and frequency of data and information collection.
- It is recommended to use a Tier 3 approach for all main animal categories when livestock density in a country is > 2 livestock units per ha (>2 LSU per ha), equivalent to an excretion of about > 200 kg N and > 40 kg P per ha agricultural land per year.
- It is recommended to use a Tier 2 approach for all main animal categories when livestock density in a country is > 0.5 LSU < 2 per ha (equivalent to an excretion of about > 50 kg N <200, and > 10 kg P < 40 per ha agricultural land per year).
- It is recommended that countries invest in Tier 2 and 3 methods (and hence use country-specific, region-specific and/or year-specific excretion coefficients).
- It is recommended to use a Tier 1 approach for all animal categories within a country when total livestock density is <0.5 livestock units per ha (<0.5 LSU per ha), which is equivalent to about 50 kg N and 10 kg P per ha agricultural land per year.

- It is recommended to use region-specific N and P excretion coefficients when N and P excretion coefficients of the main animal categories differ significantly (>20%) between regions.
- It is recommended that computer programs are made available to allow the calculation of the N and P excretion per animal category at regional and national levels in a uniform way. It is also recommended to provide training courses for the use of these programs and the calculation of the N and P excretion coefficients.
- It is recommended that all countries have well-documented and accessible methods for the estimation of N and P excretion coefficients per animal category. These reports should be updated once every 3-5 years and reviewed by external experts.
- We recommend that efforts are undertaken to harmonise the various animal categories in formal policy reporting. We recommend that the FSS categorization is taken as the main list of animal categories, also because the inventory of the number of animals takes place regularly according to the FSS list of animal categories. We recommend also that a transparent scheme and computer program is developed for translating the inventory data of FSS into the current animal categories of secondary databases (e.g., UNFCCC/IPCC, EMEP/EEA, Nitrates Directive, FAO and OECD).
- For main animal categories (e.g., cattle, pigs and poultry, contributing >10% to the total N and P excretion within a country and/or region) it is recommended to consider a secondary categorization according to 'production system', when more than 20% of the animals are in "another" system and when the N and/or P excretion coefficients differ by more than 20% from the overall mean N and P excretion coefficients. We recommend to distinguish between:
- Fast-growing and heavy breeds vs slow-growing breeds
- Organic production systems vs common production systems
- Housed ruminants vs grazing ruminants
- Caged poultry vs free-range poultry
- It is recommended that a review is made of the diversity of production systems within a country for the main animal categories cattle, pigs and poultry once in 5 yrs, so as to trace changes in production systems, including organic versus conventional systems, housed vs grazing ruminants, caged versus free range poultry, and fast growing breeds versus slow growing breeds.
- It is recommended that the N and P excretion coefficients for main animal categories (cattle, pigs poultry) in countries with a relatively high livestock density are updated every year (Tier 3 approach), because of rapid developments in animal breeding and production systems, and changes in feeding ingredients as function of weather and market conditions.
- It is recommended that the N and P excretion coefficients for minor animal categories (sheep, goat buffaloes, horses, donkeys, mink, foxes, rabbits, guinea-pigs, hamsters, deer) are updated once in 3-5 yrs.

6.6.3.4 Regionalization of the Gross Nutrient Budget with the CAPRI model

The JRC is cooperating with EUROSTAT on a methodology to use the CAPRI model for the regionalisation of the Gross Nutrient Budget (GNB) indicators (nitrogen and phosphorus) that needs to be reported regularly by countries to EUROSTAT and OECD. The GNBs are identified as one of the key agro-environmental indicators. Current reporting occurs at the national level. For policy making, a higher resolution, matching with legislative and environmental boundaries (NVZ, watershed) rather than administrative boundaries (country) is required. The CAPRI model is an economic model for agriculture, which has an environmental accounting model integrated. It has a spatial resolution of NUTS2 and reports, a.o. Nitrogen Balances at this level. The CAPRI model has a down-scaling module integrated which estimates land use shares and environmental indicators at the pixel level (1 km by 1 km). The use of the CAPRI model is motivated in view of the lack of methodology for regionalisation of the GNB and the high costs associated with building up such systems in the countries at one hand, and the thrive to harmonise the conceptual approaches.

The Working Group (WG) on agri-environmental indicators (AEI, February 2012) and the subsequent Standing Committee for Agricultural Statistics (CPSA, May 2012) decided to start a pilot projects on regionalising Gross Nitrogen Balance (GNB) with the CAPRI model. The objective of the pilot project is to evaluate differences between national GNB and the GNB calculated with CAPRI at the country and the NUTS2 scale. Italy, France, Germany and Hungary volunteered for this pilot project. The RegNiBal project (Regionalisation of Nitrogen Balances with the CAPRI Model – Pilot Project) started in February 2013.

The overall goal is to use the CAPRI model to provide (operationally) regional GNB data to complement the national Eurostat/OECD GNBs.

In the first phase of the project national data required for the estimation of the national GNB were compared with data from the CAPRI model. Differences found were analyzed with regard to the discrepancy between the models and the relevance for the resulting Gross Nitrogen Balance. The 'issues' were prioritized and selected issues were further analyzed and recommendations for further work were formulated in a report in January 2014[59].

These items were as follows:

The final issues to be tackled with during the next phase of RegNiBal was determined as follows:

- **Germany**: atmospheric deposition, N content for fodder other on from arable land (OFAR), permanent grassland (GRASS) and other cereals, biological fixation, N excretion for swine
- **France**: N content for OFAR, GRASS and other cereals, N excretion for swine and sheep & goats, biological fixation, and atmospheric deposition
- **Hungary**: N content for GRASS, maize and wheat, N excretion for swine, and mineral fertiliser
- **Italy**: N content for GRASS, olives and fruits, N excretion for swine and other cattles, mineral fertiliser, and biological fixation

During the next phase of the project additional comparison on the basis of animal nitrogen budgets will be carried out and the possibility to implement first recommendations will be evaluated.

6.6.3.5 Workshop on improving national inventories for agriculture

Under the WG1 on Annual GHG inventories under the EU Climate Change Committee and in cooperation with UK, DEFRA, a workshop on improving GHG inventories in the sector agriculture is

[59] Fethi Saban Ozbek, Adrian Leip, Franz Weiss, Gema Carmona Garcia (2014): Regionalisation of Nitrogen Balances with the CAPRI Model – Pilot Project (RegNiBal). In-depth assessment of selected (main) differences. European Commissions – Joint Research Centre – Monitoring Agricultural Resources Unit

planned as part of the 7th Non-CO_2 Greenhouse Gas Conference (NCGG7), held November 5-7, 2014 Amsterdam, the Netherlands (http://www.ncgg.info/).

The workshop will combine different session types into a 'cluster':

- Scientific: Scientific NCGG sessions with key presentations as 'normal' part of NCGG7
- Policy: Dedicated for exchange of national experience/ideas, mainly for EC-GHG inventory WG1 participants, but open to everybody
- Breakout: in-depth discussion of specific topics; topics linked to key presentations
- Plenary of Inventory session cluster: final discussion/conclusions; reporting-back from the breakout sessions

Two 'scientific' sessions will be organised:

Scientific session 1: Improving and building a national agricultural GHG emission inventory (DEFRA/CEH). Motivation

- Accurate GHG accounting requires migration to Tier 2/Tier 3
- Migrating to Tier2/3 needs to be based on scientific evidence
- How did the various countries derive the necessary scientific evidence?
- Can we learn from the experience to date and suggest best practice for those countries/N_2O emission sectors that are still at Tier 1?

Scientific session 2: To understand usability of a Tier 2 / Tier 3 approach for N_2O emissions from agricultural soils (JRC/WG1). Motivation:

- Highest share of uncertainty in the agriculture sector
- Largest 'methodological gap' ie mainly Tier 1 used despite being key category
- Scientifically very challenging: bridging scales, approaches, techniques
- Target presenters key experts
- Presentations of review/overview type

The 'policy' session will include presentations from the FAO, JRC, IPCC (tbc), and country-presentation.

6.7 Verification

6.7.1 Comparison of national inventories with EU-wide calculations with the CAPRI model

The GGELS-project on the "Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions" was commissioned by the Directorate-General for Agriculture and Rural Development to the Joint Research Centre and run from 09/2008-12/2010. The study included the implementation of an LCA (life-cycle assessment) approach into the CAPRI model including update of GHG-calculation modules, as well as an ex-ante according to the latest CAPRI projections for the year 2020 and an explorative assessment of technological and policy mitigation options. Ancillary assessments were made on a description of livestock systems in Europe, the GHG emissions related to imported meat product and livestock's impact on biodiversity.

For the LCA-approach, activity-based emissions according to the emissions source categories in the IPCC (2006) guidelines are converted to product-based emission intensities, using well-defined allocation rules. Additional emissions that are generated during the life-cycle of a product are estimated as well and included in the estimated emission intensities. The GGELS report include also a detailed comparison of activity-based emissions estimates calculated with the CAPRI model with those reported in the greenhouse gas inventory report of the European Communities in 2010 for the year 2004, which is the base year for the version of the CAPRI model used.

The report, executive summary and a related publicatation is available here:

ftp://mars.jrc.ec.europa.eu/Afoludata/Public/DOCU236/

Data tables are available on request:

A detailed description of the methodology used in the study is given in section 4.2. (Activity-based GHG emissions from the European livestock system considered in the sector 'agriculture' of the IPCC guidelines) of the report with additional data tables provided in the Annex to Chapter 4 (Quantification of greenhouse gas and ammonia emissions from the livestock sector in the EU – Methodology). Section 5 (Comparison of EU livestock GHG emissions derived by CAPRI with official GHG inventories) provides a detailed comparison between the emissions estimates.

In the following, a summary of this comparison is provided as given in the executive summary of the report:

The objective of the GGELS project was to provide an estimate of the net emissions of GHGs and ammonia (NH_3) from livestock sector in the EU-27 according to animal species, animal products and livestock systems following a food chain approach.

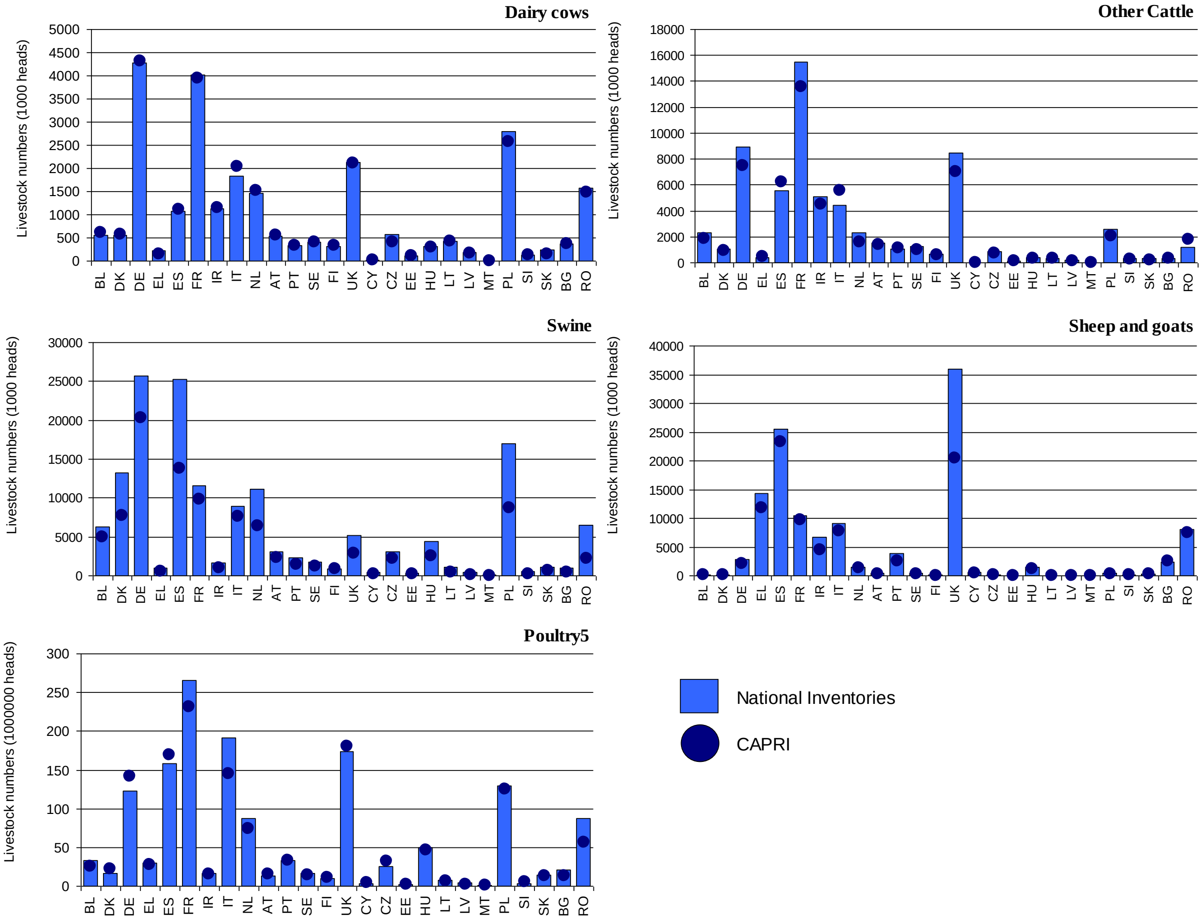
For the comparison of activity-based GHG emissions calculated in the GGELS project (taking into account only emissions directly created during the agricultural production process) with official national GHG emissions submitted to the UNFCCC, we selected the latest inventory submission of the year 2010 (EEA, 2010), using the data reported for the year 2004, the base year selected also for the CAPRI calculations.

Differences in basic input parameters, such as animal numbers and mineral fertiliser application rates are limited, since both are based on the official numbers of livestock statistics. However, on the one hand EUROSTAT data are not always in line with national statistical sources used by national inventories, and on the other hand CAPRI changes input data if they are not consistent with each other. Moreover, for some animal activities CAPRI does not use livestock numbers but numbers of the slaughtering statistics. Therefore, some differences exist, especially in case of swine, sheep and goats, where CAPRI generally uses lower numbers than the national inventories. This has to be kept in mind when looking at the results in later sections.

In some cases results differ substantially between CAPRI and the inventory submissions, which can be related to three different reasons:

- First, the approach of CAPRI and the national inventories is not always the same. Especially, the MITERRA approach, which is applied for the calculation of nitrogen emissions in the CAPRI model, differs substantially from the IPCC approach usually applied in the inventories. In CAPRI the excretion is not an exogenous parameter but is calculated as the difference between nitrogen intake and nitrogen retention of animals. For cattle and poultry deviations are generally low, while for swine, sheep and goats the differences are larger (see Figure 6.56). In case of swine the usually higher CAPRI values partly compensate the lower livestock numbers.

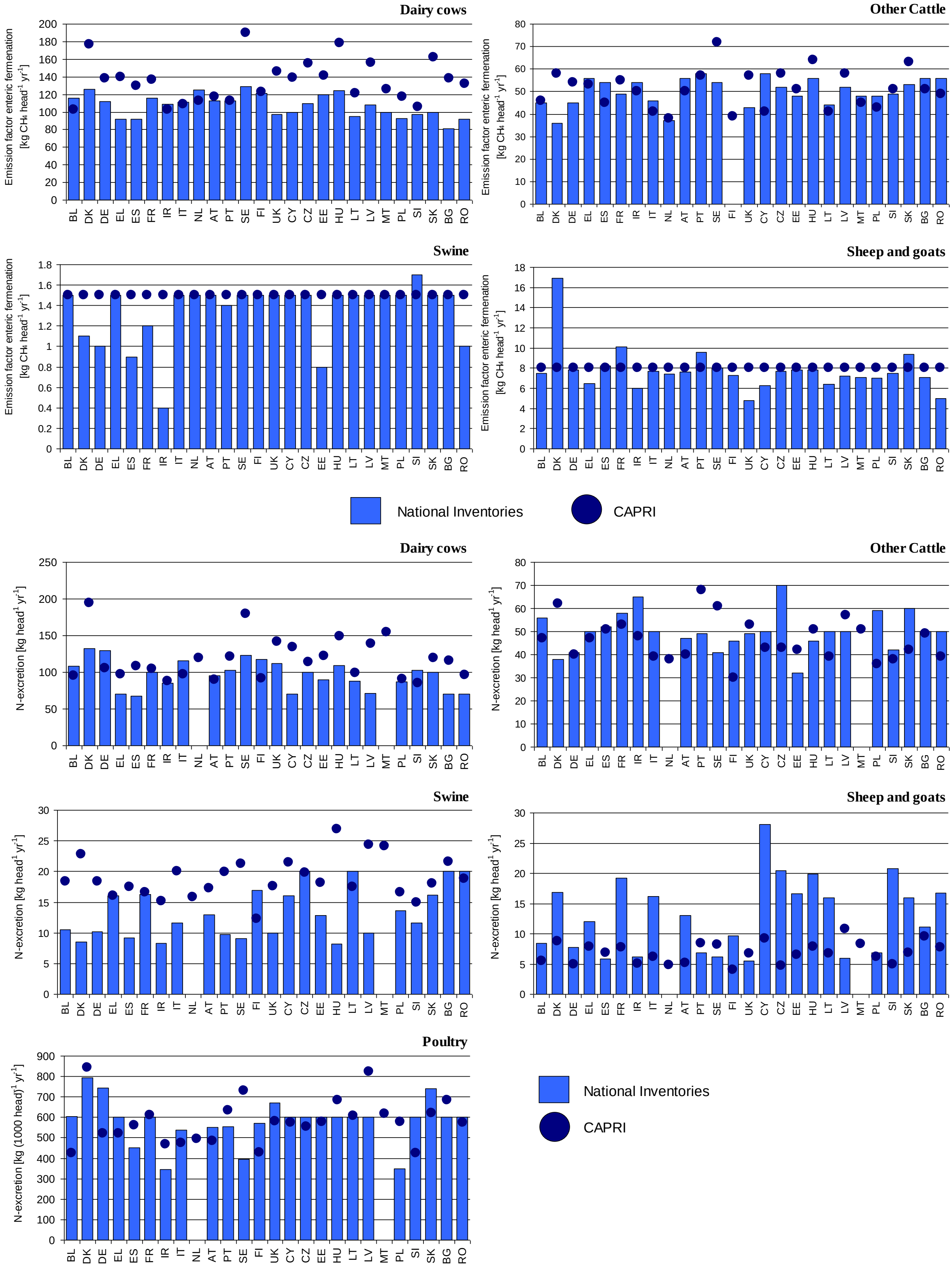
Figure 6.54: Comparison of livestock numbers used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and livestock numbers used in CAPRI



- Second, most countries base their inventory calculations on the IPCC guidelines 1996, while CAPRI uses parameters of the most recent guidelines of the year 2006. In some cases emission factors and other parameters suggested by the IPCC changed considerably between 1996 and 2006, leading to corresponding changes in the estimation of emissions.
- Finally, apart from different approaches and different parameters due to changes in the IPCC guidelines, also other input data can impact on the results. This could be i.e. differences in livestock numbers, the distribution of manure management systems or time spent on pastures, average temperatures, or more technical data like fertiliser use, milk yields, live weight, nutrient contents, nitrogen excretion etc., which are partly assumed and partly already an output of calculation procedures in the CAPRI model. Since the national inventories use other input data some differences in the results are not surprising. For example, differences in estimated CH_4 emissions from enteric fermentation are mainly due to different emission factors for dairy and non-dairy cattle, since other animal categories play a less important role with respect to total emissions from enteric fermentation.

The following factors can be identified as potential reasons for the deviations. First, for cattle (Tier 2 approach) CAPRI calculates the digestible energy endogenously, while most inventory reports use default values. Secondly, in the inventories most countries apply a methane conversion factor of 6% (default value according to IPCC 1997, see IPCC 1996), while CAPRI uses 6.5% (default value of IPCC 2006, see IPCC, 2006), leading to higher emission factors in CAPRI of around 8%. Thirdly, animal live weight impacts directly on net energy requirement, but can only be compared for dairy cows. CAPRI generally assumes a live weight of 600 kg, while national inventories use different values ranging from 500 to 700 kg. However, a simple regression suggests that live weight is not a key factor for the generally higher CAPRI values. Finally, there are differences in the weight gain and milk yields. While assumptions on the weight gain are not available in the inventory submissions and, therefore, cannot be compared, milk yields are usually higher in CAPRI than in the national submissions, favouring higher emission factors in case of dairy cows.

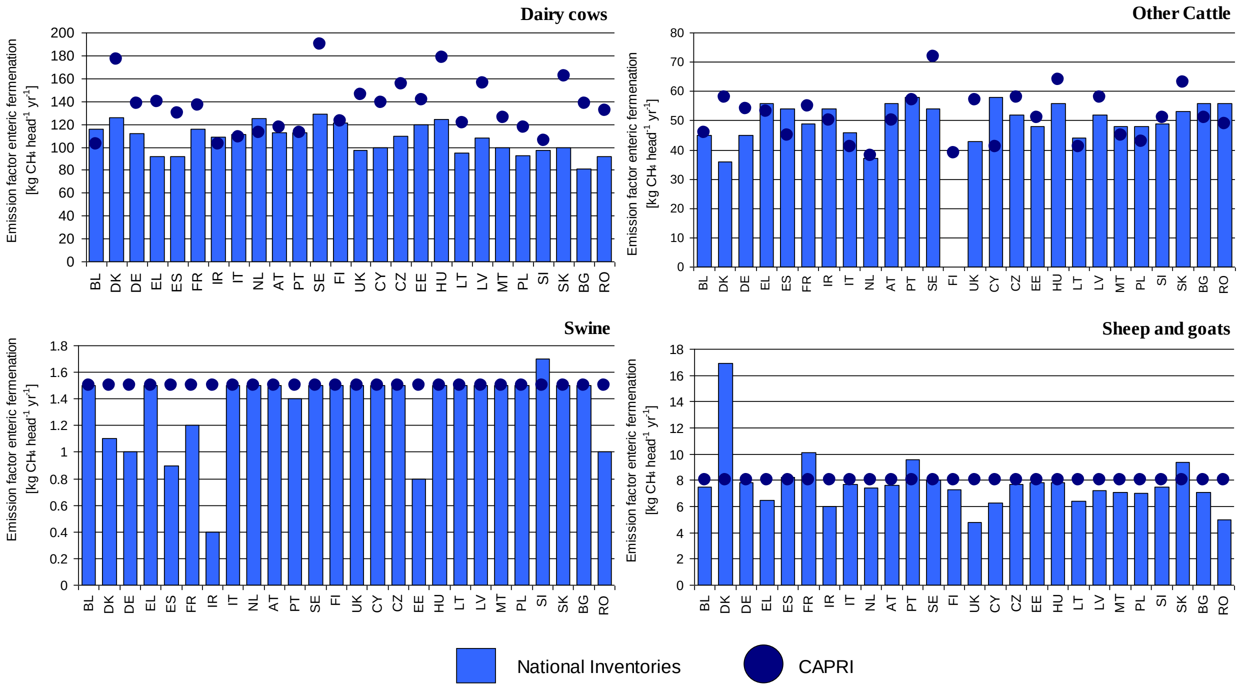
Figure 6.55: Comparison of N-excretion data used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and N-excretion data calculated with CAPRI



For EU-27, CAPRI calculates total agricultural sector emissions of 378 Mio tons of $CO_{2\text{-eq}}$, which is 79% of the value reported by the member states (477 Mio tons, biomass burning of crop residues and CH_4 emissions from rice production not included). On member state level this ranges between 54% in

Cyprus and 127% in Denmark. Therefore, Denmark is the only member state for which CAPRI estimates total emissions higher than the NIs. With respect to the different emission sources, the relation of CAPRI emissions to NIs are: 103% for CH_4 emissions from enteric fermentation, 54% for CH_4 and 93% for N_2O emissions from manure management, 92% for N_2O emissions from grazing animals, 81% for N_2O emissions from manure application to managed soils, 89% for N_2O emissions from mineral fertiliser application, 87% for N_2O emissions from crop residues, 89% for indirect N_2O emissions following volatilization of NH_3 and NO_X, 11% of N_2O emissions following Runoff and Leaching of nitrate, and 97% of emissions from the cultivation of organic soils.

Figure 6.56: Comparison of emission factors for enteric fermentation in dairy and non-dairy cattle, swine, and sheep and goats used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and the emission factors calculated (in case of dairy and non-dairy cattle) or used (in case of swine and sheep and goats) in CAPRI



6.7.2 Comparison of Cultivated Organic Soil at the FAO GHG database and JRC calculations

A comparison of the area of cultivated organic soils as reported by the FAO, in the national IRs with calculations done at the JRC has been performed by JRC in October 2013.

The FAO (FAO, 2103) provides area of cultivated organic soils on country level. The analysis is based on the Harmonized World Soil Database – HWSD – (FAO/IIASA/ISRIC/ISSCAS/JRC, 2009) and the Global Land Cover data set for the year 2000 (GLC2000).

At JRC the area of cultivated organic soils for the single countries in EU27 has been derived from overlaying the HWSD with the CORINE Land Use/Cover data set - CLC2006 (EEA, 2011) for the year 2006 (for some countries 2000). Both data sets have been resampled to a 1km by 1km raster cell size.

Definition of organic soils as given in IPCC (2006) based on FAO (1998):

Soils are organic if they satisfy the requirements 1 and 2, or 1 and 3 below (FAO, 1998):

1. Thickness of 10 cm or more. A horizon less than 20 cm thick must have 12 percent or more organic carbon when mixed to a depth of 20 cm;

2. If the soil is never saturated with water for more than a few days, and contains more than 20 percent (by weight) organic carbon (about 35 percent organic matter);

3. If the soil is subject to water saturation episodes and has either: (i) at least 12 percent (by weight) organic carbon (about 20 percent organic matter) if it has no clay; or (ii) at least 18 percent (by weight) organic carbon (about 30 percent organic matter) if it has 60 percent or more clay; or (iii) an intermediate, proportional amount of organic carbon for intermediate amounts of clay (FAO, 1998).

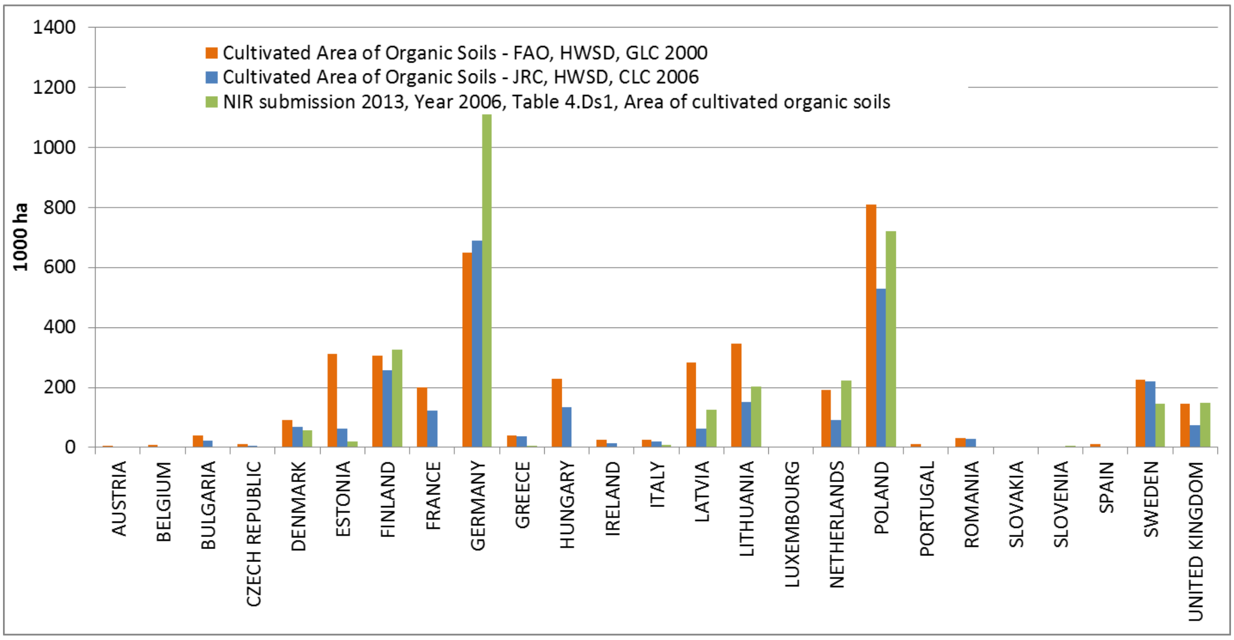
FAO gives larger area of organic soils cultivated compared to JRC results for all countries except Germany (Figure 6.57). This is mainly due to different source data sets for delineation of cropland area and the assumptions regarding the land use classification.

In the JRC approach Soil Typological Units (STU) of the HWSD are defined as "organic soils" if (1) the topsoil organic carbon content is > 18% or (2) if the topsoil organic carbon content is higher than the topsoil clay content * 0.1 + 12. All STUs in the EU27 of the HWSD which have been classified as "organic soils" showed a organic carbon content of >30%, thus de facto only criterion (1) was applied.

To delineate "cropland area" in the land use/cover map, FAO considers pure cropland classes as well as mixed cropland/other land use classes. For the latter, assumptions were made on the share of cropland within these mixed classes. However, the JRC approach takes assumes that in case of mixed land use classes the probability of the different land uses happening on organic soils are not the same, in contract to the approach of the FAO, which distribute land cover proportionally. As some crops do not grow well on organic soils it might occur that the land uses are not distributed equally on the mineral and organic soil but that 100% of the forest is grown an organic soil and the crops are cultivated only on mineral soils.

In the JRC analysis mixed land use classes are not taken into account as the shares of cropland within these classes are given as ranges in the legend of CORINE. The cropland/other land use shares in the mixed land use classes might also vary between regions. Thus, by excluding mixed land use classes, the estimate of cropland area on organic soils can be considered as conservative compared to the FAO approach.

Figure 6.57: Area of cultivated organic soils based on two studies and the values given in the National Inventory Reports (2013) for the year 2006



6.7.3 Comparison of activity data in the FAO GHG database on the national inventory reports

The Food and Agriculture Organization of the United Nations (FAO) has developed a database of greenhouse gas emissions, contained in FAOSTAT, which provides estimations of the emissions of main gases in the agricultural sector (CH_4 and N_2O) and statistics on the activity data related to these emissions for the period 1990-2010. The data base can be consulted at the following link:

http://faostat3.fao.org/faostat-gateway/go/to/download/G1/*/E

Emissions are specified for the different agricultural sub-domains, estimated by FAO following Tier 1 approach from the 2006 IPCC Guidelines for National GHG Inventories (IPCC, 2006), using activity data provided by countries and default emission factors by IPCC. The data provided by FAO does not necessarily match the numbers reported by countries to the UNFCCC in their national inventory reports.

The FAOSTAT database is intended primarily as a service to help member countries assess and report their emissions, as well as a useful international benchmark. The FAOSTAT Emissions data are disseminated publicly to facilitate continuous feedback from member countries.

A comparison between the FAOSTAT database and the data submitted to UNFCCC was carried out in March 2014, using FAOSTAT data extracted in February 2014 and the UNFCCC inventory data submitted in 2013.

Table 6.108 gives an overview of the total GHG emissions from the agricultural sector and its source categories as reported in the national IRs and the FAOSTAT database for the example of the year 2010.

Table 6.108: Total emissions for EU-28 countries plus Norway, in tons of CO_2-eq, for year 2010, by emission category; UNFCCC inventory data submitted in 2013 and FAOSTAT data (extracted February 2014)

Emission category	***UNFCCC***		***FAOSTAT***	
	tons CO_2-eq	*% total*	*tons CO_2-eq*	*% total*
CH_4 from enteric fermentation	*180*	*37*	*194*	*44*
CH_4 from manure management	*53*	*11*	*58*	*13*
N_2O from manure management	*29*	*6*	*16*	*4*
CH_4 from rice cultivation	*3*	*0.6*	*6*	*1*
N_2O from the application of synthetic fertilisers	*56*	*12*	*50*	*11*
N_2O from manure application to soils	*28*	*6*	*21*	*5*
N_2O from manure deposited on pastures	*30*	*6*	*21*	*5*
N_2O from crop residues left in the soil	*18*	*4*	*13*	*3*
N_2O from the cultivation of organic soils	*12*	*2*	*15*	*3*
CH_4 from burning agricultural residues	*0.8*	*0.2*	*1.1*	*0.3*
N_2O from burning agricultural residues	*0.2*	*0.03*	*0.3*	*0.08*
Indirect N_2O emissions from N volatilisation, deposition and leaching	*77*	*16*	*43*	*10*
TOTAL	*487*	*100*	*438*	*100*

Even if the same activity data were used by countries in their NIR and by FAOSTAT for the calculation of emissions, the result could differ due to the different methodologies applied. FAOSTAT uses tier 1 approach from IPCC 2006 guidelines. The countries use IPCC 1997, which contains some differences with IPCC 2006 in equations and in the default values provided, and usually use higher tiers in the calculation of emissions, with country specific coefficients and sometimes national methodologies.

In some cases, countries do not report a certain value in a certain year. In that case, while the UNFCCC keeps that value blank, FAOSTAT performs a gap filling process to complete the temporal series, and this would involve also differences in both databases.

The potential reasons identified for the differences in estimations between FAOSTAT and UNFCCC databases include: (1) Differences in the methodology used for the estimation of emissions. While countries follow the older IPCC guidelines (IPCC, 1997) and apply tier 1 to tier 3 approaches, depending on the emission category, FAOSTAT estimations are based on the newer guidelines (IPCC, 2006), which contain different equations and default emission factors, and follow always a tier 1 approach. (2) The use of different activity data, coming from different sources or suffering different processing after data collection.

Comparing the estimations of FAOSTAT with the UNFCCC inventory data, we find that the biggest differences correspond to N_2O emissions from burning agricultural residues, followed by CH_4 emissions from rice cultivation and N_2O emissions from manure management. These three emission categories, however, do not represent a high share of the total agricultural emissions, accounting for 0.03-0.08%, 0.6-1.3% and 3.4-5.9%, respectively.

Regarding CH_4 emissions from enteric fermentation and from manure management, the main animal categories contributing to these emissions are cattle (80 and 40-46%, respectively) and swine (11-12 and 46-58%, respectively), followed by sheep (11-12% of CH_4 from enteric fermentation). Therefore, discrepancies in the herd size of these animal categories will be important for the explanation of differences in the total emission estimations between FAOSTAT and UNFCCC databases.

When we compared the animal numbers for year 2010 in the two databases, we saw that the biggest differences correspond to mules and asses and horses, which are responsible for a very low share of emissions (2-3% of CH_4 emissions from enteric fermentation and 1% of CH_4 emissions from manure management, altogether). For dairy and non-dairy cattle, differences between the numbers in the two databases, compared to UNFCCC data are 2.8% and 0.3%, for the average of the region, while sheep presents 2.4% difference. For swine, the average differences in the population given by the two databases, compared to UNFCCC data, are a bit higher, 3.3%. One of the main swine producers, Germany, shows 20% difference between the two databases, being responsible in total of around 3% of differences in total swine population in the region.

Regarding nitrogen excretion, FAOSTAT calculates it based on default typical animal mass and nitrogen excretion per animal mass unit. We compared the animal mass with the data used by countries in their national inventories and found relevant differences for swine (183.2 kg by FAOSTAT vs. 76.3 kg EU-27), and for other animal categories which do not have a high impact in total emissions, such as buffalo and mules and asses. When we analysed total annual excretion per head by animal category, most categories presented lower values in FAOSTAT. The differences were low for dairy cattle and goat (for which typical animal mass was also very similar), higher for buffalo and swine, and very variable for the other animal categories, depending on the country. It is interesting to note the case of non-dairy cattle, where differences between the two databases are generally low, except for a few countries, where the national inventories report a much higher quantity of nitrogen excretion per head: the Netherlands (59% difference), Luxemburg (53%) and, to a lower extent, Bulgaria, Croatia and Estonia. It is also interesting to note that, for swine, although the typical animal mass considered by FAOSTAT is more than double the average mass for EU-27, the total excretion per animal and year is lower, ranging from 22.5 to 67.2% difference compared to UNFCCC numbers.

Concerning the area of rice cultivation, differences are very low between the two databases, being 0.1% and 2.9% for Italy and Spain, respectively, which account together for 76% of total rice area in the region. Differences in CH_4 emissions from rice production reached 126% for the whole region in 2010, so they cannot be explained by the differences in the activity data, but the estimation method has a higher weight.

Contrary to the emissions from rice production, the differences between databases in N_2O emissions from the application of synthetic fertilisers are highly correlated with the activity data. For 2010, the percentage difference FAOSTAT-UNFCCC compared to UNFCCC is 10.9% for the activity data and 11.3% for related emissions.

The application of nitrogen from manure shows slightly higher differences between databases than the application of nitrogen from synthetic fertilisers, but in this case FAOSTAT always indicates lower application rates (in the previous one, it depended on the year) and differences have consistently been decreasing in time. As in the previous case, there is a high correlation between activity data and emissions.

Like for the application of manure to soils, FAOSTAT gives lower values than UNFCCC inventories for manure left on pastures all along the period 1990-2010, being these differences 5.86% in 2010. It is remarkable the case of Austria, where FAOSTAT considers four times the value reported in the inventory. This also happened with the related emissions, which seem highly correlated with the activity data.

Differences between data on crop residues applied to soils are higher than for previous activity data, reaching 14.55% in 2010 (lower in FAOSTAT). It is the third activity in terms of differences between databases, after burning of agricultural residues on the field and the area of cultivated organic soils. The related emissions showed very similar trends, although generally a bit lower in FAOSTAT than the activity data.

Regarding the area of cultivated organic soils, FAOSTAT calculates a total area for EU-28 and Norway 26% higher than the reported area in the UNFCCC inventories. This can be partly due to the fact that a number of countries do not report any area of cultivated histosols. However, if we focus on EU-15 and EU-27, the differences are much lower: 9.8% higher in FAOSTAT and 29.2% lower, respectively. The correlation between the area of cultivated organic soils and the N_2O emissions from this source is very high, showing similar differences between databases for all countries.

Finally, the total amount of crop residues burnt is the activity data with the highest differences between databases, accounting for the whole region for 222% compared to UNFCCC data in 2010. This is presumably due to the use of default burning fractions by FAOSTAT, while the burning practice is forbidden in many countries. We find the same trend in the differences in emissions, but the magnitude of differences is lower for emissions: 46.4% and 108.4% difference for CH_4 and N_2O emissions, respectively, for the same year.

The aim of this analysis was to identify the magnitude of the differences between the two databases and analyse the main reasons behind those differences. Here we focus on the analysis of differences of activity data in order to dis-entangle differences due to AD and due to EFs or the methodology. The full analysis including also the comparison of emissions will be available at the JRC and FAO websites.

6.7.3.1 Animal numbers

A comparison of animal numbers by country (EU28+Norway) is shown in Figure 6.58 through Figure 6.62 for the four main animal types (dairy cattle, non-dairy cattle, swine and poultry). The figures show both the relative difference between the dataset, as well the absolute numbers and the contribution of the country to total animal number of the respective type for the whole region. Main findings are given below.

A comparison of UNFCCC and FAOSTAT data for dairy cattle numbers, averaged over the time period 1990-2010 over all countries in Europe is given in Figure 6.62.

Dairy cattle. The main dairy cattle producers in the region are Germany and France, followed by Poland, United Kingdom, Italy and the Netherlands. These six countries held 66% of total dairy cattle population of the region (EU28+Norway) in 2010. Differences between FAOSTAT database and national inventories range from 0 to 7.6% in these countries, accounting for 2.8% for the whole region (higher in FAOSTAT). The biggest difference between both databases corresponds to Greece (59%), followed by Portugal, Romania and Slovakia (around 20%).

Non-dairy cattle. Non-dairy cattle shows one of the lowest differences between the two databases, being FAOSTAT numbers only 0.3% lower for 2010, for the whole region. National differences range from 0 (Finland) to 34% (Romania). France, Germany and the United Kingdom hold together 50% of the population in the region, 66% if we add Ireland and Spain.

Poultry. Poultry population given in FAOSTAT is, for 2010, 12.5% lower than the reported by countries to UNFCCC. Differences for the individual countries range from 0 (Netherlands) to 71% (Norway). Four countries together, France, United Kingdom, Italy and Spain, account for 52% of the population in the region, according to the inventories (46% according to FAOSTAT).

Swine. Swine is the third livestock category with the lowest differences between databases, showing 3.3% higher population in FAOSTAT than in the national inventories for the whole region in 2010. The two main sheep producer countries are Spain and Germany, accounting for 32-33 % of total regional herd. The differences between herd size given by FAOSTAT and the UNFCCC inventory for Germany are 20%, compared to UNFCCC data, accounting for a relevant part of total differences in the area.

Sheep. Sheep is one of the livestock categories with the lowest differences between UNFCC and FAOSTAT databases. For 2010, the total population in the region is 2.4% higher in FAOSTAT than in the UNFCCC inventories. Differences range from 0 (Germany, Spain) to 52.3% (Norway).

Goats. Differences in goat population in the whole region between the two databases are 10% in 2010, lower in FAOSTAT. For the individual countries, those differences range from 0 (Finland, Germany) to 32% (Cyprus). 68% of goat population is concentrated in three countries: Greece, Spain and France.

Buffalo. Italy is the country which holds the major part of the buffalo population in the region (89.9% according to UNFCCC inventories, 97.2% according to FAO in 2010). For this country, there is a 5.8% difference between the national inventories and FAOSTAT data. Germany, Hungary and Romania report buffalo population in the national inventories but no buffalo population is considered for these countries in FAOSTAT database. For the whole region, FAOSTAT reports 12.8% lower population than the national inventories.

Horses. Horses is the second livestock category with the highest differences in population figures between the two databases. FAOSTAT estimates 20% lower population than numbers given in UNFCCC inventories for the whole region, ranging from to for the individual countries. For the individual countries, it ranges from 0 (Ireland) to 87% (Cyprus). The main part of the population is concentrated in Romania, France, Spain, Germany and the Netherlands, summing up together 53% of the total population in the region.

Mules and asses. Mules and asses' population presents the highest differences between FAOSTAT estimations and the numbers reported in the UNFCCC inventories being 40% higher in FAOSTAT. Differences rage from 0 (Romania) to 639% (Portugal) for the individual countries. According to national inventories, there are two main countries which hold, together, 57% of the population in the area: Bulgaria and Spain. According to FAOSTAT database, also Portugal would be at the same production level, summing up among the three countries 76% of the regional total population.

Figure 6.58: Comparison of UNFCCC and FAOSTAT data for dairy cattle numbers. Left: absolute numbers for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.

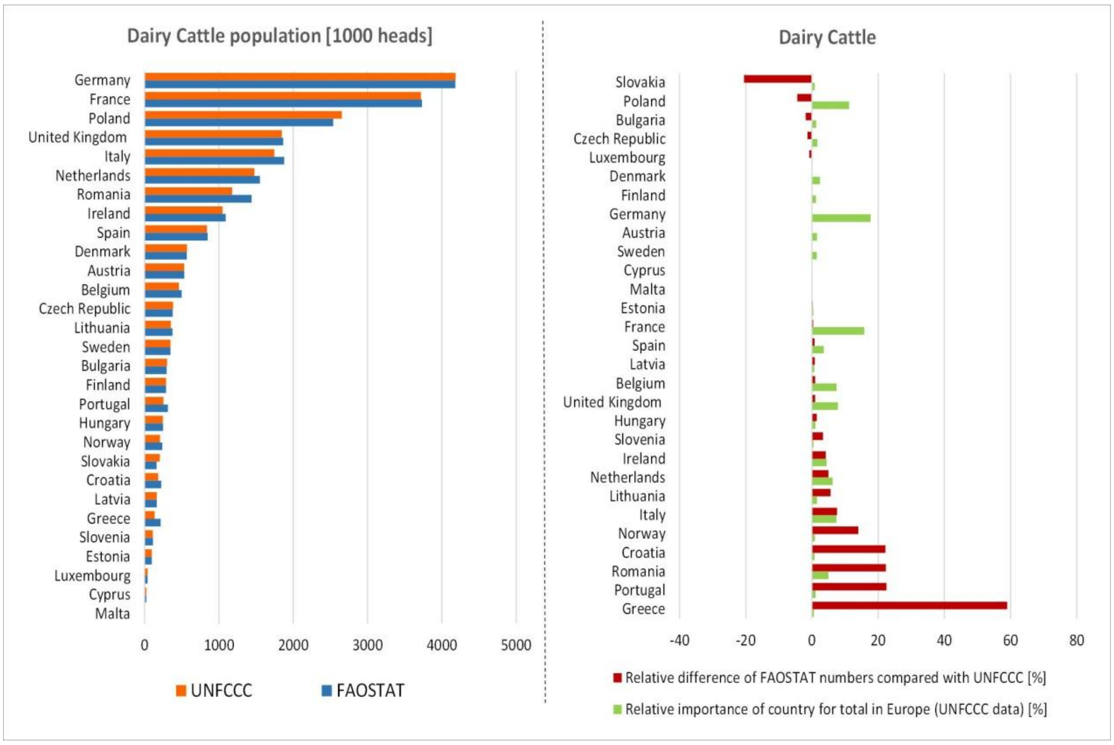


Figure 6.59: Comparison of UNFCCC and FAOSTAT data for non-dairy cattle numbers. Left: absolute numbers for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.

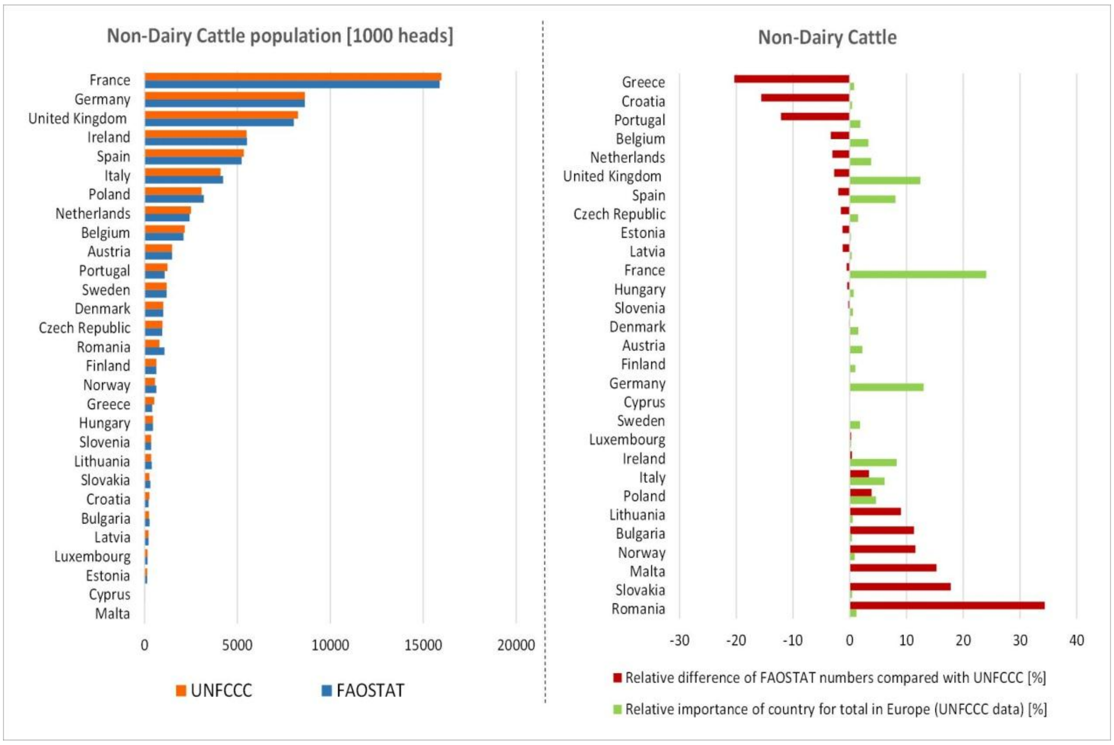


Figure 6.60: *Comparison of UNFCCC and FAOSTAT data for poultry numbers. Left: absolute numbers for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.*

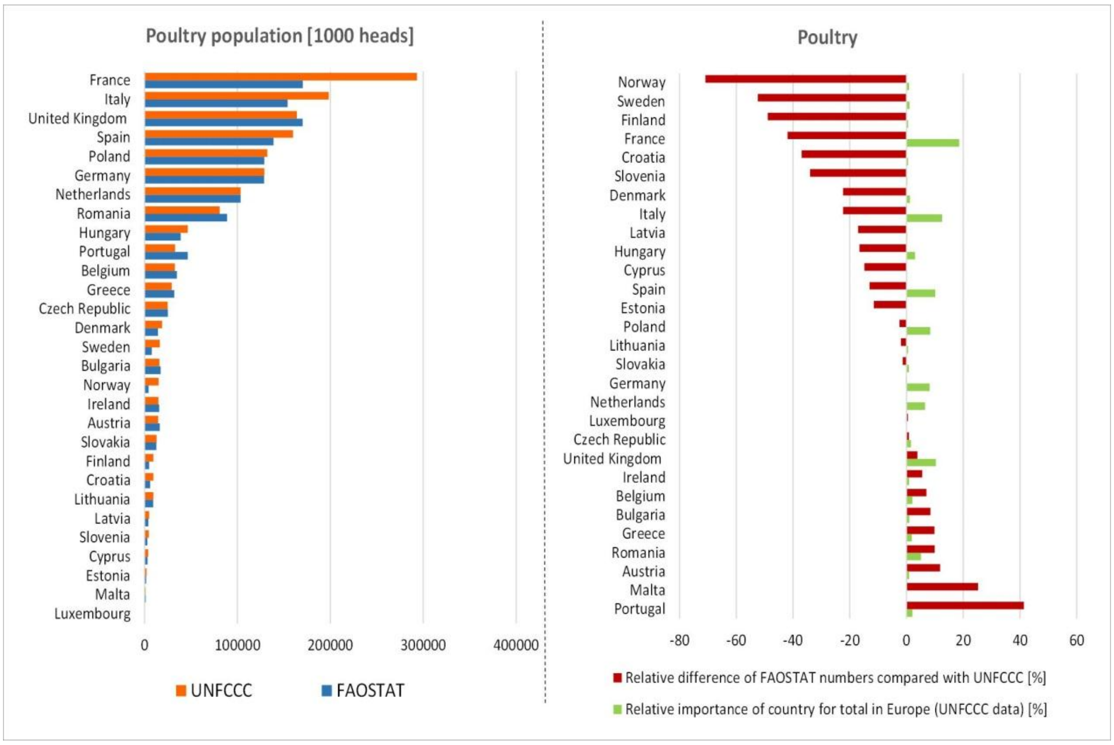


Figure 6.61: *Comparison of UNFCCC and FAOSTAT data for swine numbers. Left: absolute numbers for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.*

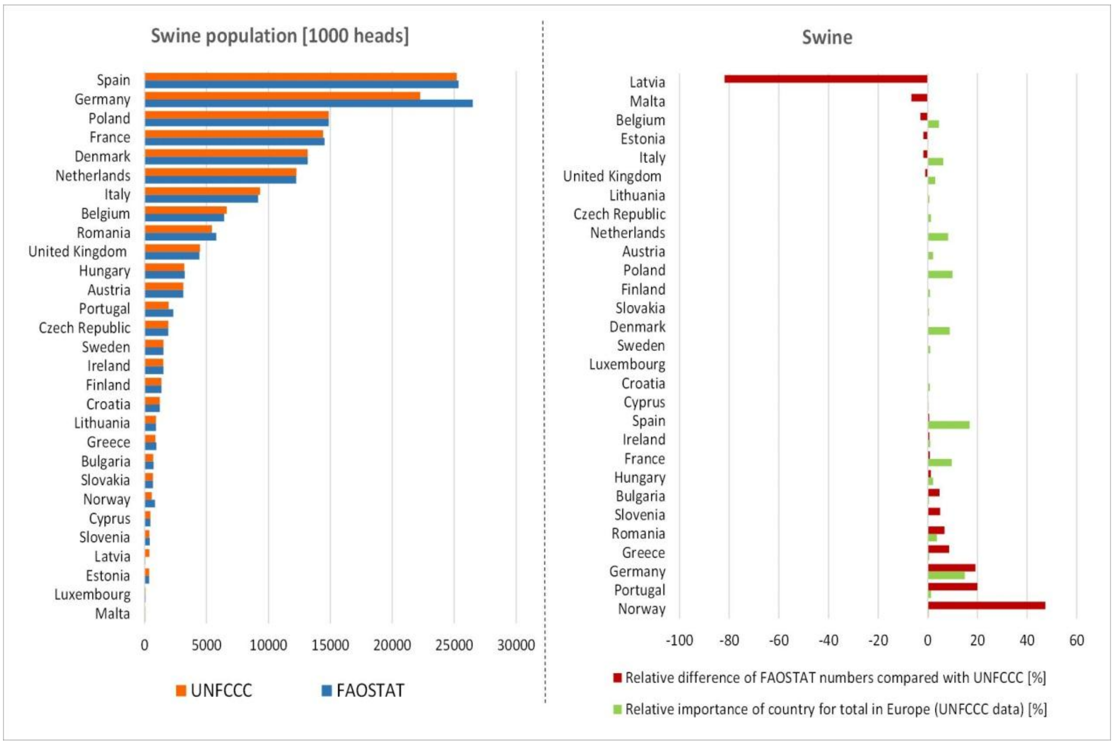
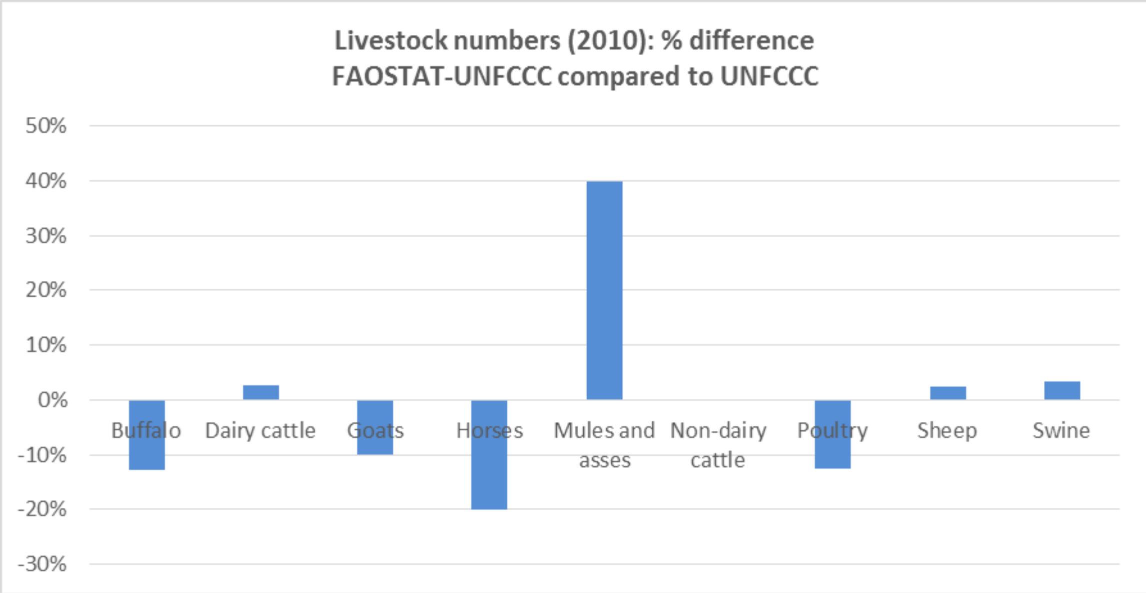


Figure 6.62: *Comparison of UNFCCC and FAOSTAT data for livestock numbers, per livestock category. Percentage difference over all countries in Europe, average 1990-2010*



6.7.3.2 Nitrogen excretion

A comparison of animal numbers by country (EU28+Norway) is shown in Figure 6.63 through Figure 6.66 for the four main animal types (dairy cattle, non-dairy cattle, swine and poultry). The figures show both the relative difference between the dataset, as well the absolute numbers and the contribution of the country to total animal number of the respective type for the whole region. Main findings are given below.

Estimations of nitrogen excretion in the FAOSTAT database are calculated from the IPCC 2006 default values for animal weight and N excretion per unit of animal weight for each animal category and geographic region. In the UNFCCC national inventories, countries specify their own excretion factor, calculated using country specific methods, and resulting generally in higher values than the IPCC 2006 defaults.

Total N excretion depends on the animal herd and the N excretion coefficient per head. Regardless the differences between the two data bases in the animal herd, N excretion is lower in FAOSTAT for all livestock categories. The differences range from 3% (poultry) to 100% (horses, mules and asses, for which FAOSTAT does not give any excretion data).

Analysing the differences between the two databases by country, for year 2010, we see that the highest differences are for Croatia (45.1%) and Luxemburg (43.0%), while Austria shows the lowest difference (2.6%). A comparison of UNFCCC and FAOSTAT data for dairy cattle numbers, averaged over the time period 1990-2010 over all countries in Europe is given in Figure 6.67.

- *Dairy cattle*. UNFCCC values given in the national inventory reports for nitrogen excretion go from 53.6 (Romania) to 138.6 kg N/head (Denmark). Differences between the country specific N excretion factors and the IPCC2006 values used by FAOSTAT range from 0.37 (Latvia) to 39.50 % (Estonia), being country specific values higher in most cases.
- *Non-dairy cattle.* The case of non-dairy cattle is similar to dairy cattle. Excretion coefficient provided by countries in their inventory reports vary from 38.2 (Romania) to 123.8 kg N/head (Netherlands). This implies differences with default FAOSTAT data ranging from 0.10% (Cyprus, Latvia) to 59.14 % (Netherlands), always being the country specific values more variable, according to the country.

- *Swine.* Nitrogen excretion factors provided by the countries in the UNFCCC inventories for swine range from 6.96 (France) to 20 kg N/head (Croatia, Czech Republic). The default coefficients used by FAOSTAT are 22.5 to 67.2% lower.
- *Poultry.* The livestock category 'poultry' includes different types of animals with different excretion coefficients. In the case of FAOSTAT database, poultry comprises chicken, ducks and turkey, and the excretion factor shown by country is a weighted average of the three populations. The UNFCCC database does not specify the species considered under the 'poultry' label, it will vary in each specific case and the information can be found in the individual country reports. Comparing the group as a whole, we find that, opposite to what happens with the other animal categories, there is not a general trend of FAOSTAT default values being lower than the excretion rates provided by the countries. In the case of poultry, differences between the two sources vary from 0.26% (the lowest difference, in the UK) to 98.7% (Luxemburg, higher in FAOSTAT) and 92.12% (Norway, higher in the national inventory), compared to country specific values.
- *Sheep.* For sheep, country specific values range from 4.47 (Romania) to 20 kg N/head (Czech Republic, Hungary, Slovenia), while FAOSTAT uses 9.20 and 15.05 kg N/ha for Eastern-Western groups of countries. This leads to differences between the two databases going from 1.20 to 115.8% compared to UNFCCC values.
- *Goats.* Differences between the two databases in nitrogen excretion for goat are quite variable, depending on the country. In the UNFCCC inventories, values go from 5.30 (Romania) to 25 kg N/head (Croatia, Czech Republic, Estonia, Slovenia), while default values used by FAOSTAT are between 14.02 and 19.88 kg N/ha.
- *Buffalo.* The six countries reporting buffalo herd are also providing an estimation of manure nitrogen excretion in the national inventories, ranging from 50 (Bulgaria) to 95 (Italy) kg N/head. FAOSTAT reports buffalo production in three of those five countries: Bulgaria, Greece and Italy, and uses an excretion coefficient of 48.5 kg N/head for Bulgaria and 45.31 kg N/head for Greece and Italy.

Figure 6.63: *Comparison of UNFCCC and FAOSTAT data for dairy cattle N-excretion. Left: absolute numbers of total N-excretion rate [kg N head^{-1} yr^{-1}] for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of the total N-excretion of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.*

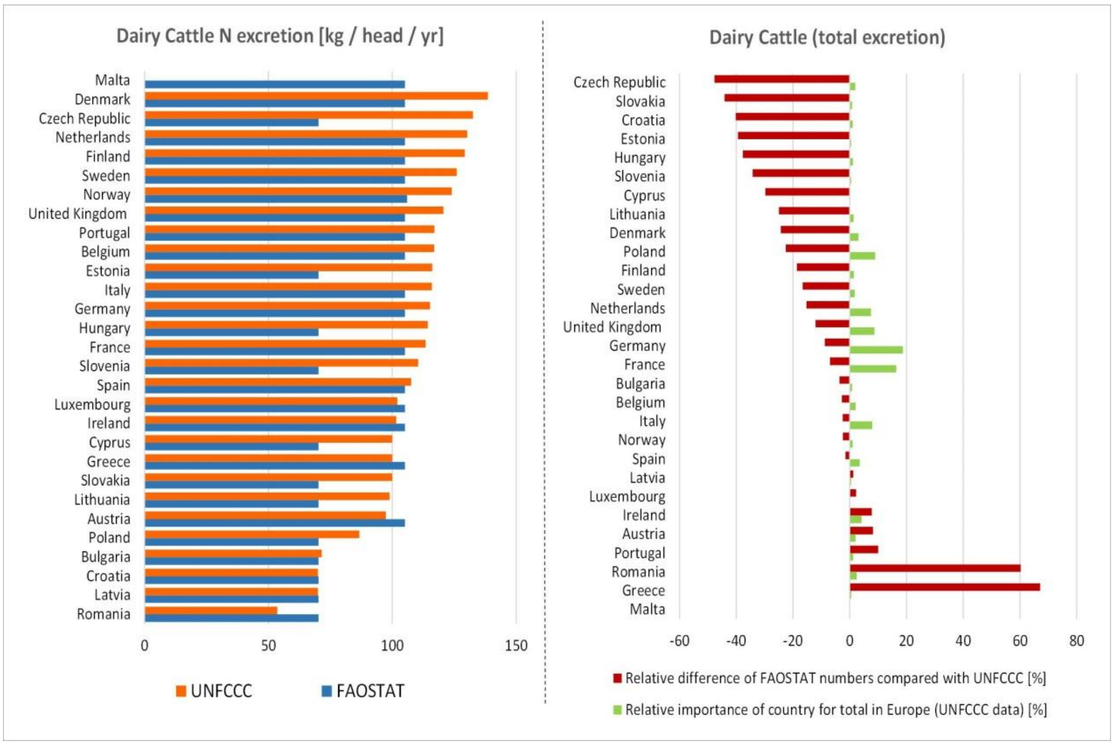


Figure 6.64: *Comparison of UNFCCC and FAOSTAT data for dairy cattle N-excretion. Left: absolute numbers of total N-excretion rate [kg N head^{-1} yr^{-1}] for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of the total N-excretion of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.*

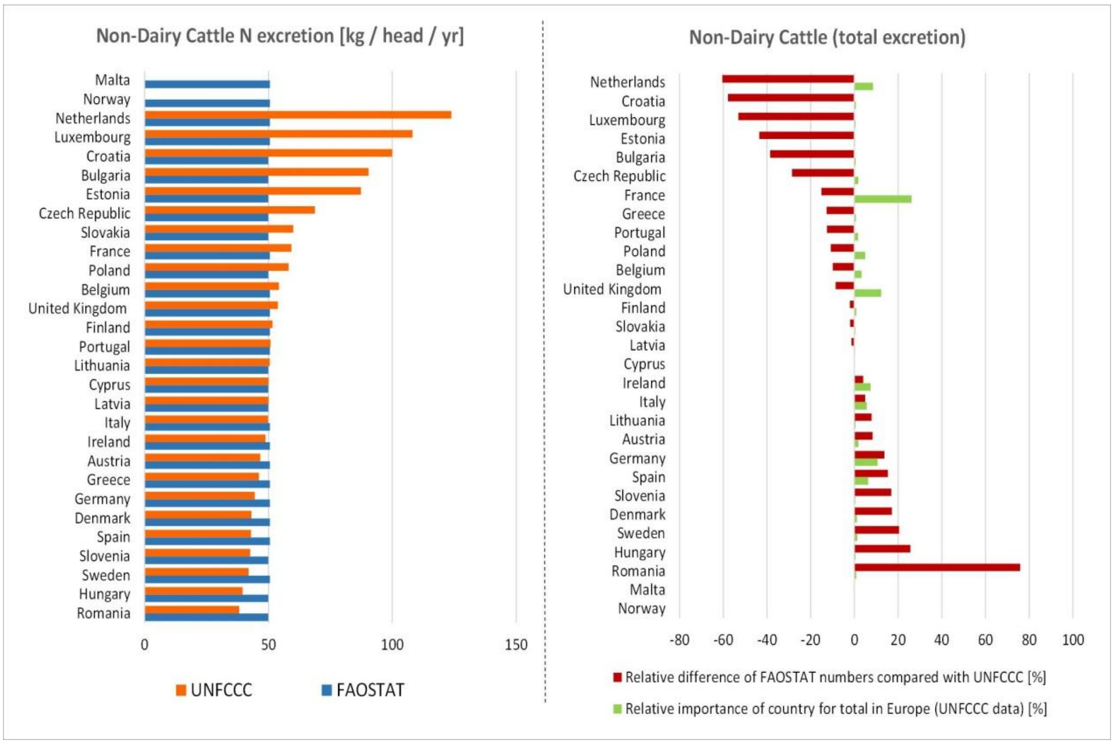


Figure 6.65: Comparison of UNFCCC and FAOSTAT data for dairy cattle N-excretion. Left: absolute numbers of total N-excretion rate [kg N head^{-1} yr^{-1}] for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of the total N-excretion of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.

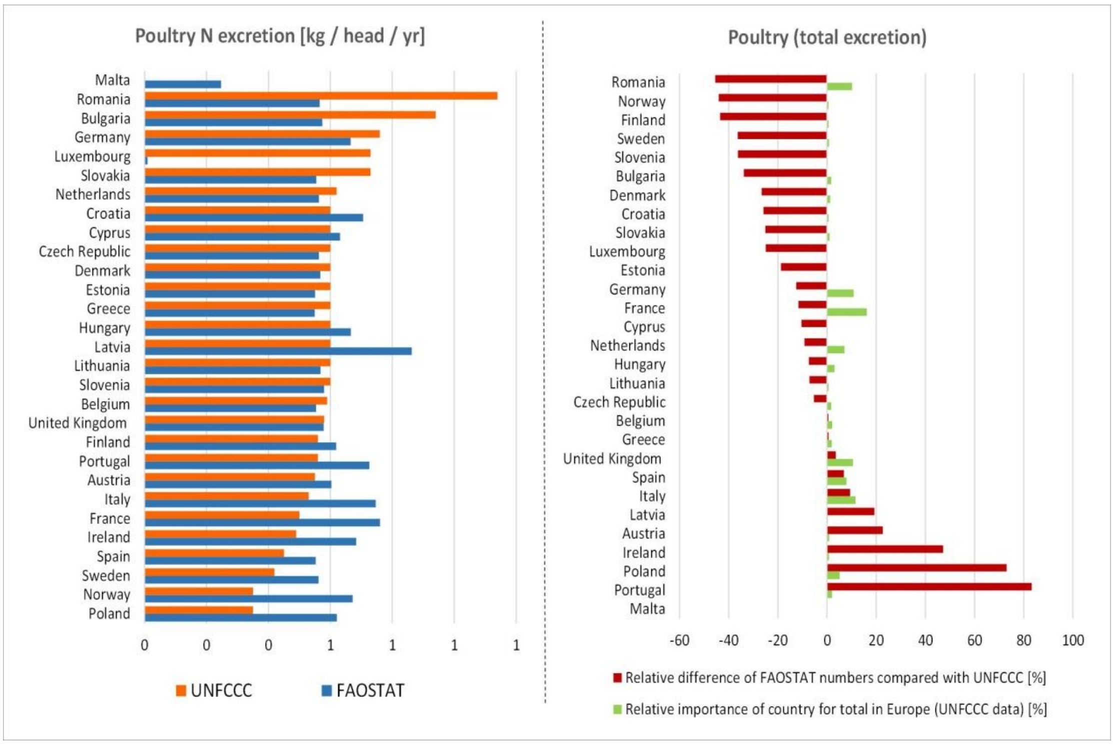


Figure 6.66: Comparison of UNFCCC and FAOSTAT data for dairy cattle N-excretion. Left: absolute numbers of total N-excretion rate [kg N head^{-1} yr^{-1}] for UNFCCC and FAOSTAT for the year 2010; right: Relative difference of the total N-excretion of FAOSTAT data compared to UNFCCC [%] and relative importance of the country for the total EU28.

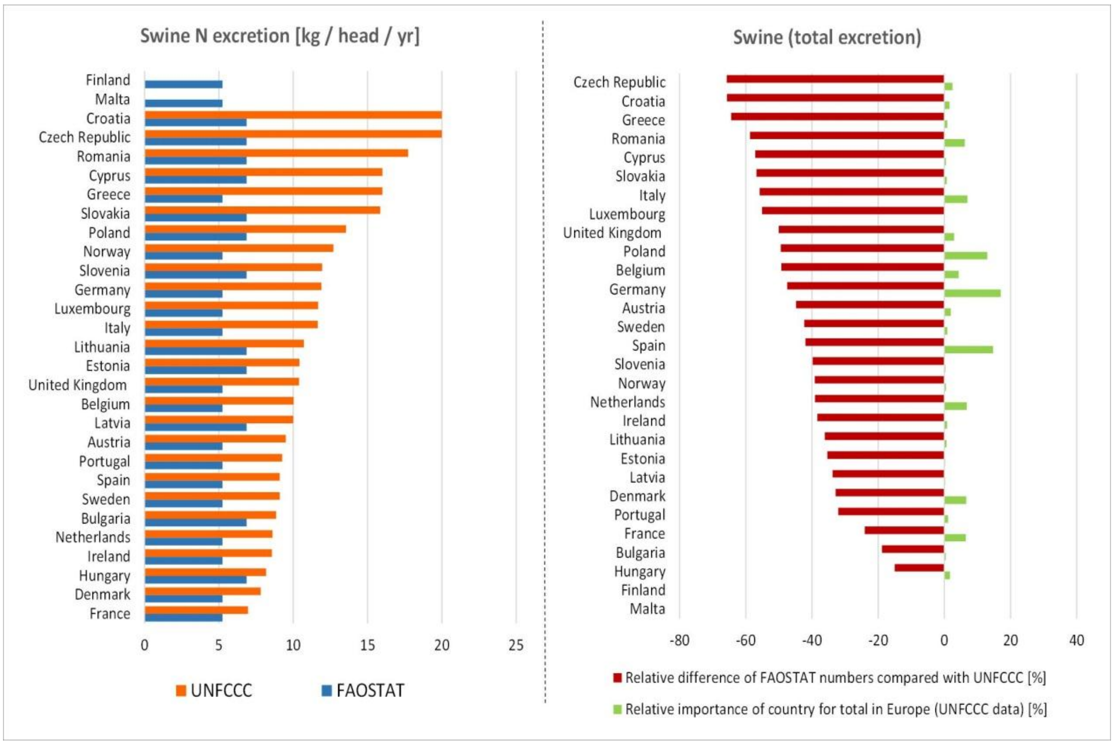


Figure 6.67: *Comparison of UNFCCC and FAOSTAT data for dairy cattle numbers. Percentage difference over all countries in Europe, average 1990-2010*

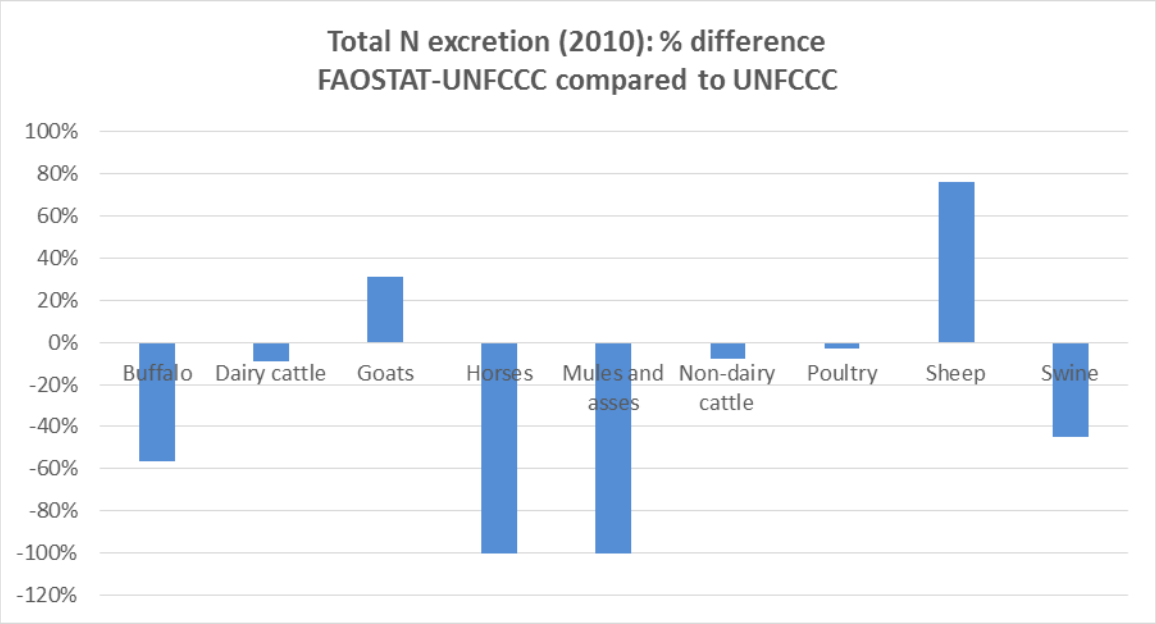
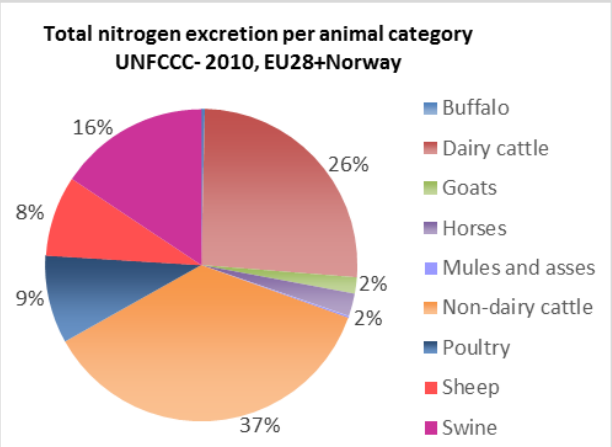
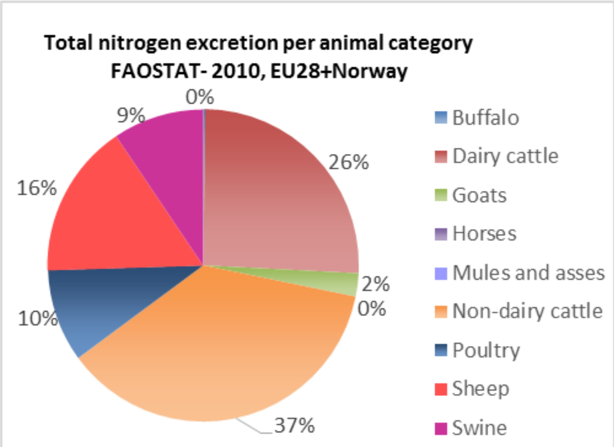


Figure 6.68: *Contribution of animal types to total N-excretion in the UNFCCC and FAOSTAT data for all countries in Europe for 2010.*





6.7.3.3 Area of rice cultivation

Rice production in the EU-28 plus Norway region is limited to eight countries: Bulgaria, France, Greece, Hungary, Italy, Portugal, Romania and Spain. From the total area, approximately 77% is covered by Italy and Spain. Figure 6.69 shows the rice area reported by countries for the UNFCCC inventories and the rice area estimated by FAOSTAT.

We can see that the differences between the two databases is quite low, varying along the years and the individual countries. In 2010, these differences range from 0% (Bulgaria) and 21% (Greece), being 1.56% for the whole region. For the two main producer countries, Italy and Spain, the differences between FAOSTAT area and the national inventories are, respectively, 0.1% and 2.9% for year 2010.

Figure 6.69: Comparison of UNFCCC and FAOSTAT data for area cultivation with rice. Percentage difference over all countries in Europe, average 1990-2010

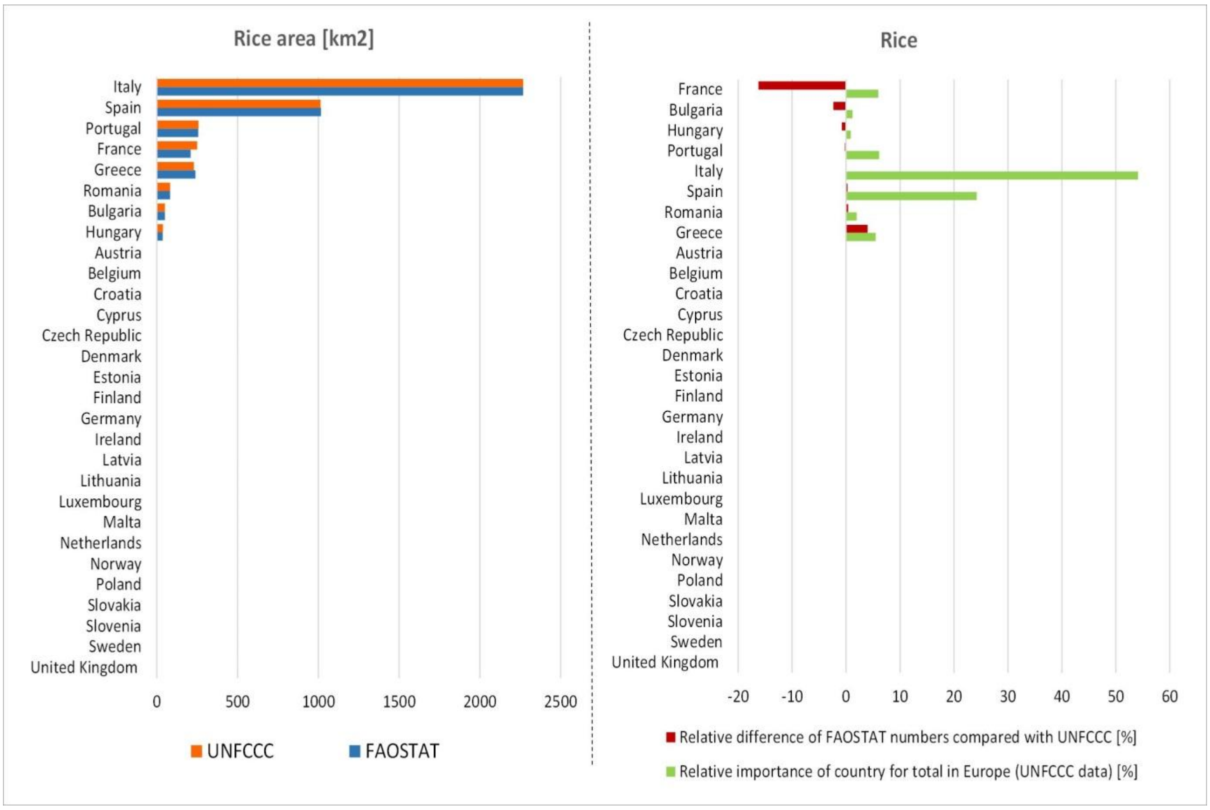
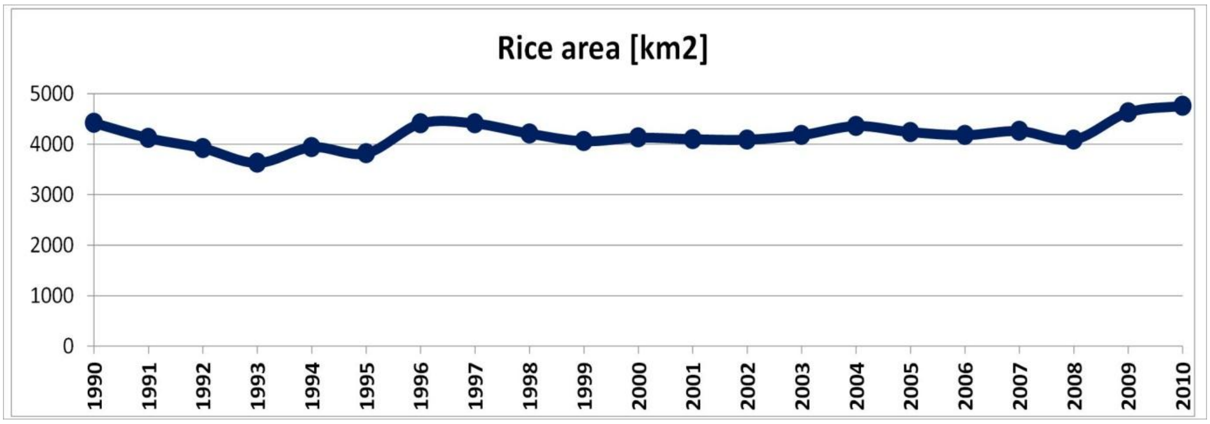


Figure 6.70: Trend of the rice area according to UNFCCC data for EU28+NO.



6.7.3.4 N input from synthetic fertilisers to soils

In FAO database, the amount of N applied from synthetic fertiliser is estimated from FAOSTAT N consumption data, assuming that this corresponds to nitrogen application, and derived in turn from annual balance of N production and net trade.

Differences between the NIR and FAOSTAT data depend on the specific year, going from 1.19 to 11.14 %, usually higher in FAOSTAT database. These differences depend also on the specific country. Focusing on 2010, which is the last year with existing data in both databases, we can see that differences between the two databases go from -45% (Lithuania) to +43% (Bulgaria) (see Figure 6.71 and Figure 6.72).

Figure 6.71: Comparison of UNFCCC and FAOSTAT data for N input from synthetic fertiliser. Percentage

difference over all countries in Europe, 2010

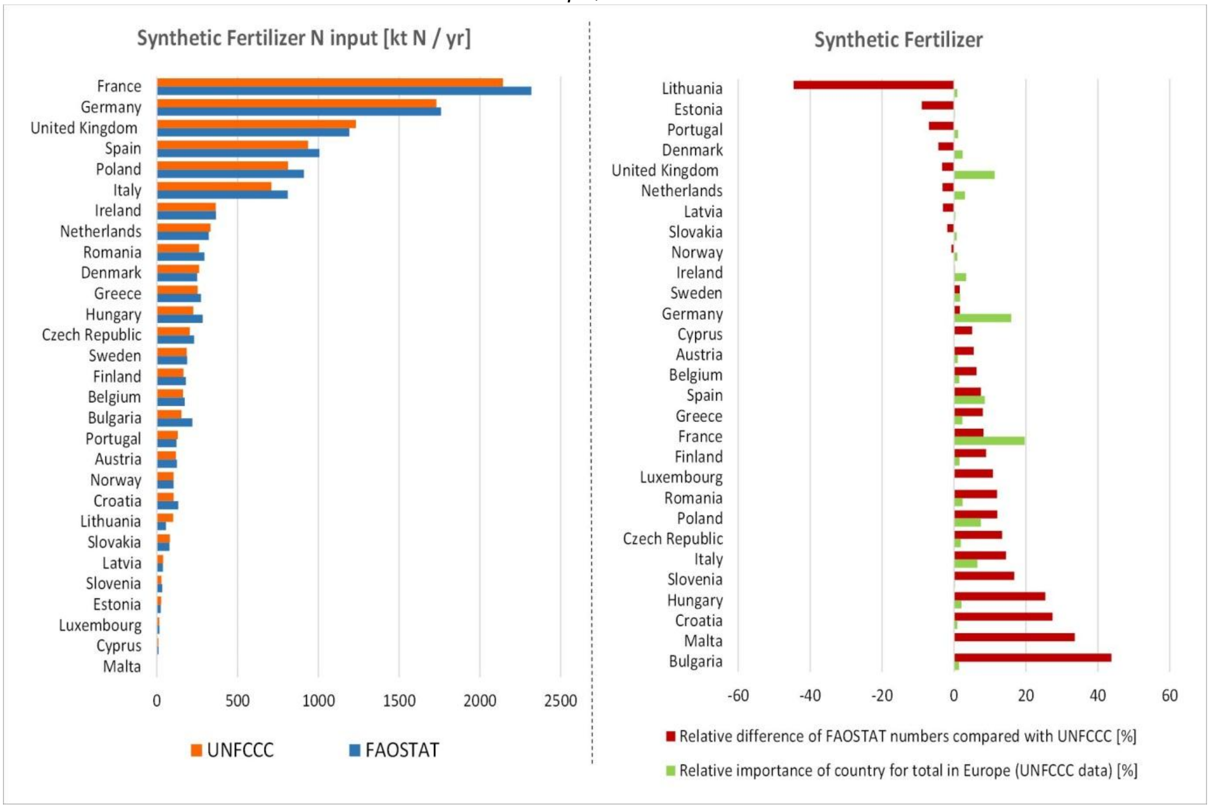
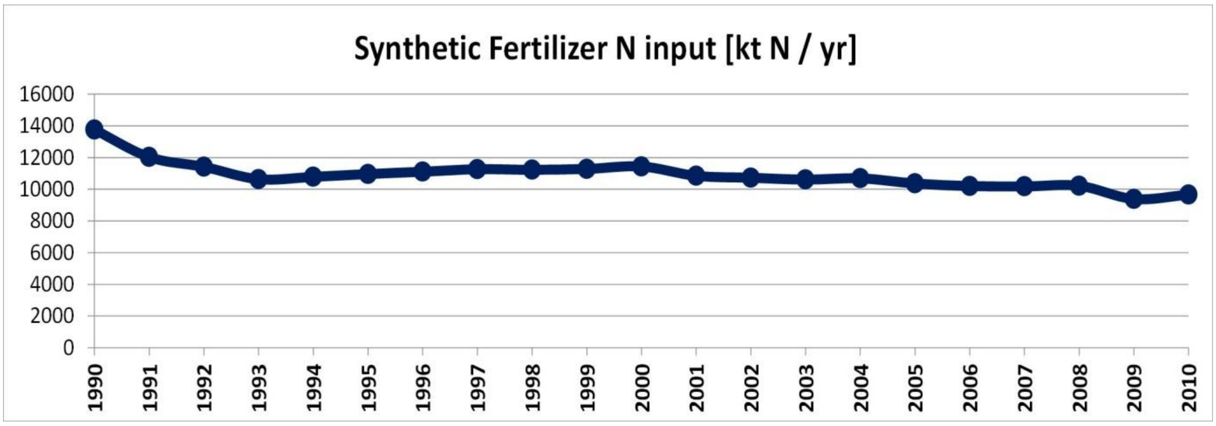


Figure 6.72: Trend of the N input from synthetic fertiliser according to UNFCCC data for EU28+NO.



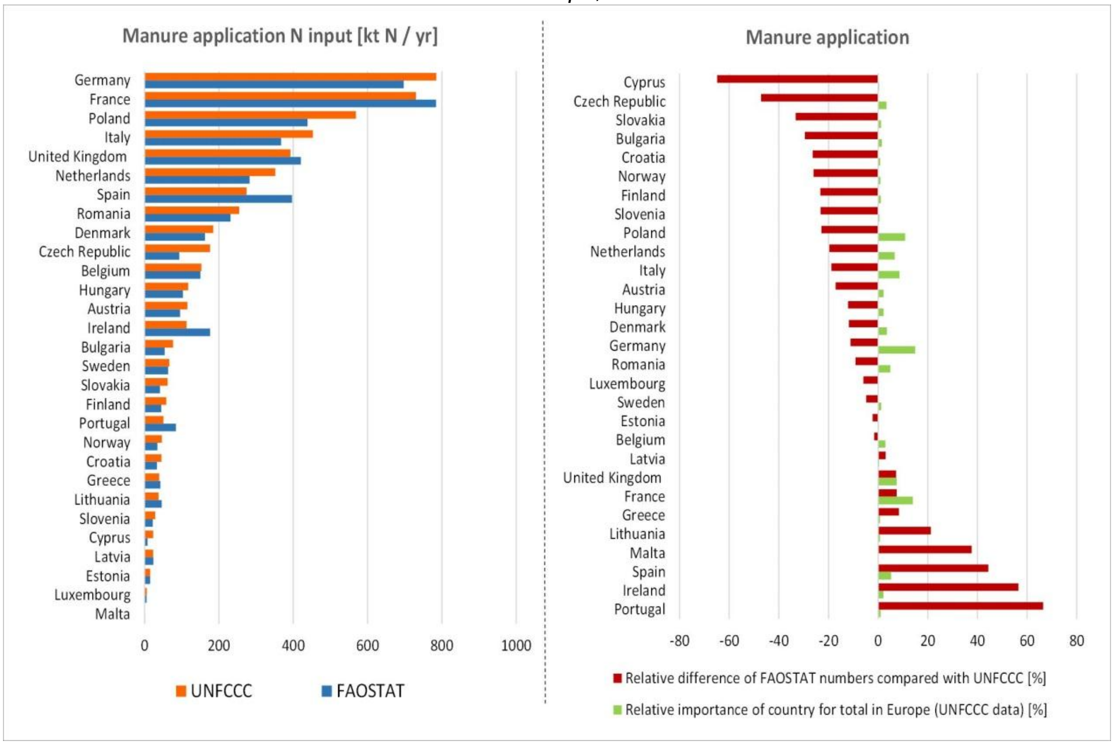
6.7.3.5 Other activity data

Figure 6.73 through Figure 6.75 show the data for other important activity data: manure application on agricultural land, manure deposition on pasture, range and paddock and N input with crop residues.

N manure applied to soils is estimated by FAOSTAT as total N excreted by each livestock category and treated in manure management systems minus net losses from volatilisation, runoff and leaching, plus the contribution of bedding materials, all parameters based on IPCC default values. To obtain the total N manure applied, default values per animal are multiplied by the number of animals contained in FAOSTAT own database.

Compared to nitrogen application from synthetic fertilisers, nitrogen from manure applied in the whole EU-28 plus Norway region presents slightly higher differences between the UNFCCC inventory data and FAOSTAT (figure 50). These differences are here more homogeneous along time (standard deviation 3.6, compared to 5.4 for synthetic fertilisers) and unlike the N from synthetic fertilisers, in the case of N from manure FAOSTAT indicates lower application rates than UNFCCC. Variability along countries is also similar to the one of N from synthetic fertilisers with differences between databases going in 2010 from -47% (Czech Republic) to +66% (Portugal), an and average of -6.9%.

Figure 6.73: Comparison of UNFCCC and FAOSTAT data for N input from applied manure. Percentage difference over all countries in Europe, 2010

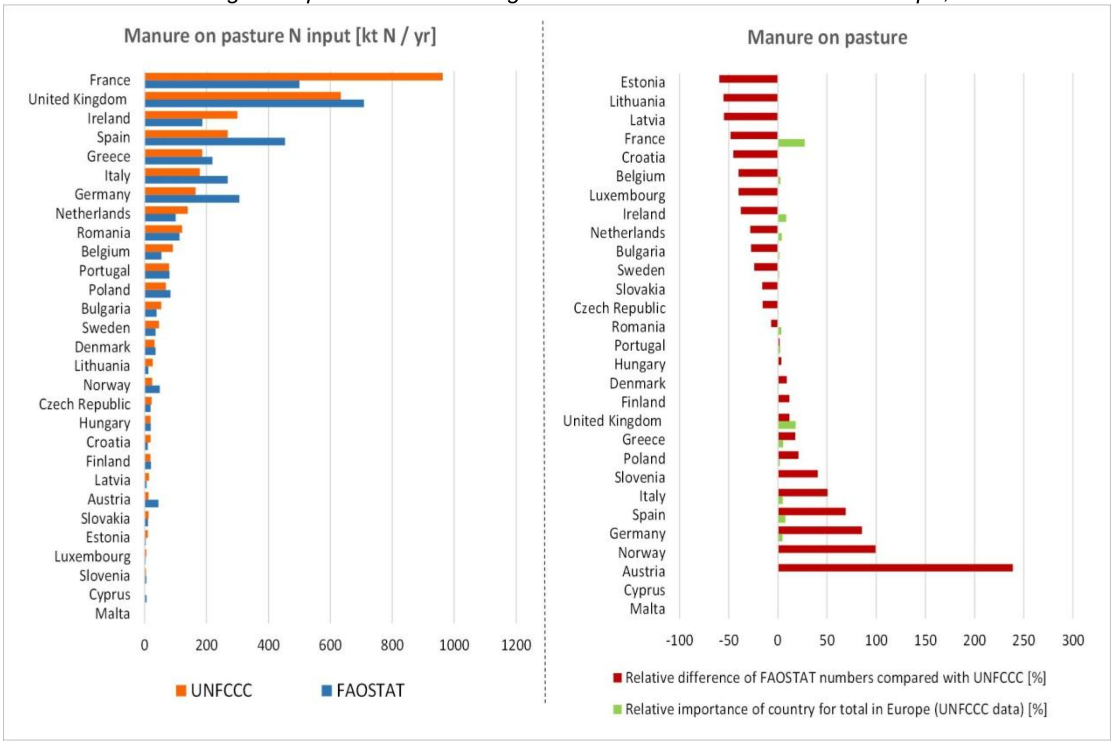


FAOSTAT estimates N input from manure excretion directly on pastures as total N excreted by each livestock category and deposited on pastures by grazing animals, based on IPCC default values for N excretion per animal category and percentage of manure deposited on pastures.

Total N manure left on pastures in the region shows a slow decrease along the years, going from 3960 thousand tons in 1990 to 3151 in 2010, according to the UNFCCC inventories, and from 3823 to 2967 according to FAOSTAT. The differences between the two databases are low, ranging from 1.27 to 5.86 % along this period.

Comparing the data by country in the two databases, we find big differences for Austria, for which FAOSTAT quadruples the value given in the UNFCCC inventory for 2010. For the other countries, differences range from -57.9% (Estonia) to 105% (Norway) in the same year. The average difference for all countries is -5.9% compared to UNFCCC inventory data.

Figure 6.74: *Comparison of UNFCCC and FAOSTAT data for N input from manure deposited on pasture range and paddock. Percentage difference over all countries in Europe, 2010*

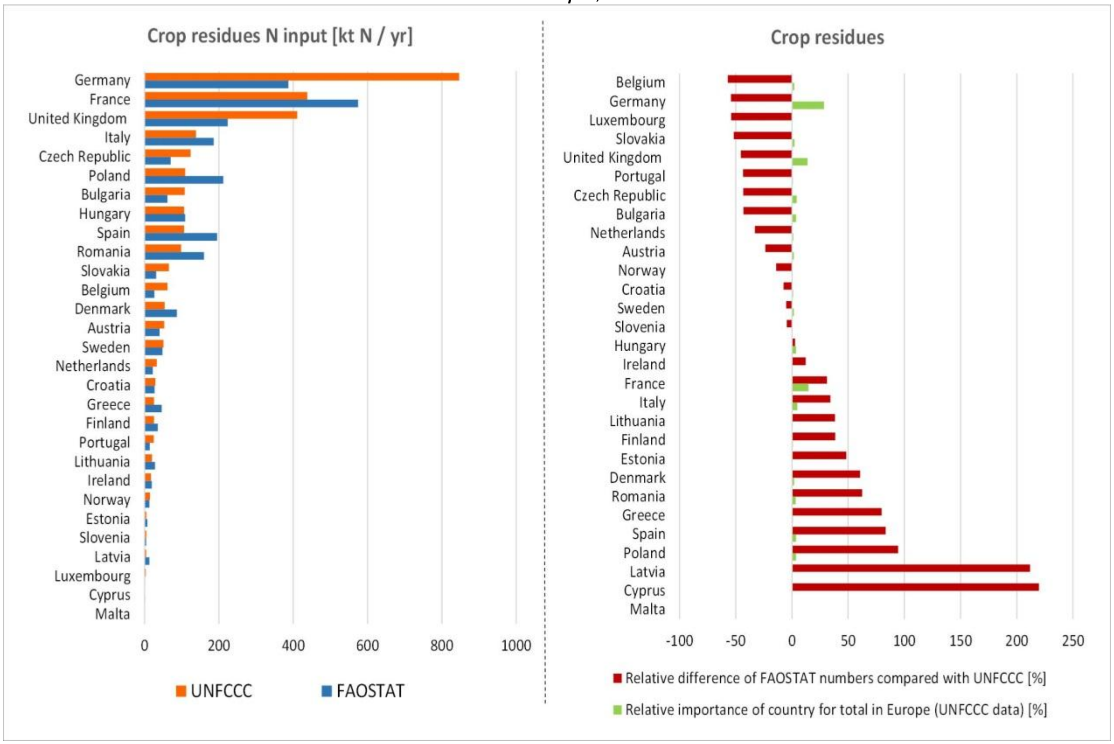


Nitrogen input from crop residues applied to soils is calculated in FAOSTAT from own data on yields and harvested and IPCC defaults for the amount of biomass N in above and below ground residues.

Differences between the two sources vary from 8.15 to 16.5% along the period 1990-2010, being always higher the UNFCCC inventory data. These differences, however, are not similar for the different countries.

Comparing the differences in the values given for N input from crop residues for 2010 in the two databases, we see that these differences vary for the different countries, ranging from -57% (Belgium) to ove 200% (Latvia and Cyprus).

Figure 6.75: Comparison of UNFCCC and FAOSTAT data for N input with crop residues. Percentage difference over all countries in Europe, 2010



The area of cultivated organic soils is estimated by FAOSTAT through the stratification of 3 databases: the Harmonized World Soil Database (FAO et al., 2012) to estimate the area of histosols, the Global Land Cover dataset, GLC2000 (EC-JRC, 2003) to estimate the area of grassland and cropland, and the Gridded Livestock of the World for cattle and sheep (Wint and Robinson, 2007) as an additional mask over grassland histosols.

A number of countries do not report any area of cultivated organic soils in their UNFCCC inventories but are given a certain value in FAOSTAT database: Austria, Bulgaria, Czech Republic, France, Hungary, Ireland, Portugal, Romania, Slovakia and Spain. The opposite situation is given for Croatia, which does provide a certain area of cultivated organic soils in the inventory but no area is considered in FAOSTAT. In the whole EU-28 plus Norway, the area of cultivated organic soils estimated by FAOSTAT is higher than the area considered in the UNFCCC inventories, except for 1990-1991, when a few countries were not still included in FAOSTAT database. Since 1993, FAOSTAT data are constant. The difference between the two databases ranges from 5.56% higher in UNFCCC (1990) to 26.56% (2010).

Analysing surfaces given by the two databases for the different countries in 2010, we find that the greatest discrepancy corresponds to Estonia, with 1390% higher area reported in FAOSTAT, compared to UNFCCC numbers. For the other countries, these differences range from 72.8% lower (Slovenia) to 487% higher (Greece) in FAOSTAT, compared to the inventories.

The area of cultivated organic soils is one of the most uncertain activities in the emission reports, due to the complexity to identify cultivated organic soils. According to the analysis performed, only the quantity of agricultural residues burnt shows highest differences between the estimations of the countries, reported in the UNFCCC inventories, and FAOSTAT estimations. But if we focus on the EU-15 and EU-27 countries, the difference are much lower: 9.8% higher in FAOSTAT and 29.2% lower in FAOSTAT compared to UNFCCC values, respectively.

Regarding the total amount of biomass burned, it is estimated by FAOSTATfrom own statistics on harvested area and IPCC default values on combustion factor and fraction of crop residues burn on-site.

FAOSTAT uses IPCC default values for residue burning, but this practice is forbidden in many countries. Consequently, FAO estimates residues burnt in a number of countries reporting no residue burning in their fields: Belgium, Croatia, Czech Republic, Germany, Lithuania (from 2002), Luxemburg (from 2000), the Netherlands, Slovakia (from 1993) and Slovenia (from 1992). There are also some countries which report some residue burning in their inventories but no data are estimated in FAOSTAT: Cyprus, Estonia (until 2006), Finland and the UK (1990-1992). For the whole EU-28 plus Norway region, FAOSTAT estimates higher amount of biomass burnt for all years, varying the difference between the two databases between 0.4% (1990) and 405.21% (2007) compared to UNFCCC data.

Focusing on 2010, we compared differences between FAOSTAT and inventory data for individual countries. FAO numbers are higher for all countries except for Greece. The greatest percentage difference, compared to the numbers reported to UNFCCC, corresponds to Austria (3407.7%). For the others, differences go from 62.6 %, higher in the inventories (Greece) to 982%, higher in FAOSTAT (Portugal).

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IPCC (Intergovernmental Panel on Climate Change), 2006. 2006 Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme. Published: IGES, Japan.

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6.8 Sector-specific recalculations

In EU-15 countries, total recalculation, averaged over the years 1990-2012 was 78 Gg CO_2eq when summed over positive or negative recalculations or 84 Gg CO_2eq when summing over the absolute changes caused by recalculations. Figure 6.76 shows the relative changes that caused by the recalculations for EU-15 countries. The contribution of countries to the overall absolute sum of recalculations for EU-15 is shown in Figure 6.77.

Largest contribution of recalculations an EU-15 level is for emissions from manure management (78%, absolute values), followed by emissions from agricutural soils (20%). Emissions from enteric fermentation contributedwith 10%, while emissions from rice cultivation and burning of agricultural residues contributed with only minor changes.

Figure 6.76: *Recalculations for 1990-2012 – Total agriculture*

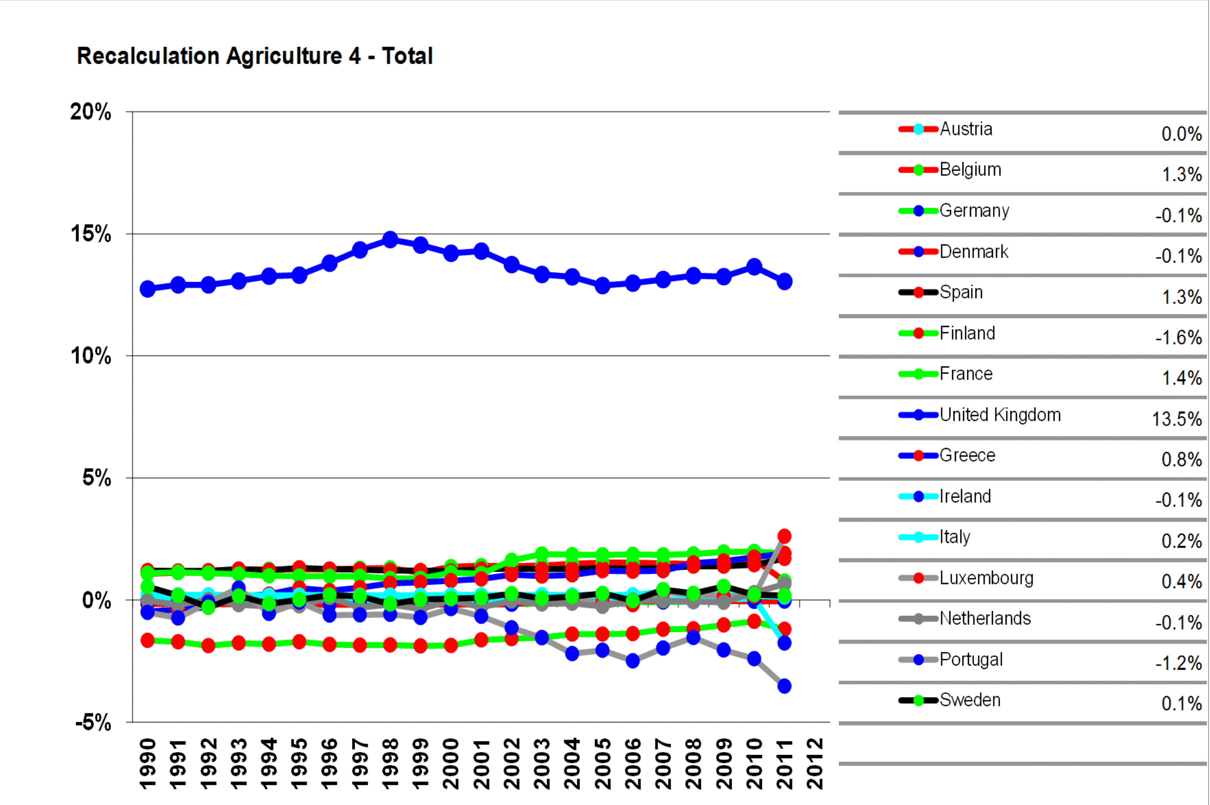
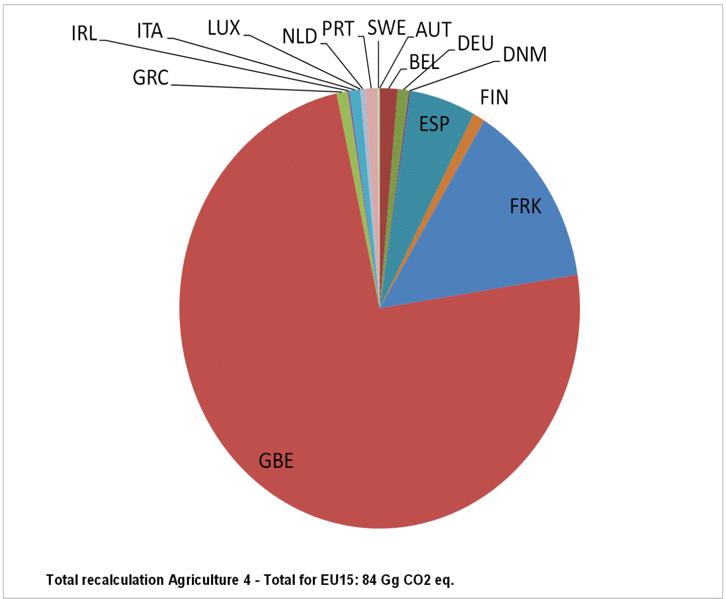


Figure 6.77: *Average recalculations for the years 1990-2012, contribution of EU-15 countries to total absolute change for EU-15 recalculation – Total agriculture*



6.8.1 Enteric Fermentation (CRF source category 4.A)

In EU-15 countries, total recalculation in category 4A, averaged over the years 1990-2012 was 4.3 Gg CO_2eq when summed over positive or negative recalculations or 8.2 Gg CO_2eq when summing over the absolute changes caused by recalculations. Figure 6.78 shows the relative changes that caused by the recalculations for EU-15 countries. The contribution of countries to the overall absolute sum of recalculations for EU-15 is shown in

Figure 6.79. Table 6.109 gives information available in the national inventory reports on the recalculations performed.

Figure 6.78: Recalculations for 1990-2012 – Enteric fermentation

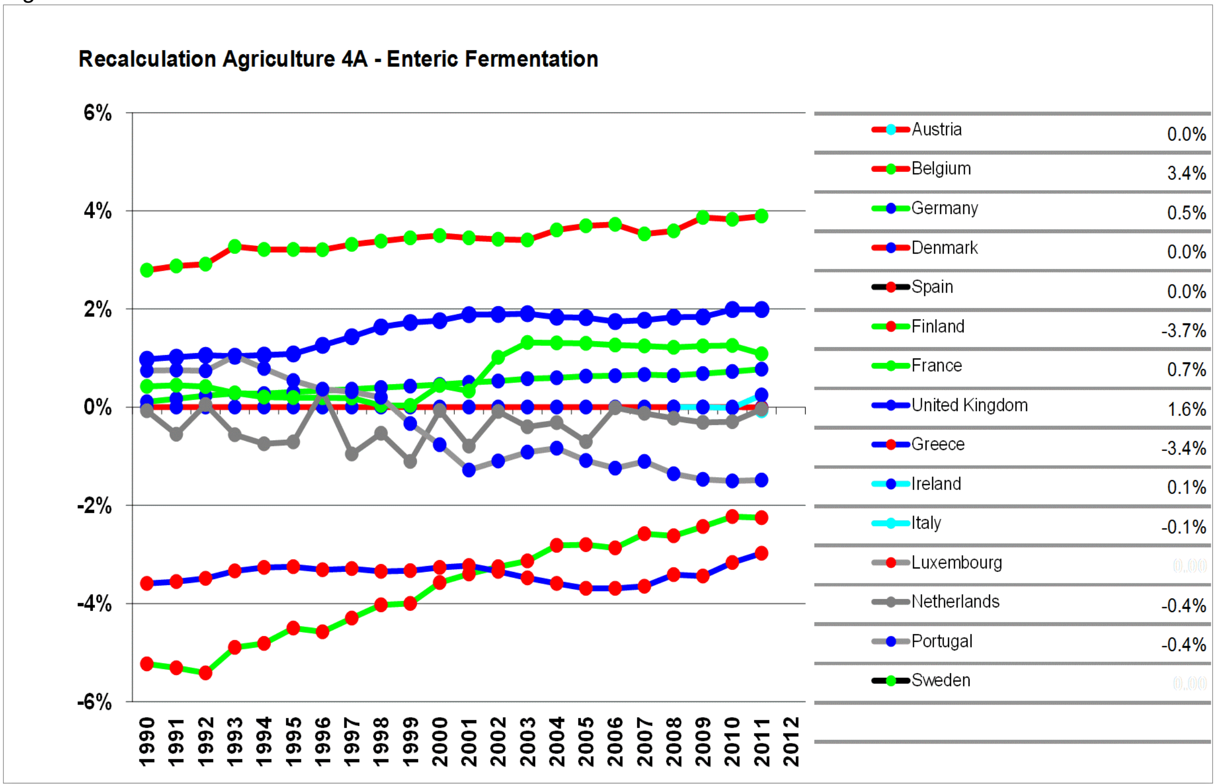


Figure 6.79: Average recalculations for the years 1990-2012, contributio of EU-15 countries to total absolute change for EU-15 recalculation – Enteric Fermentation

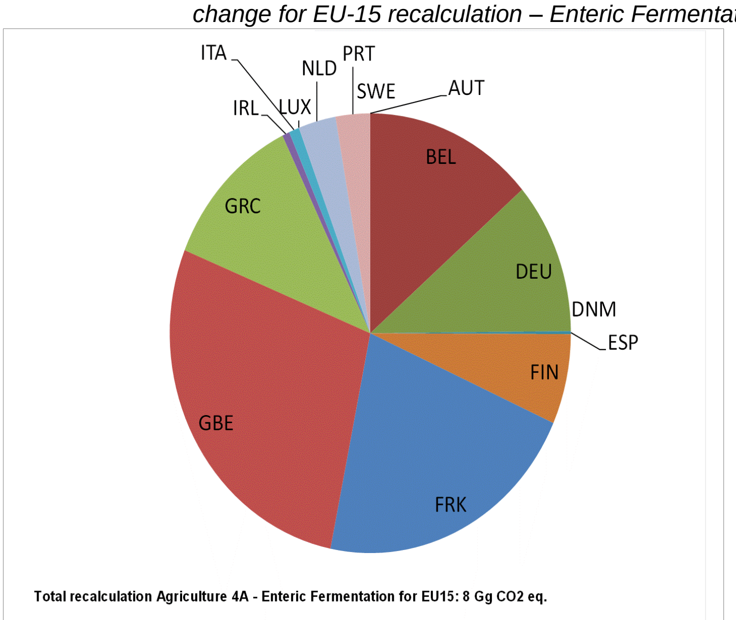


Table 6.109: Member State's background information for recalculations of emissions in category 4.A

Member State	***Recalculations***
Austria	
Belgium	*According to 2013 review, the net energy for pregnancy of dairy cows has been included in calculations as described in the IPCC Good Practice Guidance. The assumption is made that 80% of the mature females give birth in a year. This results in an increase of CH_4 emissions from enteric fermentation of maximum 1.406 Gg CH_4 in Flanders and 1.22 Gg CH_4 in Wallonia.* *Also responding to 2013 review, net energy of lactation of non-dairy cows has been taken into account in Wallonia. This increases CH_4 emissions in a maximum 4.7 Gg CH_4.* *In Flanders, from 2007, animal numbers have slightly changed, resulting in slight changes in methane emissions from enteric fermentation from a small decrease of max. 0.203 Gg in 2007 to a small increase from 0.084 Gg in 2010.* *In Brussels, livestock values for 2011 were revised.*
Denmark	*The number of geese has been changed for all years and the number of weaners and fattening pigs for 2011. This affects emissions from enteric fermentation, manure management and agricultural soils.*
Finland	*The number of fur animals was updated for 2011 (it was not available before)* *Daily weight gain of cattle was updated and the values are calculated separately for each year based on functions of mature weight and age. The mature weight of heifers and calves was also updated so that simple averages were replaced with weighted averages of dairy and suckler cows and bulls.*
France	*Animal population and milk production have been updated, following the update of national statistics.* *The EF of non-dairy cattle has been updated due to new statistical evidence.*
Germany	*Parameters for calculating gross energy intake for dairy cattle, non-dairy cattle and pigs were updated* *Live weight for poultry has been updated.*
Greece	*CH_4 emissions from enteric fermentation have been recalculated for 1990-2011 because of the update of the DE and Ym for cattle and milk yield for sheep.* *Emissions for 2008-2011 have been recalculated because of the update of the activity data for cattle population for 2009.*
Ireland	*Minor changes due to revision in animal populations for 2010 and 2011 for dairy cattle, other cattle, sheep, goats, horses, mules and asses.*
Italy	*Recalculations due to the update of milk production and fat content data for dairy cattle and the number of animals for rabbits category.*
Luxembourg	
Portugal	*Improvement of the methodology to estimate methane emissions from enteric fermentation for dairy cattle*
Netherlands	*Calculation of CH_4 emissions from enteric fermentation from mature dairy cattle follows a tier 3 approach but applied a weighted overall EF for all regions. Now calculation has been split into NW and SE regions with reported total being the sum of both. Also some small errors in chemical composition of the rations fed were corrected. Results differ from previously reported by -76 to +4 Gg CO_2-eq per year.* *Following last year's review, emissions from mules and asses were added to the inventory.*
Spain	*Update of the number of horses for 2011 and 2012, and other poultry for 2010.*
Sweden	
United Kingdom	*Dairy cow feed digestibility was corrected from 75% to 74.5234%, according to expert communication (including all decimals).* *The 2011 N excretion rate for dairy cows was linked to milk yield, which was not the case before (it was for all the other years). The milk yield data for 2011 was provisional and has been updated.* *Activity data for horses has been revised to include both agricultural and non-agricultural horses for the whole time series.*
Bulgaria	*Following recommendations of the 2013 review, change in animal weight for young cattle*
Czech Republic	
Cyprus	*For the estimation of emissions from dairy cattle tier 2 has been used, instead of tier 1 used before. Emissions from mules and asses and from poultry have been added.*
Estonia	*Updated population data for horses and young cattle due to an update in the Statistics Estonia database for years 2007 and 2008. This affects the calculation of CH_4 emissions form enteric fermentation, which decreases for young cattle from 4.35 to 4.33 Gg CH_4 in 2007, and increases for horse from 0.094 to 0.095 Gg CH_4 in 2008.*
Hungary	*Revision of gross energy intake and methane conversion rate for cattle for the full time series* *Revision of poultry population for the year 2011*
Latvia	*Recalculations for the period 2000-2011 based on ERT recommendations about different approach to calculate the number of days on pasture. Minor corrections also done according to correction in of statistical data on livestock numbers.*
Lithuania	*Gross energy intake has been recalculated for the period 1991-2012 due to a recalculation of weight of dairy cattle.* *Emissions from sheep for 2011 were recalculated due to a correction of CH_4 emission factors for baa-*

Member State	Recalculations
	lambs.
Malta	*Recalculations due to update of animal numbers. It has resulted in significant changes, particularly in early years of the time series.*
Poland	*Recalculation of non-dairy cattle population for 1988-1997 for consistency purposes.* *Update of data on fat content in cow milk in 2012.* *Update of digestibility energy index (DE) for dairy cattle in 2007-2011 and for non-dairy cattle in 1988-2011.*
Romania	
Slovakia	*Recalculation using tier 2 method for methane emissions from enteric fermentation for the whole time series, using more detailed statistical data.*
Slovenia	*Very minor recalculations for 2010 and 2011 due to updated data on population of horses.*
Croatia	*Methane emissions from enteric fermentation were recalculated for 1995-2011 period due to changes in activity data (number of horses and mules and asses).*

6.8.2 Manure Management (CRF source category 4.B(a))

In EU-15 countries, total recalculation in category 4B, averaged over the years 1990-2012 was 63.6 Gg CO_2eq when summed over positive or negative recalculations or 66.1 Gg CO_2eq when summing over the absolute changes caused by recalculations. Figure 6.80 shows the relative changes that caused by the recalculations for EU-15 countries. The contribution of countries to the overall absolute sum of recalculations for EU-15 is shown in Figure 6.81. Note that these figure thow the data for both CH_4 and N_2O emissions. Table 6.110 gives information available in the national inventory reports on the recalculations performed for CH_4 emissions from manure managmenet.

Figure 6.80: Recalculations for 1990-2012 – Manure Management

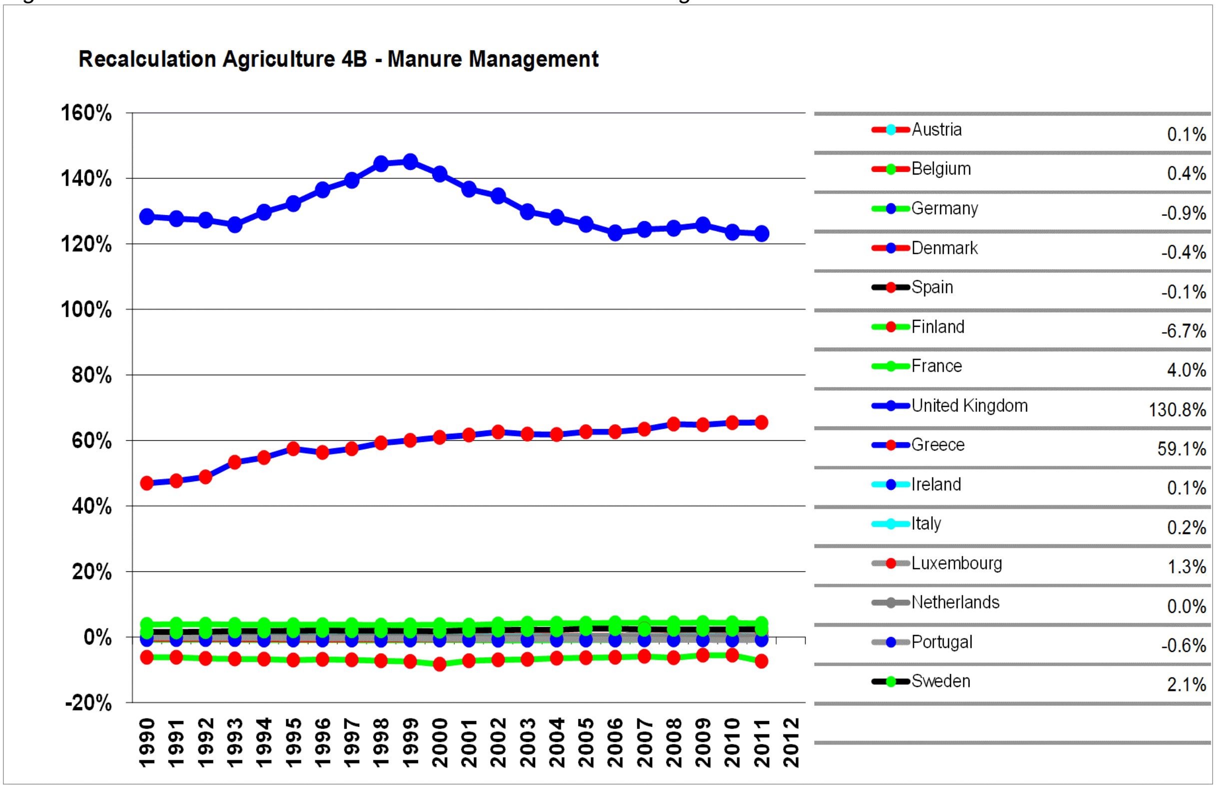


Figure 6.81: *Average recalculations for the years 1990-2012, contribution of EU-15 countries to total absolute change for EU-15 recalculation – Manure Management*

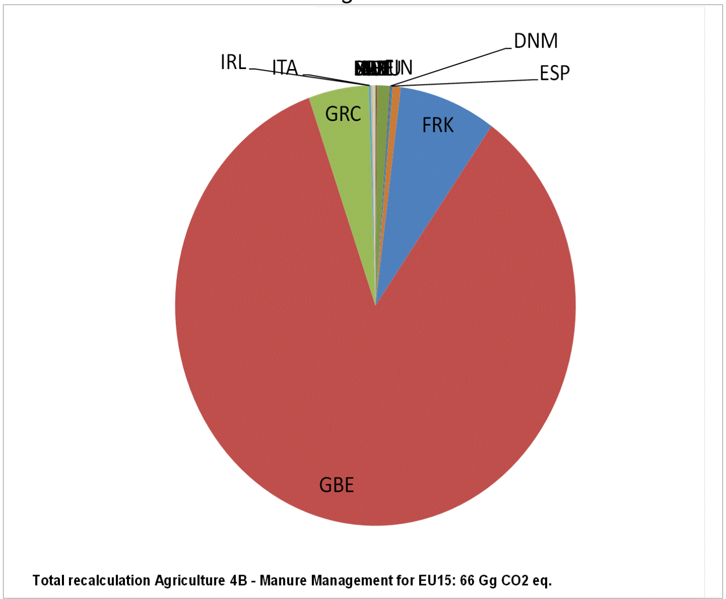


Table 6.110: *Member State's background information for recalculations of emissions in category 4.B-CH_4*

Member State	***Recalculations***
Austria	*Updated feedstock balance provided by the Austrian energy regulator E-Control showed smaller amounts of digested manure as calculated in previous inventories. The revision caused slightly higher methane emissions and minor changes in N_2O emissions in recent years.*
Belgium	*According to 2013 review, the net energy for pregnancy of dairy cows has been included in calculations as described in the IPCC Good Practice Guidance. The assumption is made that 80% of the mature females give birth in a year. This results in an increase of CH_4 emissions from manure management of max. 0.211 Gg CH_4 in Flanders and 0.115 Gg CH_4 in Wallonia.* *Also responding to 2013 review, net energy of lactation of non-dairy cows has been taken into account in Wallonia. This increases CH_4 emissions in max. 0.152 Gg CH_4.* *In Flanders, from 2007, animal numbers have slightly changed, resulting small changes of methane emissions from manure management from a small decrease of max. 0.132 Gg CH_4 in 2007 and a small increase of 0.020 Gg CH_4 in 2010.* *In Brussels, livestock values for 2011 were revised.*
Denmark	*The amount of straw used for bedding for heifers has been changed for 1990-2002, and this affected the emissions of CH_4 from manure management.* *The number of geese has been changed for all years and the number of weaners and fattening pigs for 2011. This affects emissions from enteric fermentation, manure management and agricultural soils.* *The amount of biogas treated manure has been changed in 2010 and this decreases emissions from manure management.*
Finland	*The number of fur animals was updated for 2011, and this affects both CH_4 and N_2O emissions from manure management.*
France	*Population of dairy cattle has been updated.* *The VS for non-dairy cattle have been modified following the integration of national data about feed. This has an impact on CH_4 and N_2O emissions from manure management.* *The grazing time for cattle has also been modified following the introduction of a transition time between the time spent in the buildings and on pastures.*
Germany	*Nitrogen content in animal bodies of non-dairy cattle has been updated* *The nitrogen reduced feeding system for sows has not been included in this inventory, as it is less frequently used than previously assumed and data are scarce* *Grazing share for sheep has been updated*
Greece	*CH_4 emissions from manure management have been recalculated for 1990-2011 because of the update of the DE and Ym for cattle.* *Emissions for 2008-2011 have been recalculated because of the update of the activity data for cattle population for 2009.*
Ireland	*Minor changes due to revision in animal populations for 2010 and 2011 for dairy cattle, other cattle, sheep, goats, horses, mules and asses.*
Italy	*Emissions recalculated for the whole time series due to the uploading of the fur animals' category. In 2011, CH_4 emissions also recalculated due to the updating of the number of rabbits.*

Member State	*Recalculations*
Luxembourg	
Netherlands	*Following last year's review, emissions from mules and asses have been added to the inventory.* *Small errors in the activity data (animal numbers) for manure management were detected and corrected, for 1993 and 2000-2005.*
Portugal	*Recalculations related to methodological improvement made for dairy cows CH_4 emissions, namely the use of ca country specific DE (%) value instead of a default one.*
Spain	*Update of the number of horses for 2011 and 2012, and other poultry for 2010.*
Sweden	*Percentage of volatile solids (VS) in manure was updated, using now IPCC default values (92% for cattle and 98% for swine)* *Activity data for 2011 for turkeys has been updated with the latest available statistics, resulting in minor difference in emissions from poultry.*
United Kingdom	*Dairy cow digestibility was corrected from 75% to 74.5234%, keeping all decimals according to expert information.* *In the UK, 58% of the land is subject to NVZ, where the application of manure is not allowed at certain times of the year. Application of manure is also not allowed on snow. Considering that, and following 2013 review, the AWMS values have been updated by reducing the allocation of manure to daily spread, affecting cattle, pigs and poultry. The difference was attributed to deep litter. As a consequence, MCF was updated from 1% to 39% for deep litter.* *There have been changes to the livestock numbers for the OTs and CDs since the previous submission due to improved calculations to ensure consistency of the time series, but the only significant change has been for cattle in the Cayman Islands in 1993.*
Bulgaria	*Following recommendations of the 2013 review, change in animal weight for young cattle.*
Czech Republic	*A higher tier 2 method has been implemented for CH_4 emissions from manure management, important for cattle. The result is an increase in emissions from cattle of approx. 12% in 1990 and 42% in 2011. Total methane emissions from manure management increased by 7% in 1990 and 26% in 2011.*
Cyprus	*Estimation of emissions from mules and asses has been added.*
Estonia	*Data on livestock population updated for horses and young cattle for 2007 and 2008 due to an update in the Statistics Estonia Database. This leads to a decrease in CH_4 emissions from manure management of young cattle from 0.190 Gg to 0.189 Gg CH_4 in 2007, and an increase of CH_4 from horse manure from 0.00728 Gg to 0.00742 Gg CH_4 in 2008.*
Hungary	*Revision of volatile solid excretion rate for cattle and poultry for the full time series* *Revision of poultry population for the year 2011*
Latvia	*Recalculations for the period 2000-2011 done based on ERT recommendation about different approach to calculate the number of days on pastures.*
Lithuania	*Recalculations due to an update of manure management systems for swine in 2011* *Updated average weight for the period 1991-2011 and gross energy data for dairy cattle for 2008-2011.*
Malta	*Recalculations due to revised animal number for the whole time series, with significant impact on emissions, especially for early years of the time series.*
Poland	*Recalculation of non-dairy cattle population for 1988-1997 for consistency purposes.* *Update of data on fat content in cow milk in 2012.* *Update of digestibility energy index (DE) for dairy cattle in 2007-2011 and for non-dairy cattle in 1988-2011.*
Romania	
Slovakia	
Slovenia	*Very minor recalculations for 2010 and 2011 due to updated data on population of horses.*
Croatia	*Methane emissions from manure management were recalculated for 1995-2011 period due to changes in activity data (number of horses and mules and asses).*

6.8.3 Manure Management (CRF source category 4.B(b))

Table 6.111 gives information available in the national inventory reports on the recalculations performed. Relative changes of GHG emissions from manure management and contribution of countries to total EU-15 changes see above.

Table 6.111: Member State's background information for recalculations of emissions in category 4.B-N_2O

Member State	*Recalculations*
Austria	
Belgium	*In Flanders, from 2007, animal numbers have slightly changed, resulting in changes in C2O emissions from manure management from an increase of 0.006 Gg N_2O in 2007 to a small decrease of 0.001 Gg N_2O in 2009.*

Member State	Recalculations
	In Brussels, livestock values for 2011 were revised.
Denmark	The number of geese has been changed for all years and the number of weaners and fattening pigs for 2011. This affects emissions from enteric fermentation, manure management and agricultural soils. The amount of biogas treated manure has been changed in 2010 and this decreases emissions from manure management.
Finland	The number of fur animals was updated for 2011, and this affects both CH_4 and N_2O emissions from manure management. Nitrogen excretion of sows was updated for the whole time series due to a change in the source of the amount of feed digested by sows. The value of VS for poultry was erroneous and has been corrected from 0.02 to 0.2 for the whole time series. The new value was calculated as a weighted average of different poultry groups in a national dataset.
France	
Germany	
Greece	N_2O emissions from manure management have been recalculated for 1990-2011 because of the modification of dairy cattle Nex value estimation methodology and the updating of the manure management sector system allocation of sheep, goats and poultry. Emissions for 2008-2011 have been recalculated because of the update of the activity data for cattle population for 2009.
Ireland	Minor changes due to revision in animal populations for 2010 and 2011 for dairy cattle, other cattle, sheep, goats, horses, mules and asses.
Italy	Emissions recalculated for the whole time series due to the uploading of the fur animals' category
Luxembourg	
Netherlands	Following last year's review, emissions from mules and asses have been added to the inventory
Portugal	Recalculation of emissions for the whole time series due to a revision of N excretion coefficient for swine sub-category "fattening pigs- 20-50 kg", which changes from 7 to 9 kg/head·year.
Spain	Update of the number of horses for 2011 and 2012, and other poultry for 2010.
Sweden	Activity data for 2011 for turkeys has been updated with the latest available statistics, resulting in minor difference in emissions from poultry.
United Kingdom	The 2011 N excretion rate for dairy cows was updated, it is now linked to milk yield (it was not the case before for 2011, although it was for the other years). Activity data for horses has been revised to include both agricultural and non-agricultural horses for the whole time series. There have been changes to the livestock numbers for the OTs and CDs since the previous submission due to improved calculations to ensure consistency of the time series, but the only significant change has been for cattle in the Cayman Islands in 1993. There has been an improvement in the methodology for the calculation of N_2O emissions from manure management in Bermuda, using now country specific livestock data and emission factors, like in all other regions.
Bulgaria	Following recommendations of the 2013 review, change in animal weight for young cattle and change in the AWMS distribution and nitrogen excretion for poultry.
Czech Republic	
Cyprus	Estimation of emissions from mules and asses has been added. Changes in the waste management systems applied (anaerobic digestion separated from other technologies). Nitrogen excretion rates per animal for dairy cattle, non-dairy cattle and goats were revised. Kg N_2O-N/kgN ex factor for other animal waste management system was revised.
Estonia	Data on livestock population updated for horses and young cattle for 2007 and 2008 due to an update in the Statistics Estonia Database. Initial parameters used to estimate gross energy intake were recalculated for cattle (weight of 1-2 year animals) Nitrogen excretion rates were corrected for dairy cattle and fur animals (there was an error in CRF tables), and recalculated for horses and young cattle based on updated data.
Hungary	Revision of N excretion rate of cattle and swine for the full time series Revision of poultry population for the year 2011
Latvia	Recalculations for the period 2000-2011 done based on ERT recommendation about different approach to calculate the number of days on pastures.
Lithuania	Recalculations due to the update of gross energy intake and protein consumption for the period 1990-2011, and N retention for airy cattle according to IPCC GPG 2000 methodology for the entire time series. Also updated data for manure management system for swine in 2011.
Malta	Recalculations due to revised animal number for the whole time series, with significant impact on emissions, especially for early years of the time series.
Poland	Recalculation of non-dairy cattle population for 1988-1997 for consistency purposes.

Member State	Recalculations
	Update of data on fat content in cow milk in 2012. *Update of digestibility energy index (DE) for dairy cattle in 2007-2011 and for non-dairy cattle in 1988-2011.* *Correction of AWMS for sheep and goats for 1988-2011.*
Romania	
Slovakia	
Slovenia	*Very minor recalculations for 2010 and 2011 due to updated data on population of horses.*
Croatia	*N_2O emissions from enteric fermentation were recalculated for 1995-2011 period due to changes in activity data (number of horses and mules and asses).*

6.8.4 Agricultural Soils – CH_4 (Source category 4.C)

In EU-15 countries, total recalculation in category 4C, averaged over the years 1990-2012 was -0.86 Gg CO_2eq when summed over positive or negative recalculations or 0.87 Gg CO_2eq when summing over the absolute changes caused by recalculations. Figure 6.82 shows the relative changes that caused by the recalculations for EU-15 countries. The contribution of countries to the overall absolute sum of recalculations for EU-15 is shown in Figure 6.83. Table 6.112 gives information available in the national inventory reports on the recalculations performed.

Figure 6.82: Recalculations for 1990-2012 – Rice Cultivation

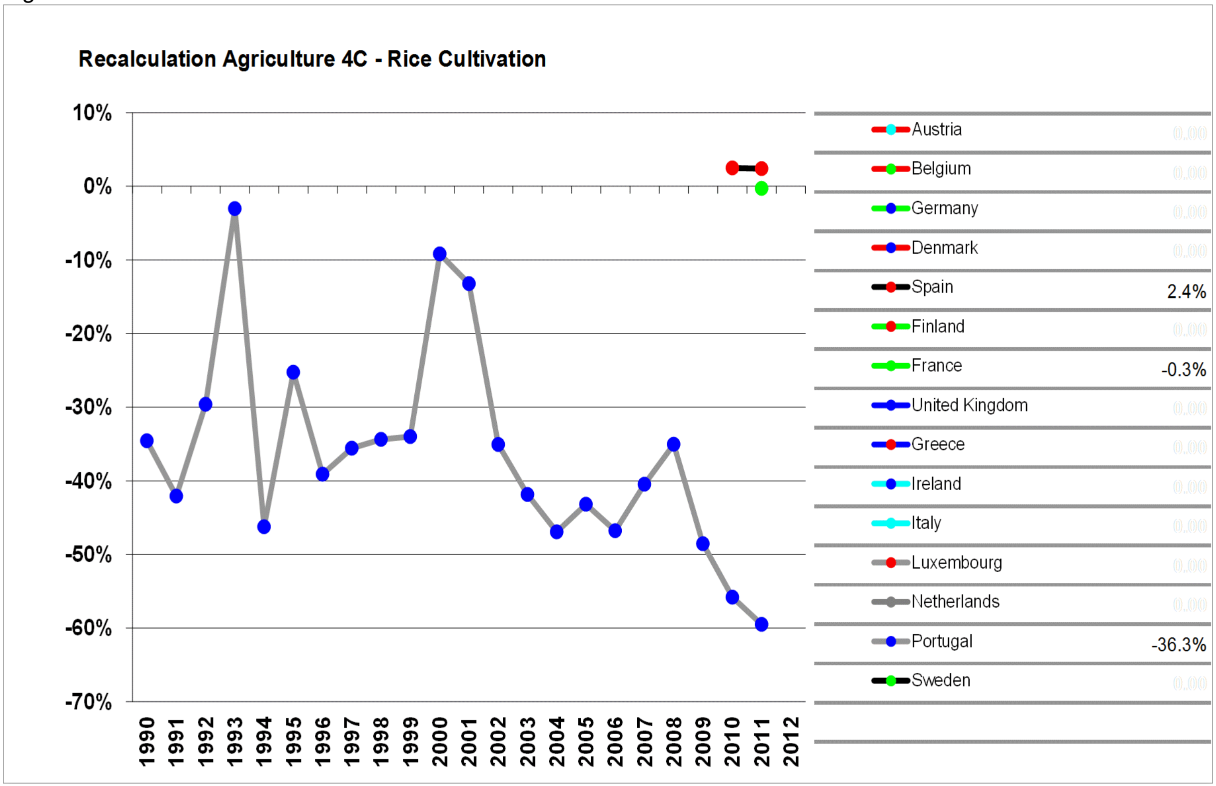


Figure 6.83: Average recalculations for the years 1990-2012, contributio of EU-15 countries to total absolute change for EU-15 recalculation – Rice Cultivation

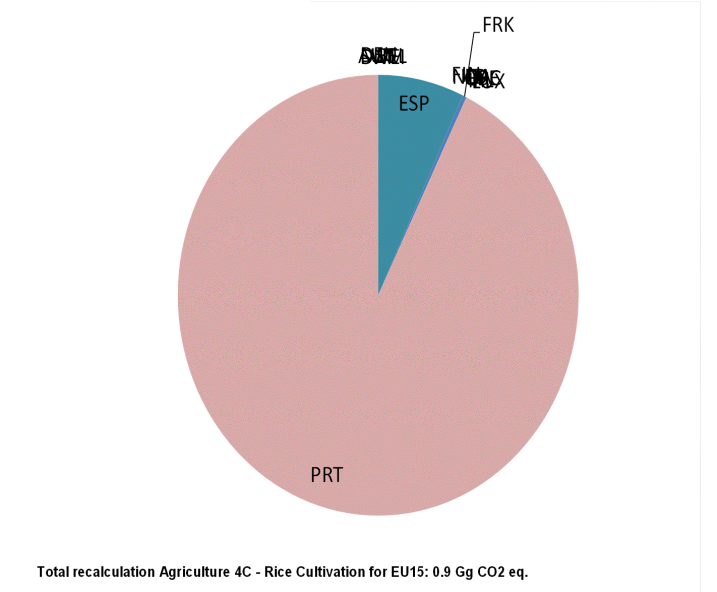


Table 6.112: Member State's background information for recalculations of emissions in category 4.C

Member State	**Recalculations**
France	*Rice area data has been updated*
Greece	
Italy	
Portugal	Revision of the methodology to estimate methane emissions from rice cultivation. The country specific EF, which was out of IPCC range, was replaced by the default IPCC value (20 g/m^2·year). A scaling factor of 0.7 was selected, in accordance with water management practices in national rice fields. Revision of rice areas with residues burnt restrictions.
Spain	

6.8.5 Agricultural Soils - N_2O (Source category 4.D)

In EU-15 countries, total recalculation in category 4D, averaged over the years 1990-2012 was 11.3 Gg CO_2eq when summed over positive or negative recalculations or 17.2 Gg CO_2eq when summing over the absolute changes caused by recalculations. Figure 6.84 shows the relative changes that caused by the recalculations for EU-15 countries. The contribution of countries to the overall absolute sum of recalculations for EU-15 is shown in Figure 6.85. Table 6.113 gives information available in the national inventory reports on the recalculations performed.

Figure 6.84: Recalculations for 1990-2012 – Agricultural Soils

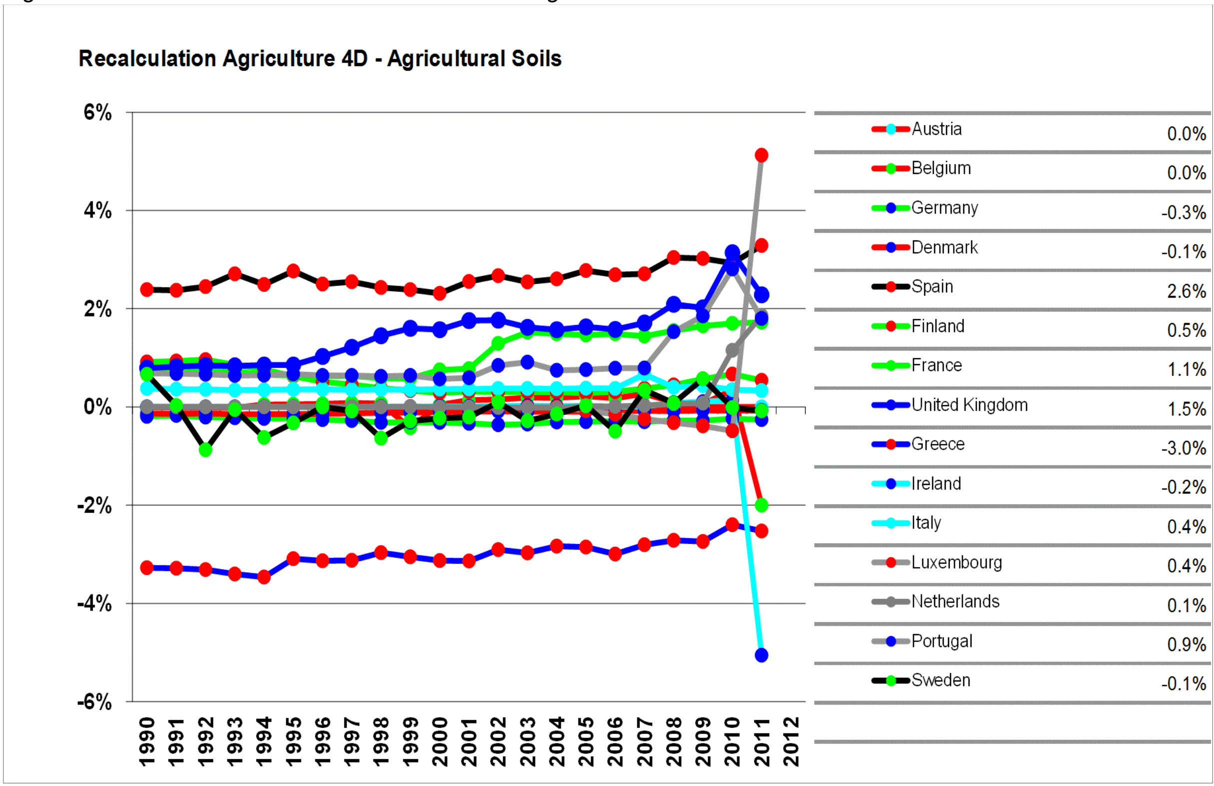


Figure 6.85: Average recalculations for the years 1990-2012, contributio of EU-15 countries to total absolute change for EU-15 recalculation – Agricultural Soils

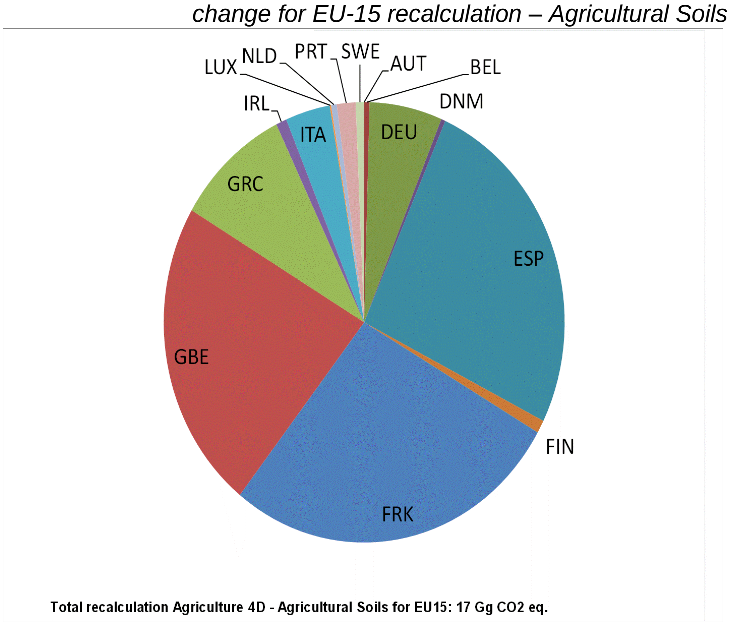


Table 6.113: Member State's background information for recalculations of emissions in category 4.D

Member State	Recalculations
Austria	
Belgium	In Flanders, from 2007, animal numbers have slightly changed, resulting in a small increase of direct N_2O emissions of max 0.026 Gg in 2007 and a small decrease of max.0.002 Gg in 2009. For indirect N_2O emissions, there is an increase of max. 0.03% in 2007 to a small decrease of max. 0.005% in 2009. In Brussels, annual yields values of N-fixing and non N-fixing crops were revised for several years and matched with those used in Flanders. The area of arable crops for 2011 was also revised.

Member State	*Recalculations*
	In Wallonia, sewage sludge was included in the estimate of indirect N_2O emissions, but only under N from leaching and runoff and not for atmospheric deposition. The impact on emissions is not significant. The activity data has also been improved, using the quantity of sludge provided by the Walloon Waste Office, instead of the estimation based on a percentage of the usable agricultural area, used before. This results in higher emissions (in 2011, an additional emission of 0.026 Gg N_2O)
Denmark	*The number of geese has been changed for all years and the number of weaners and fattening pigs for 2011. This affects emissions from enteric fermentation, manure management and agricultural soils.* *Change in emission factor for NH_3 from synthetic fertilisers for all years, based on an updated version of the EEA/EMEP guidebook in 2013. This increases emissions of N_2O from atmospheric deposition due to the increase in emission of NH_3 from synthetic fertilisers, while the emission of N_2O directly from synthetic fertilisers decreases.*
Finland	*Area of cultivated organic soils was updated for the whole time series.* *Fur animal number was updated for 2011.* *The amount of crop residues of mixed cereals was increased, as a result of adding the amount of grain+pulse mixtures.*
France	*The quantity of manure coming from imports from Belgium and from other European countries that were not considered before, have been incorporated to calculations.* *Area of histosols identified in FAO databases have been incorporated to calculate emissions from the cultivation of organic soils.* *The data of livestock herd have been updated after the update of the national statistics and excretion from cattle have been modified following the introduction of a transition time between the time spent in the buildings and on pastures.*
Germany	
Greece	*N_2O emissions from soils have been recalculated for 1990-2011 because of the modification of dairy cattle Nex value estimation methodology and updating of the manure management system allocation of sheep, goats and poultry.* *Emissions for 2008 to 2011 have also been recalculated because of the updated activity data of the population of cattle for 2009.*
Ireland	*Minor changes due to revision in animal populations for 2010 and 2011 for dairy cattle, other cattle, sheep, goats, horses, mules and asses.*
Italy	*N_2O emissions have been recalculated for the whole time series due to the uploading of the fur animals' category and to the updating of the area of cultivated organic soils.* *In 2010 and 2011, activity data on sewage sludge have been updated.* *In 1999, 2000, 2005, 2007-2010, data on crop surface and production have been updated.*
Luxemburg	
Netherlands	*Updated ammonia emission factors for the manure management of mature dairy cattle, leading to changes in N flows starting in 2002 by reducing N available for application and increasing N being deposited atmospherically. The overall effect on N_2O emissions is very slight (around 1 Gg CO_2-eq/year)* *Due to the use of air scrubbers as an abatement technology, part of the ammonia produced from animal manure has been reallocated, increasing N_2O emissions because the corresponding EF is 1.3 instead of 0.9%. Inspection reports on the use of these measures show lower levels of compliance than assumed, so implementation grades used in the calculations have been adjusted accordingly, affecting emissions. Overall it results in higher N_2O emissions from 1997 onwards, increasing to +10 Gg CO_2-eq for 2011.* *Over 2010 and 2011, there seemed to be a build up of stored manure. Closer inspection led to conclude that it was not the case, so some (in)direct emissions have been added for those years, amounting to 17 and 13 Gg CO_2-eq, respectively.*
Portugal	*Accounting of N_2O emissions from N fixed by Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL)* *Revision of 2009 to 2011 values for apparent consumption of synthetic fertilisers updated by the national statistics office.* *Following last year's review, separate accounting of N_2O emissions from sewage sludge applied to agricultural soils and reallocation of wastewater handling systems related N_2O emissions, previously reported in the waste sector, into the agriculture sector.* *Recalculations related with the revisions done of Nex coefficient for swine of 20-50 kg.* *Recalculations related to the re-evaluation of rice cultivation practices.*
Spain	*Change in the methodology to estimate grazing time, now in line with the ERT in the "Saturday Paper" (2013). This leads to annual increases from 433 to 583 thousand tons along the time series.* *Updated statistics on the application of sewage sludge.* *Updated statistics on crop area for 2010 and 2011* *Changes in the number of horses and other poultry, affecting the quantity of N applied to soils (as manure and during grazing).*
Sweden	*The formula to calculate ammonia emissions from mineral fertilisers was restructured, resulting in a small decrease in the emissions of N_2O from synthetic fertilisers between 0.01% and 0.31%, depending on the year.*

Member State	Recalculations
	Activity data for 2011 for turkeys was updated with the last available statistics, resulting in minor differences in emissions from manure application. The activity data for the calculation of emissions from crop residues was updated from standard yield to actual yearly yield. Crop residues from oil flax were added and maize is now calculated separately from green forage. Total area of agricultural land has changed for all years, which affects emissions from histosols. Data for sludge use has been updated for 2011, although it was not possible to update emissions this year due to a late publication. The formula to calculate ammonia emissions from mineral fertilisers was restructured, resulting in a small increase in emissions from atmospheric deposition. Recalculations from leaching and runoff due to that of the changes in the total area of agricultural land for all years.
United Kingdom	Some of the Scottish crop production data was updated for 2008-2011, some also for E&W from 2006. Data on amounts of sewage sludge produced was also updated with data from AEA. There have been recalculations for OTs and CDs, due to a correction in the spreadsheet, leading to lower estimates by approximately 40% across the entire time series. The inclusion of land area time series data has changed estimates for some regions by approximately 3%. The correction of an error that excluded emissions from animal manure as fertiliser has resulted in a significant increase in estimates for Montserrat (around 400 times) across the time series.
Bulgaria	Parameters of manure processing slightly modified, in compliance with IPCCC guidelines.
Czech Republic	
Cyprus	Estimation of N_2O emissions from histosols has been included. Dry matter fraction of residue for all crops except for potatoes has been revised to be in line with IPCC guidelines. Fraction of crop residue burnt has been revised. Estimation of N_2O from the application of sewage on land has been included.
Estonia	Data on areas of cultivated organic soils have been updated and emissions from the cultivation of organic soils have been added. Data on sewage sludge used in 2002-2011 has been updated and N_2O emissions from sewage sludge recalculated for 2002, 2007, 2010 and 2011. Several recalculations to estimate N_2O emissions from pasture, range and paddock (same as for category 4.B). An omission has been amended in the reporting of activity data. Recalculation of indirect N_2O emissions based on new data for sewage sludge for the years 2002-2011.
Hungary	Revision of annual amount of nitrogen applied to soils from animal manure for the whole time series. Revision of crop residue parameters for the full time series. Revision of annual amount of nitrogen applied to soils from manure directly left on pastures and of the volatized N from animal manure for the full time series, as a result of the change in the N excretion of cattle and swine.
Latvia	Recalculations of emissions from cultivated organic soils due to an updating of histosol area.
Lithuania	Recalculations of direct N_2O emissions from soils due to: recalculations in manure management- N_2O subsector, which caused recalculations in animal manure applied to soils. Following review recommendations, recalculations were also performed for sewage sludge using FracGAZF value 0.2 instead of 0.1, as well as for the quantity of sewage sludge applied to soils. Relative differences comparing previous and current submission did not exceed 0.2% decrease of emissions in direct emissions from agricultural soils. Recalculations of N_2O emissions from pastures (4.D.2) due to recalculations made in manure management- N_2O, but relative differences between this and the previous submission were minor, lower than 1.5%. Recalculations of indirect emissions from soils related to N_2O emission recalculations made for manure management. Relative differences between current and previous estimates varied from -0.7% to 0.1%.
Malta	Recalculations for the years 2010 and 2011 due to revised data on fertiliser imports, and for the years 1995-2011 due to the calculation of nitrogen input from N-fixing crops and crop residues. In addition, recalculations also due to revised animal numbers.
Poland	Amendment of AD on sewage sludge applied in agriculture in 1988-2002 and related trend of N_2O emission. Correction of animal manure used in indirect emission calculations.
Romania	
Slovakia	
Slovenia	Very minor recalculations for 2010 and 2011 due to updated data on population of horses.
Croatia	Recalculations: Of emissions from animal manure for 1995-2011 due to updated activity data regarding the number of animals (horses, mules and asses) Of emissions from histosols for 1990-2011 due to updated activity data on area of histosols

Member State	Recalculations
	Of emissions from biological fixation and crop residues for 1992 and 2011 due to the change in activity data for maize (1992) and vetches (2011)
	Of emissions from the application of sewage sludge for 2009-2011 due to new activity data.
	Of emissions from manure deposited on pastures for 1995-2011, due to changes in activity data (number of horses, mules and asses)

6.8.6 Field burning of agricultural residues - N_2O (Source category 4.F)

In EU-15 countries, total recalculation in category 4A, averaged over the years 1990-2012 was 0.01 Gg CO_2eq when summed over positive or negative recalculations or 0.07 Gg CO_2eq when summing over the absolute changes caused by recalculations. Figure 6.86 shows the relative changes that caused by the recalculations for EU-15 countries. The contribution of countries to the overall absolute sum of recalculations for EU-15 is shown in Figure 6.87. gives information available in the national inventory reports on the recalculations performed. Table 6.114 gives information available in the national inventory reports on the recalculations performed.

Figure 6.86: Recalculations for 1990-2012 – Burning of agricultural residues

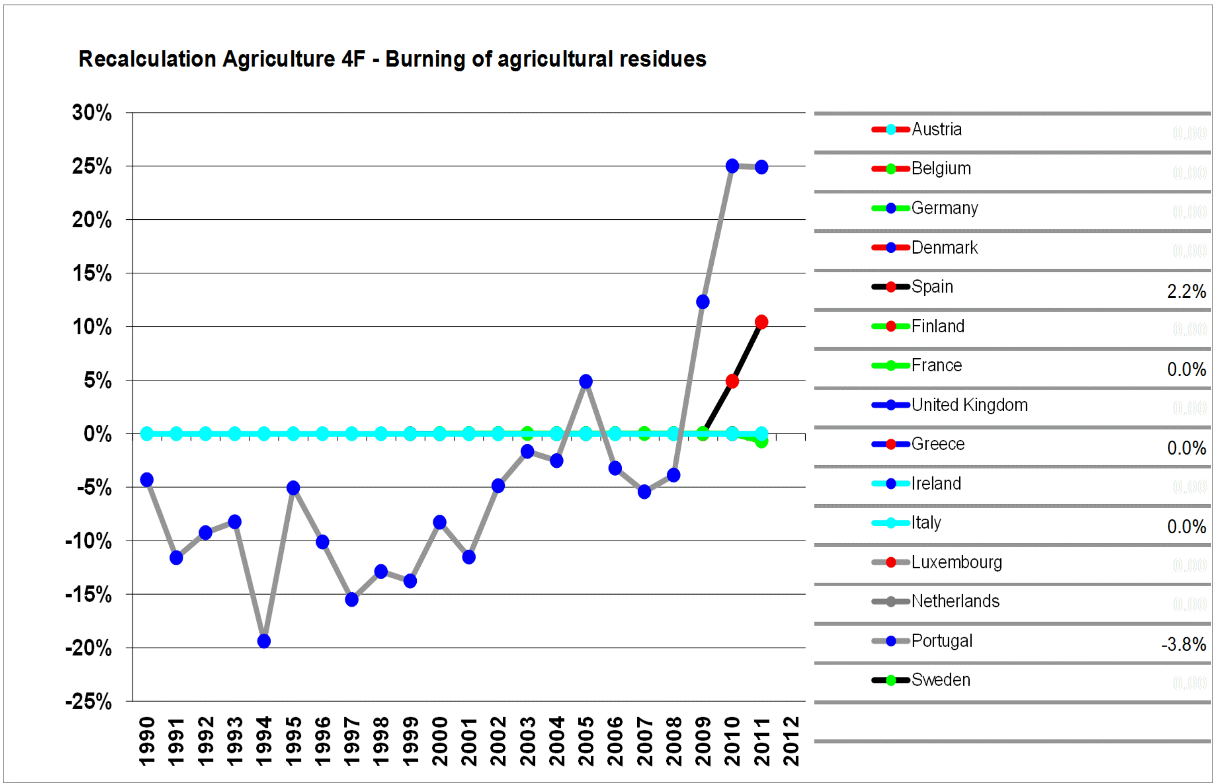


Figure 6.87: Average recalculations for the years 1990-2012, contributio of EU-15 countries to total absolute change for EU-15 recalculation – Burning of Agricultural Residues

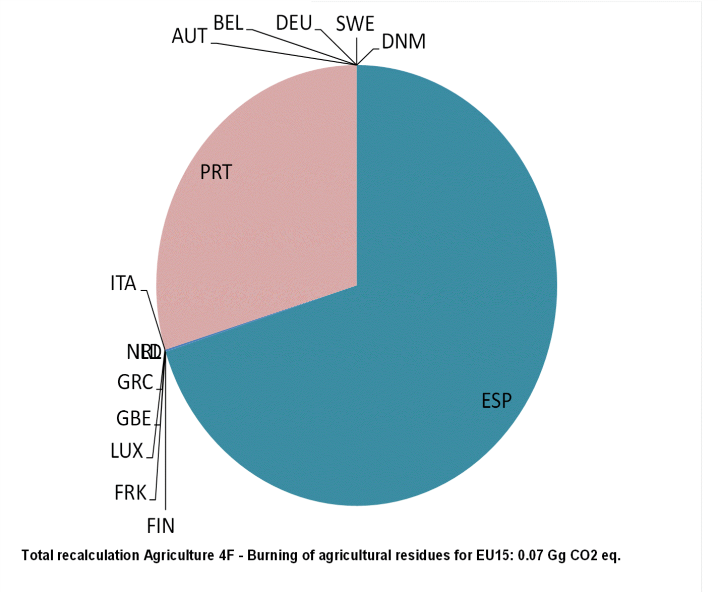


Table 6.114: Member State's background information for recalculations of emissions in category 4.F

Member State	***Recalculations***
Austria	
Belgium	
Denmark	
Finland	*Fraction of total residue burned changed a little due to the addition of mixed grain with pulses to the amount of total residue*
France	*Statistics about crop surfaces between 1990 and 2012 have been updated, following a new data release from statistics agency.*
Germany	
Greece	
Ireland	
Italy	
Luxemburg	
Netherlands	
Portugal	*Revision of crop residues amounts burnt in the fields: revision of rice crop areas with burnt restrictions and amounts of residues incorporated into the soil, and minor recalculations associated to an adjustment of residues annually produced from perennial crops, that are now estimated in relation with annual crop production.*
Spain	
Sweden	
United Kingdom	*For oats, barley and linseed replaced N-C ratio value of 0.012 (from wheat) with the correct default value of 0.015 (IPCC 1997).*
Bulgaria	
Czech Republic	
Cyprus	*Recalculations based on the revised dry mater fraction of residue, C and N fraction of residue.*
Estonia	
Hungary	
Latvia	
Lithuania	
Malta	
Poland	
Romania	
Slovakia	
Slovenia	

Member State	Recalculations
Croatia	

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7 LULUCF (CRF SECTOR 5, EU-15)

Complying with relevant EU provisions (i.e. Decision No 280/2004/EC), Sector 5 LULUCF (Land Use, Land Use Change and Forestry) of the European Union (EU) GHG Inventory is a compilation of the reports submitted by the EU's individual member states (MS). MS' NIRs of 2014 are used as the primary source of data and information, unless otherwise specified and referenced throught the text.

This chapter provides the general trends of GHG emissions and CO_2 removals from LULUCF for EU-15 (information regarding EU-28 is provided in Chapter 22), compares the methods used by different MS and describes the efforts carried out to harmonize and improve the quality of GHG inventory reporting at EU-15 level. More detailed information can be found in the NIRs of individual MS.

In particular, for the EU-15, this chapter includes: an overview of LULUCF sector including overall trends, the contribution of land use changes, the completeness of reporting, the key categories and some general methodological information; the trends of net emissions, activity data and emissions factors for each category; some specific methodological information for the relevant categories; and an overview of cross-cutting issues including uncertainties, QA/QC, time series consistency and recalculations.

Please also note that EU submission contains three sets of the CRF tables submitted to UNFCCC:

- "KP" tables refer to EU-15 (i.e. MS having commitment under the KP) and include LULUCF inventory estimates under the Convention, for which information is provided in the rest of this chapter;
- "Convention" tables refer to EU-28, for which summary information is provided in Chapter 22;
- "KP LULUCF" tables refer to EU-15 and include KP-LULUCF estimates related to the accounting for the 1st commitment period under the Kyoto Protocol. Chapter 11 includes information on KP-LULUCF estimates for EU-15 and an overview for EU-28.

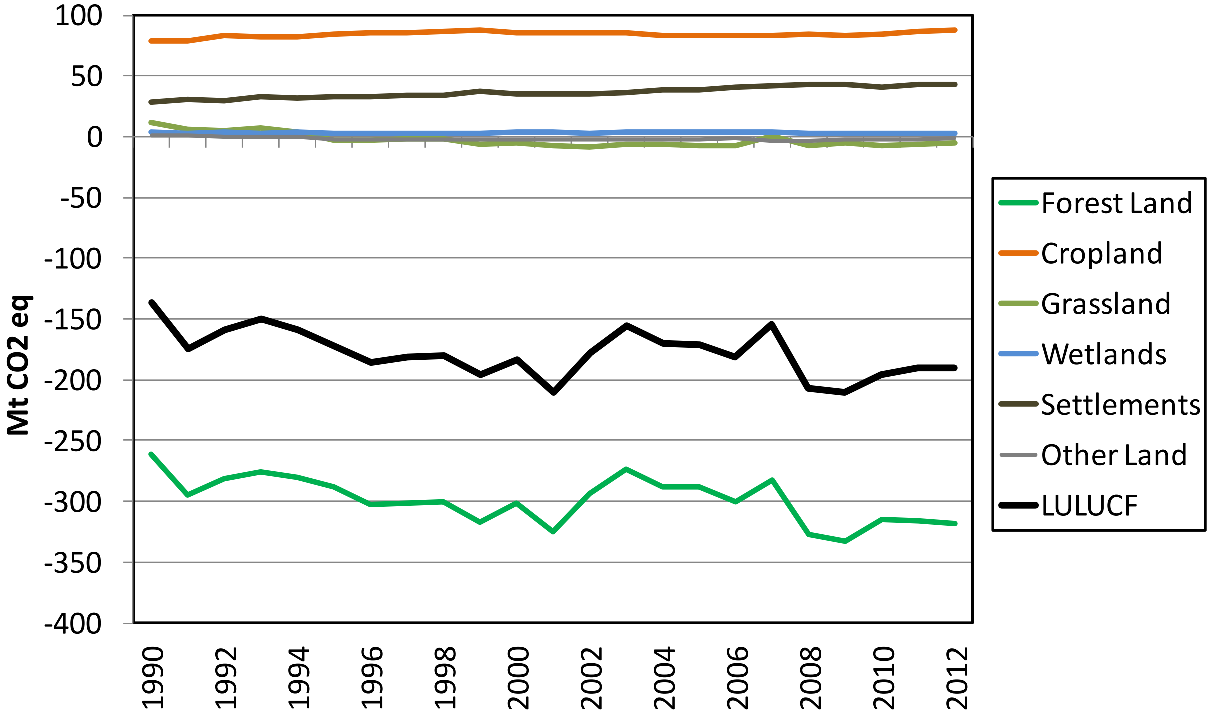
7.1 Overview of the sector (EU-15)

With almost all lands under more or less intensive management, Europe is a fine-grained mosaic of different land uses, resulting in a highly fragmented landscape. The EU agricultural and environmental policies have been the major driver of land use and land use change in Europe especially since 1990. In particular, the Common Agricultural Policy and rural development programs have stimulated less intense agricultural practices and a general decrease of area of the utilized arable land, compensated by the increase in forest and urban areas. Furthermore, the EU environmental policy (e.g. Natura 2000 network) has stimulated also the increase of forest and woodlands area under conservation regime with the purpose of preserving biodiversity and landscapes. Currently, at EU-28 level, around 25% of total forest and woodland areas are excluded from harvesting, and felling accounts for only 60% of the net annual wood increment, which explains the significant build-up of biomass (i.e. carbon removal) in the forests.

7.1.1 Trends by land use categories

The Sector 5 LULUCF of the EU-15 is a net carbon sink, resulting from higher removals by sinks than emissions from sources. Overall, the most significant carbon sink is represented by forest land compared to croplands which are a source and grasslands a small sink. In 2012, aggregated EU-15 net removals were -190.583 Gg CO_2-eq. For the 6 land use categories, net removals were -190.048 Gg CO_2-eq., representing an increase of 39% compared to the net removals in 1990; the CH_4 and N_2O emissions offset about 4% of the annual removals. In addition, at EU-15 level, six MS reported in the CRF table 5, under the category Other, total net removals of -535 Gg CO_2-eq.: Finland reports emissions while Portugal and UK reports removals from Harvested Wood Products, Germany reports emissions from lime application of forests, Netherlands reports emissions from lime application for all the land use categories, and France reports emissions form dam of Petit-Saut French Guiana, NMVOC and SO_2 from forest fires, Biogenic NMVOC from managed forest and Methane removal from forest soil.

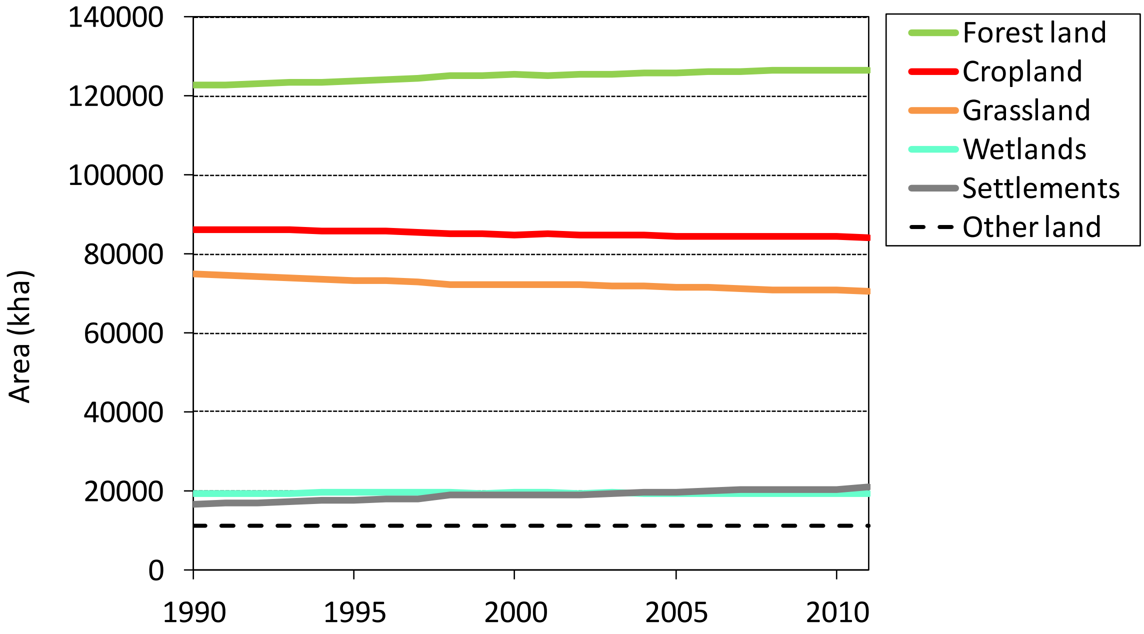
Figure 7.1 Sector 5 LULUCF: EU-15 GHG net emissions (+) / removals (-) for 1990–2012, in CO_2 eq. (Mt), for all land use categories



Overall there is an increasing trend, since 1990, in the LULUCF sink. The most relevant trend in GHG net emissions/removals for the EU-15 is related to forest land. An increase of the forest sink occurred during the '90s, mainly due to forest area expansion. It has been followed by a decline largely attributable to a general increase in harvest rate. The significant decrease of the forest sink in 2002 is due to a drop in the 5A1 sink of Germany, all occuring in a single year due to the stock-difference method used by the MS. Interannual variations of the forest sink are mainly related to major wind storms (e.g. 1999 and 2007 in central-western Europe) and wild fires (e.g. forest fires in 1990, 2003 and 2007 in Mediterranean countries).

The reported land area of the different land use categories (Figure 7.2) confirms the trends known from other EU statistics (e.g. Eurostat), although the absolute numbers may slightly differ due to different definitions linked to different reporting requirements under various processes. For the EU-15, the main changes in area from 1990 to 2012 are from Forests land (+3%), Cropland (-2%), Grassland (-6%) and Settlements (+27%).

Figure 7.2 EU-15 total land area for each of the LULUCF categories (kha), as reported in the MS' GHGI 2012



Although EU-15 reports a net sink in the LULUCF sector in 2012, which is increasing since 1990 (Table 7.1), it should be noted that the individual MS' estimates range from sources (e.g. Denmark, The Netherlands) to small sinks (e.g. Belgium and Ireland) or large sinks (e.g. France and Italy). Compared to 1990, some MS report large increase in their sink (e.g. Finland, France, and Italy) whiles other reduced it substantially (i.e. Germany).

Table 7.1 Sector 5 LULUCF: MS' contributions to net CO_2 removals in 2012

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012	
	1990	2011	2012		Gg CO_2	%
Austria	-9.898	-3.895	-3.864	2%	32	-1%
Belgium	-848	-1.338	-1.488	1%	-150	11%
Denmark	5.266	-2.755	-852	0,4%	1.904	-69%
Finland	-14.970	-25.500	-27.234	14%	-1.735	7%
France	-31.144	-43.219	-47.806	24%	-4.587	11%
Germany	-24.930	-4.579	-3.999	2%	580	-13%
Greece	-2.313	-2.966	-2.973	1%	-7	0,2%
Ireland	-2.350	-3.719	-3.223	2%	496	-13%
Italy	-5.443	-19.794	-19.864	10%	-70	0,4%
Luxembourg	345	-433	-437	0,2%	-4	1%
Netherlands	2.993	3.311	3.439	-2%	128	4%
Portugal	-2.860	-16.546	-13.727	7%	2.818	-17%
Spain	-23.513	-33.967	-33.851	17%	116	-0,3%
Sweden	-38.781	-35.696	-35.518	18%	178	-0,5%
United Kingdom	1.030	-8.211	-7.722	4%	489	-6%
EU-15	**-147.417**	**-199.307**	**-199.119**	**100%**	**188**	**0%**

Overall, for the EU-15, in the year 2012 the LULUCF sector offsets 5.3 % of the total emissions ("without LULUCF"), with values ranging at MS level from +1.8% (contributing to national GHG inventory as a source, in Netherlands) to -61.5% (as sink, in Sweden) (Table 7.2, column a). The most important LULUCF category, Forest Land, in 2012 was a net sink for each MS (Table 7.2, column b), offsetting 1.8% of total emissions in Netherlands, 73.6% in Sweden and 8.8% for the whole EU-15. The most significant contributors to total net sink are France, Germany and Sweden (Table 7.2 column c)

Table 7.2 Sector 5 LULUCF: Contribution of Sector 5 (column a) and Category 5A (column b) to total MS emissions (without LULUCF) and MS contribution to EU-15 Category 5A (column c)

Member State	LULUCF over total inventory excluding LULUCF	Category 5.A over total inventory excluding LULUCF	Member States contribution to EU-15 total for Category 5A
	(a) (%)	(b) (%)	(c) (%)
Austria	-4,8%	-5,6%	1,4%
Belgium	-1,2%	-3,3%	1,2%
Denmark	-1,6%	-8,6%	1,4%
Finland	-42,4%	-61,1%	11,7%
France	-9,0%	-14,2%	21,9%
Germany	-0,4%	-5,5%	16,3%
Greece	-2,9%	-2,0%	0,7%
Ireland	-5,4%	-6,6%	1,2%
Italy	-4,0%	-6,4%	9,3%
Luxembourg	-3,7%	-4,2%	0,2%
Netherlands	1,8%	-1,8%	1,1%
Portugal	-19,6%	-21,7%	4,7%
Spain	-9,7%	-9,7%	10,4%
Sweden	-61,5%	-73,6%	13,4%
United Kingdom	-1,2%	-2,9%	5,2%
EU-15	**-5,3%**	**-8,8%**	**100,0%**

Source: MS' submissions 2014, CRF table 5, 5A and Summary 2.

7.1.2 Contribution of land use changes

Emissions from land conversions reached 11% in EU-15 (Table 7.3, column d). Entire land use change area only represents 10% of the total reported land area in EU-15 (Table 7.3, column a) and b), slightly more than reported for year 2011.

The sink on conversions to forest land and grassland is almost balanced by emissions from conversions to cropland and settlements.

Table 7.3 Contribution of land use changes in 2012 for EU-15, in terms of area (columns a-b) and net CO_2 equivalent (columns c-d) (as ggregation of data from CRF Table 5.)

Land conversions	**a) land area (Kha)**	**b) % of area of the corresponding category[1]**	**c) emissions (+) and removals (-) (Gg CO_2 equivalents)**	**d) % of net emissions of the corresponding category[1,2]**
5A2. Land converted to Forest Land	6.268	5%	-43.024	14%
5B2. Land converted to Cropland	8.603	10%	44.631	51%
5C2. Land converted to Grassland	9.901	14%	-19.836	413%
5D2. Land converted to Wetlands	895	5%	488	16%
5E2. Land converted to Settlements	5.407	26%	39.315	90%
5F2. Land converted to Other Land	639	6%	-1.317	100%
Total land use changes	**31.714**	**10%**	**20257**	**11%**

[1] the corresponding category is 5A (Forest land) for 5A2, 5B (Cropland) for 5B2 and so on.

[2] The contribution of emissions from land use changes to the total of each category was obtained by considering separately the absolute values of each subcategory, i.e. (abs 5A2)/(abs 5A1+ abs 5A2) x 100.

Land use area under conversion is 60% higher in 2012 than in 1990 (Table 7.4). Overall, land use changes associated net emissions in 2012 are 46% less than in 1990.

Table 7.4 EU-15 land use change matrix for the years 1990 and 2012, in terms of area (kha) and net emissions (Gg CO_2 eq). Lands not under change of use are not shown in this table.

Year 1990		Land area conversions from....(kHa)						
		forest land	cropland	grassland	wetlands	settlements	otherland	Total "to"
Conversions to	forest land		615	2.205	124	154	372	3.472
	cropland	387		5.578	26	227	380	6.598
	grassland	576	5.055		70	341	230	6.271
	wetlands	71	77	104		39	94	386
	settlements	456	1324	1046	41		32	2.899
	otherland	93	57	91	20	5		267
Total "from"		1.584	7.129	9.024	280	766	1.109	19.892

Year 1990		Net emissions in conversion from ....(GgCO2)						
		forest land	cropland	grassland	wetlands	settlements	otherland	Total "to"
Net emissions in conversions to ...	forest land		-5.608	-12.856	-472	-1625	-2.425	-22.985
	cropland	5.116		27.765	283	97	3.283	36.544
	grassland	6.393	-18.261		356	-1898	986	-12.424
	wetlands	976	-363	-447		-226	925	864
	settlements	8.134	7.817	8.728	505		65	25.249
	otherland	1730	-480	32	3	0		1.285
Total "from"		22.348	-16.895	23.222	675	-3.652	2.834	28.532

Year 2012		Land area conversions from....(kHa)						
		forest land	cropland	grassland	wetlands	settlements	otherland	Total "to"
Conversions to	forest land		1505	3.580	523	279	381	6.268
	cropland	367		7.791	42	336	67	8.603
	grassland	1031	8.020		144	536	170	9.901
	wetlands	252	118	283		84	159	895
	settlements	860	2.503	1.950	58		36	5.407
	otherland	171	120	205	117	27		639
Total "from"		2.680	12.266	13.809	884	1.262	813	31.714

Year 2012		Net emissions in conversion from ....(GgCO2)						
		forest land	cropland	grassland	wetlands	settlements	otherland	Total "to"
Net emissions in conversions to ...	forest land		-14.254	-20.096	-3.117	-3.073	-2.939	-43.478
	cropland	5.799		34.066	502	-113	429	40.652
	grassland	7.392	-25.574		803	-2.951	172	-20.159
	wetlands	1423	-605	-1.132		-654	1287	319
	settlements	17.590	8.937	11.630	654		503	39.315
	otherland	287	-1262	-366	49	-26		-1.317
Total "from"		32.491	-32.757	24.103	-1.109	-6.847	-548	15.331

In terms of land area, the conversions from grassland to cropland and vice versa are the most significant, followed by conversion from grassland to forest land. On average, in 2012, from total area "under conversion" 20% is conversion to forest land, 12% is conversions to settlements and 27% and 31% are conversions to cropland and grasslands, respectively. When interpreting the data of Table 7.4 it is important to note that some differences may occur among MS in terms of both land use definitions and the reported time series (e.g. some MS start only in 1990).

7.1.3 Completeness

Table 7.5illustrates the current coverage of reporting for the various land sub-categories in the year 2012. The three main land uses have generally been covered completely.

Table 7.5 Sector 5 LULUCF: Coverage of CO_2 emissions and removals for each of the LULUCF land sub-categories for the year 2012, as derived from 2014 GHGI submissions

Party	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. F-F	5.A.2. L-F	5.B.1. C-C	5.B.2. L-C	5.C.1. G-G	5.C.2. L-G	5.D.1. W-W	5.D.2. L-W	5.E.1. S-S	5.E.2. L-S	5.F.1. O-O	5.F.2. L-O
Austria	R	R	E	E	E	E		E		E		E
Belgium	R	R	E	E	E	R		R		E		E
Denmark	R	E	E	R	E	E	E	R		E		
Finland	R	R	E	E	E	R		E		E		
France	R	R	E	E	E	R		R		E		E
Germany	R	R	E	E	E	R	E	E	E	E		
Greece	R	R	R	E	E	R		E		E		E
Ireland	E	R	E	E	E	R	E	E		E		E
Italy	R	E	E	R	R	E	E	E	E	E	E	
Luxembourg	R	R	E	E		R		E		E		E
Netherlands	R	R		E	E	R		E		E		E
Portugal	R	R	R	E	R	E		E		E		R
Spain	R	R	R	E	E	E		E		E		E
Sweden	R	R	E	E	R	R	E		E	E		
UK	R	R	E	E	R	R	E	E	E	E		

R = the pool C stock change results in net Removals; E = the pool C stock change results in a net Emissions

Empty cells = the pool was not reported, included elsewhere or reported with no net C stock change.

WL, SL and OL sub-categories are reported at lower tier in comparison to the major land categories and carbon stocks in land remaining in the same category are often assumed in equilibrium. Further, there is a quite complete reporting of GHG emissions and CO_2 removals from conversions land use categories.

Table 7.7 shows the completeness of reporting of C stock changes by pools for the three most important land sub-categories in 2012. Compared to the previous submissions, several MS have increased the number of pools estimated and reported. As for Table 7.5, empty cells in in Table 7.7 represent pools which are not reported (in some cases based on the “not a source provision appliyed for KP and demonstration that they are not a net source of emission has been provided); in most cases, efforts are ongoing in MS to prepare estimates for future submissions.

7.1.4 Key categories

The following subcategories of the LULUCF sector of the EU-15 GHG inventory were found to be key categories (Table 7.6) for the trend (T) and the level assessment (L).

Table 7.6 Key category analysis for the EU-15 (LULUCF sector excerpt)

Source category gas	Trend	Level	
		1990	2012
5 A 1 Forest Land remaining Forest Land: (CO2)	T	L	L
5 A 2 Land converted to Forest Land: (CO2)	T	L	L
5 B 1 Cropland remaining Cropland: (CO2)	T	L	L
5 B 2 Land converted to Cropland: (CO2)	T	L	L
5 C 1 Grassland remaining Grassland: (CO2)	T	L	L
5 C 2 Land converted to Grassland: (CO2)		L	L
5 E 2 Land converted to Settlements: (CO2)	T	T	L

Table 7.7 Sector 5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2012 (from Tables 5A, 5B and 5C of MS's GHGI 2014 submissions)

Party	Forest land								Cropland								Grassland							
	5.A1.				5.A2.				5.B.1.				5.B.2.				5.C.1.				5.C.2.			
	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOC org	LB	DOM	SOCmin	SOCorg
Austria	R	R	E		R	R	R		E		R		R	E	E				R	E	E	E	R	
Belgium	R	E	R		R		R		R		E	E	E	E	E				E	E	E	E	R	
Denmark	R	R		E	E	E	R	E	E		E	E	R	E	R		E			E	E	E	E	
Finland	R		R	E	R		E	E	R		E	E	E	E	E	E			R	E	R	E	R	E
France	R	E			R	R	R	E					E	E	E	E					E	E	R	E
Germany	R	E	R	E	R	R	E	E				E	E	E	E	E	E		E	E	E	E	R	E
Greece	R				R				R			E	E		E		E				E	E	R	
Ireland	E	R		E	R	R		E			R		E		E				R	E			R	E
Italy	R	R			R	R	R		E			E			E		R	R			E		R	
Luxembourg	R				R		R		E				R	E	E						E	E	R	
Netherlands	R	R			R		R					R	E	E	E					E	E	E	R	
Portugal	R	E	R		R	R	R		R		R		E	E	E				R		E	E	E	
Spain	R				R	R	R		E		R		R	E	E						E	E	R	
Sweden	R	R	R	E	R	R	R	E	R	E	E	E	E	E	E	E	R	R	E	E	E	E	R	E
UK	R	R	R	R	R	R	R	R	R		E	E	E	E	E				R		E	E	R	E

Pools: DOM – dead organic matter, LB –living biomas, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated", NE,), assumed as "no C stock change" (following IPCC tier 1), NE, or stock changes are "not occurring", NO, or the pools is not preent, NA)

7.1.5 Data and methods

This chapter provides general information on methods, activity data, carbon stock change factors and emissions factors on sink and sources for the three main land categories (5A: Forest Land, 5B: Cropland and 5C: Grassland). Detailed information regarding methodological issues follows in specific chapters.

Given the heterogeneity of the MS in terms of ecological and socio-economic conditions, there are no unique definitions of land use categories. Methods used to estimate GHG emissions and CO_2 removals from the LULUCF sector also vary considerably among MS and land use categories.Table 7.8 is a summary of relevant information on methodologies applied for each individual pool in the GHG inventory 2014 for the LULUCF sector.

Usually for reporting lands remaining in the same category a single data source is used, while there are multiple sources of data used to estimate emissions from lands under conversions.

Because of different underlying methods applied by each MS, when comparing the absolute levels or trends of the implied emission/carbon stock change factors across MS, much caution should be used. Indeed, in some cases, large differences may be attributable to the different estimating methodologies. For example, the gain-loss and stock-difference methods may yield different trends in the short term. Some implied carbon stock change factors may be significantly affected by new areas entering in a given category or time series for land conversions do not sum up for each reported year a 20-years transition period (e.g. dataset on land conversions started in 1990). Furthermore, the fact that not all MS use the 20-year default transition period for all pools or land conversions suggest that the corresponding carbon stock change factors are not fully comparable across MS.

Table 7.8 Summary of methods and C stock change factors used by MS to calculate CO_2 emission and removals of different pools in the LULUCF sector, as reported in the GHGI 2014 submissions

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	LB	DOM -1	SOC Min	SOC Org -2	BM	DOM	SOC Min	SOC Org -2	LB -3	DOM	SOC Min -4	SOC Org -2	LB -5	DOM	SOC Min	SOC Org -2	LB	DOM	SOC Min -4	SOC Org -2	LB	DOM	SOC Min	SOC Org -2
AT	CS	CS,D	D	NO	CS	CS	CS	NO	D,CS	D	CS,CS	NO	CS,CS	CS	CS	NO	NO	D	CS,CS	CS	CS	CS	CS	NO
BE	CS	CS,D	CS	NO	CS	D	CS	NO	NE	D	CS	NO	CS,NO	D	CS	NO	NO	D	CS	NO	CS,NO	D	CS	NO
DK	CS	CS,D	D	CS	CS	CS	CS	CS	CS	NA	CS	CS	CS,CS	NO	CS	CS	CS	NA	NA	D	D	CS	CS	CS
FI	CS	CS	CS	CS	CS	CS	CS	CS	CS	NE	D	CS	D	CS	CS,D	CS	NE	NA	D	CS	D	NE	CS,D	CS
FR	CS	CS,D	D	NO	CS	CS	CS	NO	D	D	NO	NO	CS,NO	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
DE	CS	CS,D	D	CS	CS	CS	CS	CS	NO	NO	NO	CS	CS,CS	CS	CS	CS	CS	NO	CS	CS	CS	CS	CS	CS
GR	CS	D	D	NO	CS	D	D	NO	CS	D	D,D	D	NO,CS	NO	IE	NO	D	D	NO	NO	NO	NO	IE,NO	NO
IE	CS	CS,D	D	CS	CS	CS	NO	CS	NO	NO	CS,D	NO	CS	NO	CS	NO	NO	NO	CS	CS,D	NO	NO	CS	CS
IT	CS	D,CS	NO	NO	CS	CS	NO	NO	D,CS	CS	NE,NO	D	CS	NO	CS	NO	CS	CS	NE,NO	NO	NO	NO	CS	NO
LU	CS	D	D	NO	CS	D	CS	NO	D	D	NO	NO	CS	D	CS	NO	NO	NO	NO	NO	CS	CS	CS	NO
NL	CS	CS	D	NE	CS	D	NE	NE	NE	NE	NE	IE	CS	CS	NE	NE	NE	NE	NE	CS	CS	CS	NE	NE
PT	CS	CS	CS	NO	CS	CS	CS	NO	CS	NO	CS	NO	CS,CS	CS	CS	NO	NO	NO	CS	NO	CS	CS	CS	NO
ES	CS	D	D	NO	CS	NE	CS	NO	CS	NE	CS	NO	NO,NO	NO	NO	NO	NE	NE	NE	NO	NE	NE	CS	NO
SE	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS,CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS
UK	CS	CS	CS	CS	CS	CS	CS	CS	CS	D	CS	CS	CS,CS	CS	CS	IE	NO	NO	CS	NO	CS	CS	CS	CS

(D: default; CS: country specific; NA: not applicable; NE – not estimated; NO- not occurring)

Source: CRFs 2014

"CS" country specific data, associated either with IPCC method (tier 2) or country-specific method (tier 3, if data are highly disaggregated). Note that sometimes not all parameters involved in the estimation are truly "CS" (e.g. root/shoot ratio and BEF are often taken by IPCC). However it is expected that if "CS" is reported, the most important parameters are truly "CS

"D" means that the default IPCC emission factors are used in the estimation. D is typically associated with IPCC default method (tier 1).

"NE" means either country assumes the emission/removal is negligible or not enough data is available for estimation

"NO" means emissions or removals "not occurring" in a country (it includes also "NA" - not applicable)

(1) for DOM under "FL r FL" the 2 notations separated by a comma mean: first one refers to DW (dead wood), second to LT (litter)

(2) for ORGANIC SOIL any notation key reported for a MS showing some activity data of org soil for any land (sub)category is assumed as NE. D refers to the use of IPCC default emissions factors

(3) BIOMASS C stock change in CL-CL is assumed only for perennial woody crops. Biomass of annual crops is always assumed zero C stock change by definition.

(4) for SOC MIN on CL and GL the 2 notation keys separated by comma mean that the country uses IPCC default method (which is tier 1 if associated with D data or tier 2 if associated with CS data); in this case, the first notation key refers to "reference C stock", and second to "C stock change factor" (see IPCC-GPG for details). A cell with a single "CS" indicate a country-specific method and data (i.e. tier 3 if data are highly disaggregated)

(5) for BIOMASS under L - CL, "conversion to cropland", the 2 notation keys used mean: first one refers to FL-CL and second to GL-CL

Grey heading means that for these pools IPCC TIER 1 allows to assume no change in C stock (note that if the category is a key category, in theory higher tiers should be used)

7.2 Forest land (CRF 5A)

7.2.1 Overview of the Forest land category

Forests land is the dominant category in the LULUCF sector, and represents 38% of EU-15 total land area. According to the data provided by the MS in their 2014 submissions, total forest area in EU-15 increased from 122.742 kha in 1990 to 126.726 kha in 2012, which is about 3% more than the 1990 area. About 5% of forest area is represented by land under conversion to forest land. This trend, reflected in official statistics of the MS and EU, is due to the decreasing grazing pressure and decreasing agricultural activities on marginal lands, which promoted natural forest expansion, and also due to the promotion of national afforestation programs (including grant-aid). The largest forest area in 2012 is in Sweden France and Finland, while the lowest share is found in Luxembourg, Netherlands and Denmark.

Deforestation does not appear to be a major issue in Europe; although it may be relevant for specific countries, (see NIR's Chapter 11 on KP LULUCF for further information on deforestation). The absolute area under conversion from forest is more than compensated by that of new planting and forest expansion.

7.2.2 Forest land remaining forest land (CRF 5A1)

7.2.2.1 Overview of Forest land remaining forest land

The area of "forest land remaining forest land" slightly increased by 1% at EU-15 level since 1990 with large differences among MS (e.g., +31% in UK, -10% in Netherlands). In absolute terms, most of the land area increase of "forest remaining forest" was reported by Italy and decrease by Spain (Table 7.9).

Table 7.9 Trend of activity data in the "forest land remaining forest land" subcategory of EU-15 MS (kha, 1990-2012)

Member State	1990	1995	2000	2005	2012	Difference 2012 to 1990
Austria	3.632	3.670	3.752	3.794	3.851	6%
Belgium	711	706	701	695	689	-3%
Denmark	544	543	543	542	538	-1%
Finland	22.026	22.012	21.976	21.911	21.893	-1%
France	22.724	22.488	22.348	22.392	22.457	-1%
Germany	10.425	10.512	10.599	10.711	10.849	4%
Greece	3.359	3.358	3.357	3.356	3.354	0%
Ireland	465	465	463	458	450	-3%
Italy	6.901	7.056	7.117	7.183	7.707	12%
Luxembourg	79	81	82	84	90	13%
Netherlands	381	369	358	347	341	-10%
Portugal	3.709	3.594	3.616	3.654	3.864	4%
Spain	14.532	14.443	14.353	14.269	14.251	-2%
Sweden	27.982	27.910	27.846	27.838	27.755	-1%
United Kingdom	1.801	2.006	2.123	2.222	2.368	31%
EU-15	**119.271**	**119.212**	**119.232**	**119.456**	**120.458**	**1%**

At EU-15 level, 5A1 is a net sink of 278.171 Gg CO_2 in 2012, 15% higher than in 1990 and 2% higher than in 2011 (Table 7.10).

Table 7.10 5A1 Forest Land remaining Forest Land: MS' contributions to net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
Austria	-7.849	-2.597	-2.608	0,9%	-11	0%	5.241	-67%
Belgium	-3.118	-3.511	-3.537	1%	-26	1%	-419	13%
Denmark	50	-6.192	-4.491	2%	1.701	-27%	-4.541	-9155%
Finland	-23.108	-36.152	-38.321	14%	-2.169	6%	-15.213	66%
France	-37.950	-56.772	-62.195	22%	-5.423	10%	-24.245	64%
Germany	-63.453	-46.994	-47.074	17%	-80	0,2%	16.379	-26%
Greece	-1.359	-1.841	-1.841	0,7%	0	0,0%	-482	35%
Ireland	-3.008	-643	-9	0,003%	634	-99%	2.999	-100%
Italy	-15.794	-23.034	-24.180	9%	-1.146	5%	-8.386	53%
Luxembourg	239	-424	-434	0,2%	-10	2%	-674	-282%
Netherlands	-2.407	-2.900	-2.881	1%	18	-1%	-474	20%
Portugal	-6.166	-12.165	-10.439	4%	1.725	-14%	-4.273	69%
Spain	-22.914	-25.605	-25.635	9%	-30	0,1%	-2.721	12%
Sweden	-44.339	-39.461	-40.025	14%	-564	1%	4.314	-10%
United Kingdom	-10.891	-15.372	-14.500	5%	872	-6%	-3.610	33%
EU-15	**-242.067**	**-273.662**	**-278.171**	**100,0%**	**-4.509**	**2%**	**-36.104**	**15%**

For 2012, all MS report a sink in 5A1. The largest changes of the MS sinks are, when compared to 1990, either sink increases (e.g. Finland, France) or decreases (e.g. Germany, Austria). France estimated a CH_4 sink represented by undisturbed forest soils that is reported as CO_2eq in the category 5,G (Other) and consequently it is not reported and accounted under Forest management. In most cases, CO_2 emissions from disturbances are implicitly included in CRF table 5A as C stock losses, while non-CO_2 emissions are reported in CRF table 5(V). The main types of disturbances across EU are forest fires (mainly Southern European countries) and wind storms (mainly in central Europe), while other type of disturbances generally have a localized effect and low magnitude, and are difficult to quantify in terms of biomass loss (e.g. insect outbreaks), thus they are practically not mentioned in the MS reports. Estimation of emissions from forest fires is made with Tier 1 method in case of small emissions (e.g. Austria) or with higher tiers where such emissions are significant (e.g. Portugal, Spain).

Large inter-annual variability in GHG estimates is given by natural disturbances:

- Forest fires (e.g. Portugal in 1990, 2003 and 2005; Italy in 1990.1993 and 2007). For instance, Spain reports areas burnt ranging between 20 – 250 kha annually;
- Windstorms (e.g. France in 1999 and 2009, and Denmark in 2000, Sweden in 2005);

or the estimation method:

- The method used for reporting, e.g. Germany uses the stock-difference method between two subsequent forest inventories: this method could be accurate for estimating C stock changes over a time period but it may results in discontinuities in trends, i.e. “steps” in single years (e.g. 2002), because the significant decrease of the sink which occurred over a period since the previous forest inventory is counted in a single year when C stocks of the more recent inventory are integrated in the calculation).

7.2.2.2 Methodological issues for forest land remaining forest land

Forest land definitions are reported by EU-15 MS in their NIR 2014. Consistency of the forest land representation is considered within the country in terms of time (tracking) and space (identifying) and

2) across the MS within EU-15. The MS' forest definitions slightly differ in terms of *quantitative* parameters, i.e., crown coverage, tree height and minimum land area (Table 7.11). In general, there is consistency with reporting under other international processes (i.e. Global Forest Resources Assessments 2005, 2010 FRA (FAO)). For forest administration purposes, lands that have no tree cover, may be included or not within forest land, thus additional *qualitative* criteria complement the forest definition provided (i.e. treatment of forest roads, nurseries, willow crops, etc.Table 7.11). Few MS have changed their forest definition since 1990, but these changes do not affect consistency of the time series of activity data. Greece has a new forest definition applied from 2003. Denmark changed from a questionnaire based forestry information system to NFI but implemented methods for ensuring the consistency of the time series (i.e. reassessment of base year data based on earth observation information).

Table 7.11 Values for forest definitions thresholds as selected by MS

Member State	NIR 2014			
	Crown cover (%)	**Height (m)**	**Area (ha)**	**Minimal width (m)**
Austria	30	2	0,05	10
Belgium	20	5	0,5	-
Denmark	10	5	0,5	20
Finland	10	5	0.25 for Southern Finland/ 0,5 for Northern Finland	20
France	10	5	0,5	20
Germany	10	5	0.01	-
Greece	25	2	0,3	-
Ireland	20	5	0,1	20
Italy	10	5	0.05	-
Luxembourg	10	5	0.05	-
Netherlands	20	5	0,5	30
Portugal	10	5	0.05	20
Spain	20	3	1.00	25
Sweden	10	5	0,5	10
United Kingdom	20	2	0.01	20

The overall effect of different forest definitions on C stock changes at EU-15 level is difficult to assess, as it depends on a number of factors (i.e. land fragmentation, land use change frequency, transition period, land registry systems, GHG estimation methodology, etc.), but it is likely to be very small (e.g strict implementation of FRA 2005 criteria for forest and OWL against national thresholds would lead to 1-2% larger forests area as highlighted by Estonia's NIR).

Table 7.12 Additional qualitative criteria for defining "Forest land"

MS	Forest land definition, additional information and description (according NIR 2014)
Denmark	Temporarily non w ooded areas, fire breaks, and other small open areas inside the Forest land, including Christmas tree crops.
Finland	Productive forest land, part of the poorly productive forest land and forest roads. Parks and yards are excluded regardless of w hether they meet the forest definition.
France	Forest roads, forest openings less than 20 m w ide (e.g. for fire control), w indbreaks and forest belts, as w ell as the poplar plantations and short rotations w oody crops, if the criteria for Forest land are met. 5% of France's European forests are unmanaged on lands such as strong slopes or used for loisir, esthétique, cultural or military. Also, 40% of France's dependencies Forest land is considered as unmanaged.
Germany	Any area of ground covered by forest vegetation, irrespective of the information in the relevant cadastral survey or similar records. "Forest" also refers to cutover or thinned areas, forest tracks, firebreaks, openings and clearings, forest glades, feeding grounds for game, landings, rides located in the forest, further areas linked to and serving the forest including areas w ith recreation facilities, overgrow n heaths and moorland, overgrow n former pastures, alpine pastures and rough pastures, as w ell as areas of dw arf pines and green alders. Heaths, moorland, pastures, alpine pastures and rough pastures are considered to be overgrow n if the natural forest cover has reached an average age of five years and if at least 50% of the area is covered by forest. Forested areas of less than 1,000 m2 located in farmland or in developed regions, narrow thickets less than 10 m w ide, w atercourses up to 5 m w ide do not break the continuity of a forest area.
Ireland	Minimum 50% of conventional stocking. Includes recently clear felled areas. Tree grow n for fruits or flow ers, and shrub species (furze, rhododendron) are excluded. Includes open areas w ithin forest boundaries.
Italy	Forest roads, cleared tracts, firebreaks and other open areas w ithin the forest as w ell as protected forest areas are included in forest. Tree plantations are included into forestland category (plantations) but the shrub lands into grassland category (shrub lands)., chestnut and cork oak, have been also included in forest
Luxemburg	Permanently unstocked basal areas that are directly connected w ith forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, w ood storage places, forest glades, forest roads) also represent forests. Areas w hich are used in short rotation w ith a rotation period of up to thirty years as w ell as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of w oody plants for the purpose of obtaining fruits such as w alnut or sw eet chestnut do not account as forests but represent cropland. Row s of trees (except shelter belts for w ind protection) and areas w ith w oody plants in a park structure are not forest land.
Netherlands	Roads in the forest less than 6 m w ide are included under 'Forest According to Definition' (FAD). Additional to FAD, 'Trees outside Forests' (TOF), that is - w ooded areas that comply w ith the previous forest definition except for their surface area (=< 0.5 ha or less than 30 m w idth). These represent fragmented forest plots as w ell as groups of trees in parks and nature terrains
Portugal	Forests (areas occupied by forests and w oodlands w hich can be used for the production of timber or other forest products) and agro-forestry areas (annual crops or grazing land under the w ooded cover of forestry species). The forest trees are under normal climatic conditions higher than 5 m w ith at least 30% canopy closure.
Spain	Any land having w oody vegetation w ith no agricultural use/activities fulfilling the threshold of forest and any other land w hich is expected achieve these parameters (including for "dehesa" w here tree cover meet the thresholds)
Sw eden	Land w hich hosts a potential yield of stem-w ood exceeding one cubic meter per hectare and year. Meanw hile, the Land w hich hosts a potential yield of stem-w ood low er than one cubic metre per hectare and year are classfied as mire (under Wetlands). Permanent forest roads (w idth>5m) are not considered as forest land. All country forests are considered managed.
UK	Forestry statistics definition used for GHG inventory includes integral open space and felled areas that are aw aiting restocking.

National Forest Inventories (NFIs) provide fundamental input data both for forest land and conversions to/from forest land areas as well as for the estimation of C stock changes in various pools. Data collection in NFIs is typically based on repeated measurements in permanent sampling plots (Table 7.13), but the sampling design differs among MS in terms of spatial density and frequency of field surveys. In recent years, the EU-15 MS have made considerable efforts to adjust their forest inventories to the specific requirements of UNFCCC/KP reporting, together with slight harmonization at European scale (especially under COST E43 Action)[60]. Also, efforts have been made to adjust the timing of inventory cycles to the timeline of first Kyoto Protocol commitment period.

[60] http://www.metla.fi/eu/cost/e43/

Table 7.13 Relevant information on the National Forest Inventories (NFI) of MS

MS	Type of survey (for 1990 and the latest cycle): sampling design, country coverage of the grid, plot area	Cycle length (for latest inventory cycle)	Frequency / First NFI in …	Datasource for period 2008-2012
Austria	Sample based inventory with four plots clusters in 4 x 4km grid. A plot is 300 m2 and includes a two concentric plots and an angle count sampling. It follows FL conversions.	3	5-10 years. First inventory 1961-1970.	NFI 2007-2011
Belgium	Regional forest inventories, with same approach for both Walloon and Flemish Regions. Ongoing single-phase, non-stratified inventory in 1.0 x 0.5km grid E-W oriented, with 1000 m2 circular plots area (including 2 other circular plots). 10 years cycle in permanent plots. It follows FL conversions.	10	10 years. First inventory 1984-1988 (Wallonia) and 1997-1999 (Flanders).	NFI 2011-on
Germany	Systematic single-level cluster sample with regionally stratified sampling intensities. Cardinal points orientation of 4x4km grid. Cluster square of side length of 150 with 4 circular plots. It follows FL conversions.	3	10 years. First inventory 1986-1989.	An interim inventory with 8 x 8 km grid in 2008.
Denmark	Continuous sample-based with partial replacement, 2x2 km grid. Four circular plots of radius of 15 m are clustered in a square with side length of 200 m. Plots consist in three concentric sub-plots. 1/3 of plots are permanent and re-measured every 5 years. It follows FL conversions.	5	5 years. First sampling inventory 2002-2006.	NFI 2007-2011
Spain	Systematic sample-based 1x1 km grid with permanent plots. The territorial units are the provinces (50). NIF is done one by one and it lasts 10 years. Sample plots consist in 4 concentric circles. It follows FL conversions.	10	Planned every 10 years	NFI 2008-2017
Finland	Sample-based systematic cluster sampling inventory covering entire country. Entire country measured in a year. Sampling design differ on the 6 regions: plots (of 250-450 m2) are organized in clusters (of 6x6 to 10x10Km).	5	~ 10 years since 1921, with first sampling inventory 1964-1970	NFI 2011-2013
France	Sample based covering entire country with temporary plots. Systematic clusters, 1.41x1.41km. Field measured circular plot is 25 m radius composed from 4 concentric plots.	5	~ 10 years, first inventory 1960-1980	NFI 2004-2011
Greece	Forest management planning database for managed forests. Forest districts is revisited every 10 years.	10	First&last NFI 1965-1983	FMP database
Ireland	Forest Inventory and Planning System is a GIS-based system containing stand and site information. It covers all forest in the country.	1	First NFI 2004-2006	Forest Inventory and Planning System (1995) and Forest Service statistics on total area
Italy	Sample-based with regional stratification. 1x1km grid. Plots consist in two circular concentric areas of 530 m2.	4	First in 1983-1986	NFI 2006-2007
Luxemburg	Simple systematic sampling. 0.1x0.05km grid. Plot consist in four concentric circular areas of 1000m2.	3	Every 5-10 years. First NFI 1999–2001	NFI 2008–2011
Netherlands	1x1km grid lay over GIS forest map. Plots are randomly drawn, with half as permanent. Plots are 300 m2. Entire country is surveyed in a year.	5	~ 10 years. First NFI 1988-1999	NFI 2001-2004
Portugal	Qualitative sampling based on interpretation of aerial photograph over a national0.5x0.5km grid, with clusters every 2x2km on forest land and 4x4km on shrub land. NFI clusters are 500/2000 m2 depending on species and consist in 5 plots of 10/40m2.	2	~ 10 years. First NFI 1965-1966	NFI 2003-2012
Sweden	Sample-based covering annually whole country, with North-South decreasing sampling intensity. Plots are distributed in square/rectangular clusters with size decreasing from North to South, both for permanent (2/3) and temporary (1/3) ones. The clusters are square-shaped with 4 or 8 circular plots with (radius 10-20m). It follow FL conversions	10	5-10 years. First NFI 1923-1929	NFI 2003-2012
United Kingdom	Permanent systematic sampling 8x8km grid, combined with a regional simple random sampling. Square sampling plot of 1 ha.	5	Various, NFI since 1924	NFI 2011-2014

Time series of annual activity data (i.e. forest land area) are usually obtained by interpolation and extrapolation of available non-annual datasets (Table 7.14). Main source of 'area' data is the national forest inventory. Other sources are national statistics or remote sensing images archives (satellite images, aerial photographs) or their products such as Corine Land Cover maps.

Table 7.14 Land representation and "activity data" sources for subcategory 5A1

Member State	Description
Austria	FL remaining FL area is derived from NFI data, with annual area interpolated between inventory years (1986-1990/1992-1996/2000-2002/2007-2009/2012-2014).
Belgium	A geo-referenced grid covers entire country on which intersection points the diagnosis of land use is carried on vectorial and raster thematic sets and layers images relevant from land us point of view.
Denmark	A land cover map was produced for 1990, 2005 and 2012 based on satellite images, other datasets used to derive 1992-2005 and NFI data from 2005 and 2012.
Finland	Estimation of the area of Forest land is based on successive NFI cycles (NFI 7-11) from different years in Northern and Southern Finland. The forest land category is further sub-divided for organic and mineral soils.
France	Land data system is based on aerial photographs dataset combined with an annual "on-the-ground" survey of lands (defining both the land use and current activity), which allows a land use change matrix both annual (to capture rapid changes) and a 20-year span (to capture slower changes). For French Guyana a photointerpretation system based on satellite images, combined with permanent plots surveying just small share of total area.
Germany	Activity data is derived from a "wall-to-wall" database based on NFIs (for Forest land and conversion from/to), topographical-cartographical information (digital landscape model) and CLC 1990, 2000 and 2006 (for land use) and earth observation (GSE data).
Greece	Several sources and databases: 1st National Forest Inventory (1994), annual Agricultural census, afforestation registry and statistics, general geographical data of National Statistical Service of Greece (i.e. decennial survey).
Ireland	Forest land area is obtained from sectorial Forest Inventory and Planning System data of 1995 and CLC maps (1990/2000/2006).
Italy	Forest area in 1990 -2012 was calculated through a linear interpolation between 1985 and 2002 data (supplied by the 1st and 2nd NFI). Data for 2003-2012 is extrapolated, building on Statistics' annual data on forest area.
Luxemburg	Land use / land cover map for 1989 (data collected in the field), 1999 (on aerial colour infra-red ortho-photos) and 2007 (high resolution satellite images) in digital format covering the entire territory. Annual data is obtained by linear interpolation for 1990-2000 and 2001-2011.
Netherland	Country level wall-to-wall approach based on harmonized and validated digital topographical maps of 1990, 2004 and 2009, linearly extrapolated till 2012.
Portugal	Systematic sampling grid (NFI) for full land-use classification and simultaneous interpretation of high resolution airborne imagery in 1995, 2005 and 2011. Intermediary years are linearly interpolated.
Spain	Forest land area is provided from a combination between CLC 1990 and 2006 with Forest Maps of Spain achieved for period 1998-2007. Further on, annual estimation of area is obtained by linear interpolation between 1990 and 2006, and then extrapolated.
Sweden	Systematic grid of permanent monitoring plots (NFI) provides estimates of the areas of all land-use categories and gross & net land-use transfers across all country.
UK	Areas of forest land come from statistics published by the Forestry Commission.

Furthermore, MS usually breakdown forest land area in various *subdivisions* according to available datasets. Breakdown criteria differ across EU-15 MS, although they are consistent across time series: e.g. by groups of species or forest types (i.e. broadleaves/coniferous; evergreen/deciduous; species based classification – beech, oak, pine, spruce, etc); by climate (i.e. temperate, tropical); by soil and site type (e.g. lowland, organic or mineral soils), administrative or geographical boundaries, and management type (e.g. coppice, high stands).

For forest land, the *definitions of carbon pools* are reported by most MS. There are slight variations among MS on pools' definitions (Table 7.15), whose impact on the estimates is difficult to assess in quantitative terms, but considered small. For instance, forest inventories define the biomass pool according to the threshold of minimal diameter (i.e. DBH–stem diameter at breast height of sampled trees) as ranging from 0 to 7,5 cm. Concerning the belowground biomass, the information on what exactly it includes is rather poor. Dead wood mostly differs in terms of threshold diameter and height/length of pieces included in the pool and decay time. Litter is either independently assessed or included with soils. In soils, C stock changes are computed according to various soil depths. Usually, carbon stock in understory's biomass is only accounted in principle for estimating forest fires emissions (although such information is often not clearly reported in the NIR).

Table 7.15 Forest carbon pools definitions in the GHG inventories of the EU-15 MS

Member State	Description
Aboveground biomass	
Austria	Stem wood over bark with a diameter at breast height over 5 cm.
Belgium	Tree and shrub species with circumference exceeding 20/22 cm at 1.50 m height (i.e. 7 cm in diameter), while in coppices the stems under 7 cm diameter are also included.
Denmark	Living trees with a height over 1.3 m, under different recording schemes (i.e. trees larger than 40 cm are measured only within a 15 m circle). Smaller trees, shrubs and other non woody are not counted. Aboveground biomass is defined as living biomass above stump height (1% of tree height).
Finland	Biomass of living trees with a height over 1.35 m, i.e. those trees that are measured in NFIs, including the stem wood, stem bark, living and dead branches, cones, needles/foliage. Understory is counted only to estimate the emission from forest fire.
France	Trees with DBH over 7.5 cm.
Germany	Trees with DBH over 7 cm.
Greece	Trees with DBH over 10 cm, but in cases of degraded forests (e.g. oak) and coppices (e.g. castanea) the threshold is 4,6 cm. The trees in the sample area under the minimum diameter are not considered. Understory biomass is considered for GHG emissions from wildfires.
United Kingdom	Modeled living woody biomass (complete individual cycle of trees, it does not include understory and annual/perennial non woody vegetation).
Ireland	Modeled individual cycle of living biomass (but not the understory and annual/perennial non woody vegetation).
Italy	Trees with DBH over 3 cm.
Luxemburg	Diameter of 4 cm at 3,5 m of the total height (average value)
Portugal	Living biomass above the soil, including: stems, stumps, branches, bark and foliage, and forest understory (only for estimation of emissions from forest fires).
Spain	Trees with DBH over 7.5 cm at the ground level are measured, while those under 7.5 cm are only counted.
Sweden	Biomass of living trees with a height over 1.3 m. Small trees, shrubs and other vegetation (i.e. herbs) are not counted. Aboveground biomass is defined as tree part above stump height (1% of tree height).
Netherlands – na (there is no information available the NIR 2012)	
Belowground biomass	
Austria, Ireland, United Kingdom	Fine roots pool is simulated within integrates models.
Belgium	Diameter of estimated roots > 5 mm.
Denmark	Stumps from harvested trees within a year from the measurement are measured.
France	Fine roots are included with the soil organic matter.
Finland	Stumps and roots down to a minimum diameter of 1cm.
Germany , Greece and Luxemburg,	Applies default "root- to-shoot" factor
Italy and Spain	Applies a country specific "root- to-shoot" factor
Portugal	Living biomass of below ground biomass (the lower limit of root diameter, if any, is not explicitly defined).
Sweden	Biomass of living trees below stump height (1% of tree height) down to a root diameter of 2 mm.
Netherlands: definition not available in the NIR 2014	
Dead Organic Matter – Litter	
Austria, Ireland, United Kingdom	Litter is simulated by models.
Denmark	Non-living biomass which is not included in other classes, under various status of decomposition on top of mineral or organic soil. It includes the litter, fumic and humic layers.
Finland	Non-living biomass with a diameter less than 10 cm in various status of decomposition (allocated by model in compartments: fine woody litter, coarse woody litter, extractives, celluloses and lignin-like compound). Biomass of ground vegetation (eg moss-, lichen-shrub- and twig vegetation) is not included in the living biomass, but it is included when the litter input to the soil is estimated.
France	Non-living dead wood lying on soil with maximum 7.5 cm diameter, dead leaves, humic and fumic layers, fine roots
Germany	Dead organic cover with a fraction < 20 mm
Italy	The amount of carbon in litter is estimated from the aboveground carbon amount with linear relations.
Portugal	Non-living biomass on top of mineral soil, in various stages of decomposition (include fumic, humic) (considered only in forest fires).
Sweden	Non-living biomass not classified in other classes, under various stages of decomposition, on top of mineral or organic soil: litter, fumic and humic layers. Litter includes, as well: a) live fine roots (<2 mm) from O horizon and b) coarse litter with "wood stem diameter" between 10-100 mm.
Belgium, Greece, Luxemburg, Netherlands, Spain	Assumed in balance (Tier 1). Although sometimes pools is measured, the definitions are not available in the NIR 2014

Dead Organic Matter - Dead wood	
Austria	Only standing dead w ood.
Belgium	Dead w ood as measured by NFI, namely standing dead trees and fallen logs and branches. A dead tree is considered as fallen w hen it tilts at a vertical angle equal or superior to 45°. Dead trees above 20 cm of circumference are measured, under 20 cm are estimated visually.
Denmark	Standing deadw ood w ith a DBH larger than 4 cm. Lying dead w ood w ith a diameter of more than 10 cm, w hose length is recorded. The degree of decay is recorded on an ordinal scale.
Finland	Non-living biomass w hich is not contained in litter (described by model as coarse w oody litter input, larger than 10 cm in diameter, from natural mortality of trees and harvesting residues)
France	Standing trees, dead for less than 5 years, plus 10% from the w ood w hich is annually harvested
Germany	Fallen dead w ood w ith a thicker-end diameter of at least 20 cm; standing dead w ood w ith a diameter of at least 20 cm at breast height and trunks w ith either a height of at least 50 cm or a cut surface diameter of at least 60 cm. NFI 2008 collected data on all dead-w ood objects w ith a thicker-end diameter of at least 10 cm. Data collection w as for both NFIs on 3 species groups and 4 decomposition class.
Ireland, United Kingdom	Pool is simulated by models.
Italy	The amount of carbon in dead w ood is estimated from the aboveground carbon amount w ith an expansion factor.
Greece	Dead w ood that remain on site after fire is assumed to fully decompose in 10 years
Portugal	Non-living w oody biomass on top of mineral soil, in various stages of decomposition (considered only in forest fires)
Sw eden	Dead w ood is defined as fallen dead w ood, snags or stumps including coarse and smaller roots dow n to a minimum "root diameter" of 2 mm. Dead w ood of fallen dead w ood or snags should have a minimum "stem diameter" of 100 mm and a length of at least 1.3 m.
Luxemburg, Spain	Assumed in balance (Tier 1).
Netherlands: definition not available in the NIR 2014	
Soil Organic Carbon (for organic soils see more in the section 7.6)	
Austria, Finland, United Kingdom, Ireland	Pool is simulated by models (undefined depth or dimensions)
Belgium, France, Germany, Italy, Luxemburg, Portugal,	Organic carbon in 0-30 cm top soil.
Denmark	Organic carbon in the mineral soils below the litter, fumic and humic layers and all organic carbon in soils classified as Histosols. It is for 30 cm depth betw een top of the mineral soil or, alternatively, from the soil surface (if histosol).
Spain	Organic carbon in the mineral soils dow n to 100 cm.
Sw eden	Organic carbon in the mineral soils below the litter, fumic and humic layers and all organic carbon in soils classified as histosols, dow n to a depth of 50 cm.
Greece, Netherlands: : definition not available in the NIR 2014	

For inventory completeness purpose, it should be considered that what is not reported under a pool is reported under another one (e.g., fine roots are reported either as litter or as soil organic matter), so that no bias in estimation are expected to occur.

Inventory estimates follow GPG by estimating the change in the forest pools. For Living Biomass pool the methods are based either on the "stock change" or "gain-loss" IPCC methods (IPCC GPG LULUCF 2003) (Table 7.16).

*Table 7.16 Estimation methods used by MS for C stock changes in Living Biomass pool. Estimation method is either stock change (**bold**) or gain-loss.Non-NFI data is shown in italics*

MS	Estimation method
Austria	Gain-loss method based on NFI data
Belgium	**Stock change (Walloon region) and gain-loss method (Flemish region) both based on NFI data**
Germany	**Stock change method based on NFI data**
Denmark	***Stock change based on Forest census (before 2000) and NFI (since 2001)***
Finland	Gain-loss method based on NFI and harvest datasets
France	Gain-loss method based NFI and harvest from non-NFI statistics
Greece	***Stock change method based on FMP database***
Ireland	Gain-loss method from forestry statistics & yield table data based model and harvest statistics & firewood estimates
Italy	Gain-loss method based on NFI and harvest data derived from regional harvest statistics
Luxemburg	*Gain-loss method based on forestry statistics & yield table and harvest statistics*
Netherlands	Gain-loss method based on NFI data and national harvest statistics
Portugal	Gain-loss method based on NFI data and harvest statistics
Spain	**Stock change based on NFI data**
Sweden	**Stock change based on NFI data**
UK	*Gain-loss method modeled from forestry statistics on area & yield table data and harvest statistics*

Sources of data for the estimation of *C stocks change in living biomass* also differ across MS, upon data availability. Actually, NFI represents the primary source of information for 11 MS, while the others rely on forestry statstics and yield tables; in addition, forest fire statistics complement both sources. Data collection and data analysis programme are ongoing in most MS to further improve the completeness and quality estimates, primarily of C stock change.

Table 7.17 Sources of data and basic methodological information for estimating of the C stock changes in Living Biomass pool in the subcategory 5A1

Member State	Description
Austria	Austrian NFI provides data on grow ing stock volume increment and drain (harvest, other losses). Annual data of increment and harvest result from using relative variation indices. Harvest indices results from ratio of NFI to other non-NFI datasets. Country specific biomass functions are applied to account for branches, evergreen foliage and a general function for below ground biomass.
Belgium	Regional, but National Forest Inventories like, datasets. Solid w ood volumes of each species (aboveground w oody biomass: stem + branches) is obtained from forest inventories data. BEF2 and R derived by expert judgement from IPCC.
Denmark	Data from and Forest census and NFIs. Tree volume estimates is based on volume functions developed for the most common Danish forest tree species.
Finland	Biomass increment is estimated based on individual tree measurements (DBH, tree height) in successive NFIs and country specific tree biomass models. Loss is calculated from annual statistics, and includes logging, fuel w ood and unrecovered natural losses.
France	Gain-loss method is used. National data rely of NFI data on forest grow th, w hile loss by harvest statistics (both commercial and non-commercial). BEFs, allocation in roots, as w ell as C content in w ood are country specific.
Germany	"Stock change method" is used w ith data from forest inventories. Biomass functions, country specific volume expansion factors and IPCC default root-to-shoot ratio. For former Eastern Germany data from forestry management plans is combined w ith NFI 2002 and 2008.
Greece	Annual change in carbons stock is calculated as linear interpolation of stocks provided by successive forest inventories (stand w ise forest inventories). IPCC default factors are used.
Ireland	Annual increment is estimated using a model w hich calculates total standing carbon stock of forests year-on-year, based on Irish forest yield tables by species. Wood harvest is from national statistics. Same country specific BEFs and w ood density are applied for gain and loss.
Luxemburg	Increment of grow ing stock biomass in m^3 per ha and year w as calculated on forest types using yield-tables and lossess derived from the harvest official statistics.
Italy	Model applied at regional scale under availability of forest-related statistical data. The grow ing stock volume of the previous year is increased by the annually calculated increment of the current year and reduced by the losses due to harvest, mortality and w ildfire in the current year. Aboveground and below ground biomass w ere obtained by using country specific BEFs. Commercial w ood harvest data has been obtained from statistics.
Netherlands	Country specific Tier 2 methodology based on grow ing stock volume data from NFI plots, using the equations from a European database and national data on harvest statistics.
Portugal	Tier 2 based on NFI data. Annual increment rate constant in time and equal to that from last NFI. Equations used w ere parameterized for Portuguese conditions and parameters used w ere country specific (updated in previous NFI).
Spain	Data from successive NFIs.
Sw eden	C stock change method that integrates Sw edish NFI and Sw edish Forest Soil Inventory in the same sample design and plots. Aboveground & below ground biomass per trees in permanent sample plots is obtained by biomass functions on NFI data.
United Kingdom	Carbon accounting model input w ith pre- and post-1920 plantation statistics and grow th modeled according to the Yield tables. Model simulates both gain and losses, w ith loss based on clear-felled, then replanted, at the time of stand maximum increment.

In 2014 submission, the implied C stock change factors for net C stock change in biomass range from 2.62 to -0.82 MgC ha^{-1} among MS (Figure 7.3). Generally, low values of IEF are shown by MS with most intensive forest exploitation or with less favourable climatic conditions (i.e. lower growth and also more losses by natural disturbances); while higher values are for MS where planting is the main instrument to ensure forest regrowth.

Figure 7.3 Implied net carbon stock change factor for living biomass pool in 5A1 (Mg C ha-1 year-1). Bars represent average, minimum and maximum values reported by MS across the time period 1990-2012.

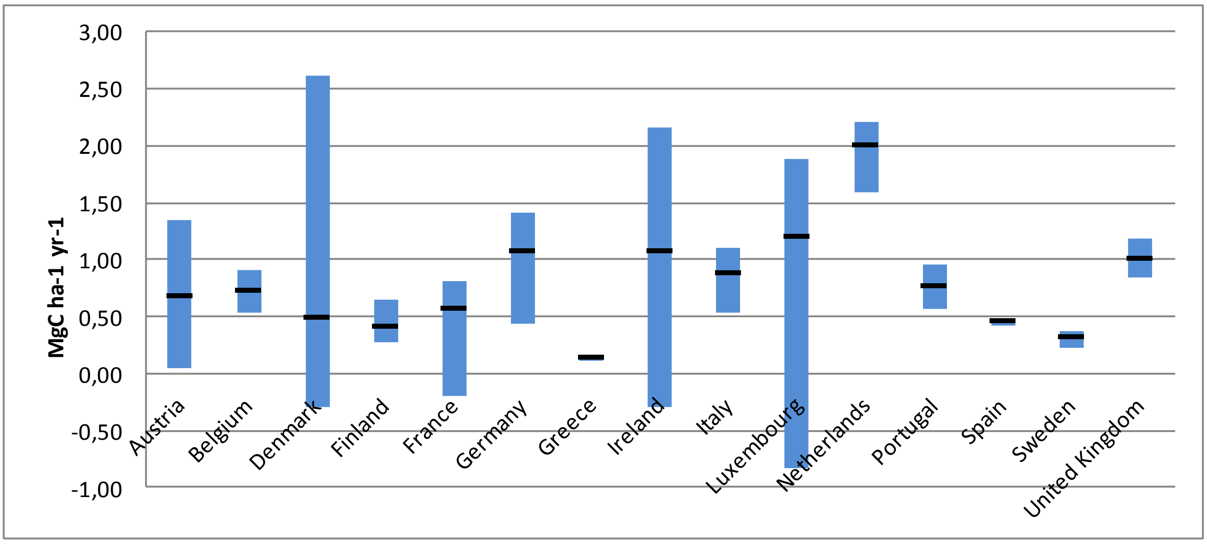
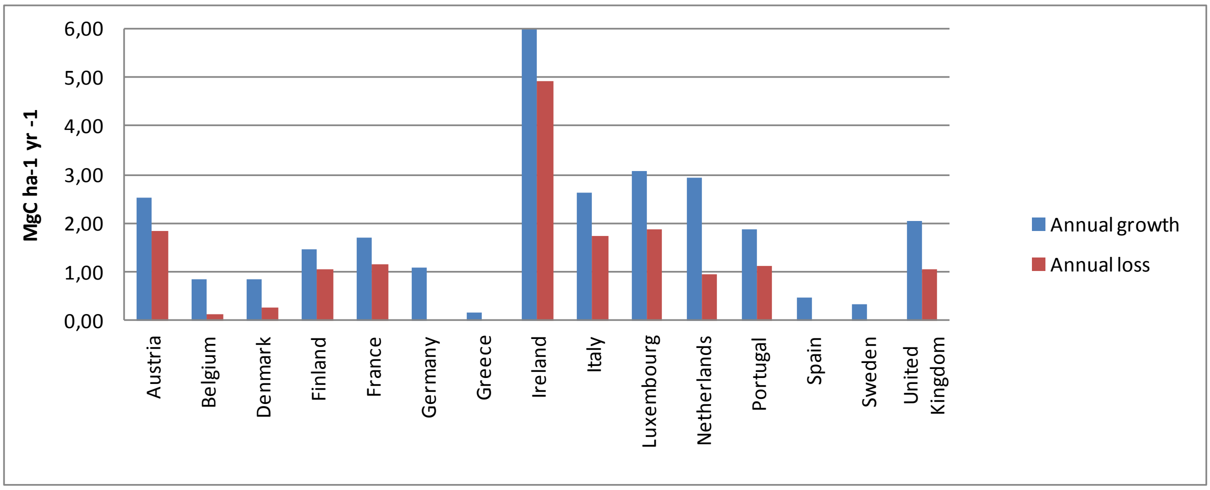


Figure 7.4 Average implied carbon stock change factors for gain (blue) and loss (red) of living biomass in 5A1 (Mg C ha-1 year-1) reported by MS across the time period 1990-2012.(only net C stock changes displayed for MS reporting with the 'stock-difference' method).



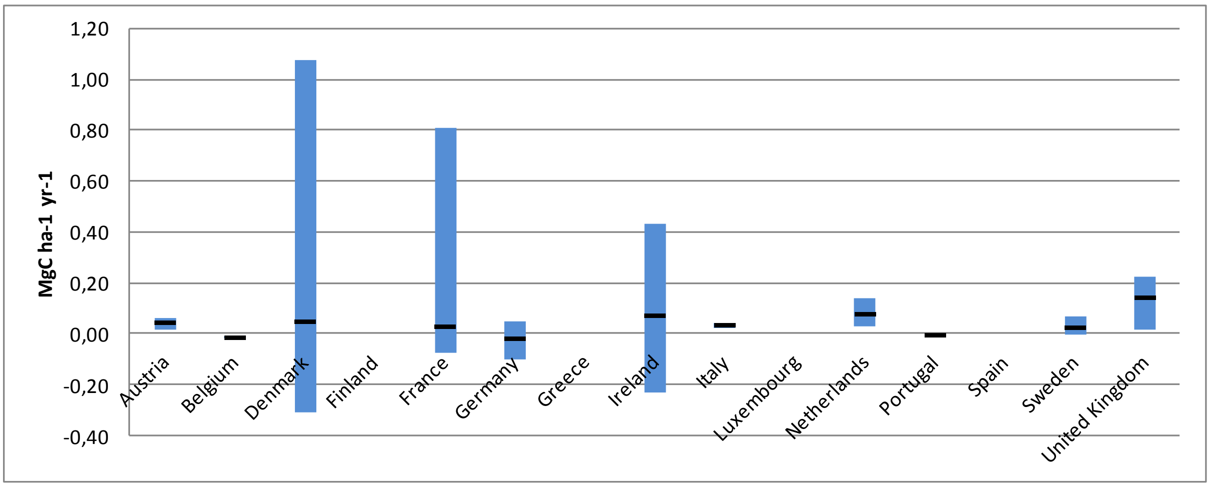
C stock changes in SOCmin and DOM are mostly reported applying Tier 1 which assumes that these pools are at equilibrium and therefore no net C stock changes occur (thus NO, NE is used in the CRF), or when estimated, mostly rely on data collected by NFI (see also Table 7.7 on completness). The large use of the Tier-1 assumption is due to the lack of appropriate data (and the high costs for collecting them) or the very high uncertainty of existing data. In most cases, MS document the ongoing efforts to estimate emissions and removals from these pools. Data are either directly used for estimating with thestock difference or gain-loss methods, or integrated in models (Table 7.18). According to available datasets, DOM C stock changes are often reported shared between dead wood (DW) and litter (LT).

Table 7.18 Sources of data and methods for estimating C stock changes in dead organic matter (DOM) and soil organic carbon (SOC) for 5A1.

Member State	Methods			Description
	DW	LT	SOCmin	
Austria	Stock-change	Gain-loss	Gain-loss	NFI database, assuming a ratio of DW betw een deciduous/coniferous as the proportion of the tress in the stand. LT and SOC are modeled by Yasso07 also including management options.
Belgium	Stock-change	Tier1	Stock change	DW is measured in NFI plots. LT pool is considered neutral (based on measurements). SOC is estimated based on various datasets and research projects and activities.
Denmark	Stock-change	Stock-change	Tier1	Database on soil sampling in successive moments in time (first in 1985, roughly every 10 years). NFI soil distribution database is used for scaling the sampled plots to total forest area. C content at 15 cm top soils multiplied by a factor depending on the species and basal area of stand.
Finland	Gain-loss	Gain-loss	Gain-loss	DW, LT and SOC in mineral soils are estimated using a model-based method. In organic soils, country specific measured emission factors w ere used in estimating decomposition of peat, combined w ith a model to estimate aboveground C stock changes.
France	Stock-change	Stock-change	Tier1	DW is provided by the NFI and a share of 10% of the harvest is considered as LT (emitted in the year of the event). An annual removal of 2,4 kg/ha CH4 is also counted by undisturbed forest soils.
Germany	Stock-change	Stock-change	Stock change	Both LT and DW are computed based on country datasets (NFIs, Biosoil, soil inventory)
Greece	Tier 1	Tier 1	Tier1	Tier 1 for SOC and DOM. For w ildfires affected areas there is a Tier 2 approach for DOM w ith country specific data.
Ireland	Tier 1	Gain-loss	Tier1	SOC and DW are considered neutral. LT C stock change is modeled.
Italy	Stock-change	Stock-change	Tier1	C stock change in DW and LT is linearly regressed w ith country specific equations from the aboveground carbon stock, on available stratification of forests (on forest type, groups of forests types).
Luxemburg	Tier 1	Tier 1	Tier1	SOM and LT are considered neutral. DW w ill be derived from NFI.
Netherlands	Gain-loss	Gain-loss	Tier1	DW is computed based on fix rate of tree mortality and dead w ood decay. Leaves and roots w ere not taken into account for the build up of dead w ood.
Portugal	Stock-change	Stock-change	Stock change	Country specific data.
Spain	Tier 1	Tier 1	Tier 1	Pools are considered neutral.
Sw eden	Gain-loss	Gain-loss	Stock change	DW is modeled by NFI based measured data and harvest dataset. Litter and soils on Forest Soil Inventory database. C stock is estimated by conversion factors from harvest biomass to stump and root biomass. LT is separately estimated for three different compartments: coarse litter, annual litter fall and fine litter, each either associated to soil pool or DOM. Change in mineral soils is estimated based on repeated soil sampling in combination w ith pedotransfer functions (based on fraction of fine earth and other physical characteristics of soil). Organic soils emissions are estimate w ith emission factors from annual below ground litter input (from NFI) and the heterotrophic respiration (national and regional research).
United Kingdom	Gain-loss	Gain-loss	Stock change	Pools are simulated in a model w ith living biomass.

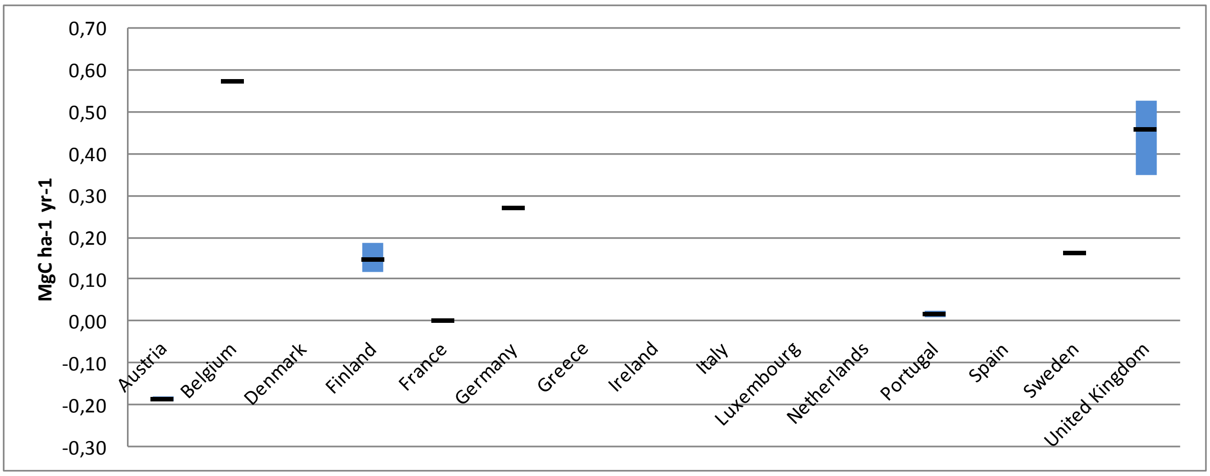
C stock change in DOM is estimated by 11 out of 15 MS: Finland includes it with SOM, while Greece, Luxemburg and Spain report it with notation keys under Tier 1. DOM is a sink for most of MS reporting estimates. Some MS (Belgium, Denmark, Germany, Ireland, and France) report it, at least occasionally, as a small source. Among MS, DOM ranges from -0.31 to 1.08 Mg C ha-1 yr-1 (Figure 7.5). Following the windstorms in 1999 and 2009, France applies Tier 2 and reports DOM as a major sink in the years when the storm occurred then as a source for the following time period, although in pre-storm periods and for areas not affected by storm DOM is assumed in equilibrium according to the Tier 1 method.

Figure 7.5 *Implied net carbon stock change factors in DOM pool in 5A1 (MgC ha-1 yr-1). Bars represent average, minimum and maximum values reported by MS across the time period 1990-2012. No mark means Tier 1 method applied (i.e. assumed no net C stock change).*



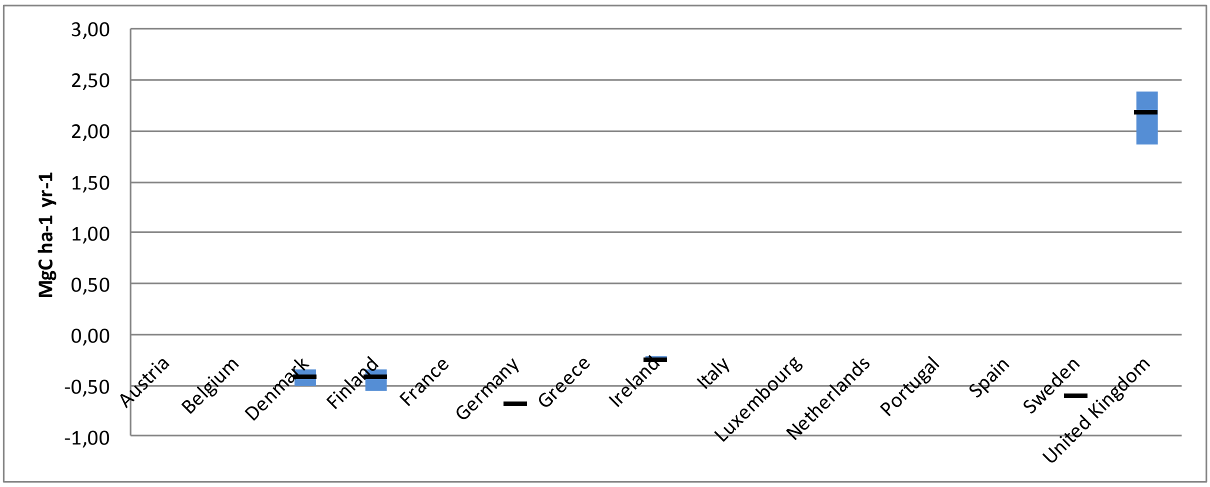
SOC in mineral soils is estimated by 8 MS out of 15. Mineral soil is generally reported as a small sink with the exception of Austria (IEF value of -0.19 Mg C ha-1 yr^{-1}, in average). Among MS values range from -0.19 to 0.57 Mg C ha-1 yr-1 (Figure 7.6).

Figure 7.6 *Implied net carbon stock change factor in mineral soils SOM in 5A1 (Mg C ha-1 yr-1). Bars represent average, minimum and maximum values reported by MS across the time period 1990-2012. No mark means Tier 1 method applied (i.e. assumed no net C stock change).*



Six MS that reports *organic soils* under managed forests estimate CO_2 emissions associated with drainage. Others report insignificant areas of organic soils. IEF among MS range from 2.38 to -0.68 Mg C ha-1yr-1 (just note that only UK reports a sink from organic soils, which is not consistent with the IPCC GPG). Additional information could be found in sub-chapter 7.6.

Figure 7.7 Implied net carbon stock change factor in organic soils in 5A1 (Mg C ha-1 yr-1). Bars represent average, minimum and maximum values reported by MS across the time period 1990-2012. No mark means Tier 1 method applied (i.e. assumed no net C stock change).



7.2.3 Land converted to forest land (CRF 5A2)

7.2.3.1 Overview of Land converted to forest land

In 2012, the area of subcategory 5A2 - Land Converted to forest land was 4.9% of the total forest land area, and increased by about 81% from 1990 (Table 7.19). 5A2 net removals represent 13% of total net removals of 5A. Largest conversions occur from grasslands (57%), cropland (24%), wetlands (8%), settlements (4%) and other land (6%). Note that Six MS start from 1990 the area accumulation in this category so from 2009 onward their estimates are comparable with other MS). For 2012, Italy and Spain together contributes for 40% of area reported under this subcategory.

Table 7.19 Trend of activity data in subcategory 5A2 – land converted to forest land – in the EU-15 MS (kha)

Member State	1990	1995	2000	2005	2012	Difference 2012to 1990
Austria	260	261	204	185	162	-38%
Belgium	2	8	13	19	27	1115%
Denmark	4	25	46	67	94	2154%
Finland	161	194	210	193	131	-19%
France	577	988	1.224	1.225	1.167	102%
Germany	606	606	606	514	400	-34%
Greece	NE,NO	6	23	32	33	na
Ireland	16	111	185	244	293	1752%
Italy	689	923	1.252	1.577	1.434	108%
Luxembourg	14	14	13	11	7	-53%
Netherlands	3	18	33	46	56	1801%
Portugal	387	528	603	663	497	28%
Spain	28	317	817	1.081	1.130	3927%
Sweden	146	215	276	306	561	286%
United Kingdom	578	465	431	385	275	-52%
EU-15	**3.472**	**4.677**	**5.936**	**6.546**	**6.268**	**81%**

At EU-15 level, in 2012 5A2 is a net sink of -43.147 Gg CO_2, 89% higher than in 1990 (Table 7.20) and 4% less than in 2011. In 2012, about 50% of removals were reported by France, Spain and Italy. Finland, Netherlands and Denmark report this subcategory as a net source mainly due to significant emissions from soils (especially from organic soils) under the early stages of conversion when soils preparation takes place.

Table 7.20 5A2 Land converted to Forest Land: MS' contributions to EU15 net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
Austria	-3.081	-1.929	-1.879	4%	50	-3%	1.202	-39%
Belgium	-20	-296	-307	0,7%	-12	4%	-288	-
Denmark	77	-119	38	-0,1%	157	-132%	-39	-51%
Finland	131	-117	-116	0,3%	1	-1%	-247	-189%
France	-2.844	-8.262	-7.959	18%	303	-4%	-5.114	180%
Germany	-5.879	-4.988	-4.777	11%	211	-4%	1.102	-19%
Greece	NE,NO	-144	-145	0,3%	-1	1%	-145	-
Ireland	18	-3.794	-3.847	9%	-54	1%	-3.865	-21908%
Italy	-3.149	-5.752	-5.883	14%	-131	2%	-2.734	87%
Luxembourg	-113	-66	-59	0,1%	7	-10%	54	-47%
Netherlands	54	-599	-581	1%	18	-3%	-635	-1169%
Portugal	-2.862	-5.319	-4.606	11%	712	-13%	-1.744	61%
Spain	-158	-8.578	-8.406	19%	172	-2%	-8.248	5234%
Sweden	30	-2.485	-2.436	6%	50	-2%	-2.465	-8307%
United Kingdom	-4.974	-2.267	-2.184	5%	84	-4%	2.790	-56%
EU-15	**-22.770**	**-44.714**	**-43.147**	**100,0%**	**1.567**	**-4%**	**-20.377**	**89%**

Overall, Living Biomass is a sink with C stock change factor among MS ranging from of 3.40 Mg C/ yr-1 ha-1 or -5.20 Mg C/ yr-1 ha-1.

7.2.3.2 Methodological issues for Land converted to forest land

Methods used to identify and represent the areas under conversion, as well as to report GHG emissions and CO_2 removals, are generally the same used for category 5A1 (Table 7.21)

Table 7.21 Background information on sources of data and methodologies in subcategory 5A2.

Member State	Description
Austria	NFI datasets w hich capture changes to/from Forest land betw een NFIs cycles. NFI covers entire country and each grid point is terrestrially inspected. The split into subcategories of previous or follow ing land uses is done based on NFI determined ratio. When conversions occur, NFI records data on the type of land in the neighborhood of the plot. C stock change in living biomass is estimated based on national scale value of annual increment (a constant value over the 20 years transition) and loss, w ith country specific conversions factors, using the default method. SOC in mineral soils and litter pools are estimated as average values for five forest grow th Regions from Biosoil project (BFW, 2009) and former forest soil survey (BFW, 1992).
Belgium	Activity data results from the country w ide grid of points in the reference years. SOC is estimated based on reference C stocks w ith each land use, available from various national datasets and research activities. C stock change in DOM (LT, DW) is assumed neutral (Tier 1).
Denmark	Activity data are determined from NFI grid (w ith 1990 reconstructed on satellite imagery datasets). Living biomass C stock change is estimated using country specific biomass. SOC is estimated based on research projects, old databases and NFI. For DOM change country specific constant values are used for each type of conversion.
Finland	Data on land conversions is derived by successive NFIs. Mean biomass annual increment is estimated as an average of current stock per area unit divided by the number of years since the conversion. SOC, DW and LT are simulated w ith Yasso07into an integrated estimate.
France	Land conversion area is determined by an approach combining datasets of aerial photographs w ith an annual on-the-ground survey of lands (assess both land use and occurring activities). NFI provides data to estimate C stock change in biomass and DOM. National reference C stocks in soils is available each land use type. French Guyana is only partially assessed (w here relevant for conversions) by a photo interpretation system based on remote sensing combined w ith permanent plots, w hile biomass data are delivered by field measurements.
Germany	Based on NFIs in former Western Germany and on management plans & NFI 2002 in former Eastern Germany, the area of conversion is deducted and assumed linearly distributed in time. Previous land use is reported only for the former Western Germany. Data from 2002 is extrapolated till 2007 and starting w ith 2008 the absolute value of land use changes from and to forest land is provided by federal cadastral system. NFI datasets and single tree biomass functions are used. For SOC there is used a country specific emission factor for each type of conversion. Litter w as estimated from national datasets. No dead w ood accumulation is determined after field measurements.
Greece	Afforestation area is provided from statistics, disaggregated by forest types. Changes in carbon pools are estimated using a Tier1 methodology and data from the GPG for LULUCF for all type of conversions. SOC and DOM w ere assumed neutral .
Ireland	Annual area is a spatially explicit GIS database for after 1990, w ith detailed information given by LPIS (including on the previous land use). Afforested area maps superimposed on Soil map and CORINE 1990 Land Cover Map supported the identification of the soils types. Biomass C stock is modeled. No change is demonstrated for SOC, w hile DOM (DW and LT) is modeled based on country specific data.
Italy	Land use change matrix starting 1990 has been assembled based on national land use statistics. NFI provides data for biomass increase. Reference soil C stocks on land use are available.
Luxemburg	Annual biomass increment factor is computed based on yield tables for young stands. SOC reference C stocks values are available as country averages on land use.
Netherlands	A land use matrix is available w ith land-use changes calculated based on land use maps in 1990, 2004 and 2009. Changes in carbon stocks in living biomass are approximated by a linear regression as the mean grow th rates per age, derived from the NFI. DW and LT are assumed as sinks of uncertain magnitude and not reported. SOM is reported based on research projects database.
Portugal	Conversion area from systematic sampling grid (NFI). DOM (only litter) stocks are country specific. Reference C stocks in soils are derived based on ICP Forest Level I/ Biosoil data.
Spain	Area data is given by national statistics (related to EU funding schemes and national funding for afforestation).
	Annual average increment in aboveground biomass is estimated as the value of average C stock from NFI split by 20 years, computed for each of region.
	SOC is estimated based on reference values on land use on province (several in a region). DOM pools are considered neutral.
Sw eden	NFI provides explicit gross & net land-use transfers from the base year onw ard. Estimation of C stock change in living biomass is based on NFI data and country specific biomass functions. For SOC and DOM a Tier 2 based on country specific method.
United Kingdom	Areas of land use change to Forest are available form planting statistics of the Forestry Commission. C pools changes in post 1990 afforestation are modeled based on country data.

Heterogeneity in the approaches used by MS for subcategory 5A2 suggests caution in interpreting differences in the implied carbon stock change factors. For instance, possible reasons of differences may include activity data time series length and their starting point, use of time averaged or annual biomass growth increment, CO_2 emissions from previous land use, including lagged emissions,.

MS have developed land identification systems that are able to identify and track land use conversions to forest.Estimates of GHG emissions and CO_2 removals are usually reported at tier 2.

SOC is reported either at tier 2 (e.g. Greece, Ireland, Spain and Belgium) or at tier 3 by using soil carbon models (e.g. Denmark, UK) (Table 7.22).

Table 7.22 Values of the reference C stock in mineral soils on forest land/grassland/cropland as reported by the MS

MS	Land use	Value (tC/ha)	**Comments** (i.e. considered depth)
Austria	Forest land	77-117	0-50 cm, includes litter above the mineral soil
	Cropland	56-90	0-50 cm, includes litter above the mineral soil
	Permanent cropland (vineyard)	58-78	0-50 cm, includes litter above the mineral soil
	Grassland (intensive use)	75-100	0-50 cm, includes litter above the mineral soil
	Grassland (extensive use)	120-139	0-50 cm, includes litter above the mineral soil
Belgium	Forest Land	111/94	Wallonia / Flanders
	Cropland	44/52	Wallonia / Flanders
	Grassland	87/86	Wallonia / Flanders
	Peat land	100	Belgium (country level)
Finland	Cropland	59.1/74.6	IPCC based reference for high activity soils/sandy soils
Greece	Cropland	48	National average IPCC derived
Luxemburg	Forest Land	85	Country average
	Cropland	77	Country average
	Grassland	92	Country average
France	Forest land	70	Depth not specified
	Cropland	40	Depth not specified
	Grassland	65	Depth not specified
Italy	Grassland	78.09.00	For undisturbed soil grasslands
	Cropland	56.07.00	Depth of 30 cm
Spain	Grassland	94.05.00	Values are valid at country level for the transition from cropland to grassland. Various depths 30-100 cm as available in the databases
	Cropland	71	Values are valid at country level for the transition from cropland to grassland. Various depths 30-100 cm as available in the databases
United Kingdom	All land use categories		Reference C stock for all regions and all land use, 1 m soil depth

DOM is a small sink with the implied C stock change factor with a range of MS values from -0.20 to 1.26 Mg C ha-1 yr-1.

SOC is reported as either a sink or a source with a range of MS values from -0.69 to 1.31 Mg C ha-1yr-1.

For *SOC of organic soils*, the average IEF of MS ranges from -10.48 France (in WL converted to FL) to 2.79 Mg C ha-1 yr-1by UK.

7.3 Cropland (CRF 5B)

7.3.1 Overview of the Cropland category

Subject to intensive agriculture, cropland is an important contributor to European Union GHG budget. This category includes arable lands for annual crops and permanent crops, set aside lands or cultivated areas in ‘dehesa’ and rice-fields. Based on the MS submissions, cropland area in EU-15 covers 84.057 kha in 2012 (2% less than in 1990), equal to 25% of total reported EU-15 area. In 2012, 10.3% of the cropland area is reported as land under conversion to cropland.

7.3.2 Cropland remaining cropland (CRF 5B1)

7.3.2.1 Overview of Cropland remaining cropland

According to MS' GHG inventories, the area of "cropland remaining cropland" constantly decreased since 79.407 in 1990 to 75.454 kHa in 2012, which is 5% less than in 1990.

MS report a net decrease of cropland area, with the exception of Germany, Luxembourg and United Kingdom. The largest decreases are reported by Netherlands and Ireland. (Table 7.23)

Table 7.23 Trend of activity data in subcategory 5B1 - Cropland remaining Cropland in EU-15 MS (kha)

Member State	1990	1995	2000	2005	2012	Difference 2012 to 1990
Austria	1.466	1.452	1.424	1.418	1.374	-6%
Belgium	966	939	911	883	811	-16%
Denmark	2.713	2.687	2.661	2.635	2.590	-5%
Finland	2.378	2.366	2.339	2.328	2.323	-2%
France	15.354	14.148	13.495	13.763	13.884	-10%
Germany	12.274	12.360	12.445	12.478	12.557	2%
Greece	3.944	3.906	3.848	3.802	3.565	-10%
Ireland	405	392	373	317	236	-42%
Italy	10.704	10.704	10.403	9.795	8.598	-20%
Luxembourg	37	36	37	41	57	52%
Netherlands	999	899	799	710	631	-37%
Portugal	2.451	2.193	2.216	2.184	2.169	-12%
Spain	20.950	20.533	19.876	19.656	19.604	-6%
Sweden	3.073	3.020	2.981	2.936	2.883	-6%
United Kingdom	1.692	2.060	2.507	3.271	4.173	147%
EU15	**79.407**	**77.697**	**76.315**	**76.218**	**75.454**	**-5%**

At EU-15 level, in 2012 subcategory 5B1 was a net source, 8% higher than in 1990 (Table 7.24)

Table 7.24 5B1 Cropland remaining Cropland: MS contributions to net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
Austria	-165	44	43	0,1%	-1	-2%	209	-126%
Belgium	1.126	986	937	2%	-48	-5%	-189	-17%
Denmark	4.845	3.194	3.026	7%	-168	-5%	-1.819	-38%
Finland	5.328	5.539	5.628	13%	88	2%	300	6%
France	852	853	951	2%	98	11%	99	12%
Germany	21.767	24.304	24.462	57%	158	1%	2.695	12%
Greece	-982	-247	-228	-0,5%	20	-8%	754	-77%
Ireland	20	20	10	0,02%	-11	-52%	-10	-52%
Italy	1.641	4.012	4.030	9%	18	0,5%	2.390	146%
Luxembourg	-6	12	10	0,02%	-1	-12%	16	-273%
Netherlands	IE,NA,NE,	IE,NA,NE,	IE,NA,NE,	-	-	-	-	-
Portugal	34	-188	-190	-0,4%	-2	1%	-224	-665%
Spain	-846	-3.483	-3.531	-8%	-48	-	-2.684	-
Sweden	2.231	1.316	1.819	4%	503	38%	-411	-18%
United Kingdom	4.137	5.989	6.120	14%	132	2%	1.984	48%
EU-15	**39.980**	**42.350**	**43.088**	**100,0%**	**737**	**2%**	**3.108**	**8%**

Mediterranean countries report 5B1 as a small sink or source as owing large areas of permanent croplands (i.e. olive groves, vineyards). Overall, emissions are dominated by Germany where this land subcategory is a source for all the pools, with significant emissions associated with organic soils (25% of total CO_2 emissions in 2012, the share was decreasing since 1990).

7.3.2.2 Methodological issues for Cropland remaining Cropland

Land included under this subcategory generally matches well the IPCC definition (Table 7.25) although there may be small national particularities (e.g. treatment of some woody crops). Quite often, because of the management practices, cropland may not be clearly separated from grassland, and the reporting approach may vary amongst MS.

Table 7.25 Information on cropland definitions and/or description

Member State	Description
Austria	Arable land, including annual and perennial crops (rotation period of up to thirty years), as well as forest arboretums, forest seed orchards, Christmas tree plantations and orchards (e.g. walnut or sweet chestnut) and rows of trees and areas with woody plants in parks and green areas, and house garden.
Belgium	Tillage land and agro-forestry systems with vegetation falling below the thresholds for forests.
Denmark	Annual crops, wooden perennial crops, hedgerows and "other agricultural area" (i.e. small undefined areas lying inside the cropland area). It includes farmlands, commercial plantations with perennial crops (fruit trees, orchards and willow), house gardens, hedgerows (perennial trees/bushes not meeting the forest definition) in the agricultural landscape, as well as willow plantations on agricultural land for bioenergy purposes.
Finland	Arable crops, grass covered (for less than 5 years), set-aside, permanent horticultural crops, greenhouses and kitchen gardens.
France	Annual crops, temporary pastures (which last for maximum 6 annual harvests) and permanent crops (orchards, vineyards, olives, etc).
Germany	Annual crops and cropland with perennial crops (long-lived crops: fruit crops, osiers, poplars, Christmas tree farms, nurseries) and lands for cultivation of vegetables, fruit and flowers.
Greece	Annual and perennial crops, temporary fallow land and perennial woody crops, i.e. tree crops and vineyards.
Ireland	Permanent crops and tillage land, including set-aside, as recorded by annual statistics.
Italy	Annual crops and perennial woody crops
Luxemburg	Agro-forestry systems where tree cover falls below the forest thresholds, respectively covered by permanent crops, annual crops, artificial meadows (not permanent) and lands temporarily set aside
Netherlands	Arable and tillage land, including rice-fields, and agro-forestry systems where the vegetation structure falls below the thresholds for forest and nurseries (including tree nurseries).
Portugal	Rain-fed annual crops (without irrigation and fallow-land integrated into crop-rotations), irrigated annual crops (under irrigation, greenhouses), rice cultivation lands, wineyards, olives and other species of woody crops
Spain	Annual crops and fallow land, perennial crops (olive groves, wines and other woody crops) and mix of annual and permanent crops (except when they qualify as forest land, i.e. in "dehesa").
Sweden	Regularly tilled agricultural land.
United Kingdom	Arable and horticultureal land.

GHG estimates are reported mainly for soils and living biomass for perennial woody crops (i.e. orchards, vineyards, Christmas trees, fruits, bushes, and plantations). C stock change in living biomass under annual crops is estimated by Germany as neutral sink or a source for Denmark. For soil organic matter pool, the definitions vary among MS, in terms of the estimated soil depth (e.g. 30 cm in Finland and 100 cm in Spain); no depth is specified in case of modeled approaches.

Methods used for GHG estimation depend on data type and their time series availability (Table 7.26)

Table 7.26 Background information on data and methodology for the estimation of activity data and C stocks changes in the subcategory 5B1

Member State	Description
Austria	Activity data is compiled from Statistic Austria (based on IACS*). For crops not covered by the IACS the data are revised and estimated by expert judgment. Annual C stock change in biomass is considered according to the type of permanent woody crops (Tier 1 for orchards, vineyards and house gardens and Tier 1 for energy crops, Christmas tree) and estimated based on country specific total biomass carbon stock at harvest/removal. C stock in mineral soils is computed from national reference C stocks and country specific average C stock change factors adjusted according to the technology and management change.
Belgium	Activity data for SOC is derived based on landscape units distribution generated by the topological intersection of the Corine Land Cover 1990 and the digitized Soil Association map (Tavernier et al., 1972). C stock for each type of unit is estimated for the years 1960, 1990 and 2000, based on several databases and modeling approaches. C stock change in biomass is not estimated.
Denmark	Activity data by Statistics Denmark in a GIS analysis of the country's agricultural area combined with LPIS databases and detailed climate, soil maps, mineral & organic soils and cropland & grasslands, based on aerial photos for 1990 and 2005. Further on stratified on administrative criteria. C stock change in horticultural biomass is estimated based on the country's average stock biomass for each crop type, while for hedgerows is modeled with NFI data. SOC in mineral soils is modeled at county level. For organic soils, emission factors are country specific.
Finland	Cropland area is derived from NFI and Yearbook of Farm Statistics. Based on soil analysis the area is stratified on mineral & organic soils, low/high activity soils and fallow/till/no-till lands. C stock change in woody biomass is determined by country specific data for perennial crops (apple trees and dwarfish). C stock changes in soils are computed from reference soil C stocks and IPCC default factors. CO_2 emissions from cropland on organic soils are computed based on national emission factors on land categories and use.
France	Data derived from a grid based land assessment system for all land categories. C stock changes are considered neutral in all pools.
Germany	"Wall to wall" approach built by the landscape model (ATKIS - Amtliches Topographisch-Kartographisches Informations system), CORINE land cover (CLC – 1990, 2000), digital soil map of Germany (BUEK 1000) and German Official Statistic data (land use surveys in 1991, 1999, 2003), harvests survey in 1989 – 2005, revision of NUTS 3 in 1998 and NFI). The approach allows estimating the area of land uses and the ratio of organic/mineral soils. Emissions from organic soils are estimated using a Tier 3 methodology, with country specific emission factors. Mineral soils are considered to be in CO_2-equilibrium.
Greece	Area data form national statistics. The default IPCC method is combined with a Tier 2 methodology to estimate C stock changes in biomass in permanent woody crops. Tier 1 emission factor data is used for the estimation of C stock changes in mineral soils, with IPCC's default C stock change factors and C stock reference in mineral soils. A crop weighted average value for reference soil organic carbon stock is computed at national level, based on default IPCC data.
Ireland	Annual statistics for tillage crops. For C stock change in biomass, Tier 1 is assumed. Tier 1 is applied for C stock change estimation in mineral soils. Soil types on land uses are derived from GIS analysis of CLC 1990 superimposed on the General Soil Association Map of Ireland. Reference C stocks are established in details for each soil type, and then assimilated with IPCC defaults, while adjusted by unique national values of stock change factors.
Italy	National land use statistics is available. Tier 1 based on highly aggregated area estimates for generic perennial woody crops has been used to estimate only aboveground biomass carbon stock change. Biomass plantations C stock change is modeled at regional scale (NUTS2). No change for mineral and organic soils was assumed.
Luxemburg	Living biomass of land converted to cropland follows Tier 1 method. SOC is reasoned as not changing.
Netherlands	Land use maps for 1990, 2004 and 2009 and annual data by linear interpolations or extrapolated to date. Soil carbon is conservatively reported as zero based on country specific data. C stock change is considered as zero in all other pools.
Portugal	Tier 2 based on NFI data. Data for permanent biomass is based on neighbor countries values. Soil C stock change is estimates with country specific data (from national grid).
Spain	Activity data is obtained from CLC 1990 and 2000, Forest Map of Spain (to exclude forest areas), survey of yields and crop areas (1990-2003) and annual statistics of agriculture ministry (2004-2012). C stock change in biomass is estimated only for perennial woody crops based on CS data on each main type of crop: olives, wines and other woody crops. Soil C stock change is weighted from provinces to administrative region under the constraint of management data availability at regional level.
Sweden	Activity data is provided by a national level systematic grid. Change in mineral soils is estimated based on repeated soil sampling in combination with pedotransfer functions. In organic soils the changes are based on country specific emission factors.
United Kingdom	Statistics of CL, GL and SL in 1990, 1998 and 2007 come from the Broad Habitat areas reported for each country (England, Scotland, Wales and Northern Ireland) in the Countryside Surveys. A dynamic model of carbon stock change is used with the land use change matrix to estimate soil C stock changes due to land use change.

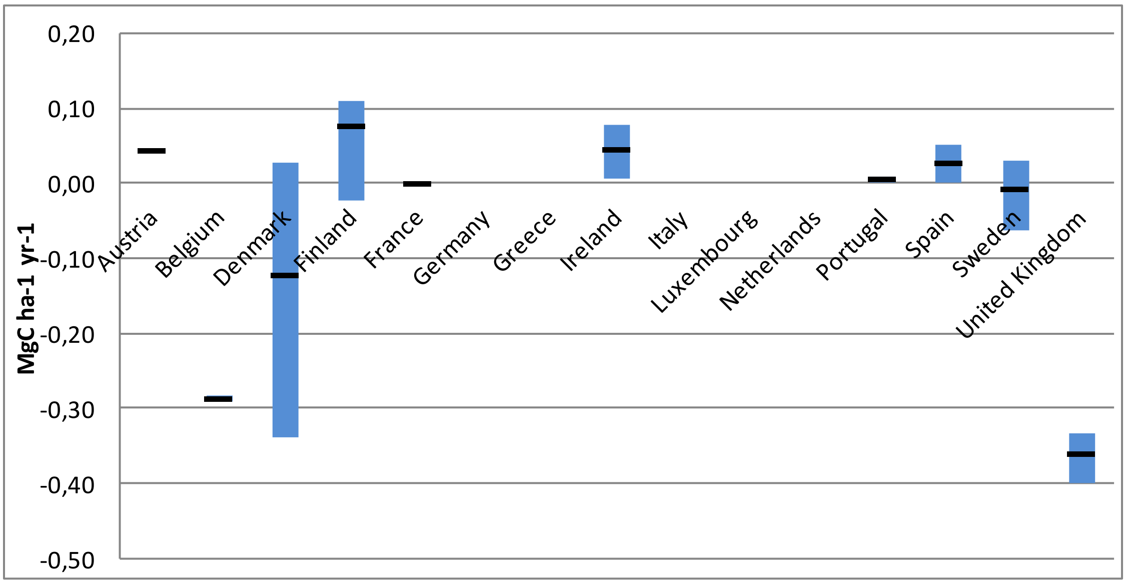
**IACS - Integrated Administrative Control System for EU subsidy payment scheme*

C stock change factors for *living biomass* of permanent crops vary within a very narrow range, depending by the types of crops and management across Europe, from North (i.e. bush-type currant crops) to South (i.e. olives crops and agro-forestry systems). At EU-15 level MS values ranging from -0.11 to 0.10. Usually a source in this category is associated with a decrease of area (e.g. since 1995, Austria, for some years Denmark and Spain). In few countries, the biomass is assumed at equilibrium reported by notation keys (e.g. Germany, Ireland), or is not estimated (by Netherlands).

For the estimation of C stock changes in *mineral soils*, most MS apply IPCC default method and Tier 1 or 2 for emission factors, while few MS report using Tier 3 methodology based on models (e.g. C-tool by Denmark and ICBM by Sweden). Reference C stock (t C ha^{-1}) in mineral soils varies between MS (Figure 7.8). Actually, Tier 2 may consist of country specific reference C stock and IPCC default factors for tillage/management factor (F_{MG}), land use factor (F_{LU}) and organic material input factor (F_I). In some cases IPCC default factors have been slightly modified to adapt them; but changes rely more on expert judgment than on a statistical analysis of measurements. There is one exception, Austria which derived own factors by close comparison with IPCC similar strata.

Overall, the mineral soils are reported as small sources, with implied carbon stock changes factors reported by MS from -0.39 to 0.11 (Figure 7.8).

Figure 7.8 Implied C stock change factor in SOC mineral soils in 5B1 (Mg C ha-[1] yr-1).



On an area basis, the largest sink values are reported by Belgium, Denmark and UK.

Organic soils under cropland are mostly reported applying Tier 1 or Tier 2 when country-specific emission factors are used (e.g. Finland, Sweden). Ireland reports that there are no annual crops on organic soils (see NIR 2014 for more info). Some countries developed a set of EF stratified by type of crops or soil status (e.g. Denmark on soil management type). Emission factors range from -11 (Denmark and Germany) to some -1.9 Mg C ha-1 y-1 (UK). An overview on the organic soils in EU-15 is provided in Chapter 7.6.

7.3.3 Land converted to cropland (CRF 5B2)

7.3.3.1 Overview of Land converted to cropland

Area reported under "land converted to cropland" decreased by 30% since 1990 (Table 7.27). Overall, the area under conversions is 10 % of total cropland area and represents 51% of total annual emissions from cropland. Largest conversions occur from grassland (91% of total area under conversion) and 4% from forest land, wetlands and settlememnts (i.e. conversion from settlement are mainly reported by France). Together UK, France and Germany report 80% of total area of land converted to cropland, mostly associated with cultural rotation of crops and grasses on same land.

Table 7.27 Trend of activity data in subcategory 5B2 - Land converted to cropland – in EU-15 MS (kha) (na- if time series reported starts after 1990)

Member State	1990	1995	2000	2005	2012	Difference 2012 to 1990
Austria	41	40	38	38	51	25%
Belgium	11	39	66	94	151	1272%
Denmark	1	5	9	19	77	8807%
Finland	77	68	73	102	116	52%
France	2.380	3.449	4.107	3.824	4.446	87%
Germany	1.038	1.038	1.038	1.031	1.247	20%
Greece	0	0	0	0	0	3255%
Ireland	NO	17	27	66	144	na
Italy	136	220	84	84	50	-63%
Luxembourg	8	8	8	8	7	-18%
Netherlands	14	86	157	224	314	2091%
Portugal	528	365	270	230	219	-58%
Spain	51	305	559	597	494	872%
Sweden	25	42	51	66	69	177%
United Kingdom	2.287	2.404	2.396	1.894	1.218	-47%
EU15	**6.598**	**8.085**	**8.886**	**8.276**	**8.603**	**30%**

Emissions decreased by 11% since 1990 (Table 7.28). In 2012, as well as in 1990, the largest emissions are reported by France.

Table 7.28 5B2 Land converted to cropland: MS' contributions to net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
Austria	199	179	182	0,4%	3	1%	-17	-9%
Belgium	113	922	944	2%	22	2%	832	737%
Denmark	10	-37	-70	-0,2%	-33	89%	-81	-782%
Finland	628	1.346	1.296	3%	-50	-4%	668	107%
France	12.445	21.561	22.184	55%	623	3%	9.739	78%
Germany	6.351	6.634	6.784	17%	150	2%	433	7%
Greece	0,1	0,4	0,3	0,001%	-0,1	-14%	0,3	369%
Ireland	NO	326	378	1%	51	16%	378	-
Italy	534	263	197	0,5%	-66	-25%	-337	-63%
Luxembourg	40	13	14	0,03%	1	4%	-26	-65%
Netherlands	158	1.215	1.251	3%	36	3%	1.093	693%
Portugal	4.313	796	793	2%	-3	-0,3%	-3.520	-82%
Spain	-38	1.680	1.538	-	-	-	-	-
Sweden	149	221	141	0,3%	-80	-36%	-8	-5%
United Kingdom	11.643	5.543	5.023	12%	-520	-9%	-6.620	-57%
EU-15	**36.544**	**40.663**	**40.655**	**100,0%**	**-8**	**0%**	**4.110**	**11%**

7.3.3.2 Methodological issues for Land converted to cropland

IPCC default methodology, with default EF or country specific EF, are generally used in estimating and reporting C stock changes. Data sources used by MS for estimating C stock changes are shown in Table 7.29

Table 7.29 Background information on C stock change estimation data and methodology for subcategory 5B2

Member State	Description
Austria	FL conversion from/to data from NFI and CL from /to GL from IACS data base. Estimates of living biomass are based on country specific factors. Soils C stock change is estimated by reference C stocks on regions, different land uses and a default transition period of 20 years.
Belgium	Activity data derived from countrywide NFI grid. Estimates of living biomass only for conversion from forest. SOC is computed based on regional reference C stock values.
Denmark	Data derived from aerial photo in 1990 and 2005, combined with data in LPIS and other statistics. It is further stratified with the soil map in both mineral and organic soils & cropland and grasslands (further broken down for: annual crops, set-a-side, grass in rotation and permanent grassland). No conversion from forest to cropland. SOC is modeled.
Finland	Data from NFI. Woody biomass and DOM data are also from NFI (in conversion from GL). Mineral soils C stock change is estimated by Yasso07 (in conversion from forest) and, for other conversions, computed based on default C stocks, assuming 20 years transition period.
France	Activity data from land systematic use/cover survey. Emissions from conversion from forests are estimated based on biomass, DOM and SOC NFI data. Emission from mineral soils is estimated based on country specific national reference values.
Germany	Activity data derived from "wall-to-wall" methodology. Emissions are estimated based on country specific data (spatially explicit and disaggregated at soil association unit level).
Greece	For conversion from forests, data was provided by local forest service offices and derived from national statistics for other conversions. Tier 1 data for all other conversions.
Ireland	GIS based LPIS* database. SOC emissions are estimated based on a Tier 1 methodology.
Italy	Conversion result from the land use change matrix constructed national land use statistics, annual effective conversions derived under a hierarchy of expert judgment assumptions on well-known patterns of land-use changes in the country. Conversions from forest are from administrative records at regional level collected by National Institute of Statistics. SOC estimated based on country specific papers.
Luxemburg	Calculation of annual change in carbon stocks of living biomass of land converted to cropland follows Tier 1 method with default C stock change factors.
Netherlands	The activity data is derived from "wall to wall database" and soil maps. Digitized soil maps are combined with soil profile details for 1990, 2004 and 2009, then extrapolated. National average data of C stock is from a large database of soil samples from farmers.
Portugal	Area based on NFI data. Data. Soil C stock change is based on country specific data base (from national grid).
Spain	There are no detected conversions to croplands (reported as NO).
Sweden	Activity data is provided by successive NFIs. Biomass data for conversion from forests is given by NFI. For C stock change in soils it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Land use change data is derived from countries statistics from three consecutive Countryside Surveys (1990, 1998 and 2007), extrapolated to 2012 and the areas of land use change from Forest come from Forestry Commission data, the Department for Communities and Local Government and the Countryside Survey dataset. Changes in biomass and SOC due to land use change depends on a matrix of change based on repeated land surveys, linked to a dynamic model of carbon stock change and a database of soil carbon density for the UK.

Member State	Description
Austria	FL conversion from/to data from NFI and CL from /to GL from IACS data base. Estimates of living biomass are based on country specific factors. Soils C stock change is estimated by reference C stocks on regions, different land uses and a default transition period of 20 years.
Belgium	Activity data derived from countrywide NFI grid. Estimates of living biomass only for conversion from forest. SOC is computed based on regional reference C stock values.
Denmark	Data derived from aerial photo in 1990 and 2005, combined with data in LPIS and other statistics. It is further stratified with the soil map in both mineral and organic soils & cropland and grasslands (further broken down for: annual crops, set-a-side, grass in rotation and permanent grassland). No conversion from forest to cropland. SOC is modeled.
Finland	Data from NFI. Woody biomass and DOM data are also from NFI (in conversion from GL). Mineral soils C stock change is estimated by Yasso07 (in conversion from forest) and, for other conversions, computed based on default C stocks, assuming 20 years transition period.
France	Activity data from land systematic use/cover survey. Emissions from conversion from forests are estimated based on biomass, DOM and SOC NFI data. Emission from mineral soils is estimated based on country specific national reference values.
Germany	Activity data derived from "wall-to-wall" methodology. Emissions are estimated based on country specific data (spatially explicit and disaggregated at soil association unit level).
Greece	For conversion from forests, data was provided by local forest service offices and derived from national statistics for other conversions. Tier 1 data for all other conversions.
Ireland	GIS based LPIS* database. SOC emissions are estimated based on a Tier 1 methodology.
Italy	Conversion result from the land use change matrix constructed national land use statistics, annual effective conversions derived under a hierarchy of expert judgment assumptions on well-known patterns of land-use changes in the country. Conversions from forest are from administrative records at regional level collected by National Institute of Statistics. SOC estimated based on country specific papers.
Luxemburg	Calculation of annual change in carbon stocks of living biomass of land converted to cropland follows Tier 1 method with default C stock change factors.
Netherlands	The activity data is derived from "wall to wall database" and soil maps. Digitized soil maps are combined with soil profile details for 1990, 2004 and 2009, then extrapolated. National average data of C stock is from a large database of soil samples from farmers.
Portugal	Area based on NFI data. Data. Soil C stock change is based on country specific data base (from national grid).
Spain	There are no detected conversions to croplands (reported as NO).
Sweden	Activity data is provided by successive NFIs. Biomass data for conversion from forests is given by NFI. For C stock change in soils it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Land use change data is derived from countries statistics from three consecutive Countryside Surveys (1990, 1998 and 2007), extrapolated to 2012 and the areas of land use change from Forest come from Forestry Commission data, the Department for Communities and Local Government and the Countryside Survey dataset. Changes in biomass and SOC due to land use change depends on a matrix of change based on repeated land surveys, linked to a dynamic model of carbon stock change and a database of soil carbon density for the UK.

** LPIS – Land Parcel Information System (used by MS to implement the Common Agricultural Policy of the EU).*

Generally it is assumed that the entire C stock loss in LB, DW and LT occurs in the year of conversion, while for SOC it is reported over a transition period of, usually, 20 years.

7.4 Grassland (CRF 5C)

7.4.1 Overview of Grassland (CRF 5C)

According to MS submissions, in 2012 the total grassland area was 70.403 kha or 21% of total reported land area of EU-15. The largest area of grasslands is in France (14,309 kha) and United Kingdom (13.738 kha).

7.4.2 Grassland remaining grassland (CRF 5C1)

7.4.2.1 Overview of grassland remaining grassland

In 2012, the area reported under this land subcategory is 12% less compared to 1990 (Table 7.30)

Table 7.30 Trend of activity data in “grassland remaining grassland” subcategory in EU-15 MS (kha, 1990-2012)

Member State	1990	1995	2000	2005	2012	Difference 2012 to 1990
Austria	1.944	1.924	1.906	1.791	1.733	-11%
Belgium	747	704	661	617	540	-28%
Denmark	399	382	364	341	260	-35%
Finland	186	174	175	183	183	-1%
France	13.809	12.218	11.216	11.260	10.557	-24%
Germany	7.201	6.964	6.726	6.452	5.723	-21%
Greece	4.796	4.795	4.793	4.790	4.791	0%
Ireland	4.414	4.367	4.332	4.269	4.165	-6%
Italy	8.566	7.985	7.592	7.488	7.080	-17%
Luxembourg	79	79	78	75	61	-23%
Netherlands	1.485	1.372	1.259	1.146	992	-33%
Portugal	173	205	181	232	380	120%
Spain	12.604	12.185	11.794	11.608	11.637	-8%
Sweden	481	452	432	411	388	-19%
United Kingdom	11.732	11.310	11.062	11.484	12.013	2%
EU15	**68.617**	**65.116**	**62.572**	**62.147**	**60.502**	**-12%**

Category 5C1 was a net source of CO_2, with an amount of emissions in 2012 39% smaller than in 1990 and slightly higher than in 2011 (Table 7.31).

Table 7.31 5C1 Grassland remaining Grassland: MS' contributions to net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
Austria	0,4	2	2	0,01%	-0,002	-0,1%	1	310%
Belgium	680	397	351	2%	-45	-11%	-329	-48%
Denmark	162	240	426	3%	186	77%	264	163%
Finland	875	344	341	2%	-3	-1%	-533	-61%
France	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Germany	12.352	10.530	10.388	74%	-143	-1%	-1.964	-16%
Greece	0,2	0,1	0,4	0,003%	0,3	467%	0,2	101%
Ireland	600	341	303	2%	-38	-11%	-297	-50%
Italy	5.603	1.600	2.849	20%	1.249	78%	-2.754	-49%
Luxembourg	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Netherlands	4.249	4.249	4.249	30%	0	0%	0	0%
Portugal	IE,NO	-247	-270	-2%	-22	9%	-270	-
Spain	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Sweden	-370	-53	-40	-0,3%	14	-26%	330	-89%
United Kingdom	-993	-4.308	-4.523	-32%	-215	5%	-3.530	356%
EU-15	**23.160**	**13.096**	**14.078**	**100,0%**	**983**	**8%**	**-9.082**	**-39%**

The largest contributor is Germany and it is a net source, while UK reports an increasing sink. Some MS report notation keys (i.e. France reports no change in all pools based on country specific datasets), while several MS report no change under Tier 1 for biomass. The C stock change in mineral soils on grassland is reported as not estimated by some half of the MS (e.g. Italy, Spain) or demonstrated as being nil. Few MS report the existence of unmanaged grassland (e.g. Ireland, France).

7.4.2.2 Methodological issues for Grassland remaining Grassland

Definitions available in MS' NIRs show good match with the IPCC land use definition, despite different eco-regions and management approaches across the EU (Table 7.32)

Table 7.32 Definition and description of grassland

Member State	Description
Austria	Meadow s cut once/tw ice/several times, cultivated pastures, litter meadow s, rough pastures, alpine meadow s and pastures and abandoned grassland.
Belgium	Rangelands and pasture land that is not considered under cropland. It also includes systems w ith vegetation that fall below the threshold of forest land category and are not expected to exceed it, w ithout human intervention.
Denmark	Land defined as grazing land under LPIS, heath land w hich may or may not be used for sheep grazing, as w ell as all other areas not meeting the definitions of forest land. The area of grassland is divided in “grazing land” and “other grassland”.
Finland	Grassland includes area of grass cover (for more than 5 years), ditches associated w ith agricultural land and abandoned arable land. Abandoned arable land in this context means fields w hich are not used any more for agricultural production and w here natural reforestation is possible or is already going on.
France	Land covered by natural and seeded herbaceous for more than 5 years. Includes areas covered trees and bushes being under the forest definition or not included under land category.
Germany	Meadow and pasture areas that cannot be considered cropland. Includes land covered w ith trees and shrubs that does not fall w ithin the definition of "forest", as w ell as natural grassland and recreational areas.
Greece	Rangeland and pasture w ith vegetation that falls below the threshold of national forest definition and are not expected to exceed that w ithout human intervention. Pastures that have been fertilized or sow n are considered as cropland.
Ireland	Improved grassland (pasture and areas used for the harvesting of hay and silage) and unimproved grassland (rough grazing) in use as recorded by annual statistics.
Italy	Grazing lands, forage crops, permanent pastures, and set-aside lands since 1970, all shrub lands (data derived from NFI) and other w oodlands that don't fulfill forest definition.
Luxemburg	All grasslands that are not considered as cropland including systems w ith vegetation or tree cover below forest threshold, natural grassland, recreational areas as w ell as agricultural systems. It includes one cut meadow s; tw o and more cut meadow s, cultivated pastures, litter meadow s, rough pastures and pastures and abandoned grassland.
Netherlands	Any type of terrain w hich is predominantly covered by grass. Rangeland and pasture land is the land that is not considered croplands. It also includes all orchards (w ith standard fruit trees, dw arf varieties or shrubs) and the vegetation that falls below the threshold used in the forest land category and are not expected to exceed, w ithout human intervention, the threshold used in the forest land category. The category includes: “Grasslands” - areas predominantly covered by grass vegetation (w hether natural, recreational or cultivated) and “Nature” - natural areas (excluding grassland) consisting in heath land, peat moors and other nature areas, w ith many of them having occasional tree as part of the typical vegetation structure.
Portugal	Lands covered by permanent herbaceous cover.
Spain	Pasture land, including grazing land not included in cropland. It includes also pastures and meadow s in the dehesa (forested pasture) that do not comply w ith the definition of forest.
Sw eden	Agricultural land that is not regularly tilled. All grasslands are assumed managed.
United Kingdom	Area classified as follow ing broad habitats: improved grassland, natural grassland, calcareous grassland, acid grassland, bracken, dw arf shrub heath, fen/marsh/sw amp, bogs and mountains.

Distinghuishing among grassland and cropland is challenging because of cultural systems with rotation of crops and grasses (indeed conversions of cropland to grassland and grassland to cropland cover more that 60 % of the total area of EU15 reported), for this reason several data sources are usually used. (Low tiers data and methods are usually used for reporting emissions and removals for this land use category (Table 7.33)

Table 7.33 Background information on C stock change estimation data and methodology for subcategory 5C1

Member State	Description
Austria	Activity data is compiled from Statistic Austria (based on IACS). Biomass is assumed neutral. SOC is estimated w ith Tier 2 based on national reference C stock and C stock change factors. Emission from organic soils w as estimated based on area from soil inventories and Austrian Soil Information System and the IPCC default emission factors.
Belgium	Activity data is derived based on landscape units distribution generated by the topological intersection of Corine Land Cover (CLC1990) geo-dataset and digitized Soil Association map of Tavernier et al. (1972). Biomass is not estimated. SOC change is estimated based on a number of heterogeneous databases and modeling efforts.
Denmark	Grassland area is obtained by LPIS, w ith potential area reported under cropland. SOC is modeled based on country specific data. Living biomass is only estimated for conversions from "grazing land" to/from "Other grassland".
Finland	Area estimate of grasslands w as derived from national statistics (Farm statistics) and NFI data. C stock change in the biomass is not estimated. IPCC default soil C stocks for high activity and sandy grassland soils for w et temperate climate w ere used together w ith the default carbon stock change factors. For organic soils, both activity data and emission factor are country specific.
France	Data derived from a grid based land assessment system for all land categories. Resulting matrix also classifies managed and unmanaged grasslands. For biomass, the C stock change is estimated only for w oody biomass, w ith tree data from NFI. All other pools are considered in equilibrium.
Germany	Integrated "w all to w all" system for land and land conversion classification, mapping and ranking in time. The approach allow s for estimating the area of organic soils and their land use. Biomass C stock change is estimated based on country specific datasets for w oody and non-w oody land uses w ithin the category. SOC stock change is considered based on national datasets and research only for the conversions w ithin the category.
Greece	The area is provided by agricultural statistics. No change in biomass. Aboveground grass and tree biomass are only considered for estimating emissions in case of w ildfires. DOM and SOC are assumed to be neutral.
Ireland	Central Statistic Office's statistics on improved grassland (pastures and areas harvested for silage and hay) and unimproved grassland, in use for agricultural purposes. The IPCC soil types on land use categories are derived by GIS LPIS analysis of superimposition of CLC 1990 w ith General Soil Association Map of Ireland (w ith peat areas entirely classified under w etlands). No biomass C stock change assumed under static management practices. For SOC, the IPCC default values are used to establish the reference C stocks, and they are corrected for by using FLU, FMG and FI default factors to account for land use and farming practices. On organic soils, emissions are estimated using w ith the IPCC default factor.
Italy	National land use statistics is available. Grassland includes grazing land and other w ooded land. For Grazing land a Tier 1 methodology is used, therefore, no change in carbon stocks in the biomass, SOC and DOM pools is assumed. For "other w ooded land (i.e. shrub lands) C stock changes in biomass is modeled and change in DOM is estimated by linear relation against aboveground carbon. SOM is neutral.
Luxemburg	Assumed neutral.
Netherlands	The activity data is derived from "w all to w all" land use database and soil maps.
	C stock change in Living biomass and SOM is assumed neutral. Country specific method is used to estimate emissions from the drainage of organic soils.
Portugal	Area data Area data is given by Corine Land Cover maps (1990, 2006), nationw ide NFI grid data and agricultural statistics. SOC data is country specific.
Spain	The activity data is obtained from CLC 1990 and 2006, and Forest Maps of Spain (to exclude forest areas), survey of yields and crop areas (1990-2003) and annual statistics of agriculture ministry (2004-2012). SOC change is estimated based on country specific data.
Sw eden	All data is provided by the nationw ide NFI. On organic soils country specific annual heterotrophic respiration is available. For C stock change in soils and DOM, it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Non-spatially-explicit land use land use data is provided from countries statistics, namely areas of CL, GL and SL in 1990, 1998 and 2007 come as Broad Habitat proxy reported for each country (England, Scotland, Wales and Northern Ireland) in the Countryside Surveys. A dynamic model of carbon stock change is used w ith the land use change matrices to estimate soil C stock changes due to any land use change.

7.4.3 Land converted to grassland (CRF 5C2)

7.4.3.1 Overview of Land converted to grassland

The area of land converted to grassland represents some 14% in the EU-15 of total grassland area, and it increased by 58% compared to 1990 (Table 7.34). From total area in conversions to grassland, 82% was from cropland, 10% from forest land and 5% from settlements (i.e. in the case of conversions from Setllements, data are mainly reported by France, UK and Germany). 5C2 is a sink which in absolute value is some 50% larger than the souce from 5C1. The highest share of conversion to grassland was reported by France, Italy and UK, mainly from cropland.

Table 7.34 Trend of activity data in the "land converted to grassland" subcategory 5C2 in EU-15's MS (kha, 1990-2012) (na- if time series reported starts after 1990)

Member State	1990	1995	2000	2005	2012	Difference 2012 to 1990
Austria	49	53	51	52	57	17%
Belgium	8	28	48	68	124	1456%
Denmark	2	12	21	30	51	2544%
Finland	98	84	85	85	84	-14%
France	2.872	4.052	4.667	4.233	3.752	31%
Germany	387	387	387	399	366	-5%
Greece	0	33	74	112	344	na
Ireland	19	22	35	88	170	818%
Italy	325	292	594	777	1.839	466%
Luxembourg	16	16	16	15	12	-27%
Netherlands	16	93	171	256	354	2180%
Portugal	370	529	538	471	292	-21%
Spain	58	351	643	713	637	990%
Sweden	26	39	59	74	92	252%
United Kingdom	2.026	2.268	2.414	2.176	1.726	-15%
EU15	**6.271**	**8.259**	**9.803**	**9.549**	**9.901**	**58%**

In contrast to 5C1, 5C2 is a sink of 19.894 Gg CO_2 in 2012. The sink increased by 60% compared to 1990 and slightly decreased compared to 2011. The highest removals are reported by Italy, France and United Kingdom (Table 7.35)

Table 7.35 5C2 Land converted to Grassland: MS' contributions to the net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
Austria	321	42	40	-0,2%	-2	-5%	-282	-88%
Belgium	74	-505	-539	3%	-34	7%	-613	-832%
Denmark	21	37	127	-1%	90	241%	106	498%
Finland	-118	-23	-10	0,05%	13	-57%	108	-92%
France	-8.893	-11.844	-11.910	60%	-66	1%	-3.017	34%
Germany	-729	-291	-270	1%	21	-7%	459	-63%
Greece	0	-834	-917	5%	-83,41	10%	-917	-3165518%
Ireland	-106	-268	-355	2%	-87	32%	-249	234%
Italy	-1.275	-4.653	-4.653	23%	0	0	-3.378	265%
Luxembourg	32	-49	-45	0,2%	4	-7%	-77	-243%
Netherlands	198	-70	-40	0,2%	30	-43%	-237	-120%
Portugal	2.943	601	535	-3%	-66	-11%	-2.408	-82%
Spain	-19	852	996	-5%	144	17%	1.015	-5463%
Sweden	446	247	325	-2%	78	32%	-120	-27%
United Kingdom	-5.299	-3.418	-3.179	16%	239	-7%	2.120	-40%
EU-15	**-12.404**	**-20.175**	**-19.894**	**100,0%**	**281**	**-1%**	**-7.490**	**60%**

7.4.3.2 Methodological issues for Land converted to grassland

The methods and datasources for estimating CO_2 removals and emissions from this land subcategory are fully consistent with those used for 5B1, both for activity data and C stock changes in pools.

For lands converted to grassland, the highest C stock change reported is related to the living biomass in conversions from forest land. The change in SOC varies between a -1.14 by to an increase of 1.70 Mg C ha-1 yr-1 by Belgium.

7.5 Wetlands, Settlements and Other land

7.5.1 Wetlands (CRF 5D)

In the EU-15, the Wetlands (5D) area is 19,383 kha or 6% of total EU-15 land reported in 2012. Largest areas have been reported in Finland and Sweden. At EU-15 level, 5D1 is a source of 2.592 Gg CO_2 and 5D2 was estimated as a sink of 319 Gg CO_2. Under Wetland remaining wetland MS mostly report emissions from peat extraction. For lands under conversion to WL, C stock change in soil pool is always computed. The land included under this category has different definitions among MS (Table 7.36)

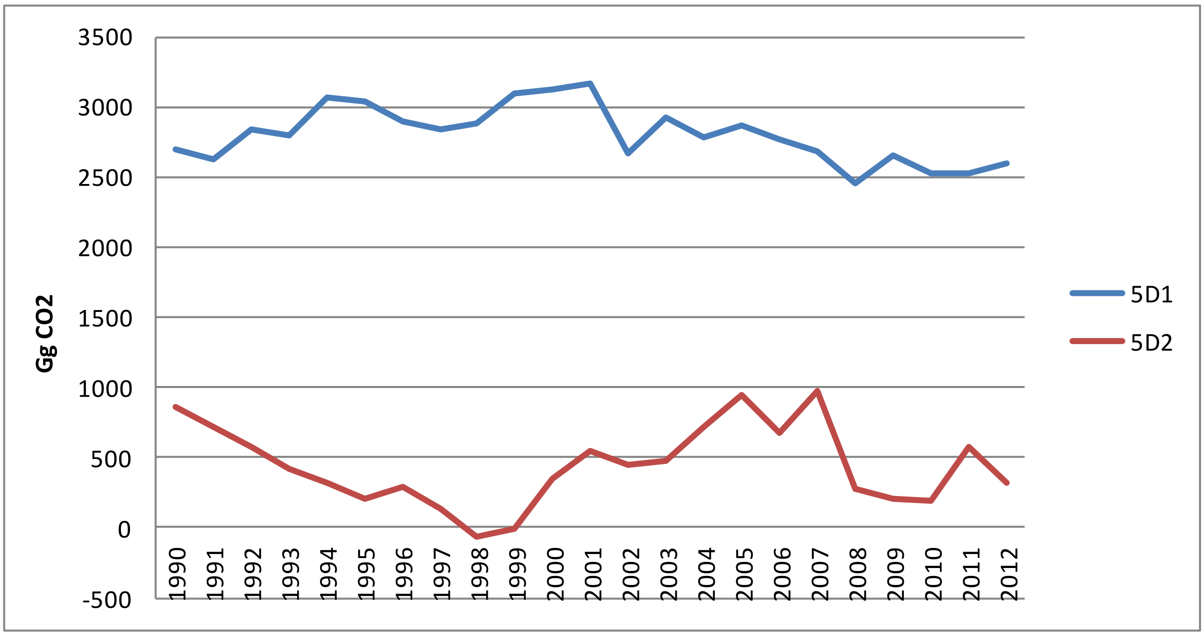
Table 7.36 Definitions of land included by MS under the category 5D Wetlands

Member State	Description and supplementary elements for land classification
Austria	Rivers, lakes, mires and peat areas (protected areas, in general) as classified by national statistical system.
Belgium	Land covered or saturated by w ater for all or part of the year (e.g. peatland) and that does not fall into the other land category. It includes reservoirs as a managed subdivision and natural rivers and lakes as unmanaged subdivisions.
Denmark	Permanent w etlands, w etlands for peat extraction and re-established anthropogenic w etlands. Several subdivisions may be distinguished: unmanaged fully w ater covered w etlands (lakes and rivers); unmanaged partly w ater covered w etlands (fens and bogs); managed drained land for peat extraction; managed partly w ater covered w etlands (re-established w etlands on primarily former cropland and grassland).
Finland	Inland w aters (reservoirs, natural lakes and rivers), peat extraction areas and peatlands w hich do not fulfill the definition of other land uses.
Germany	Reporting in the w etlands category primarily covers emissions from organic soils that are released during peat extraction, covering: CO2 losses from extraction areas, and during extraction and spreading of peat. Also, it includes (but they are not estimated) the few non-drained semi-natural bogs that have been largely free of anthropogenic impacts, flooded lands, w ater-storage facilities (dams, reservoirs, etc.) and settling basins that are used for energy production, irrigation, shipping and recreation, and that are flooded or drained, or that otherw ise have large w ater-level fluctuations.
Greece	Land that is covered or saturated by w ater for all or the greatest part of the year (e.g. lakes, reservoirs, marshes), river bed (including torrent beds) and that does not fall into the forest land, cropland, grassland or settlements categories.
France	Lands covered or saturated by w ater all year long or part of it.
Ireland	Natural unexploited w etlands and areas commercially exploited for public and private extraction of peat and areas used for domestic harvesting of peat.
Italy	Lands covered or saturated by w ater, for all or part of the year, harmonized w ith the definitions of the Ramsar Convention on Wetlands.
Luxemburg	Land that is covered or saturated by w ater for all or part of the year (e.g. peat land, reservoirs) and that does not fall into other categories.
Netherland	Land covered or saturated w ith w ater for all or part of the year and does not fall into the other land category. It includes reservoirs as a managed sub-division and natural lakes and rivers as unmanaged, including natural open w ater in rivers, but also man-made open w ater in channels, ditches and artificial lakes.
Portugal	Inland w etlands, coastal w etlands, salt marshes, saline and intertidal flats.
Spain	Includes the lands covered or saturated by w ater all year long or part of it.
Sw eden	Wetlands is assumed unmanaged (mires and areas saturated by fresh w ater) and managed (cca 10 000 ha used for peat extraction).
UK	Includes sites currently registered for commercial extraction w here extraction activity is visible on recent aerial/ satellite photographs or by field visits.

In 2012, the areas under conversion to wetlands (5D2) represent only 5% of total wetlands area, with an absolute value of 895 kha in 2012. This category is often subject to conversions to natural water regime and wetlands, in general established in areas of organic soils on grasslands. For 2012 the higher share of land under conversion is reported from forest land (28%) and grassland (32%), in addition 10% is reported as converions from settlement, mainly reported by France and Germany and 18% from other lands. Area of conversion to wetlands is reported as more than doubled since 1990, with the highest contribution of Sweden (area increased by 7 times since 1990).

Permanent wetlands are considered unmanaged by some MS (e.g. France, Portugal), but other report it as sources because of activities associated to conversion to wetlands (e.g. Finland, Sweden). Overall, the CO_2 emissions from Wetlands (5D) have decreased by 18% since 1990 (Figure 7.9)

Figure 7.9 CO_2 emissions (Gg) from Wetlands remaining wetlands (5D1) and Lands converted to wetlands (5D2)



Emissions of CH_4 and N_2O from peat extraction activities (i.e. Finland, Denmark) are reported under Table 5(II), and these include emissions from active and temporarily set-aside peat extraction fields and abandoned non-vegetated peat extraction areas. The IEF N_2O-N per area drained (kg N_2O-Nha-1) varies from 0.17 (Denmark) to 1.6 (Finland). In general, in case of land use change to water bodies, all MS use final reference carbon stock of 0 Mg C ha-^{1}, so all C from the previous land use is considered emitted, as lost within 5 years from the conversion. Finland developed regional weather-dependent emission factors following the statistical relationship between CO_2 evolution with soil temperature at a depth of 5 cm and the position of the water table.

7.5.2 Settlements (CRF 5E)

In EU-15, the total reported settlements (5E) area in 2012 is 21.090 kha, 26% of which being under conversion. Definitions of lands included under this category vary across EU-15 MS (Table 7.37). All countries report increasing areas of settlements compared to 1990. For lands under conversion, in order of relevance, the conversion from cropland is 46% of area, grassland is 36% of area and from forest land is 16% of area.

Table 7.37 Definitions of land reported by MS under land category 5E Settlements

Member State	Descriptions and supplementary information for land classification
Austria	Includes buildings land: sealed, partly sealed and unsealed areas; parks and gardens; roads and railw ay tracks; excavation areas, and other not further differentiated settlement area.
Belgium	All developed land, including transportation infrastructure and human settlements of any size (i.e. including road sides) unless they are already included under other categories.
Denmark	Urban cores, industrial areas, roads, high and low buildup areas. Low build-up areas are characterized as single-family houses surrounded by gardens, graveyards, sports facilities, etc (estimates are reported only for low build-up areas).
Finland	Combined area of NFI built-up land, traffic lines and pow er lines. Includes parks, yards, farm roads and barns.
France	Artificialized land (settlements, parks, roads and infrastructure, etc.).
Germany	Open settlement and transport areas.
Greece	Developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other land-use categories.
Ireland	Urban areas, roads, airports and the footprint of industrial commercial/institutional and residential buildings.
Italy	Artificial surfaces, transportation infrastructures (urban and rural), pow er lines and human settlements of any size, comprising also parks.
Luxemburg	Developed land, including transportation and any size of human settlement unless already included under other category.
Netherlands	Developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories.
Portugal	Artificial areas such as urban, industrial, commerce and transport units, mines, dump and construction sites and artificial non-agricultural vegetated areas.
Spain	All developed land, transport infrastructure and establishments of any size, unless they are included in other categories.
Sw eden	Infrastructure such as roads and railw ays, pow er lines, municipality areas, gardens and gravel pits.
UK	Covers urban and rural settlements, farm buildings, caravan parks and other man-made built structures such as industrial estates, retail parks, w aste and derelict ground, urban parkland and urban transport infrastructure. It also includes domestic gardens and allotments, linearly arranged landscape features such as hedgerow s, w alls, stone and earth banks, grass strips and dry ditches.

Annual emissions from conversions to settlements (5E2) have increased by 56% since 1990 (Table 7.38)

Table 7.38 5E2 Land converted to Settlements: MS' contributions to the net CO_2 emissions (CRF table 5)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
Austria	184	92	88	0,2%	-4	-5%	-96	-52%
Belgium	248	585	579	1%	-7	-1%	331	133%
Denmark	13	52	91	0,2%	39	76%	78	603%
Finland	929	1.069	906	2%	-163	-15%	-23	-2%
France	6.738	14.013	13.876	35%	-137	-1%	7.139	106%
Germany	953	2.345	2.517	6%	172	7%	1.564	164%
Greece	6	12	25	0,1%	12	96%	18	284%
Ireland	78	56	256	1%	201	361%	179	229%
Italy	6.996	7.768	7.774	20%	6	0,1%	778	11%
Luxembourg	139	74	71	0,2%	-3	-4%	-67	-49%
Netherlands	459	1.103	1.126	3%	23	2%	667	145%
Portugal	38	2.276	2.356	6%	80	4%	2.317	6086%
Spain	412	1.126	1.139	3%	13	1%	728	177%
Sweden	2.978	4.537	4.709	12%	172	4%	1.731	58%
United Kingdom	5.078	3.718	3.801	10%	83	2%	-1.277	-25%
EU-15	**25.249**	**38.827**	**39.315**	**100,0%**	**487**	**1%**	**14.066**	**56%**

Reporting is almost complete, in terms of C pools reported,for conversions from major land categories: forest, cropland and grassland.

Conversion from Forest land to Settlements is an important component of the total deforestation, being some 33% of total area reported as deforested and some 16% of total area reported under all conversions to settlements. While conversions to WL and OL may be caused by natural effects, forest conversion to SL is always, by definition, the result of human actions. Generally, the C pools are not uniformly disturbed over the whole area converted (i.e. usually only part of converted area is sealed, trees or upper soils layer is removed) and carbon transfer to DW, LT and SOM pools diminish significantly. Generally, carbon stock changes associated with deforestation are reported by using the IPCC default methodology and country-specific data.

For reporting DOM (DW, LT) it is generally assumed that the entire C stock in DOM pools is instantaneously oxidized in the initial moment of conversion from FL to SL. It is also assumed that there is no dead wood and litter on settlements lands. Emissions are estimated based on per area average C stock of DW and LT determined either at national or regional scale or specific to each deforestation site.

For reporting SOM, different assumptions have been implemented by different MS, generally based on expert judgment or, occasionally, from some scientific studies. For instance, in Sweden C stock in SL is estimated as the weighted average of C stocks in two strata: unsealed and sealed. Unsealed area is usually considered to cover 40-60% of national SL or conversion to SL area (e.g. AT, LU), going down to 2-3% in cities (i.e. BG). Associated C stocks are derived from one of the following options (depending on MS):

- data from measurements in green area of the city (from scientific studies);
- same C stock as under 'GL remaining GL' (assuming that under national circumstances GL is the source of land for settlement's expansion);
- lowest C stock value among the major land categories FL, CL and GL (assuming limited change of C stock in the soil under construction);
- applying a factor against C stock in previous land use (e.g. constant loss of 50% by FR).

7.5.3 Other land (CRF 5F)

The area of category Other land (5F) covers at EU-15 level 11,020 kha in 2012. Definitions implemented to report such lands are close amongst MS and match IPCC general description (Table 7.39). The largest share of "Other land" is reported by Sweden (4.385 kha), Spain (1.167 Kha) and Portugal (1.142 kha).

Table 7.39 Definition for the categorization of lands under 5F - Other land

Member State	Description and supplementary elements for land classification
Austria	Area w ith i) rocks and screes, ii) glaciers and iii) unmanaged alpine dw arf shrub heaths. It is calculated as the difference of total country area and all other land uses, show ing max 2% difference by relevant cadastral data.
Belgium	Bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories.
Denmark	Unmanaged area like moors, fens, beaches, sand dunes, lakes and other areas w ithout human interference.
Finland	Mineral soils on poorly productive forest land, w hich do not fulfill the threshold values for forest, unproductive lands on mineral soils on rocky lands and treeless mountain areas.
France	All lands that do not correspond to a ny other land use categories (e.g.. rock areas).
Germany	Waste and sw aths/aisles, glacier areas, scree slopes and sand bars and other land w hich cannot be allocated under other land categories. "Other land" consists of areas that are neither influenced nor cultivated by people.
Greece	All land areas that do not fall into any of other land-use categories (e.g. rocky areas, bare soil, mine and quarry land).
Luxemburg	This category includes bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories. It allow s the total of identified land areas to match the national area.
Netherlands	Surfaces of bare soil w hich are not included in any other category like: bare sands and the earliest stages of succession from sand in the coastal areas (beaches, dunes and sandy roads) or uncultivated land alongside rivers. It does not include bare areas that emerge from shrinking and expanding w ater surfaces (w hich are included in w etlands).
Ireland	Natural grasslands not in use for agricultural purposes. Water bodies, bare rocks.
Italy	Definition is not available in NIR 2014.
Portugal	Beaches, dunes, sand plains and bare rocks and shrubland.
Spain	Bare soil, rock areas, ice and other areas of land that do not fall into any of the other land category.
Sw eden	Waste land and most of the mountain area in northw est Sw eden. It is assumed unmanaged.
UK	Inland rock, standing w ater and canals and rivers and streams.

Other land category is sometimes also used to report unmanaged land areas. For conversion from forest land, in many cases, the pools for which reporting is not mandatory were omitted by some MS because methods are not available in the IPCC LULUCF GPG (2003). Emissions from 5F2 turned from source to sink since 1990, being in 2012 around 1.317 Gg CO_2-eq.

7.6 Emissions from organic soils in EU-15

At EU-15 level, organic soils on 5A, 5B and 5C cover some 13,612 kha, mostly located in Northern MS. Total emissions from organic soils (under 5A, 5B, 5C) was, in 2012, 71.621 Gg CO_2 which represents 36% of total EU-15 net removals from LULUCF or 22% of Forest land sink in 2012.

The largest area of organic soils is in Finland (~ 6,400 kha), Sweden (~ 4,000 kha), Germany (1,500 kha).Only in few cases the definitions of organic soils are reported in the NIRs (Table 7.40), so presumably other MS apply the FAO definition as suggested in the IPCC GPG LULUCF 2003 .

Table 7.40 Elements to define C pool in organic soils

MS	Definition
Austria	>17% of organic matter in top 30cm of soil
Denmark and Ireland	>20% of organic matter in top 30cm of soil
Finland	Soil is considered to be organic if the soil type is peat. In forest land a site is classified as peatland if the organic layer is peat or if more than 75% of the ground vegetation consists of peatland vegetation. In cropland and grassland >20% of organic matter in top 20 cm of soil
United kingdom	Modeled based on habitat explicit soil C content database assuming 1 m depth (without implementing any threshold between mineral and organic soils)

Area of forest organic soils is mainly estimated using country specific values, while countries having a small share of organic soils within the forest area, report carbon stock changes for this pool by using IPCC default factors. In Finland, organic soils activity data were derived from NFI database and geo-referenced soil database across all land uses. In Germany areas with organic soils is determined via a geo-referencing procedure with overlaying the General soil map of Germany and cadastral data for each type of land use. In Sweden, data is also provided by NFI combined with Swedish Forest Soil Inventory. Emission factors are derived based on continuous monitoring and/or modelling.

Overall, in the EU-15, most of organic soils area is under forest land use, but most of the emissions come from cropland (Table 7.41), since those organic soils are always drained. A decrease, from 1990 to 2012, in emissions is reported for 5A1 where Finland estimates a slightly decreasing of 40% less emission because of the enhanced tree growth is determining a higher amount of litter input to soils of historically drained areas.

Area of organic soils reported under conversion to cropland increases from 1990 to 2012, while area of organic soils of all other categories decreased.

Organic soils in forest lands show the lowest IEF values dues also to the fact that not the entire area of organic soils under forest land is drained.

Table 7.41 Area and average implied C stock change factors in the EU-15 (average across the time period 1990-2012)

Land use subcategory	Area in 2012 (kha)	IEF (MgC ha-1 yr-1)	Net annual C stock change (Gg C)	Share in annual CO2 emissions from Org. soils (5A+5B+5C)	2012 estimate emissions change compared to 1990
5A1	10.448	-0,39	-4.095	21%	-26%
5A2	308	-0,69	-213	1%	-277%
5B1	1.239	-7,5	-9.294	48%	2%
5B2	169	-7,38	-1.246	6%	34%
5C1	1.279	-3,37	-4.307	22%	-12%
5C2	168	-2,25	-379	2%	52%
Total	13.612		-19.533	100%	-5%

Overall, CO_2 emissions at the EU-15 level steady decreased by 5% compared to 1990.

In general in the EU-15 MS, there are still small quantitative inconsistencies in reporting organic soils under 5B1 and 5B2 (or/and 5C1 and 5C2) and Table 4Ds1 regarding organic soils area under cultivation, mainly because of the inconsistent definition of cultivation (which includes both activities on cropland and grassland, but it is interpreted sometimes as only including arable land).

7.7 Other emissions from land uses: Tables 5(I)-5(V)

7.7.1 Direct N_2O emissions from N fertilization sources (CRF Table 5(I))

This source category covers direct N_2O emissions from forest land fertilization by synthetic chemicals. The majority of MS report that there is no fertilization of forest land, with few including it in the emissions reported under the agricultural sector, using appropriate notation keys in the CRF tables (Table 7.42). Only Finland, Sweden and the UK report N_2O emissions under this source category. Sweden actually reports the highest amount of N_2O emissions from N fertilization occasionally applied to increase the wood production in some middle aged or older stands on mineral soils.

Table 7.42 Direct N_2O emissions from N fertilization of Forest land and Other (Gg N_2O)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg	%	Gg	%
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Finland	0,09	0,07	0,05	28%	-0,02	-29%	-0,04	-45%
France	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Germany	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Portugal	IE	IE	IE	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	0,2	0,1	0,1	70%	-0,02	-14%	-0,06	-35%
United Kingdom	0,02	0,003	0,004	3%	0,00	31%	-0,01	-71%
EU-15	**0,3**	**0,2**	**0,2**	**100,0%**	**-0,04**	**-18%**	**-0,11**	**-40%**

For reporting MS activity data result from national or sectoral statistics, either in terms of total amount and type of synthetic fertilizer annually applied (i.e. Finland, Sweden) or as a fixed application rate and total annually fertilized area (i.e. UK). IPCC default emission factor are applied. The IEF of the N_2O-N emissions per unit of fertilizer applied is around 0.01 kg N_2O-N/kg N yr-1.

N_2O emissions are less in 2012 compared to 1990 due to a decrease in the area fertilized. Total EU-15 emissions from fertilization of forests soils in 2012 from this category is 0.17 Gg N_2O, knowing that some important share of such emissions is reported under Chapter 4 Agriculture.

7.7.2 N_2O emissions from drainage of soils (CRF Table 5(II))

This source category covers non–CO_2 GHG, respectively direct N_2O and CH_4 emissions from drainage of soils (CO_2 emissions are reported under the relevant land use category, usually under Wetlands, while indirect N_2O emissions are reported under Chapter 4 Agriculture). Nevertheless, since methodologies are only provided in Appendixes 3a.2 and 3a.3 of the GPG LULUCF 2003, it is not mandatory for Parties to estimate emissions from this source. Accordingly, most countries do not report them also because those emissions are considered negligible (NO or NE), although few transparently report drained area. EU-15 drained area reported by MS is 9% larger compared to 1990 in forest land, reaching 6.519 kha and 12% higher in wetlands reaching 181 kha in 2012. Overall annual N_2O emissions practically did not change much over time summing up 5 Gg N_2O (Table 7.41) and 3 Gg CH_4 in 2012 (Table 7.41), with insignificant changes for individual reporting countries.

Table 7.43 N_2O emissions from drainage of soils (Gg)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg	%	Gg	%
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	0,05	0,04	0,04	1%	-0,00003	-0,1%	-0,01	-23%
Finland	3,92	4,18	4,19	88%	0,01	0,2%	0,3	7%
France	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Germany	0,18	0,21	0,21	4%	0,001	1%	0,03	15%
Greece	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Ireland	0,09	0,13	0,13	3%	0,001	1%	0,04	49%
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	NA,NE	NA,NE	NA,NE	-	-	-	-	-
United Kingdom	0,16	0,18	0,18	4%	0,001	1%	1%	8%
EU-15	**4,41**	**4,74**	**4,74**	**100,0%**	**0,01**	**0,2%**	**0,3**	**8%**

In Denmark and Ireland, N_2O emissions from peatland are estimated based on organic matter's C:N-ratio and default IPCC emission factor of 1.25%, while the activity data is provided by sectoral statistics. In Finland a Tier 2 methodology is used, with directly measured based CS emissions factors for CO_2, N_2O and CH_4, while the activity data (annual area of peatlands with active extraction, set aside peat lands, industrial stocks) are compiled from statistics.

IEF for N_2O emission per area of drained forest land is in average 0.3 kg N_2O-Nha-1 year-1.

Table 7.44` CH_4 emissions from drainage of soils (Gg)

Member State	CH_4 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg	%	Gg	%
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Finland	2	3	3	100%	0,04	1%	1	35%
France	NA	NA	NA	-	-	-	-	-
Germany	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Greece	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Ireland	NA,NE	NA,NE	NA,NE	-	-	-	-	-
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	NA,NE	NA,NE	NA,NE	-	-	-	-	-
United Kingdom	NA,NE	NA,NE	NA,NE	-	-	-	-	-
EU-15	**2**	**3**	**3**	**100,0%**	**0,04**	**1%**	**1**	**35%**

IEF for CH_4 emission per area of drained forest land is in average 0.3 kg CH_4 ha-1 year-1.

7.7.3 N_2O emissions from disturbances associated with conversion to cropland (CRF Table 5(III))

This source category covers direct N_2O emissions from mineral soils under conversion to cropland. Change of land use (usually from forest land, grassland and wetlands) or management, causes SOM C stock losses due to the mineralization of organic matter (so emissions of both CO_2 and N_2O) followed by the stabilization of the C content in soil at a lower level.

At the EU-15 level, land reported under conversions to cropland in table CRF Table 5(III) is 12.356 in 2012, with 96% represented by conversions from grassland. A very small share occurs on organic soils. Most of these conversions occur in France, which reports large areas of conversion from grassland to cropland and UK.

Overall, N_2O emissions are increasing and in 2012 are 33% higher than in 1990 (Table 7.45), with the highest contribution from France and UK.

Table 7.45 N_2O emissions from disturbances associated with land-use conversion to cropland (Gg)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg	%	Gg	%
Austria	0,1	0,1	0,1	1%	0,00	4%	0,02	24%
Belgium	0,03	0,3	0,3	3%	0,02	6%	0,3	1179%
Denmark	0,001	0,001	0,003	0,03%	0,002	209%	0,002	298%
Finland	0,02	0,04	0,04	0,3%	0,00	4%	0,02	78%
France	4	7	7	59%	0,2	3%	4	89%
Germany	1	1	1	11%	0,1	4%	0,3	29%
Greece	0,000003	0,0001	0,0001	0,001%	-0,000004	-4%	0,0001	-
Ireland	NA,NO	0,1	0,1	1%	0,01	13%	0,1	-
Italy	0,2	0,1	0,1	1%	-0,02	-25%	-0,1	-63%
Luxembourg	0,01	0,01	0,01	0,1%	0,00	-2%	0,00	-14%
Netherlands	0,01	0,2	0,3	-	-	-	-	-
Portugal	1	0,2	0,2	2%	0,01	3%	-0,9	-79%
Spain	0,1	1	1	-	-	-	-	-
Sweden	0,1	0,2	0,2	2%	-0,01	-3%	0,1	228%
United Kingdom	2	2	2	15%	-0,1	-5%	-0,6	-26%
EU-15	**9**	**12**	**13**	**100,0%**	**0,2**	**2%**	**4**	**39%**

The methodology used by MS corresponds to Tier 1, the C:N ratio in SOM is either country-specific or the IPCC default. The IEF ranges from 04 to 1 kg N_2O-Nha-1 year-1.

7.7.4 CO_2 emissions from agricultural lime application (CRF Table 5(IV))

This source category covers CO_2 emissions from liming. Liming occurs especially in croplands (87% of applied amount) and on permanent grassland (13%). In the EU-15, annual consumption of lime has decreased by almost 16% since 1990, with a total EU-15 of some 11.720 kt lime applied in 2012. Associated, total EU-15 emissions decreased by 18% since 1990 (Table 7.46).

Table 7.46 CO_2 emissions from agricultural lime application

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg	%	Gg	%
Austria	90	87	87	2%	0	0%	-3	-4%
Belgium	64	51	51	1%	-1	-2%	-14	-21%
Denmark	623	165	192	4%	27	16%	-431	-69%
Finland	618	183	194	4%	11	6%	-424	-69%
France	852	853	951	20%	98	11%	99	12%
Germany	1.276	1.840	1.905	39%	65	4%	630	49%
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	355	361	229	5%	-131	-36%	-126	-35%
Italy	NA,NO	13	10	0,2%	-4	-27%	10	-
Luxembourg	1	5	5	0,1%	0,2	4%	4	758%
Netherlands	183	73	73	2%	0	0%	-110	-60%
Portugal	13	13	13	0,3%	0	0%	0	0%
Spain	83	53	45	-	-	-	-	-
Sweden	170	88	85	2%	-3	-3%	-84	-50%
United Kingdom	1.577	1.033	1.019	21%	-13	-1%	-558	-35%
EU-15	**5.904**	**4.819**	**4.860**	**100,0%**	**42**	**1%**	**-1.044**	**-18%**

The activity data are available from official national or sectoral statistics (e.g. agriculture sectors) or from field studies, sometimes derived by expert judgment (e.g. Austria). All reporting countries rely on IPCC default factor (*EF limestone* =0.120, and *EF dolomite*=0.122). The majority of the MS do not differentiate between dolomite or lime, rather, they use a unique emission factor, as the share of dolomite in total amount applied is small (around 15%). Commercially available products are discounted in terms of water content to only account for the limestone content in the calculations (i.e. Finland).

7.7.5 CO_2, CH_4 & N_2O emissions from Biomass Burning (CRF Table 5(V))

This source category covers CO_2, CH_4 and direct N_2O emissions from biomass burning, as well as emissions of other GHG (NO_X and CO). It includes emissions both from wildfires and controlled burning, on any type of land use (i.e. Forest land, Cropland, Grassland, Wetlands and Settlements). In general, CO_2 emissions from forest fires are reported under 5A Forest land, while CO_2, if counted, for the other land categories and non-CO_2 gases emissions are reported in table 5(V); note that CO_2 emissions from annual living biomass should not to be reported since, for annual biomass, the balance of that gas in a year is 0 (i.e. the uptake from the atmosphere is equivalent to the emissions in the atmosphere.

Controlled burning on managed land is not common practice in the EU-15, with few exceptions (.e.g. Finland, Sweden, UK for forest land and UK, Spain for grassland) for confined areas.

For most of the MS emissions from fires are indeed negligible. Only UK reports fire non-CO_2 emissions from conversion to settlements (in deforested areas). The methodology used to report emissions for fires is always Tier 2 for CO_2 with activity data provided by national statistics and country specific emission factors, whereas Tier 1 data is used for estimation of CH_4 and N_2O emissions.

Overall, emissions from biomass burning decreased compared to 1990. CO_2 emissions from burning biomass are reported as NO or IE, while often CH_4 and N_2O emissions are reported as NE by some MS. Overall, CO_2 emissions have decreased by 17% since 1990 (Table 7.47). The CH_4 emissions decreased by 22% (Table 7.48) and those of N_2O by 17% (Table 7.49), but their trends are related to wildfire incidence, which is characterized by a large inter-annual variability.

Table 7.47 CO_2 emissions from Biomass Burning (in Gg CO_2)

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg	%	Gg	%
Austria	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Belgium	5	68	NO	-	-68	-	-5	-100%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	3	5	1	0,01%	-5	-84%	-3	-75%
France	1.596	425	269	4%	-156	-37%	-1.327	-83%
Germany	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Greece	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Ireland	101	83	21	0,3%	-62	-75%	-80	-79%
Italy	5.330	2.631	4.467	58%	1.837	70%	-863	-16%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	9	11	11	0,1%	0	1%	3	31%
Portugal	1.967	455	1.605	21%	1.150	252%	-362	-18%
Spain	4	61	105	1%	44	73%	102	2796%
Sweden	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
United Kingdom	232	542	1.169	15%	627	116%	937	404%
EU-15	**9.247**	**4.282**	**7.649**	**100%**	**3.367**	**79%**	**-1.599**	**-17%**

Table 7.48 CH_4 emissions from Biomass Burning (in Gg CH_4)

Member State	Net CH4 emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg	%	Gg	%
Austria	0,03	0,01	0,01	0,01%	0,002	25%	-0,02	-73%
Belgium	0,02	0,30	NO	-	-0,3	-	-0,02	-100%
Denmark	0,03	0,00	0,00	0,001%	0,001	88%	-0,02	-95%
Finland	0,2	0,05	0,02	0,02%	-0,03	-59%	-0,2	-90%
France	55	47	45	40%	-2	-3%	-9	-17%
Germany	0,4	0,1	0,1	0,1%	0,02	27%	-0,3	-78%
Greece	1	1	1	1%	1	109%	-0,1	-6%
Ireland	0,4	0,4	0,1	0,1%	-0,3	-75%	-0,4	-79%
Italy	71	23	50	43%	27	115%	-21	-30%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0,3	0,4	0,4	0,3%	0,001	0,2%	0,05	16%
Portugal	9	3	8	7%	5	212%	-1	-8%
Spain	8	4	6	6%	3	71%	-2	-22%
Sweden	0,1	0,1	0,05	0,04%	-0,1	-55%	-0,04	-45%
United Kingdom	1	2	3	3%	1	50%	2	214%
EU-15	**146**	**80**	**115**	**100,0%**	**34**	**43%**	**-32**	**-22%**

Table 7.49 N_2O emissions from Biomass Burning (in Gg N_2O)

Member State	Net N_2O emissions (Gg)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		(Gg)	(%)	(Gg)	(%)
Austria	0,0004	0,0001	0,0001	0,01%	0,00002	25%	-0,0003	-73%
Belgium	0,02	0,2	NO	-	-0,2	-100%	-0,02	-100%
Denmark	0,001	0,0001	0,0001	0,01%	0,00005	88%	-0,001	-93%
Finland	0,001	0,0003	0,0001	0,01%	-0,0002	-60%	-0,001	-90%
France	0,5	0,3	0,3	22%	-0,02	-5%	-0,2	-34%
Germany	0,01	0,001	0,001	0,1%	0,000	27%	-0,005	-78%
Greece	0,01	0,004	0,01	1%	0,004	109%	-0,0005	-6%
Ireland	0,003	0,002	0,001	0,04%	-0,002	-75%	-0,002	-79%
Italy	1	0,5	1	54%	0,3	71%	-0,2	-17%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	0,03	0,04	0,04	2%	0,00000	0%	0,005	17%
Portugal	0,1	0,04	0,1	8%	0,1	212%	-0,01	-8%
Spain	0,1	0,03	0,04	3%	0,02	71%	-0,01	-22%
Sweden	0,001	0,001	0,0003	0,02%	-0,0004	-55%	-0,0003	-45%
United Kingdom	0,1	0,05	0,1	9%	0,1	135%	0,1	127%
EU-15	**2**	**1**	**1**	**100,0%**	**0,3**	**23%**	**-0,3**	**-17%**

On site burning of biomass (controlled burning) is prohibited in most of the EU MS, therefore, emissions are usually reported as 'not occurring'. CO_2 emissions from biomass burning in power plants are considered as part of the living biomass losses or neutral when originate by annual biomass.

7.8 Cross-cutting issues (EU-15)

7.8.1 GHG estimates uncertainty

For the year 2012 LULUCF uncertainty was estimated in 27,5% for the level uncertainty estimates and 26,5% for the trend (Table 7.50).

Table 7.50 Level and trend uncertainty assessment of the annual EU-15 emission/removal on LULUCF land subcategories and GHG sources.

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
5.A Forest Land	CO2	-204.868	-237.990	16%	11%	0,0%
5.A Forest Land	CH4	1.122	698	-38%	28%	0,1%
5.A Forest Land	N2O	248	242	-2%	108%	0,1%
5.B Cropland	CO2	63.340	62.002	-2%	34%	0,1%
5.B Cropland	CH4	17	21	23%	82%	0,2%
5.B Cropland	N2O	1.703	1.556	-9%	88%	0,2%
5.C Grasland	CO2	20.190	8.437	-58%	146%	0,4%
5.C Grasland	CH4	633	572	-10%	96%	0,2%
5.C Grasland	N2O	297	263	-11%	95%	0,2%
5.D Wetlands	CO2	4.278	5.108	19%	21%	0,1%
5.D Wetlands	CH4	0	0		0%	0,0%
5.D Wetlands	N2O	8	3	-60%	116%	0,2%
5.E Settlements	CO2	21.021	27.691	32%	34%	0,1%
5.E Settlements	CH4	5	7	34%	20%	0,1%
5.E Settlements	N2O	1	1	34%	20%	0,1%
5.F Other Land	CO2	67	188	183%	50%	0,9%
5.F Other Land	CH4	0	0		0%	0,0%
5.F Other Land	N2O	0	0		0%	0,0%
5.G Other	CO2	-587	254	-143%	192%	0,6%
5.G Other	CH4	0	0		0%	0,0%
5.G Other	N2O	0	0		0%	0,0%
5.I	CO2	0	0		0%	0,0%
5.I	CH4	0	0		0%	0,0%
5.I	N2O	27	15	-45%	139%	0,6%
5.II	CO2	0	0		0%	0,0%
5.II	CH4	42	57	36%	30%	0,1%
5.II	N2O	1.231	1.310	6%	30%	0,0%
5.III	CO2	0	0		0%	0,0%
5.III	CH4	0	0		0%	0,0%
5.III	N2O	7	13	86%	55%	0,4%
5.IV	CO2	1.241	386	-69%	36%	0,2%
5.IV	CH4	0	0		0%	0,0%
5.IV	N2O	0	0		0%	0,0%
5.V	CO2	3	1	-75%	71%	0,5%
5.V	CH4	5	0	-90%	70%	0,6%
5.V	N2O	1	0	-91%	65%	0,4%
5 (werhe no subsector data were subm	*all*	*-38.497*	*-48.092*	25%	*67%*	*81%*
Total - 5	**all**	**-128.466**	**-177.258**	**38%**	**27,5%**	**26,5%**

7.9 Time series consistency

EU GHG inventory is compiled by aggregation of national GHG inventories, thus its consistency strictly depends on MS inventory consistency. Time series consistency is annually checked for all MS submissions as part of the EU GHG Monitoring Mechanism Regulation, in terms of land categories definitions and land representation across time and over space (e.g. the sum of all land use areas should be constant over time and match the official MS area), as well as trends and outliers in datasets. MS do early submissions to the European Commissions that is in charge to implement a set of quality checks and to provide suggestions on how to solve any detected problem.

One of the key features of the methodologies implemented by MS national systems is to ensure full consistency in definitions, parameters and datasets used for preparing the GHG inventory a challenging issue especially when historical data adequate to the reporting requirements are not available.

Land use category and subcategory definitions are not fully consistent across the EU-15 MS (in the sense of identical quantitative thresholds), but they are consistent with IPCC definitions for each individual member state (IPCC GPG for LULUCF). Differences are given by slightly different treatment of particular lands (e.g. different thresholds for forest definitions; hedges or bush areas categorized either under the cropland, grassland or forest land; woody plantations either under cropland or forest land), which is mainly related to historical definitions and databases.

Following the improvements made within the national systems over recent years, in 2014 submissions there were very small inconsistencies in the time series of activity data and land allocation on land sub-categories (e.g. against country's official geographical area). Such small differences are justified as due to data updating and to the mapping systems (e.g. measurement errors, increase of land area or coastal erosion). In general, the land reported under UNFCCC varies by 1-2% than official geographical area, so there are small risks that some emissions have not been counted.

7.10 Quality Assurance and Quality control

GHG inventories of the EU MS are under double QA/QC checks: one at the country level and another one, performed under the EU GHG Monitoring Mechanism Regulation, at EU level (covering EU-28 MS of the European Union) carried out at EU level by the Joint Research Centre of the European Commission in collaboration with MS.

At the EU level, the main activity is the annual checking of early versions of the MS national GHG inventories. Focus is on calculation errors and timeseries inconsistencies, and QA/QC procedures are implemented by interacting with national experts to get clarifications and to plan possible improvements. During the analysis of the 2014 submissions, 152 findings (i.e. possible problems) were communicated to the MS on: use and justifications of notations keys, inconsistency in land representation, inconsistent reporting of activity data amongst CRF tables and between CRF tables and NIR, and outliers in IEFs value for all categories.

Specific, completeness and consistency checks are applied to time series of estimates reported under Conevntion and under KP, as follows (non-exhaustive list):

1. Completeness check: the use of the notation key "NE", but also possible inappropriate use of "NA" or "NO", whenever IPCC methods are available in the IPCC's GPG, is carefully monitored and followed up where necessary with the relevant MS,;
2. Checks of *time series of activity data* for both KP and GHG inventory
   a. Total reported land area against official data from national authorities and international databases (i.e. country's official websites, FRA 2010 (FAO));
   b. Discontinuities in time series for any land subcategory and subdivisions.
   c. The share of the land category "Other land" on the total;
3. Checks of the *time series of emissions factors* (for each land subcategory and subdivision, and each pool)
   a. Comparison of IEF with IPCC GPG LULUCF default factors;
   b. Discontinuities in IEFs along the time series;
   c. Comparison among IEF of other MS, with taking into consideration of eco-regions, soil type and method used for each estimate, and any information provided in the latest NIR, including the definition of the pool;
   d. Comparison with other data sources (country's official submission under other international processess, e.g. FAO);
   e. Comparison of CO_2 and N_2O emissions to check consisntency of C/N ratio
4. Check the *consistency within annual submissions*
   a. Between GHG inventory tables (e.g. area of organic soils under 4.Ds1 and sum of areas of organic soils under Cropland (and Grassland); activity data for the estimation of N_2O emissions from mineral soils in land under conversion from Forest land and Grassland to Cropland)
5. Check the *consistency between KP and GHG inventory tables* (land area between UNFCCC and KP: 5A2 with AR; sum of area of 5B2.1; 5C2.1; 5D2.1; 5E2.1; 5D2.1 with D; 5A1 with FM). It is expected that AR area equals conversion to forest in 2009 (only if a 20 years tranition is implemented and all conversion to forest are directly human induced) or that FM area is smaller or equal to 5A1 area any time, with explanation to be provided in NIR.

6. Consistency *within KP tables*
    a. Area reported under activity tables matches NIR2;
    b. NIR2 is consistent across years (i.e. is ARD area increasing or constant over the commitment period? Is CM, GM area change explained by transfers to other elected 3.4 activities? Is the final area reported for an activity in the year X equal to the initial area reported for the same activity in the year X+1?);
    c. For each activity, data reported in NIR table-2 are identical to data reported in the activity-tables;
    d. For KP CRF 1990 data relevant for net-net accounting of elected activities are provided.
7. Consistency *with the IPCC GPG LULUCF 2003, ERT recommendations and reporting requirements set under decision 15/CMP1*.
    a. Is a key category ? If so, is a higher tier implemented?
    b. Pools omitted from accounting undeer the KP: is documentation provided demonstrating that the pool is “not a source”?
    c. Transparency and documentation: description of data sources, methods, assumptions, inferences used.
    d. Are reported values supported by adequate information on uncertainties?
    e. Are rationales, methodological changes and quantitative effects of recalculations explained in the NIR?
8. *Accounting tables*: check of the CRF reporting tool settings (e.g. is 3.3 offset option activated for countries that elected FM ?)

Additional activities at EU level are meant to improve reporting and the quality of both national GHG inventories of the MS and EU, as follows:

- Starting 2010, the EU has implemented an internal review, as an annual exercise, which focuses on key LULUCF issues identified mainly in conjunction with reporting under Kyoto Protocol. The exercise is led by the JRC and involves LULUCF reviewers also involved in the UNFCCC review process. For example, in 2012 the exercise focused on reporting DW, LT and SOC. In 2013 the following issues were analyzed: “providing transparent demonstration and justification that a pool is not a source” and “methods used by MS to estimate emissions from DOM and SOM in Forest land converted to Settlements”.
- Efforts for improving and harmonizing MS inventories, in close cooperation with the research community. Examples include:
    - Two support-projects for improved reporting by some MS are implemented by the European Commission;
    - Starting in 2010, the implementation of the “JRC decision trees on notation keys”: a) Use of notations keys for C POOLS - Tables 5(KP-I) of mandatory or elected activities and b) Use of notations keys for GHG SOURCES- Tables 5(KP-II) of mandatory or elected activities. The purpose was to ensure more harmonized use of notation keys as to identify the incompleteness issues in due time and allow further automatic checks by EU, both for reporting under the Convention and Kyoto Protocol.
    - For the purpose of enhancing reporting, sharing experience amongst MS, also for the harmonization of methods for estimation, a series of technical workshops dedicated to UNFCCC reporting (including Kyoto Protocol), under the auspices of European Commission/Joint Research Center (DG ENV, DG JRC) were organized:
    - JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 05-07 May 2014, Ispra, Italy.
    - JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 04-06 November 2013, Ispra, Italy.
    - JRC technical workshop on LULUCF reporting under the Kyoto Protocol, 27 February-1 March 2013, Ispra, Italy.

- “JRC technical workshop on LULUCF issues under the Kyoto Protocol”, held in Brussels, November 16, 2011.
- “JRC technical workshop on LULUCF issues under the Kyoto Protocol”, held in Brussels, November 9-10, 2010.
- Technical workshop on projections of GHG emissions and removals in the LULUCF sector, Ispra (Italy), 27-28 January 2010.
- Technical workshop on LULUCF reporting issues under the Kyoto Protocol, Ispra (Italy), November 13-14, 2008.
- “Technical meeting on specific forestry issues related to reporting and accounting under the Kyoto Protocol” (Ispra, 27-29 November 2006).
- “Improving the Quality of Community GHG Inventories and Projections for the LULUCF Sector”, Ispra (Italy), September 22-23, 2005.

For further information on these workshops, see: **http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/**

- The JRC’s AFOLU DATA web site (**http://afoludata.jrc.ec.europa.eu/data&tools**) offers interrogative databases (e.g. BEFs, conversion factors, European forest inventories and yield tables, models and other tools) to promote transparent, complete, consistent and comparable estimates of greenhouse gas fluxes in the AFOLU sector in Europe, and for the use of researchers, inventory experts and GHG inventory reviewers.

7.11 Verification

It is not in the EU GHG inventory scope to provide independent verification of LULUCF estimates; however, the EU is a running project funded by the European Commission and implemented by its Joint Research Center, “Analysis of proposals for enhancing Monitoring, Reporting and Verification of greenhouse gases from Land Use, Land Use Change and Forestry in the EU (LULUCF MRV)” which has a component aimed at modeling the forest net C stock changes for all MS, based on NFI data. The output of this modeling may be compared by MS with their own estimates as a verification exercise. Another exercise on comparison has been implemented by the EU JRC for deforestation area in neighbouring countries (i.e. Spain and Portugal, Italy and France) under similar ecological and socio-economic conditions similar dynamic of land uses are expected.

Finally, the JRC recommended to national LULUCF experts to verify, where available data allow, the gain-loss methodology applied for estimating their forest land with an alternative estimate prepared by applying the stock-difference method and vice versa.

7.12 Improvement status and plan

Status of implementation of the recommendations (Table 7.49) from the Annual Inventory Review Reports 2013 made to the member states by ERTs was checked in latest submissions to UNFCCC (available as 15.04.2014). For MS for which the ARR 2013 was not available at that date, information on the status of implementation of recommendations is based on the ARR 2012. In addition, whether information on the implementation of recommendations was not available on MS NIRs, the information provided in Table 7.51 is based on assessment by the JRC.

Table 7.51 Recommendations by the UNFCCC's ERT in ARR 2013 and implementation status according to NIR 2014

Category	Recommendations	Status	Improvement made
AUSTRIA (ARR 2013, NIR 2014)			
Sector overview	Provide more detailed information regarding the definition of all carbon pools and how balanced carbon flows are maintained between model system boundaries to show that double counting is avoided when the YASSO model is used.	Implemented	Definitions of the C pools and specific information on the C pools/fluxes included in the Yasso modelling were included.
Forest land remaining forest land	Report estimates of CSC for "forests not in yield" using best available data. Alternatively, the Party should provide information that CSC for 'forests not in yield' is zero and report these as "NA" in its annual submission	Implemented/ongoing	Estimates for the CSC of this category can be made on basis of the next NFI, because in NFI 2011/13 the stocks were assessed for the first time. Until then 'forests not in yield' will be reported as 'NA'.
Land converted to forest land and grassland	Refine the methodology used for determining SOC stocks of drained water-bodies to ensure that SOC removals for the subsequent land use are not overestimated.	Implemented	C stock changes in mineral soils of LUC lands to and from WL were assumed to be 0.
Grassland remaining grassland	Organic soils in grassland remaining grassland reported as IE. The ERT recommends reporting documented values separately under organic soils in CRF 5.C.1	Implemented	Separate reporting of areas and C stock changes in organic soils was carried out for submission 2014.
Biomass burning	The ERT recommends that the Party report CO2 emissions from fires as "IE" under biomass under cropland and N2O and CH4 emissions as "IE" under the agriculture sector.	Implemented	Additional information is included in the NIR 2014.
BELGIUM (ARR 2012, NIR 2014)			
General	Explain in greater detail the methods used to monitor land-use changes and to ensure the consistent representation of land	Implemented	Land use change monitoring is presented in section 10.2 (8 pages) and 7.1.1. Further information will be included in the next submission.
Forest Land remaining Forest Land	Increase the transparency of the report by providing in the NIR background data and ancillary information to justify the difference in per hectare average carbon stock changes in mineral soils between the Walloon region and the Flemish region	Implemented	Information on the calculation of carbon stock changes in soils has been added in section 7.2.2.1. C of the NIR. More detailed information will be added in the next NIR.
Cropland remaining Cropland,	Report organic soils and associated CO2 emissions under cropland and, if appropriate, report estimates for AD, carbon stock changes and GHG emissions for organic soils under the 2 subcategories cropland remaining cropland and land converted to cropland	Implemented	The estimates have been reported in the April 2014 submission. Methodology is described in section 7.3.2.1 (B) of the NIR.
Cropland remaining Cropland,	For liming in cropland, refine the emission estimates using country-specific data and report information on methodologies and parameters used in the estimations	Ongoing	No CS information was available by the time of the submission in April 2014. Some information has been received in the meantime and is now analyzed. It would be used in the next submission in 2015. Methodology is described in section 7.3.2.1 (D) of the NIR.
Cropland remaining Cropland	Report the gains and losses of carbon stock for living biomass	Implemented	The estimates of orchards have been reported in the April 2014 submission. Methodology is described in section 7.3.2.1 (A) of the NIR.
Grassland remaining Grassland	Review its reporting and, if appropriate, report estimates of AD, carbon stock changes and GHG emissions for Org.soil in grassland	Implemented	The estimates have been reported in the April 2014 submission. Methodology is described in section 7.3.2.1 (B) of the NIR.
Grassland remaining Grassland	For liming in grassland, refine the emission estimates using country-specific data and report information on methodologies and parameters used in the estimations	Ongoing	No CS information was available by the time of the submission in April 2014. Some information has been received in the meantime and is now analysed. It should be used in the next submission in 2015. Methodology is described in section 7.3.2.1 (D) of the NIR
Biomass burning	Use the notation key "IE" if the emissions are reported in another category (or "NO" if not occurring) and report information on which category the emissions are included.	Implemented	NO is used for subcategories or years without fire. Information has been added in the documentation box.
DENMARK (ARR 2012, NIR 2014)			
Sector overview	Improve the QA/QC processes and report on the improvements made, particularly those related to the NFI in terms of sampling procedures and estimation methods	Implemented/Ongoing	The QC procedures have been further expanded for all parts of the LULUCF sector.
Forest land remaining forest land	Make continuous efforts to ensure time-series consistency	Implemented	The work to improve time-series consistency is continuously ongoing. Any changes will be reflected in the NIR.
Forest land remaining forest land	Provide additional information to explain the large inter-annual variations in the carbon stock in forest land remaining forest land (i.e. information on changes in the composition of tree species and the age structure of forest stands; the area and volume of clear cutting; and the area subject to destructive disturbance)	Implemented	Additional information has been provided in the NIR.
Cropland remaining cropland	Include the underlying data that support the explanations of the emissions from cropland remaining cropland, particularly those that demonstrate the link between temperature and yield	Implemented	There is not clear relationship between temperature and crop yield. The crop yield depends on many different factors where precipitation and sun hours combined with decent temperatures are the most important. The temperature is only used in the degradation model for organic matter in the soil. Here are used monthly mean values for the different years. More detailed data e.g. on a daily basis has very little influence on the output from the degradation C-TOOL. Annual average temperature file has been included in Annex 3F table 14.

	FINLAND (ARR 2013, NIR 2014)		
Land converted to forest	The ERT identified that Finland has reported cropland conversion to forest land, but the Party continues to report other conversions to forest land as "IE" in CRF table 5.A. In response to a question raised by the ERT during the review, Finland explained the reason for this reporting is that the losses in carbon stocks in the living biomass of trees were not estimated separately because the method used gives an estimate of the average net growth of the growing stock. The ERT reiterates the recommendation made in the previous review report on this matter that Finland include in its annual submission an enhanced description of the method used for estimating and reporting losses in carbon stocks in living biomass for all types of land converted to forest land.	Implemented	The reason why the conversion from cropland to forest land is reported in a different way than other land use changes to forest land is, because the losses in carbon stock in conversion from cropland to forest land is from the crop biomass in the year of conversion. Such biomass is not on other types of lands. The gains and losses in living tree biomass is estimated and reported in a same way for all LUC types; an aggregate estimate for gains and losses.
Grassland remaining grassland	Finland has reported carbon stock changes in living biomass as "NE" in CRF table 5.C. The ERT considers that this reporting is not in line with the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (hereinafter referred to as the IPCC good practice guidance for LULUCF). The ERT reiterates the recommendation made in the previous review report that Finland report carbon stock changes associated with the living biomass pool in its annual submission.	Not implemented	We agree that there may be some woody biomass on abandoned fields that are included in GL. Since cutting of biomass does not occur on these areas they are a missing sink, not a source. New data on the woody biomass will be available during the coming years and an estimate of the biomass C changes will be reported as soon as possible.
Grassland remaining grassland	Finland has reported a total uncertainty in grassland remaining grassland in the range of –256 to +328 per cent, and a corresponding range for land converted to grassland of –412 to +455 per cent (see NIR, page 310). The ERT considers this to be high because the overall emission uncertainty is ranged only –25 per cent to +34 per cent (see NIR, page 506). In response to a recommendation of the previous review report, Finland indicated that it plans to improve its methods for estimating uncertainties for all land-use categories. The ERT recommends that Finland report on its progress to improve the uncertainties in the LULUCF sector in its annual submission.	Implemented	The method of estimating the uncertainties has been improved but the values remain high as long as the biological diversity of fields is high and the GL areas and especially the converted areas are a small percentage of the total area.
Wetlands remaining wetlands	Finland reported in CRF table 5.D for 2011 a area of 2,867.52 kha as wetlands remaining wetlands that excludes inland waters. In table 7.1-4 of the NIR, the area of wetlands remaining wetlands is 2,957 kha. The ERT recommends that Finland correct this inconsistency in the annual submission.	Implemented	There was an error in the footnote text in Table 7.1-4. Table note corrected and text added.
Other	Finland reported different CO2 emissions from agricultural lime application between NIR table 7.1-2 and CRF table 5(IV). During the review, Finland informed the ERT that there are erroneous figures in table 7.1-2 in the row "Liming". Only liming of cropland is included in these figures and the liming of grassland is missing. The ERT recommends that Finland accurately report these figures in its annual submission.	Implemented	The figures are now corrected.
	FRANCE (ARR 2012, NIR 2014)		
Sector overview	To revise the estimates for the LULUCF sector (cropland) for the next annual submission, in order to avoid the double counting of emissions from the use of limestone in agriculture	Implemented	Corrected
Sector overview	To clarify the reporting of emissions in CO2 eq. and to provide the AD for CH4 removals from forest soils	Implemented	Information is added in the NIR
Sector overview	For the missing carbon pools, to report estimates, report them as "NE", or justify why they do not occur	Not implemented	The notation key NO is still used.
Sector overview	To use the appropriate notation key, or provide estimates, to report some carbon pools instead of zero	Not implemented	Zero is still used.
Sector overview	To update the uncertainty analysis, taking into consideration recalculations	Not implemented	Same methodology and values are used
Forest land remaining forest land	To revise the estimates using data on actual biomass growth and removals, or provide sufficient justification for the assumption that forest carbon stocks in some territorial areas are stable	Ongoing/Not implemented	France considers these forests in balance in the submission 2014
Forest land remaining forest land	To improve transparency in the explanation of trends and inter-annual changes	Implemented	Explanation in the NIR
	GERMANY (ARR 2013, NIR 2014)		
Sector overview	Include information on how the changes in areas affect the IEFs for different land-use categories.	Implemented	In the chapter 7.1.2 more description is given.
Sector overview	Examine all cases where "NO" is reported in the LULUCF sector, and provide a transparent explanation justifying the election of the notation key and use other notation keys, if appropriate	Implemented	The notations keys were updated in the respective CRF tables 5.B - 5.F.
Sector overview	In order to ensure time-series consistency, evaluate the inventory methodologies with regard to the use of data from a variety of sources that differ in their coverage and methods, and transparently document how the timeseries consistency issues have been addressed.	Implemented	In the chapter 7.1.3.2.1 more description is given.
Sector overview	Provide more detailed, transparent information on the category-specific QC checks performed for all categories in the LULUCF sector.	Implemented	The chapter 7.1.8 und the subchapters of the different land-use categories were updated.
Land to forest land	Include the information on the time assumed for average carbon stocks to form in litter	Implemented	More information is given under the chapter 7.2.4.3
Land to forest land	Transparently describe the methodology used to estimate carbon stock change in litter, clearly demonstrating its consistency with the methodology provided in the IPCC good practice guidance for LULUCF	Implemented	More information is given under the chapter 7.2.4.3
Wetlands	Report the emissions and removals from wetlands according to the wetlands subcategories defined in the IPCC good practice guidance for LULUCF	Implemented	In submission 2014 the subcategories are restructured according the ERT recommendations, chapter 7.5.3 was updated see picture 66a.

GREECE (ARR 2013, NIR 2014)			
Sector overview	Provide transparent information on how the annual land-use change matrices have been developed	Implemented	Done. The necessary information is provided in chapter 7.
Sector overview	Provide a complete set of annual land-use change matrices for the whole time series.	Implemented	Done. The necessary information is provided in chapter 7
Sector overview	Correct the typographical error in the equation for estimating the annual increase in carbon stocks due to biomass growth in new plantations.	Implemented	Done.
Sector overview	Provide more information on the QA procedures employed for the LULUCF sector.	Implemented	Done. The necessary information is provided in chapter 7.
Sector overview	Cropland to forest land and cropland to grassland by initial crop type and report the carbon stock changes in mineral soils in the appropriate categories.	Implemented	Done. The necessary information is provided in chapter 7.
Sector overview	Provide clarification on its reporting of the carbon stock changes in mineral soils in cropland converted to forest land and cropland converted to grassland and the use of a default transition period of 20 years in the estimation process for carbon stock changes in mineral soils for the land-use conversion categories.	Implemented	Done. The necessary information is provided in chapter 7.
Forest land remaining forest land	Report the carbon stock changes in the dead organic matter and soil carbon pools, or provide evidence transparently substantiating the assertion that the carbon stock changes in the dead organic matter and soil carbon pools are zero.	Implemented	Done. The necessary information is provided in chapter 7.
Forest land remaining forest land	Perform a verification of the results of the carbon stock change method using the IPCC gain–loss method, include the results of this verification, and revise the estimations, if necessary.	Implemented	Done. The necessary information is provided in chapter 7.
Land converted to forest land	Collect the necessary information and estimate the carbon stock changes in dead organic matter in land converted to forest land using higher tier methods.	Implemented	Done. The necessary information is provided in chapter 7.
Land converted to forest land	Provide information to substantiate the assumption that there have been no losses due to natural disturbance in land converted to forest land since 1994, or provide revised estimates taking into account the carbon stock losses in the living biomass pool due to natural disturbance.	Implemented	Done. The necessary information is provided in chapter 7.
Land converted to cropland	Estimate and report the N2O emissions from disturbance associated with the conversion of forest land and grassland to cropland.	Implemented	Done. The necessary information is provided in chapter 7.
Land converted to cropland	Report the correct numbers for the areas in the CRF tables.	Implemented	Done. The necessary information is provided in chapter 7.
Land converted grassland	Estimate and report the carbon stock changes in the living biomass for cropland converted to grassland or provide evidence to substantiate the assertion that carbon stock changes in the living biomass pool amount to zero.	Implemented	Done. The necessary information is provided in chapter 7.
IRELAND (ARR 2012, NIR 2014)			
Sector overview	Until the next national forest inventory is completed, use the Kyoto Protocol version of the CARBWARE model for the reporting under the Convention, using back casting techniques, as necessary, for the years prior to 2006	Ongoing	The recalculations for LULUCF includes a complete revision of the time series, now based on land remaining a land use category for the periods before 1990 and lands converted to other land uses since 1990. This required a major methodological change for forest lands resulting mainly from wider use of the national forest inventory data in the CARBWARE model for forest land and its development to ensure consistency between the LULUCF submissions under the Convention and the Kyoto Protocol.
Sector overview	Continue work to harmonize the methods used for estimating the emissions and removals reported under the Convention and its Kyoto Protocol	Ongoing	This required a major methodological change for forest lands resulting mainly from wider use of the national forest inventory data in the CARBWARE model for forest land and its development to ensure consistency between the LULUCF submissions under the Convention and the Kyoto Protocol
Land converted to forest land	Clarify the assumptions used for the addition of the accretion area	Implemented	The recalculations for LULUCF includes a complete revision of the time series, now based on land remaining a land use category for the periods before 1990 and lands converted to other land uses since 1990
Grassland remaining grassland	Ensure the consistency of the information on areas of grassland between the CRF tables and the NIR	Implemented	Corrected
Grassland remaining grassland	Provide clear explanations of where grassland emissions have been reported	Not implemented	Reported as IE in the NIR and NO in CRF table 5
Other land	Cross-check the information in the NIR and in the CRF tables and, as appropriate, revise the calculations for the time series	Implemented	Corrected
Other land	Introduce natural grassland areas as a subdivision of the land-use category grassland	Implemented	Natural, unmanaged, grasslands are included in the Grassland land use category for the first time. Previously these lands have been included in the Other Land category.
ITALY (ARR 2013, NIR 2014)			
Sector overview	Provided detailed explanations for all recalculations in future submissions	Implemented	A detailed description related to the recalculations applied in the different categories has been provided in the NIR.
Sector overview	Assess which type of cropland and grassland is converted to settlements and review use of notation keys	Implemented	Detailed information has been reported in the NIR
Sector overview	Use the IUTI data to update the land-use matrices and recalculate the estimates for the period 1990–2011 in the next submission	Implemented	The ERT's recommendation has been addressed and an updated methodology to assess land uses and land use changes has been used, on the basis of the IUTI data, as detailed in the NIR
Forest land remaining forest land	Improve the explanation of how the AD are derived	Implemented	Detailed information has been reported in the NIR
Forest land remaining forest land	Improve clarity of the NIR text regarding the method used for estimating stock changes in mineral soil	Implemented	Detailed information has been reported in the NIR
Cropland remaining cropland	Report all areas of plantations in forest land or alternatively disaggregate the areas of plantations and report in cropland only those considered very short rotations	Implemented	The ERT's recommendation has been addressed and plantations, previously included into cropland category, have been allocated in forest land category as described in the NIR.
Land converted to settlements	Correct the value of the carbon content of the biomass of woody crops	Implemented	The ERT's recommendation has been addressed and the correct value has been used to estimate carbon stock changes for cropland converted to settlements as described in the NIR
Land converted settlements	Provide further documentation on the adequacy of the linear relation method for estimating soil organic content for the national circumstances of Italy	Implemented	In the NIR (§7.2.4) a detailed description of the methods and data used to estimate soils carbon stocks (and the consequent carbon stock changes) is reported. These SOCs have been used to assess the carbon stock changes for forest land converted to settlements.

LUXEMBOURG (ARR 2013, NIR 2014)			
Sector overview	Include the full citations for the literature referenced in the LULUCF sector in chapter 16 of the NIR	Not implemented	This information is not included in NIR 2014.
Sector overview	Include the more precise percentages in section 7.1.3 of the NIR	Implemented	Detailed information has been reported in NIR 2014.
Sector overview	Improve QC procedures to ensure the consistency of the data reported	Not implemented	Minor inconsistencies between the land-use net emissions/removals reported in NIR compared with those reported in the CRF tables still exist.
Sector overview	Provide information on ground verification exercises in the NIR	Not implemented	This information is not included in NIR 2014.
Sector overview	Use the more accurate results from the second National Forest Inventory (NFI) to recalculate the emission/removal estimates from forest land remaining forest land and land converted to forest land	Ongoing	This information is not included in NIR 2014. Data collection for the second national forest inventory (NFI-2) has been finalized and the results have been published in March 2014.
Forest land remaining forest land	Provide transparent documentation on the verification data used to support the growth rates applied	Not implemented	This information is not included in NIR 2014.
Forest land remaining forest land	Prioritize work to collect data on the changes in dead organic matter and soil carbon pools	Ongoing	Luxembourg indicated that a study could be made at the earliest in 2014.
Forest land remaining forest land	Provide in the NIR the rationale for differences between data reported in the CRF tables and data reported to the Food and Agriculture Organization of the United Nations (FAO)	Not implemented	This information is not included in NIR 2014.
Forest land remaining forest land	Clarify reporting of information regarding the soil carbon stock data on forest land on pages 354 and 359 of the NIR	Implemented	Detailed information has been reported in NIR 2014
Land converted to forest land	Prioritize data analysis from the second NFI to analyse carbon stock change in organic soils and dead wood	Ongoing	This information is not included in NIR 2014. Data collection for the second national forest inventory (NFI-2) has been finalized and the results have been published in March 2014.
Land converted settlements	Implement the Party's stated intent to re-evaluate the land use with new land use data from 2012, for the period 2008–2012	Implemented	Luxembourg indicated that for the period 2008–2012, the land use was re-evaluated with new land use data from 2012.
Cropland remaining cropland	Elaborate on the discussion of trends in the NIR	Implemented	Detailed information has been reported in NIR 2014
Cropland remaining cropland	Correct inconsistencies between the NIR and CRF table 5.B. regarding reporting of net CO_2 emissions	Not implemented	The inconsistencies between the NIR and CRF table 5.B. regarding reporting of net CO_2 emissions were not corrected.
Settlements converted to other lands	Provide a detailed description of the rationale for the use of the 20-year method in its NIR	Implemented	Detailed information has been reported in NIR 2014
NETHERLANDS (ARR 2013, NIR 2014)			
Sector overview	Obtain the data and make the estimates for those categories reported as "NE", in which the IPCC methodology and the default EFs exist in the IPCC good practice guidance for LULUCF.	Implemented	Carbon stock changes in mineral soils have been assessed and are now included. N_2O emissions resulting from conversions from land to cropland have been included. Estimates have been included for emissions from wildfires, other than forest fires. Forest Fires were included already in the NIR 2013. Additional wildfires (area and emissions) have been included under 'grassland remains grassland', as this is likely the most prominent source for wildfires outside forests. Notation keys have been updated.
Grassland remaining grassland	Obtain the data, make the estimates and report on carbon stock changes in living biomass for the 'grassland remains grassland' category and justify the fact that the mineral soils under this category are not an emission source.	Implemented	Carbon stock changes from mineral soils for grasslands remaining grasslands have been explicitly included. * Carbon stock changes in living biomass for grasslands remaining grasslands could not yet be included, but will be considered for future reporting. Potential data sources have been investigated.
Emissions conversion to cropland	Obtain the data and estimate N_2O emissions from disturbance associated with land-use conversion to cropland.	Implemented	N_2O emissions from disturbance associated with conversions to cropland have been included in the NIR 2014, covering the time series since 1990.
Biomass burning	Provide a description of the legislation on controlled biomass burning and reconcile the use of the notation keys for different land-use categories. Obtain the data on the areas of wildfires, estimate CO_2 and non-CO_2 emissions for the entire time series and include them.	Implemented	Notation keys have been updated to reflect the new reporting of wildfires. The notation key for controlled burning was set to IE, NO because the area included under wildfires partly includes the occasional burning that is done under nature management. Controlled burning of harvest residues is not allowed in the
PORTUGAL (ARR 2012, NIR 2014)			
Sector overview	Improve the transparency of the reporting in the next annual submission by providing a clear and detailed description of the methods, AD and parameters used for all pools, as well as the emission sources for each category	Implemented	NIR related chapters have been further developed and thorough explanations have been provided
Sector overview	Enhance the QA/QC procedures for the next annual submission	Implemented	BEF have been corrected. Consistency between Convention and KP-LULUCF have been improved (non-tillage activity and biodiversity sowing of pasture activity are now considered in both reporting)
Sector overview	Conduct an uncertainty analysis for the key categories in the LULUCF sector	Ongoing	Under implementation
Forest land remaining forest land	Use the correct BEF values, reconsider the choice of root–shoot ratio and transparently describe the data sources used in the NIR of the next annual submission	Implemented	BEF values included in NIR
N_2O emissions from N fertilization of forest land	Disaggregate direct N_2O emissions from N fertilization of forest land and report the N_2O emissions from N fertilization of forest land and other land in the appropriate category under the LULUCF sector in the next annual submission	Not implemented	No available data to separate forest from agriculture N fertilization. Explanation is given in the NIR.

SPAIN (ARR 2012, NIR 2014)			
Sector overview	Continue the efforts to improve the completeness of the reporting	Implemented/ Ongoing	Spain has reduced the number of NE in the submissions 2014. See Table 7.1.4 in submission 2014 and 2013
Sector overview	Revise the time series of land-use areas and soil management practices for the period 1970–1990	Not implemented	No information found.
Forest land remaining forest land	Continue the efforts to move to a higher-tier estimation method for dead wood, litter and soil organic carbon	Not implemented	Tier 1 is used for DOM under forest land remaining forest land
Forest land remaining forest land	Explore ways to enhance the consistency of the time series of net removals and AD	Implemented	Corrected
Forest land remaining forest land	Report the parameters D and BEF2 in a disaggregated manner in the NIR	Implemented	Values of BEF by species are provided in the NIR
Land converted to forest land	Improve accuracy by providing estimates for the dead organic matter carbon pool and use a more accurate characterization of land converted to forest land	Implemented	DOM estimates are provided.
Land converted to forest land	Provide information on the mix of species and the growth rates of trees for the areas of land converted to forest land	Implemented	The methodology has been revised following the recommendations from the ERT
Cropland remaining cropland	Improve the accuracy of the estimates of carbon stock change in mineral soils by implementing a tier 2 method	Ongoing	The improvement plan has not been yet implemented
Cropland remaining cropland	Enhance the coverage of the cropland area and include information on soil crop management practices for herbaceous crops and fallows	Not implemented	No information found.
Cropland remaining cropland	Stratify the areas of cropland and resolve the inconsistency in the soil depths between the reference soil organic carbon contents and the IPCC stock change factors	Not implemented	No information found.
Cropland remaining cropland	Improve the accuracy and consistency of the time series of estimates of carbon stock change in mineral soils for cropland	Implemented	Corrected
Land converted to settlements	Revise the methodology used to estimate the effect of land converted to settlements by collecting more recent AD	Implemented	Corrected
Land converted to settlements	Enhance the explanation of the trend in the IEF for carbon stock change in living biomass and dead organic matter	Implemented	Corrected
Liming of agricultural	Revisit the assumption that liming of agricultural soils does not occur in the country	Implemented	Corrected
Biomass burning	Collect AD on controlled fires to estimate the associated emissions	Implemented	Corrected
Biomass burning	Enhance the transparency of the reporting of CO2 emissions from wildfires for forest land remaining forest land	Not implemented	CO2 emissions are reported as IE
SWEDEN (ARR 2013, NIR 2014)			
Sector overview	The ERT recommends that Sweden checks net removal from the Land Use, Land-Use Change and Forestry LULUCF value and reports the correct estimation in a consistent manner in the NIR and the CRF tables	Implemented	This was a typing error that will be corrected in the next submission.
Sector overview	The ERT recommends that Sweden to include information showing that the variability between units within a stratum is reduced as compared to the variability within the entire population, since the stratification is intended to increase efficiency by improving the accuracy of the estimate for the entire population (changes of carbon in tree biomass at county level).	Implemented	The IPCC recommends stratification because its normally improves the accuracy of estimates. A prerequisite is that variation within stratum is small and between strata is large, however, stratification does not decrease the accuracy e.g. compared with simple random sampling. Sweden believes that the stratification has improved the accuracy of estimates e.g. because there is gradient from the North to the South with difference in trees species composition and site fertility. See 3.2.2 in Annex to NIR
Sector overview	In the previous review report the ERT encouraged Sweden to include additional information in the next annual submission to explain the trend and the way in which the areas for the five subcategories are estimated using the new approach (using an extrapolation approach based on five-year rolling averages), while ensuring consistency with the areas	Implemented	In the annex to NIR, Sweden has added information that explains consequences of the extrapolation applied. See Annex to NIR 3.2.3.
Forest land remaining forest land	The ERT recommends provides in addition quantified information on the units of land subject to Article 3.3 and 3.4 activities (FM) within the geographic boundaries, which have resulted from the stratification of the country in accordance with the approach 3 (4.2.2.3), as well as the methods in Sections 4.2.2.5 (generic methods) and 4.2.5 to 4.2.10 (activity	Implemented	An example that matches quantified information for Art. 3.3 and 3.4 for estimates and accuracy of estimates to stratum is now found in annex to NIR 3.2.2 . The geographical location of each of 31 strata is found in NIR Figure 11.4.
Forest land remaining forest land	Sweden has reported in its NIR for LULUCF sector that the estimates are based on stratification by 31 counties while in the KP section points out that the sample frame is divided into about 30 strata. Sweden confirm during the review that estimates are based on stratification by 31 strata (counties) and such map with the boundaries at county level was provided. The ERT recommends that Sweden checks this information in the NIR report and correct consistently across the document.	Implemented	This have been checked and changed in the NIR.
UK (ARR 2012, NIR 2014)			
Sector overview	Prioritize the implementation of the data assimilation process to build the time series of land-use changes and other activities as listed in the improvement plan for the LULUCF sector.	Ongoing	This is included as a priority task on the 2014 improvement programme and is expected to be included in the 2015 submission.
Sector overview	Improve the transparency of the information reported in the NIR.	Implemented	2013 submission
Sector overview	Include a full set of annual land-use transition matrices.	Implemented	2013 submission
Forest land remaining forest land	Meet the planned deadline for reporting the carbon stock change estimates using the FC CARBINE model for inclusion in the 2014 annual submission	Implemented	2014 submission
Forest land remaining forest land	Meet the planned deadline for reporting the carbon stock change estimates for pre-1920 forest land in the 2014 annual submission	Implemented	2014 submission
Cropland and grassland	Differentiate between mineral and organic soils in the cropland and grassland categories and report the carbon stock changes in mineral and organic soils separately	Implemented	Changes in grassland and cropland on organic soils are now reported as IE (was previously NO), with the data included in the mineral soil value. The pro rata approach to divide the emissions based upon the total land areas of mineral and organic soil will be investigated for future submissions. This is included in the 2014-15 improvement programmes.
Land converted to cropland	Build a consistent time series of emissions for the OTs and CDs from 1990 onwards.	Implemented	2014 submission

The Plan of improvement for next year EU GHG inventory cycle and submission includes:

- To restructure the NIR according to new reporting guidelines
- To restructure the QA/QC procedures according to new reporting requirements
    - Develop specific checks and oulier tools according the new CRF tables.
    - Develop specific procedures to check the consistency under the new CRF tables and among the KP and UNFCCC CRF tables.

7.13 Recalculations

Recalculations have been done by MS for various reasons (Table 7.52). Either activity data or emissions factors or both have been updated as a result of new available data or of fixing error from previous submissions (as highligjhted by EU QA/QC or UNFCCCC review process).

Table 7.52 Reasons for recalculations arising from by EU-15 MS submissions in 2014. X indicated that a recalculation occurred.

AUSTRIA	
FL	New activity data for LUC from and to forest based on the ARD NFI 2011/13 and revision of these LUCs for the whole time series. Data on biomass and dead wood changes for LUCs from and to forest land on basis of the results of the NFI 2007/09 and the ARD NFI 2011/13. Revisions of the litter and soil C stock changes for LUCs from and to forest land due to the new activity data. In response to review findings the estimates of the emissions/removals in the mineral soils of LUC categories with wetlands were revised. It is assumed that the soil carbon stocks do not change after conversion. The changed emission/removal figures for biomass and dead wood of LUC lands to and from forests had also an impact on the biomass and dead wood results of 5.A.1. The 5.A.1 results are based on the results of the NFIs for all Austria minus those biomass and dead wood stock changes due to LUCs involving forests (in order to avoid double accounting). A change in 5.A.2 or in LUC categories from forest to other land uses rep-resents also a change in subtrahends for the derivation of the results for the subcategory 5.A.1 on basis of the NFI results for all Austria.
CL	The LUCs between perennial and annual CL and the LUCs between CL and GL of the most re-cent years were updated on basis of an assessment of the most recent statistics. In addition, the extrapolation factor from the assessed subsample to all Austria used in previous submissions was improved.
GL	The areas of CL and GL of the most recent years were updated on basis of an assessment of the most recent statistics. In addition, the extrapolation factor from the assessed subsample to all Austria used in previous submissions was improved.
WL	In response to a review finding the soil C stock changes in the LUC-categories to WL were assumed to be 0. An update of these LUC areas led also to different LUC lands GL to WL due to area consistency reasons. As a consequence, the related emissions/removals of this LUC category had to be revised.
SL/OL	An update of the LUC areas to/from forests and between GL and CL led also to different LUC lands CL and GL to SL and OL, due to area consistency reasons. As a consequence, the related emissions/removals of these LUC subcategories had to be revised.
BELGIUM	
FL	Emissions and removals from liming in forest land converted to cropland or grassland were recalculated for the complete time series in Belgium. New estimations of the losses of carbon stocks from orchards converted to forest land following the 2013 review recommendation. Update of areas in Flanders following last data available (2008-
CL	Carbon stock change in living biomass in cropland (orchards) are newly estimated and reported in the 2014 submission. Carbon emissions from organic soils in cropland are newly estimated and reported in the 2014 submission. Emissions originating from liming are included.
GL	Carbon emissions from organic soils in grassland are newly estimated and reported in the 2014 submission.
DENMARK	
General	As the land use matrix is slightly changed the emissions from land use con-version for all sectors are changed slightly for the whole time series. These changes have no effect on the emissions from agricultural soils as these are based information from the EU Land Parcel Information System, i.e. the actual land use. Two minor technical errors have been found in the accounting estimate and corrected: living biomass in Settlements and the area accounted for in Cropland Management and Grassland Management under article 3.4. These errors have only a small impact on the inventory.
FL	Since the NFI was initiated in 2002 and have a 5-year rotation, a full measurement is available from 2006. Calculation of carbon stock in the period 2000-2005 is based on interpolation between the carbon stock observed in the NFI in 2006 and the carbon stock as calculated for 2000. For 2006-2012 car-bon stock is calculated solely on the basis of the NFI - with additional information about the total forest area from satellite image mapping. Reported values from the NFI correspond to the last year of a five year measurement cycle (i.e. reported values for 2010 rely on data from 2006-2010). Same approach was applied in the 2014 submission.
FINLAND	
FL	The land-use areas were recalculated due to new data, updating of NFI data and error corrections in calculations. Due to the recalculation of forest land areas, the carbon stock changes in the biomass, DOM and SOM pools were also recalculated.
CL/GL	The time series of the areas were updated and all soil and biomass emissions were recalculated.
WL	New area estimates were calculated as a result of new data, updating of NFI data and corrections. In addition, the emission estimates changed due to the recalculated land areas. This resulted in recalculations of the emissions from lands converted to Wetlands.
SL &OL	New area estimates were calculated due to new data, updating of NFI data and error corrections. This resulted in recalculations for the whole time series.
Other sources	The whole time series was recalculated as the result of updated time series for the area data in the N2O emissions from disturbance. The FL area data were updated and allocation of wildfires on these areas changed in the years 2008-2010. The estimates for year 2011 were recalculated due to the updated FAOSTAT values in HWP.
FRANCE	
General	Adding wildfires overseas territories. Updating deforested after 2008 Guyana surfaces. Updated emissions from Petit-Saut dam in French Guiana. Changes matrices change of land tenure. Methodological changes to the consideration of fuelwood consumption. Updated data of soil carbon stock
GERMANY	
General	Improvement of the LUM for the reference year, with the help of CIR aerial photos (as of 1990) (5.A-5.F; KP). Change of the basis for calculation of activity data (areas), with the help of new ATKIS data for 2012 and land information from 2012 National Forest Inventory (BWI) (as of 2009) (5.A-5.F, KP). Complete implementation of data from the 2012 National Forest Inventory (BWI) (5.A- 5-F; KP). New EF for dead wood (5.A-5.F; KP). Change in method for determination of forest biomass, and change in the EF for forest fires (5. A-5.F; KP). Correction of peat-removal quantities (2010, 2011) (5.D)

GREECE	
General	Correction of the small discrepancies in the land use change matrices for the period 1990 –2012, in order for the total area of the country to equal the sum of all land use
FL	Update of the Forest Management Plans database and inclusion of data from the more recent Forest Management Plans that resulted in recalculations in the whole time series in the "Forest land remaining Forest land" category. Performing for the first time a verification activity of the results on carbon stock changes in above and below ground biomass pools in "Forest land remaining Forest land" category which were estimated using the carbon stock change method as described in the GPG LULUCF. Recalculations of non-CO2 emissions from wildfires in Forest land remaining Forest land category (use of updated data). Estimation and reporting for the first time of CO2 and non-CO2 greenhouse gas emissions resulted from biomass burning in Cropland converted to Forest land category.
CL	Use of the smallest IPCC emission factor for estimating carbon stock changes in living biomass in Cropland converted to Forest land category. Correction in allocation and reporting to the appropriate categories of carbon stock changes in mineral soils in Cropland converted to Forest land, and in Cropland converted to Grassland, and subsequent change in the reporting of carbon stock changes in mineral soils in Cropland remaining Cropland. Estimation and reporting for the first time on N2O emissions from disturbance associated with land use conversion to cropland, namely N2O emissions arising from Forest land converted to Cropland (Deforestation activity under KP), and Grassland converted to Cropland
GL	Reporting for the first time on methodologies applied on and emissions/removals resulted from carbon stock changes in mineral soils in Grassland converted to Cropland, Grassland converted to Settlements, Grassland converted to Other land categories, as well as from carbon stock changes in dead organic pool and mineral soils in Grassland converted to Wetlands category. Estimation and reporting for the first time of carbon stock changes in living biomass pool in Cropland converted to Grassland category.
IRELAND	
FL	Changes in the harvest removed from land converted to forest land and forest land remaining forest land. Changes in the previous land use categories used for land converted to forest land. Changes in the areas under categories 5.A.1 and 5.A.2 due to changes in the deforestation area between 2006 and 2012. A complete recalculation for the time series adjustment for 1990 to 2006 due to the new NFI data. A correction to dead organic pool calculations for forest land remaining forest land. This was due to the use of the incorrect sign adjustment factor used for the time series adjustment. An increase in deforestation emissions in 2011 from 29 Gg in the previous submission to 332 Gg CO2 in this submission. Inclusion of emission estimated from mineral forest soils converted to settlement and other lands as recommended by previous ERT (ARR 2012, 2013).
GL	Natural, unmanaged, grasslands are included in the Grassland land use category for the first time. Previously these lands have been included in the Other Land category. The revision means there is increase in the total area of Grassland, and a corresponding decrease in area of Other Land. All previous transitions between Grassland and Other Land, and the GHG emissions associated with these, are now reported under Grassland Remaining Grassland. A recalculation has also been undertaken due to revision of the estimate of area of improved grassland in 2011.
SL	Estimates of changes in soil carbon due to conversion from other land uses to Settlement are reported for the first time, in response to the ERT
OL	Recalculations for all years due to a revision of the methodology to remove natural grassland from the Other Land category and include it in the Grassland category. In response to the ERT
ITALY	
FL	Plantations have been allocated in FL instead of CL. Methodology to estimate emissions from fires have been updated. Methodology to estimate litter coefficients has been changed.
GL	Methodology to estimate emissions from fires has been updated. Methodology to estimate litter coefficients has been changed.
LUXEMBOURG	
CL	Liming activity data of CaCO3 used for liming for the year 2010 was revised as new statistical data became available. The revised value is slightly higher
NETHERLANDS	
General	Improved calculation method for LULUCF based on new actual land use change matrix (5A to 5G for 2009-2012). Improved carbon stock changes in LULUCF based on new forest inventory for the year 2012-2013 (5A in 2000-2012). New method to calculate emissions from mineral soils (5A to 5F in1990- 2012). Before emissions from mineral soils were assumed to be small sinks of unknown magnitude that were reported as NE. N2O emissions associated with disturbance from conversion to cropland were included for the first time (5A in 1990-2012)
PORTUGAL	
General	The replacement of the information on land use and land use changes in Mainland Portugal with data from the Land-Use Cartography of 1995, 2007 and 2010, recently made available from the Direcção Geral do Território. Revision of the soil emission factors, incorporating the LUCAS Data Set and reflecting only statistically significant changes in C Stocks. Revision on annual burnt areas per land use, using the revised information provided by Instituto de Conservação da Natureza e Florestas released in 2013.
SPAIN	
General	A full revision of variables, methodologies and cartography used to build up the LUM was done. Controlled burning is reported by first time. Updated values as a result of new data from NFI4 (5A). DOM reported for first time under several land use changes. Specific recalculation of WL areas. SOC pool reported for first time under CL and GL in transition to SL. Significant recalculation of OL areas due to the inclusion or shrublands under GL.
SWEDEN	
General	In the current submission to improve the accuracy of estimates, the living biomass pool and areas have been recalculated for the years 2008-2012. Each estimate is now based on 6000 more sample plots and incomplete inventory cycles have been extrapolated to 2012. To enhance the consistency between UNFCCC and KP reporting, the allocation of carbon stock changes has been revised. New reporting method is consistent with the methodology used for reporting carbon stock changes in living biomass under the KP. The National Forest Inventory estimates living biomass per tree fraction using two different models and, to improve the accuracy of estimates and consistency, now only one model is used per fraction. This has only slightly changed the estimates and this is also valid for minor corrections of single plots. The pools dead organic matter and soil organic carbon on mineral soils on Forest land remaining forest land and Grassland-remaining-Grassland have been recalculated for the whole time series from 1990 to 2012 due to introduction of more re-inventoried sample plots. For land-use change categories these pools have been recalculated due to updated activity data from the NFI (areas). Activity data (production area of peat extraction) is no longer provided. Thus, managed area for peat extraction is converted to production area by a constant.
UK	
General	Main methodological revisions are the use of the CARBINE carbon accounting model for carbon stock change modelling and the inclusion of emissions from all forests older than 20 years in the Forest remaining Forest Land category – instead of just from post-1921 forests as was reported in previous submissions. Methodological revision occurred is the inclusion of by-products from sugar production for soil liming. There have also been recalculations in the time series for the OTs and CDs.

The EU-15 overall quantitative effect of recalculations in the LULUCF sector in 2014 submission compared to previous one is a increase of net removals of 17.538 Gg CO_2 for the year 2011. Table 7.53

Table 7.53 Quantitative recalculations in total LULUCF by EU-15 MS (difference between 2014 and 2013 submissions, for specific years), in Gg CO_2 eq. Negative sign means removals are, by that amount, larger in submission 2014 compared to previous estimate.

MS	1990	1995	2000	2005	2011
Austria	49	16	-295	-328	-380
Belgium	79	61	89	112	101
Denmark	-191	22	16	-220	-79
Finland	1487	1369	1279	1374	463
France	-5826	-1682	938	1224	4925
Germany	11240	11039	10834	1746	-13421
Greece	213	155	186	76	-413
Ireland	350	439	416	359	63
Italy	8545	6683	8860	8729	11451
Luxembourg	0	0	0	0	-136
Netherlands	13	-10	-553	-734	139
Portugal	-10785	-13627	-12310	-11249	-11089
Spain	-4199	-4693	-7918	-7639	-4620
Sweden	-1519	-6326	-6969	-3817	-356
United Kingdom	-2128	-1766	-2496	-3078	-4186
EU-15	-2671	-8319	-7922	-13445	-17538

The largest percentage recalculations occurred on forest land category (Table 7.54) by Germany, Spain and Portugal, for the entire time series.

Table 7.54 Quantitative recalculations in 5A by EU-15 MS (difference between 2014 and 2013 submissions, for specific years), in Gg CO_2 eq. Negative sign means removals are, by that amount, larger in submission 2014 compared to previous estimate.

MS	1990	1995	2000	2005	2011
Austria	933	848	418	366	837
Belgium	0	0	0	0	16
Denmark	7	7	7	-51	88
Finland	1112	1119	1123	1289	909
France	-2750	-1262	662	-763	678
Germany	11307	11162	11014	-647	-19193
Greece	-15	2	138	124	144
Ireland	280	267	-252	-420	-183
Italy	-963	-148	136	242	880
Luxembourg	0	0	0	0	-21
Netherlands	-2	-12	-529	-702	-1065
Portugal	-8469	-7191	-6876	-7831	-9828
Spain	-4261	-4935	-8400	-8716	-8926
Sweden	-3716	-7636	-8506	-4021	-2645
United Kingdom	-3867	-2189	-3427	-3246	-7425
EU-15	-10404	-9967	-14492	-24376	-45735

Major recalculations also occurred in 5B, whose emissions increased by 11.993 Gg CO_2-eq as reported in the submission 2014 for the year 2011, or 5C, where the net sink reported for 2011 decreased by 3.011 Gg CO_2-eq.

8 WASTE (CRF SECTOR 6)

This chapter starts with an overview on emission trends in CRF Sector 6 Waste for EU-15 Member states. For each EU-15 key source, overview tables are presented including the Member states contributions to the key source in terms of level and trend, information on methodologies and emission factors. The quantitative uncertainty estimates for this sector and the sector-specific QA/QC activities are summarised in separate sections. This chapter furthermore includes an overview of recalculations. In a separate chapter, an overview of the sector for EU-28 is provided.

8.1 Overview of sector (EU-15)

CRF Sector 6 Waste is the fourth largest sector in the EU-15, after energy, agriculture and industrial processes, contributing 3 % to total GHG emissions. Total emissions from Waste have been decreasing by 40 % from 171 Tg in 1990 to 102 Tg in 2012 (Figure 8.1). In 2012, emissions decreased by 3.3 % compared to 2011. The key sources in this sector are:

- 6 A 1 Managed Waste disposal on Land:(CH_4)
- 6 A 2 Unmanaged Waste Disposal Sites:(CH_4)
- 6 B 1 Industrial Wastewater: (CH_4)
- 6 B 2 Domestic and Commercial Wastewater:(CH_4)
- 6 B 2 Domestic and Commercial Wastewater:(N_2O)

Figure 8.1 Sector 6 Waste: EU-15 GHG emissions, 1990-2012

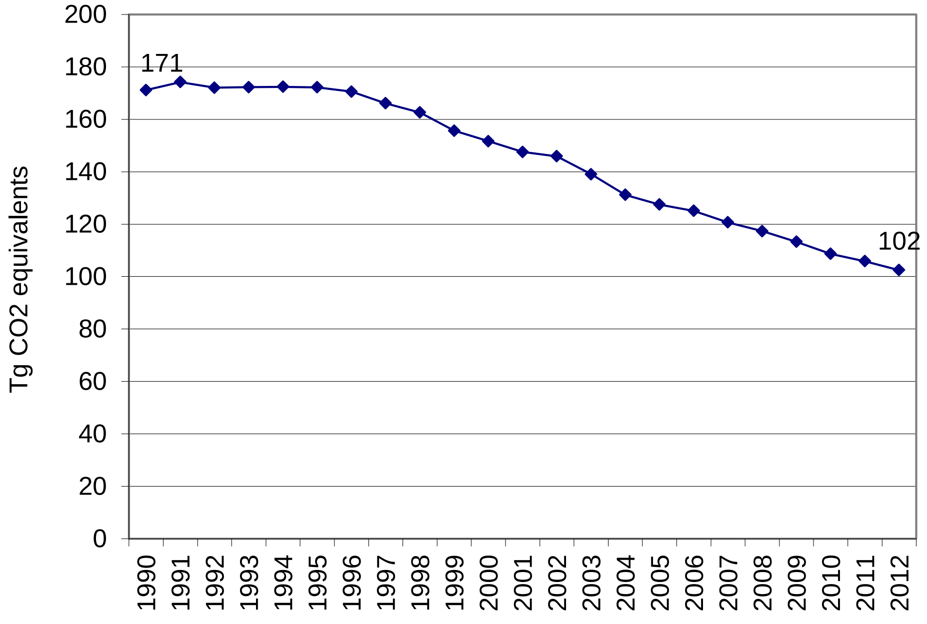
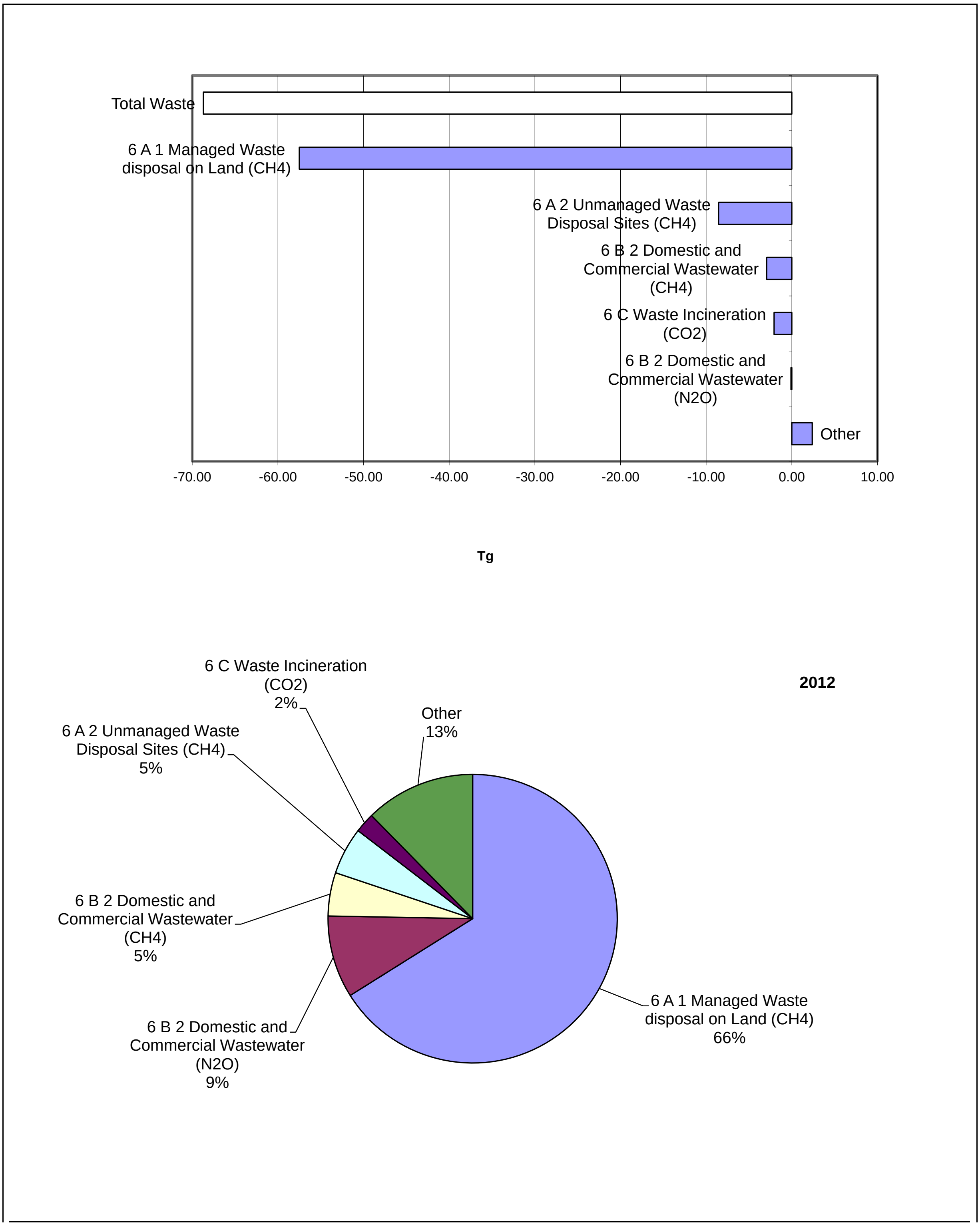


Figure 8.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 66 % of waste-related GHG emissions in the EU-15 in 2012.

Figure 8.2 Sector 6 Waste: Absolute change of GHG emissions (in CO_2 equivalents) by large key source categories, 1990–2012, and share of largest key source categories in 2012



8.2 Source categories (EU-15)

8.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-15)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. Methane is produced from anaerobic microbial decomposition of organic matter in solid waste disposal sites. Source category 6A1 Managed waste disposal on land includes CH_4 emission arising from managed solid waste landfills. Source category 6A2 comprises corresponding CH_4 emissions from unmanaged landfills. The EU-15 reports CH_4 emissions from managed solid waste landfills in source category 6A1. The methane recovery that takes place in those managed solid waste landfills is also reported in CRF-table 6A,C but those amounts are not included in the reported CH_4-emissions, as prescibed by the IPCC guidelines. In the unmanaged solid waste landfills, no CH_4-recovery is taken place. Only Ireland reports CH_4 recovery from unmanaged landfills in the years 1996 – 1998, as there where no managed landfills in Ireland at this time.

Table 8.1 provides total greenhouse gas and CH_4 emissions by Member state from 6A Solid Waste Disposal on Land. CH_4 emissions from this category decreased by 46 % between 1990 and 2012 in the EU-15. Twelve EU-15 Member states reduced their emissions from this source, Greece, Portugal and Spain did not.

Table 8.1 6A Solid Waste Disposal on Land: Member states' contributions to total GHG emissions and CH_4 emissions, and information on methods applied and emission factors

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)
Austria	3 314	1 201	3 314	1 201
Belgium	2 450	579	2 450	579
Denmark	1 366	698	1 366	698
Finland	3 635	1 737	3 635	1 737
France	8 627	8 621	8 627	8 621
Germany	38 598	10 206	38 598	10 206
Greece	2 226	3 204	2 226	3 204
Ireland	1 173	804	1 173	804
Italy	15 254	11 303	15 254	11 303
Luxembourg	67	26	67	26
Netherlands	12 011	2 973	12 011	2 973
Portugal	3 033	5 044	3 033	5 044
Spain	5 088	10 964	5 088	10 964
Sweden	2 874	1 094	2 874	1 094
United Kingdom	42 817	18 483	42 817	18 483
EU-15	**142 533**	**76 938**	**142 533**	**76 938**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.2 provides information on emission trends of the key source CH_4 from 6A1 Managed Waste Disposal on Land by Member state. CH_4 emissions from this source account for 2 % of total EU-15 GHG emissions. Between 1990 and 2012, CH_4 emissions from managed landfills declined by 46 % in the EU-15. Ten EU-15 Member states reduced their emissions from this source during that period, France, Greece, Portugal and Spain did not. In 2012, CH_4 emissions from managed landfills decreased by 4 % compared to 2011. A main driving force of CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by 52 % between 1990 and 2012. In addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilised or flared. The share of CH_4 recovery has increased significantly in EU-15 since 1990.

The Member states with most emissions from this source in 2012 were the United Kingdom, Germany, Spain, Italy and France. These MS account for 83 % of EU-15 emissions in 2012. The largest reductions in absolute terms between 1990 and 2012 were reported by Germany and the United Kingdom. The emission reductions are partly due to the (early) implementation of the landfill waste directive or similar legislation in the Member states. The landfill waste directive was adopted in 1999 and requires the member states to reduce the amount of biodegradable waste disposed untreated to landfills and to install landfill gas recovery at all new sites.

Table 8.2 6A1 Managed Waste Disposal on Land: Member states' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	3 314	1 286	1 201	2%	-85	-7%	-2 113	-64%	T2	CS,D
Belgium	2 450	578	579	1%	1	0.1%	-1 871	-76%	CS	CS
Denmark	1 366	731	698	1%	-33	-5%	-668	-49%	T2	CS,D
Finland	2 088	1 090	1 075	2%	-15	-1%	-1 013	-49%	T2	CS,D
France	4 848	7 717	7 657	11%	-60	-1%	2 808	58%	T2	CS
Germany	38 598	11 046	10 206	15%	-840	-8%	-28 392	-74%	T2	D,CS
Greece	63	1 032	942	1%	-90	-9%	879	1394%	T2	CS,D
Ireland	NO	726	671	1%	-55	-8%	671	-	T2	CS,D
Italy	10 060	10 287	9 889	15%	-397	-4%	-171	-2%	T2	CS
Luxembourg	67	29	26	0.04%	-4	-12%	-41	-61%	T2	D
Netherlands	12 011	3 166	2 973	4%	-193	-6%	-9 038	-75%	T2	CS
Portugal	428	2 279	2 137	3%	-143	-6%	1 709	400%	T2	CS, D
Spain	4 202	10 014	10 056	15%	42	0%	5 854	139%	T2	D,OTH,CS
Sweden	2 874	1 193	1 094	2%	-98	-8%	-1 780	-62%	T2	D, CS
United Kingdom	42 817	19 490	18 483	27%	-1 007	-5%	-24 334	-57%	T2	CS
EU-15	**125 187**	**70 664**	**67 687**	**100%**	**-2 977**	**-4%**	**-57 499**	**-46%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

The ERT recommended to provide reasons for the increase of methane emissions from managed waste disposal on land for those Member states showing the largest increase during the time series (France, Spain, Portugal, Italy and Greece) (FCCC/ARR/2009/EC, para 83). Therefore and in response to another recommendation by the ERT (FCCC/ARR/2009/EC, para 81), an analysis of the trends of emissions of these Member states and of those Member States influencing most the European Union's trends is given.

In the EU CRF the notation key "NE" is reported in the CRF tables for some of the parameters. The reason for this reporting is the heterogeneity of the AD reported by the member States, which cannot easily be compared. Therefore summary tables with such parameters (e.g. IEF, MCF and DOC values per Member State, and differences in the waste generation rate between the member States) are provided in the NIR as recommended by the review.

The UK decreased its CH_4 emissions steadily between 1990 and 2004 due to the implementation of methane recovery systems at UK landfill sites which reached a maximum in 2005, thus the British emission change after 2005 is less noticeable. Compared to last year's submission, the share in EU-15 emissions increased from 21% to 27%. The reason for this emission increase is a change in the methodology for estimating methane recovery, which has been amended to address a recommendation from the 2013 UNFCCC review. Methane recovery is now calculated using monitored data.

CH_4 emissions in Spain increased continuously from 1990 and 2002 due to a growth of the annual municipal solid waste going to solid waste disposal sites by 123 %. During 2002 and 2004 no change in emissions could be observed; the reason for the interruption of the trend is the increase in the volume of biogas captured and burned in some of managed waste landfills in that time: a lot of landfills with biogas recovery systems were incorporated in the inventory. While in 2000 there were only 14 managed waste landfills with individual and detailed information, in 2004 the number increased to 25.

Portugal, contributing with 3 % to EU-15 emissions in 2012, managed to slow down the increasing trend due to elevated biogas flaring in landfills; four new CH_4 recovery systems were established in 2005 and 2007.

France, contributing with 11 % to EU-15 emissions in 2012, increased its emissions from **managed** solid waste disposal sites steadily until 2003; followed by rather stable emissions until 2008 and a slight decrease thereafter. Emissions followed the increased amount of municipal waste going to landfills until 2000, which decreased afterwards.

Greece's share in total EU-15 emissions in 2012 amounts to only 1 %, thus its contribution to the EU-15 emissions trend is marginal. The CH_4 generation from managed solid waste disposal sites varies during the time series; for the period 1990 to 2000 it increased steadily, taking into account that the starting year for managed sites is the year 1990 and that quantities of municipal solid waste for the period until 2000 were estimated on the basis of population figures and assumptions regarding generation rates per capita and day. Since 2001, more accurate data was provided by the waste management sector of the Ministry of Environment, Energy and Climate Change (MEECC), showing an increasing trend until 2010 and thereafter a slight decrease.

Germany, contributing with 15 % to EU-15 emissions in 2012, managed to reduce CH_4 emissions steadily until now, inter alia due to an increase of methane recovery as facilities for gas collection were installed on almost all landfill sites; the collected part of the landfill gas increased continuously between 1990 and 1999 and declined thereafter due to a decreasing generation of landfill gas.

Italy, contributing with 15 % to EU-15 emissions in 2012, featured an increasing trend of CH_4 emissions from landfills until 2001 and a decreasing trend thereafter. This is driven, inter alia, by the increasing amount of waste landfill until 2000 and a decrease thereafter. Also, CH_4 recovery has increased throughout the time series.

Additional information with respect to a detailed analysis of review findings from UNFCCC inventory reviews is provided for 6A1 in EU-15. Table 8.3 summarizes the recommendations from the 2013 (where available, otherwise 2012) UNFCCC inventory reviews in relation to the category 6A1 Managed Waste Disposal on Land.

Table 8.3 6A1 Managed Waste Disposal on Land: Findings of the 2013 (2012) UNFCCC inventory review in relation to CH_4 emissions and responses in 2014 inventory submissions

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
Austria	The ERT noted that a rationale for the significant reduction in the CH_4 IEF between 2010 (262.6 kg/Mg) and 2011 (218.3 kg/Mg) presented in table 258 of the NIR was not clearly provided. In response to a recommendation made in the previous review report, Austria provided, in the NIR (table 261) the time series of DOC and Lo (methane generation potential) of residual waste. Nevertheless the ERT note that this information does not reflect the carbon content of the disposed waste in 2011. In response to a question raised by the ERT during the review, the Party provided detailed information regarding the amount of solid waste disposed at	To improve transparency, information on the development/gaining importance of the non-residual waste fractions over the time series is now included in the NIR 2014. . [AT NIR 2014, p. 238, 473]

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	solid waste disposal sites and calculated the associated emissions using the disposed waste composition categorized by waste component. The ERT considers that information on annual waste composition could justify a reduction in DOC of disposed waste in 2011, as the increased waste amount disposed of in 2011 compared with that in 2010 was composed mainly of inert waste, resulting in the lower DOC of disposed waste in 2011. The ERT recommends that Austria present time-series information on DOC and Lo of non-residual waste to improve the transparency of its reporting.(FCCC/ARR/2013/AUT, para 66)	
	Austria has reported in its NIR (page 423) that the CH_4 concentration in recovered landfill gas decreased from 48 per cent in 2002 to 45 per cent in 2007 but that the same CH_4 concentration as in 2007 was assumed for 2008–2011. The ERT considers that this may represent a lack of accuracy in relation to recovered CH_4. In response to a question raised by the ERT during the review, the Party explained that the actual CH_4 concentration in recovered landfill gas during 2008–2011 will be derived from a new study, which will only be available in November 2013 and that the new collected data will be implemented and the time series recalculated in the next annual submission. Austria also explained that a CH_4 concentration of 55 per cent (default value) was used for the estimation of CH_4 production. The ERT welcomes the effort made by Austria to update its reporting of CH_4 concentrations in recovered landfill gas on a regular basis and recommends that the Party provide information on recovered landfill gas calculated using an updated methane concentration in the NIR. .(FCCC/ARR/2013/AUT, para 67)	Results of a new study on landfill gas recovery, also taking into account actual methane concentrations, have been considered in the NIR 2014. [AT NIR 2014, p. 443, 473]
Belgium	CH_4 emissions from solid waste disposal on land were estimated using two different approaches: a combination of the multiphase model for active landfills ("16 solid waste disposal sites" (SWDS)) and the FOD model for closed landfills for the Flemish region; and the FOD model for the Walloon region. There are no landfills in the Brussels-Capital region. The ERT noted a lack of transparency in the descriptions of the models and in the explanations of the selection of the region-specific parameters. The ERT reiterates the recommendation in the previous review report that Belgium list, in the NIR of its next annual submission, the parameters used for each model in a single table, using the same terminology.(FCCC/ARR/2012/BEL, para 123)	A table has been provided given an overview of region specific parameters used in the different models. [BE NIR 2014, p. 212]
	The ERT noted a lack of justification in the NIR for the use of two different models to estimate the CH_4 emissions from	An explanation why two separate models are used in the Flemish region is included. [BE NIR

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	closed and active landfills in the Flemish region. In addition, the ERT noted that a scientific rationale for use of the region-specific multiphase model was not provided in the NIR. In order to increase the transparency of the CH_4 emission estimates for this category, the ERT recommends that Belgium explore the possibility of using a harmonized approach for the estimation of CH_4 emissions from solid waste disposal on land in the Flemish region. Further, if Belgium continues to use the region-specific multiphase model, the ERT recommends that the Party provide a rationale for using this model for recent landfills only, in its next annual submission. (FCCC/ARR/2012/BEL, para 124)	2014, p. 211]
	Since Belgium estimates CH_4 emissions from solid waste disposal sites, by region, using different approaches and methodologies, the ERT reiterates the recommendation in the previous review report that the Party report the emissions separately, by region, in CRF table 6.A, in order to ensure the transparency of its reporting. (FCCC/ARR/2012/BEL, para 125)	Not yet addressed. [BE 2014 submission]
	The ERT noted that the region-specific multiphase model used for the estimation of CH_4 emissions from new landfills in the Flemish region is compatible with the IPCC FOD method, and the "formation factor" parameter is similar to the methane correction factor from the IPCC FOD method. A region-specific parameter of 0.6 was used for the "formation factor" in the region-specific model, taking into account the conditions of landfill sites, however the Party did not provide a rationale or references in the NIR for use of this factor. The ERT noted that the IPCC default methane correction factor for emissions from managed waste disposal sites is 1.0 and considered that there could have been an underestimation of CH_4 emissions as a result of using a "formation factor" of 0.6. During the review week, the ERT recommended that Belgium either provide justification for using the region-specific "formation factor" of 0.6 for SWDS in the Flemish region or submit revised emissions estimates of CH_4 for the Flemish region using a "formation factor" of 1.0 in order to avoid the potential underestimation of emissions. In response to the list of potential problems and further questions raised by the ERT during the review week, Belgium provided revised estimates of CH_4 emissions for the Flemish region using a "formation factor" of 1.0. The ERT concluded that the revised estimates of CH_4 emissions. (FCCC/ARR/2012/BEL, para 126)	For calculating CH_4 emission from landfills a MCF of 1 has been applied in the 2014 submission. [BE NIR 2014, p. 212]
	The Flemish region estimates the amount of CH_4 recovery from 16 SWDS. In response to questions raised by the ERT	Recovery (R) has been considered separately for flaring and valorisation, in accordance with

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	during the review, the ERT learned that the amount of CH_4 recovery in each SWDS was estimated by multiplying a region-specific value of 80 per cent or a site-specific value of 10 per cent (De Kock Huldenberg) or 1 per cent (Igemo) with the amount of CH_4 generation in each SWDS based on expert judgment, without any justification for the values used. The ERT also noted that the IPCC good practice guidance (section 5.1.1.2, page 5.10) states that the default value for CH_4 recovery is zero and that this default value should only be changed when references are available. Therefore the ERT considered that Belgium could be overestimating recovery (i.e. underestimating emissions) and recommended that Belgium provide estimates of CH_4 emissions from solid waste disposal on land, based on the metering of gas recovered for energy utilization and flaring, in line with the IPCC good practice guidance. In response to the list of potential problems and further questions raised by the ERT during the review week, Belgium provided revised estimates of CH_4 recovery from 16 SWDS in the Flemish region based on metered gas recovery data, which are consistent with the Flemish regional energy balance. The ERT concluded that the issue has been resolved by the Party by providing revised estimates of CH_4 recovery from the 16 SWDS in the Flemish Region. (FCCC/ARR/2012/BEL, para 127)	the IPCC guidelines. Recovery is assumed to be 0 or based on measurements where data is availbale (BE NIR 2014, p.206, 212]
Denmark	Solid waste disposal on land was identified as a key category both by the level and by the trend assessment using both tier 1 and tier 2 key category analyses. To estimate the emissions from this category, Denmark uses the first order decay (FOD) model, as described in the 2006 IPCC Guidelines, using country-specific AD and a combination of country-specific and IPCC default values for the degradable organic carbon (DOC) and methane generation rate constant (k). The ERT encourages Denmark to conduct research in order to develop country-specific parameters for the FOD model, in order to improve the accuracy of the estimates for this category, in its next annual submission. (FCCC/ARR/2012/DNK, para 88)	Not yet addressed. [DK 2014 submission]
	For the years 1994–2008, Denmark's waste was divided into eight waste categories: domestic waste, bulky waste, garden waste, commercial waste, industrial waste, building waste, sludge, and ash and slag. The Party also assessed data on waste from the Information System for Waste and Recycling database for 2004 and subsequently divided the waste into eight different waste types: food waste, cardboard and paper, wet cardboard and paper, plastics, other combustibles, glass, metal, and other non-combustibles. For the waste category	For the category 6A SWDS, an in depth disaggregation of deposited waste for the years 2010, 2011 and 2012 have been performed based on the new waste reporting system in Denmark. 18 categories have been identified of which eleven have been evaluated as inert waste. A detailed description of the waste characterisation, allocation into 18 categories and back casting from 2010 to 1990 are

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Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	"other combustibles", DOC values from the Danish waste characterisation survey reported by the Danish EPA in 1993 have been used. The data and information provided by the Party indicate that, after 1993, there was no food waste, cardboard, paper or plastics disposed of at waste disposal sites. The Party also informed the ERT that the nature of the "other combustibles" waste type is not well defined in the country. The ERT strongly recommends that the Party analyse and report, in the next annual submission, updated information on the composition of the waste category "other combustibles", divide it into different well characterised waste types, in order to document and assign each type a DOC value, and thereby improve accuracy. (FCCC/ARR/2012/DNK, para 89)	described in Nielsen et al. and Thomsen et al. [DK NIR 2014, pp. 494]
Finland	The composition of MSW that is deposited on landfills is derived from the estimated composition of generated MSW and waste fraction data. Data for landfill gas recovery were taken from the Finnish Biogas Plant Register. The ERT noted that there is an observed significant increase in the gas recovery from 2000 that corresponds with the implementation of the regulations of landfill gas recovery (Council of State Decree 861/1997 on Landfills). In response to a question raised by the ERT during the review in relation to the reported zero recovery figures for several plants presented in the list of the landfill gas recovery plants (see Appendix 8(b) in the NIR), Finland explained that this is due to the temporary inoperativeness of the plants. The ERT recommends that the Party include this clarification in its annual submission. (FCCC/ARR/2013/FIN, para 77)	In the 2013 and 2014 submission only the Kerava plant reported zero recovery in Appendix 8(b). Information was included that this plant was not used in these years. [FI NIR 2014, p. 435]
France	France uses a tier 2 method, the first order decay (FOD) model from the IPCC good practice guidance, to estimate CH_4 emissions from managed and unmanaged landfills. France has applied a combination of country-specific data (methane generation rate constant (k) and degradable organic carbon (DOC) value) and default IPCC parameters, including fraction of CH_4 in landfill gas and CH_4 oxidation factor. In response to questions raised by the ERT during the review, France provided the ERT with access to the spreadsheets used by France to implement the method, and the ERT concluded that the method was applied in line with the IPCC good practice guidance. The ERT encourages France to analyse the possibility of applying the method to each landfill site or group of landfills with similar conditions, in order to improve the accuracy of the emission estimates, and to report on any improvements made in its next annual	The model was applied with average parameters for all landfills and not to groups of landfills or individual sites.

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Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	submission. . (FCCC/ARR/2012/FRA, para 103)	
	The ERT noted that the country-specific data were not transparently explained in the NIR, and that there was a lack of information on the waste categorization (rapidly degradable, moderately degradable or slowly degradable) and on the composition of waste sent to solid waste landfills. In response to questions raised by the ERT during the review, France provided improved documentation to the ERT on the country-specific data and waste composition. For instance, the ERT could understand that the k values were derived from 160 in-situ measurements on over 50 landfills and that the waste categorization was based on the CH_4 generation potential (100 m3/Mg waste for rapidly degradable, 50 m3/Mg for moderately degradable and 0 m3/Mg for inert). The composition of the different waste categories used to derive DOC values was also provided. The ERT recommends that France include this documentation of country-specific parameters (k and DOC values) and waste composition in the NIR of its next annual submission. (FCCC/ARR/2012/FRA, para 104)	The NIR mentions in a general way that 160 measurements were taken on 50 landfills and that some parameters are based on these measurements, however it is not explained what was measured and how the parameters were derived. [NIR 2014, part 1, p. 233]
	The ERT identified that CH_4 recovered from landfills that could be subtracted from emissions was reported as "NO". France explained that this approach followed the conclusions of the 2010 review report and was due to the fact that the Party could not yet obtain complete data on the amount of CH_4 recovered at landfill sites when the 2012 annual submission was being prepared. Surveys are being conducted to collect data for the period 2008–2011 from all French landfills (300 sites) and France expects to have these data by the end of September 2012. The ERT commends France for these efforts and encourages the Party to use improved data on the amount of CH_4 recovered and provide revised estimates of CH_4 emissions from landfills in its next annual submission. (FCCC/ARR/2012/FRA, para 105)	Measurement data for the CH_4 recovery and subsequently flared and used for energy generation were collected and included in the 2014 inventory calculations [NIR 2014, part 1, p. 232.]
	According to the information provided in the NIR, figures for the amount of waste sent to landfills were collected by surveys conducted every two years. However, it was not clear from the NIR when the first and last surveys were conducted and how data between surveys and historical data back to 1960 were interpolated or extrapolated. In response to questions raised by the ERT during the review on this issue, France clarified that surveys were conducted by ADEME in 1980, 1985, 1989, 1993, then each year between 1995 and 2000 and every two years between 2002 and 2008. The missing data between surveys were estimated by linear	No additional information on the activity data is provided in the NIR and no improvements are foreseen according to the NIR; e.g. related to the historical extrapolation.

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	interpolation and historical data back to 1964 were estimated by means of simple extrapolation using the trend in the existing data. The ERT recommends that France include this information in its next annual submission. The ERT also recommends that France analyse the possibility of using extrapolation based on drivers (e.g. gross domestic product and population) to estimate the historical amount of waste landfilled for its next annual submission. (FCCC/ARR/2012/FRA, para 106)	
Germany	According to the NIR, there are no official statistics on biodegradable waste fractions for 2011 and therefore the Party has assumed that the waste quantities remained unchanged with respect to 2010. However, the ERT noted that in the NIR (table 292), different values for landfilled garden and park waste were reported for 2010 (1 kt) and 2011 (0 kt). In response to a question raised by the ERT during the review, the Party explained that there was a transcription error from the calculation file to the NIR. The ERT recommends that Germany correct the value and strengthen its QC activities to avoid such errors. (FCCC/ARR/2013/DEU, para 67)	The NIR 2014 states that for the year 2012 there are no official statistics on biodegradable waste fraction available and therefore waste quantities remain unchanged with respect to 2011. In 2011 the reported value for organic is zero, and for garden and park waste is 0.4 for 2011 and 2012. Thus the reporting is consistent. [DE NIR 2014, p. 626, table 313, p.675]
	The ERT noted that the explanations in the NIR on mechanical-biological waste treatment (MBT) are very limited and ambiguous. The ERT reiterates the recommendation made in the previous review report that Germany provide further information in the NIR on the range of techniques employed in MBT processes (how MBT works and inputs and outputs of waste) and on the correlation of MBT processes with emissions from different subcategories of the waste sector in order to improve the transparency of its reporting. (FCCC/ARR/2013/DEU, para 68)	Detailed information on MBT, including inputs and outputs e.g. are included in the NIR 2014. [DE NIR 2014, pp. 648, figure 73, 676]
Greece	Greece carried out category-specific QC procedures for the waste sector, which include the cross-checking of data, a comparison of data with those of other countries and checking the estimates using different calculation tools. During the review, the ERT noted several inconsistencies in the information in the NIR compared with that provided in the CRF tables (see paras. 79 and 81 below) and errors in the NIR (e.g. table 8.2 shows that country-specific EFs are used for the estimation of CH_4 and N_2O emissions from composting, however the NIR states that IPCC default values are used). The ERT recommends that Greece strengthen its QA/QC procedures to ensure the accuracy and consistency of the information provided in the NIR with that provided in the CRF tables in its future annual submissions.	Errors were corrected while QA/QC procedure is strengthen by adopting more detailed checking of the documents. Please see section 8.2.2, chapters 'Industrial solid waste' and 'Construction and demolition solid waste', section 8.3.1, chapters 'CH_4 emissions from industrial wastewater handling' and section. [GR NIR, p.378]

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	(FCC/ARR/2013/GRC, para 75)	
	Greece has used a tier 2 first order decay method from the IPCC good practice guidance in its estimation of CH_4 emissions from solid waste disposal on land. In the NIR, Greece explained that historical data on construction and demolition waste were estimated using drivers. However, information on these drivers was not provided in the NIR. In response to a question raised by the ERT during the review, Greece explained that the gross domestic product (GDP) was used as a key driver up to 1995, and for the remaining years of the time series the gross value added (GVA) was used because GVA data are not available for the years prior to 1995. The ERT recommends that Greece provide an explanation of how historical data on the amount of construction and demolition waste are estimated in its next annual submission. . (FCC/ARR/2013/GRC, para 77)	Information on the important drivers for historical data for construction and demolition waste is included. [GR NIR, p.327, 378]
	Greece reported in the NIR that the fraction of degradable organic carbon dissimilated (DOCf) for sludge disposed at solid waste disposal sites is 40 per cent and that the sewage sludge remains at wastewater treatment facilities under aerobic conditions with negligible CH_4 production; therefore, a value lower than the default was applied. In response to a question raised by the ERT during the review, Greece explained that there was an error in the NIR and that the default value of 0.6 from the IPCC good practice guidance was used instead of the value 0.4 which was used in the previous annual submissions. The ERT recommends that Greece ensure the accuracy of the information provided in the NIR in its future annual submissions. (FCC/ARR/2013/GRC, para 78)	Errors were corrected. Please see section 8.2.2, chapters ‘Other parameters’. [GR NIR, p.379]
	Greece reported in the NIR that emissions from industrial solid waste and from construction and demolition waste disposed in solid waste disposal sites have been reported for the first time in the 2013 annual submission. However, the ERT noted that CH_4 emissions from construction and demolition waste have been estimated and reported since the 2012 annual submission. In response to a question raised by the ERT during the review, Greece clarified that the emissions from industrial solid waste and from construction and demolition waste disposed in solid waste disposal sites have been reported since the 2012 submission. The ERT recommends that Greece ensure the accuracy of the information provided in the NIR and the consistency with the information provided in the CRF tables in its future annual submissions. (FCC/ARR/2013/GRC, para 79)	Errors were corrected. Please see section 8.2.2, chapters ‘Industrial solid waste’ and ‘Construction and demolition solid waste’.[GR NIR, p.379]

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
Ireland	Ireland used a tier 2 method to estimate CH_4 emissions from solid waste disposal on land, which is in line with the IPCC good practice guidance. A combination of IPCC default and country-specific EFs were used in this category and default degradable organic carbon (DOC) values from the 2006 IPCC Guidelines were used for the different waste types (wood and straw, and textiles). However, the ERT noted that the Party did not provide documentation justifying the appropriateness of the default values from the 2006 IPCC Guidelines for the national circumstances of Ireland. The ERT recommends that the Party provide such documentation in its next annual submission, in order to improve transparency. (FCCC/ARR/2012/IRL, para 82)	Information has been provided in this submission. [IE NIR 2014, pp. 225, p.421]
	Ireland used a combination of decay constants (k) for different waste types, which required historical data for three to five half-lives for each waste type. In the NIR, the Party did not provide information on the historical time series for each of the model runs, as raised in the recommendations in previous review reports. However, in response to questions raised by the ERT during the review, the Party provided additional information on the generation of the time series for each model run. The ERT recommends that the Party incorporate this additional information in its next annual submission. . (FCCC/ARR/2012/IRL, para 83)	Not yet addressed. [IE NIR 2014]
	Ireland uses waste composition data from national statistics to quantify the fractional distribution of waste between food waste, paper, wood and straw, textiles and disposable nappies in order to assign different DOC and methane conversion factor values for each waste type. The Party did not provide any information in the NIR on the source of the AD for garden waste. In response to a question raised by the ERT during the review, the Party provided additional information showing that the organic waste reported in national statistics is biodegradable food, garden and landscaping waste, and, where the context permits, also includes industrial organic sludges. For the purposes of emission estimates, organic waste is classified as food, as that is the largest proportion of organic material, and no further information on the composition of organic waste is available. The ERT recommends that Ireland provide information on the composition of organic waste (in terms of food, straw, wood, etc.), for the purpose of assigning input parameters for the first-order decay method, in its next annual submission, in order to improve the accuracy of its inventory. . (FCCC/ARR/2012/IRL, para 84)	Not yet addressed. [IE NIR 2014]

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Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
Italy	The transparency of information on CO_2 emissions from recovered landfill gas has been improved in the 2013 submission with the provision of a detailed breakdown of the sources of biomass AD in the commercial/institutional subcategory in the energy sector (table 8.12 in the NIR). This table includes information relevant to other waste categories and the energy sector. To ensure transparency in all categories/subcategories, the ERT recommends that Italy appropriately reference table 8.12 in all relevant sections of the NIR in both the energy and the waste sector in its next annual submission. (FCCC/ARR/2013/ITA, para 60)	Not yet addressed. [IT NIR 2014]
Luxembourg	The calculation of the emission estimates takes into account the emissions from pretreatment of solid waste prior to landfilling, starting from 1993. The emissions are estimated according to the share of waste sent to landfills and pre-treatment. In response to the recommendations made in the previous review report, Luxembourg has included in the NIR an explanation for the use of a methane conversion factor (MCF) of 0.1 for mechanical-biological treatment (MBT). According to Luxembourg, the low MCF can be explained by the fact that up to 95 per cent less CH_4 is produced with MBT than with untreated waste in solid waste disposal sites (SWDS) (vol. 5, p. 4.4 of the 2006 IPCC Guidelines). Based on the information provided in the NIR, the ERT accepts that there is no underestimate of emissions taking place with the use of an MCF of 0.1. However, the ERT considers that MBT is biological treatment, as categorized in chapter 4 of the 2006 IPCC Guidelines, and should not be classified as an uncategorized landfill. During the review, the ERT asked the Party to explain the conditions and system of MBT implemented in Luxembourg. In response to the questions raised by the ERT during the review, the Party agreed that MBT should not be classified as an uncategorized landfill, but indicated that there is no clear place for reporting these emissions in the CRF tables. The ERT concludes that the system of MBT is biological treatment, which produces emissions and should not be classified as uncategorized SWDS and therefore recommends that Luxembourg allocate emissions from MBT to other (waste) for the year 1993 onwards. (FCCC/ARR/2013/LUX, para 69)	Not yet addressed. [LU NIR 2014, CRF, NIR 2014]
	Recommendations made in previous review reports included that Luxembourg revise the CH_4 recovery from solid waste disposal on land for 2000, for which a value from 2001 was used (0.15 Gg CH_4). Luxembourg has not revised the value in the 2013 annual submission. Therefore, the ERT reiterates the recommendation made in the previous review report that,	In the CRF table 6 A,C in the year 2000 NO is reported for recovery. The NIR 2014 states that for the year 2000, no data is available, so that the IPCC default for nonmonitored data was used.. (LU NIR 2014, p.414, CRF table 6 A,C)

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Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	consistent with the IPCC good practice guidance, the Party use monitoring data to report CH_4 recovery or assume that no recovery occurs. (FCCC/ARR/2013/LUX, para 70)	
Netherlands	The QA/QC activities in the waste sector are covered by the general QA/QC procedures and by the category-specific QA/QC procedures performed by the inventory compilers. The ERT noted that the NIR does not provide information on which category-specific QA/QC procedures have been implemented. The ERT reiterates the recommendation made in the previous review reports that the Netherlands include information on the category-specific QA/QC procedures and their results in the relevant sections of the NIR, in order to enhance the transparency of its reporting. (FCCC/ARR/2013/NLD, para 65)	Not yet addressed. No specific QA/QC procedures are mentioned in this source category. [NL NIR 2014]
	The ERT noted that the uncertainty assessments have remained at the same level as in previous years, despite the improvements in AD in recent years, and therefore reiterates the recommendation made in the previous review report that the Netherlands provide an explanation of the expert judgement used in the uncertainty assessments for the waste sector. (FCCC/ARR/2013/NLD, para 66)	A new study for estimating uncertainty for CH_4 emissions from waste disposal is mentioned. More information on uncertainty analysis is provided in Annex 7 [NL NIR 2014, p. 246]
	The Netherlands applied the first order decay (FOD) model from the IPCC good practice guidance to estimate CH_4 emissions from landfills. The ERT noted inconsistencies between NIR table 8.2 and CRF table 6.A (additional information) regarding the parameters used in the FOD model. For example, according to the NIR the fraction of degradable organic carbon in municipal solid waste in 2011 was 0.03 but according to CRF table 6.A it was 0.05. In response to a question raised by the ERT during the review, the Party confirmed that the data in NIR table 8.2 are correct. The ERT recommends that the Netherlands rectify those inconsistencies and strengthen its QC activities to avoid such errors. (FCCC/ARR/2013/NLD, para 67)	Improved. There is no inconsistency between the NIR and the CRF tables with regard to fraction of DOC. [NL NIR 2014, p. 142, CRF table 6A,C]
Portugal	The quantity and composition of disposed industrial solid waste are based on annual waste registries for 1999 onwards. In 2000, there was a significant drop in the quantities of some organic waste fractions (particularly paper and sludge). The ERT considers that there has been an underestimation of emissions from industrial solid waste disposal associated with the low estimate of solid waste disposed and the degradable organic carbon (DOC) estimate for 2000. In addition, the ERT considers that the solid waste disposal and DOC estimates for 2001 have also been underestimated as the disposal data for 2001 have been	To calculate industrial solid waste disposal and DOC for 2000 and 2001 an interpolation techniques between the years 1999 and 2002 has been applied. [PT NIR 2014, p. 8-15]

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Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	derived using interpolation techniques for between 2000 and 2002. If an underestimation of the amount of solid waste disposed and the DOC estimate has occurred, this will lead to an underestimation of emissions for all years following the disposal of waste. The ERT therefore recommends that Portugal revise the solid waste disposal and DOC estimates for 2000 and 2001 using interpolation techniques for between 1999 and 2002. (FCCC/ARR/2012/PRT, para 154)	
	Portugal uses a revised waste classification system to estimate the weighted average of DOC for 2004 onwards. This has led to a structural break in the time series of DOC values, as several waste types that were previously reported individually have been aggregated in the revised classification system. Portugal assumes a DOC value for the aggregated waste category “household and similar waste” of 0.15; this value does not accurately reflect the paper and wood fractions of this waste category. The ERT considers that this approach has caused an underestimation of the DOC values and an associated underestimation of emissions for the years 2004–2010. When the composition is taken into account, the DOC value becomes 0.17. The ERT recommends that the Party use interpolation techniques to derive the data on the amount of waste disposed and the DOC value for the years 2004–2006 where no disposal or composition data are currently available, and that Portugal make efforts to obtain disposal and DOC data for those years. In the absence of the required waste composition data, the ERT recommends that Portugal use waste composition data from countries with similar national circumstances to derive an appropriate DOC value. (FCCC/ARR/2012/PRT, para 155)	Implemented. [PT NIR 2014, p.8-14, 8-15]
	In response to the list of potential problems and further questions raised by the ERT during the review week, Portugal provided revised estimates for 2000 onwards. These recalculations have resulted in an increase in estimated emissions from industrial solid waste disposal on land of 645.45 Gg CO_2 eq for 2010. The ERT recommends that the Party include a full description of the measures taken to address the time-series consistency issues and provide revised emission estimates in its next annual submission. (FCCC/ARR/2012/PRT, para 156)	Not yet addressed. [PT NIR 2014]
Spain	The ERT noted that, in line with what was identified in the previous review report, for the waste sector, substantial use is made of IPCC default values for the parameters used in the calculations (e.g. for the methane conversion factor	Some parameters have been updated by using detailed information from individual landfills where available.[ES NIR 2014, pp. 8.15]

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Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	(MCF), the fraction of degradable organic carbon (DOC) dissimilated and the methane generation rate constant (k)). The Party informed the ERT during the review that it will work to improve these parameters for the next annual submission. (FCCC/ARR/2012/ESP, para 129)	
	In addition, the ERT concluded that there are other instances where Spain has not used sufficient country-specific data or provided sufficient justification to ensure the accuracy of the estimates for this key category; for example: Spain has not provided sufficient justification in the NIR for the use of some parameters (e.g. for the oxidation factor, there is no reference to management practices); the Party has not considered fractions of MSW when determining k values, instead using the same value for all fractions of MSW; the Party has not supported with data the assumption that 50 per cent of waste is deposited in deep and 50 per cent in shallow unmanaged landfills; and DOC values have still been extrapolated for the period 1997–2010, regardless of recommendations made in previous review reports. (FCCC/ARR/2012/ESP, para 130)	For the oxidation factor Spain used the IPCC default factor for managed waste disposal sites and confirmed this factor with several landfills and IPCC guidelines make no further reference to management practices beyond the separation between managed and unmanaged sites. Spain is not using the same k value for all landfills, but for 4 landfills K values specific for these landfills. DOC values have been updated based on a new study. [ES NIR 2014, p. 8.13 ff]
	Furthermore, the ERT found some inconsistency between the information obtained by the questionnaires, as provided by the Party during the review, and the MSW composition reported in the NIR: the MSW composition reported in the NIR excludes garden and park waste, as well as sludge from wastewater treatment, which are deposited in landfills after having been dried. This impairs also the accuracy of the DOC value. Spain clarified to the ERT during the review week that this situation results mostly from differences between levels of accessibility to information for individualized and non-individualized landfills. Therefore, the ERT reiterates the encouragement made in previous review reports for Spain to enhance its efforts to establish country-specific parameters, improve the AD collection process and recommends that Spain increase the transparency of the documentation of its choice of parameters for its next annual submission. (FCCC/ARR/2012/ESP, para 131)	Sludge and garden and park waste have been taken into account and are explained in the part related to waste composition. [ES NIR 2014, p. 8.15 ff]
Sweden	Sweden applied the first order decay (FOD) method with default and some country-specific parameters. The ERT noted that CH_4 emissions from this category have an uncertainty of 56.0 per cent and make a significant contribution (5.9 per cent) to the uncertainty of total GHG emissions in 2011. The ERT also noted that in the 2011 and 2012 annual review reports it was recommended that Sweden conduct studies to obtain country-specific parameters for use in the FOD method to reduce the	The recommendation has been changed to an encouragement by ERT during in country-review submission 2013, since country-specific parameters are not a reporting requirement. Not addressed. [SE NIR 2014, p. 434, 436]

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Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	uncertainty and improve the accuracy of the CH_4 estimates for this key category. This recommendation was not addressed in Sweden's 2013 annual submission. In response to a question raised by the ERT during the review, Sweden explained that this improvement is listed in the approved improvements with funding for the Swedish national inventory. Therefore, the ERT encourages Sweden to conduct the pertinent studies to develop and use the resulting country-specific parameters in its next annual submission. (FCCC/ARR/2013/SWE, para 84)	
United Kingdom	CH_4 emissions from solid waste disposal on land were calculated using the IPCC first order decay model and some country-specific parameters (e.g. national data on waste quantities, composition, properties and disposal practices). For the 2012 annual submission, the AD on the amount of waste landfilled and the country-specific degradable organic carbon values were updated, in line with an official research study published in 2011. The model adopted in the previous annual submission was revised in order to address the errors identified in the previous review report (e.g. the overestimation of landfilled dissimilable degradable organic carbon compounds (DDOC) from commercial and industrial waste and inconsistencies in the method used to calculate the DDOC values). Recalculations were therefore applied to the entire time series. However, the ERT noted a lack of transparency in the explanations of the recalculations provided in the NIR, particularly in relation to the revised errors in the model and the update of the waste composition data considered for solid waste disposal on land. The ERT recommends that the United Kingdom improve the transparency of its explanations of the recalculations performed in its next annual submission. (FCCC/ARR/2012/GBR, para 114)	Clearer descriptions of recalculations were included in the 2013 submission. No feedback has been received from review team so this approach will continue to be used.(GB NIR 2014, p.508)
	The ERT noted that CH_4 emissions from solid waste disposal on land were not estimated for one of the OTs (Montserrat) for all years of the time series. The ERT considered this to be a potential underestimation of emissions. In response to questions raised by the ERT during the review, the United Kingdom provided the ERT with additional information and informed the ERT of its intention to estimate and report these emissions. In response to the list of potential problems and further questions raised by the ERT during the review, the United Kingdom submitted revised estimates for this category for the complete time series. These estimates resulted in an increase in emissions of 1.13 Gg CO_2 eq, or 0.01 per cent of total sectoral emissions, for 2010. The ERT agreed with the	Included in the 2013 submission.[GB NIR 2014, p. 508]

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2013 submission**	**Status in 2014 submission**
	revised emission estimates. (FCCC/ARR/2012/GBR, para 115)	
	The United Kingdom estimated the CH_4 captured using the figures of gas utilized for energy purposes and the total available flaring capacity of the landfills. The previous review report highlighted as an issue the fact that the CH_4 collection efficiency rate increased from 1990 to 2004 and was considered constant and equal to 75 per cent from 2005 onwards. In the current annual submission, the CH_4 collection efficiency rate has remained the same as in the previous annual submission. In the NIR, the Party does not justify its use of the assumed values, but makes reference only to the permit conditions for landfill operators in the United Kingdom (to collect 85 per cent of the CH_4 formed in landfills) and states that a pilot study is being implemented in a selection of landfills of different ages in order to improve the accuracy of the calculations of the CH_4 collection rate. In response to questions raised by the ERT during the review, the United Kingdom provided additional information on this issue to the ERT: the preliminary results of the study show a wide range of values for the CH_4 collection rate for different landfills and, thus, the data could not be used as a basis for extrapolation for all landfills from 2005 onwards. During the review, the United Kingdom informed the ERT that it is planning to improve the study and that the results will be provided in the next annual submission. The ERT strongly reiterates the recommendation in the previous review report that the United Kingdom improve the estimates of the CH_4 collection rate in order to provide better evidence to support its estimates of landfilled waste emissions in the United Kingdom. Moreover, the ERT also noted that the CH_4 collection values presented in table A 3.8.2 of the NIR are not consistent with the values presented in the text in the NIR. The ERT recommends that the United Kingdom ensure that these values are consistent across the NIR in its next annual submission. (FCCC/ARR/2012/GBR, para 116)	The ERT recommends UK to revise the calculation of methane emission from SWDS for the whole time series by using gas recovery data from monitored sources only. Unless well documented monitoring data on flared methane is available, only methane recovery for power generation should be taken into account, and the amount of CH_4 recovery flared should be considered as zero. (GB NIR 2014, p.502)

Note: Review reports (ARR 2013), (ARR 2012)
Source: NIR 2014, CRF 2014 UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6947.php
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6616.php

CH_4 emissions from **6A2 Unmanaged Waste Disposal on Land** account for 0.1 % of total EU-15 GHG emissions in 2012. Between 1990 and 2012, CH_4 emissions from this source decreased by 61 % (Table 8.4). All member states with unmanaged waste disposal feature a decreasing emission trend, due to a decreasing amount of municipal waste going to unmanaged waste disposal sites.

In Spain, emissions in 2012 are higher than in 1990, though, due to an increase of emissions until the year 2000 and a decline only thereafter. The trend of the emissions from unmanaged landfills is influenced by two kinds of emissions: instant emissions, due to waste burning, and emissions originated by waste disposed in a series of years up to the current year. The latter emissions are estimated by Spain with the first order kinetic methodology as the processes for decomposition in landfill of the municipal waste have a maturing period of several years, which may range from one year for the more labile components up to over 35 years for those with the lowest biodegradation rate. The combination of both processes (burning of wastes disposed in the current year plus emissions from wastes disposed in the past) produces this reversal of CH_4 emissions trend in 2000.

This could similarly be observed for Portugal in 1998, due to a continuous reduction of waste disposal in unmanaged sites. Since 1997 there has been a continuous reduction of this disposal type; the majority of unmanaged dumping sites closed in 2002.

Not all member states reported emissions from this source since all waste disposal sites in the countries are managed (Austria, Belgium, Denmark, Finland, Germany (due to first Waste Act since 1972), Luxembourg, the Netherlands, Sweden) or considered to be not significant sources (the UK). France, Italy, Greece and Spain are responsible for about 89 % of the total EU-15 emissions from unmanaged waste disposal sites. France and Italy show large absolute reductions between 1990 and 2012. In these two countries, waste is not disposed on unmanaged landfill sites any more (in Italy since 2000, in France since 2006). However, emissions are still produced from the waste disposed in the past.

The reduction of emissions from unmanaged waste disposal on land in Italy is caused by legal acts. The first legal provision concerning waste management was issued in 1982. In this decree, uncontrolled waste dumping as well as unmanaged landfills are forbidden, but the enforcement of these measures was concluded only in 2000. Thus the share of waste disposed on uncontrolled landfills gradually decreased, and in the year 2000 it is assumed as equal to zero; nevertheless emissions still occur due to the waste disposed in the past years.

Following the Greek National and Regional Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is in progress, and unmanaged solid waste disposal sites in Greece are expected to decline (from 4690 unmanaged sites in 1987 to 2182 sites still operating in 2000 and further).

Table 8.4 shows that 100 % of the EU-15 emissions are estimated using higher tier methodologies.

Table 8.4 6A2 Unmanaged Waste Disposal on Land: Member states' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	IE,NO	NO	NO	-	-	-	-	-	NA	NA
France	3 779	1 032	965	18%	-67	-7%	-2 814	-74%	T2	CS
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	1 911	1 564	1 501	28%	-63	-4%	-410	-21%	T2	CS,D
Ireland	1 173	142	133	2%	-9	-7%	-1 041	-89%	T2	CS,D
Italy	5 194	1 484	1 414	26%	-70	-5%	-3 780	-73%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	1 006	533	490	9%	-43	-8%	-516	-51%	T2	CS,D
Spain	885	953	908	17%	-45	-5%	23	3%	T2	D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**13 948**	**5 707**	**5 409**	**100%**	**-298**	**-5%**	**-8 538**	**-61%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.5 provides information on the contribution of member states to EU recalculations in CH_4 emissions from 6A Solid Waste Disposal on Land for 1990 and 2011 and main explanations (as available in the national inventory reports) for the largest recalculations in absolute terms.

Table 8.5 6A Solid Waste Disposal on Land: Contribution of member states to EU recalculations in CH_4 emissions for 1990 and 2011 (difference between latest submission and previous submission)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	33	2.7	New data on the landfill gas recovery became available, leading to revised CH4 emissions for 2008-2011. Based on a new study on landfill gas practice in Austria, less CH4 is recovered and consequently more CH4 emitted (recalculation 2011: + 33 Gg CO2e).
Belgium	-164	-6.3	-83	-12.5	Wallonia: correction oxidation factor : impact= -33 kt. Flanders: optimization activity data (+/- -50 kton CO2eq).
Denmark	-112	-7.6	32	4.6	The recalculation of emissions from Solid Waste Disposal on Land is caused by an in depth 1) disaggregation and re-allocation of the old ISAG waste cat-egories according to 18 characterised waste types and 2) allocation of waste amounts reported in the new waste data system into the same 18 defined waste types within this years.
Finland	0	0.0	0	0.0	
France	190	2.3	0	0.0	Transcription error: improved accuracy.
Germany	0	0.0	0	0.0	
Greece	0	0.0	94	2.9	Updated Activity Data.
Ireland	0	0.0	37	4.4	Methane emissions from solid waste disposal on land (6.A.1) have been revised for all years from 2004-2011 due to a disaggregation of organic waste into food and garden waste.
Italy	0	0.0	-763	-6.1	Update of activity data. Correction of a mistake regarding CH4 flaring.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-12	-0.2	2011: AD (waste quantities) for Açores Islands revised for 2008-2011.
Spain	-16	-0.3	-931	-7.8	Ammounts of waste burned have been incorporated and Changes in waste compositon have been applied
Sweden	0	0.0	0	0.0	
UK	-110	-0.3	5 395	38.3	Methane recovery data for landfills now taken from monitored data.
EU-15	**-212**	**-0.1**	**3 804**	**5.0**	

8.2.2 Wastewater handling (CRF Source Category 6B) (EU-15)

Source category 6B includes the key sources CH_4 from industrial wastewater and CH_4 and N_2O from 6B2 Domestic and commercial wastewater. Methane and nitrous oxide are produced from microbial processes (anaerobic decomposition of organic matter, nitrification) in sewage facilities. N_2O is also indirectly released from disposal of wastewater effluents into aquatic environments[61]. Domestic and commercial wastewater includes the handling of liquid wastes and sludge from housing and commercial sources through wastewater collection and treatment, open pits/latrines, ponds, or discharge into surface waters.

Table 8.6 shows total GHG, CH_4 and N_2O emissions by member state from 6B Wastewater Handling. Between 1990 and 2012, CH_4 emissions from wastewater handling decreased by 21% in EU-15 (a decrease of emissions took place in 8 member states, whereas Denmark, France, Ireland, Italy, Portugal, Spain and Sweden increased their emissions), N_2O emissions from wastewater handling remain at the level of 1990 (with an increase in 9 member states, whereas Denmark, Finland, France, Luxembourg, the Netherlands and Sweden reduced their emissions of nitrous oxide).

[61] In most countries, indirect N_2O emissions from disposal of wastewater effluents are the major source of N_2O emissions from wastewater handling, whereas direct N_2O emissions from wastewater treatment plants are small or not relevant.

Table 8.6 6B Wastewater handling: Member states' contributions to total GHG, CH_4 and N_2O emissions from 6B

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2012 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N2O emissions in 2012 (Gg CO2 equivalents)
Austria	211	289	102	23	109	266
Belgium	504	388	210	79	293	309
Denmark	170	147	65	74	105	73
Finland	297	213	154	114	144	99
France	2 278	2 027	874	1 254	1 404	773
Germany	3 842	2 412	1 483	22	2 359	2 389
Greece	3 662	1 492	3 331	1 109	331	383
Ireland	126	164	15	19	112	145
Italy	3 821	4 661	1 990	2 725	1 831	1 935
Luxembourg	15	10	6	3	9	7
Netherlands	771	656	290	199	482	457
Portugal	2 945	3 112	2 486	2 530	459	582
Spain	1 554	1 879	481	610	1 072	1 269
Sweden	502	460	292	305	211	155
United Kingdom	2 835	2 798	1 677	1 624	1 158	1 174
EU-15	**23 535**	**20 708**	**13 456**	**10 692**	**10 080**	**10 016**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 6B1 Industrial Wastewater account for 0.2 % of total EU-15 GHG emissions. Between 1990 and 2012, corresponding CH_4 emissions increased by 4 %. Large decreases in absolute terms are reported by the UK and Italy, whereas Portugal shows significant emission increases (Table 8.7). Portugal is responsible for 31 %, the UK for 22 % and Italy for 21 % of EU-15 emissions from this source in 2012.

Table 8.7 6B1 Industrial Wastewater: Member states' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-
Denmark	IE	IE	IE	-	-	-	-	-
Finland	22	16	17	0.3%	1	8%	-5	-22%
France	74	76	76	1%	0.01	0.02%	2	3%
Germany	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Greece	855	854	853	15%	-1	-0.1%	-1	-0.2%
Ireland	2	5	5	0.1%	-0.02	-0.5%	3	165%
Italy	1 277	1 198	1 189	21%	-9	-1%	-88	-7%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	5	7	7	0%	0.2	3%	2	36%
Portugal	1 430	1 786	1 787	31%	1	0.1%	357	25%
Spain	401	494	477	10%	-17	-3%	76	19%
Sweden	7	10	10	0.2%	-1	-6%	2	29%
United Kingdom	1 376	1 349	1 266	22%	-83	-6%	-111	-8%
EU-15	**5 450**	**5 795**	**5 687**	**100%**	**-108**	**-2%**	**237**	**4%**

Abbreviations explained in the Chapter 'Units and abbreviations'

An important driver for CH_4 emissions from 6B Wastewater Handling are CH_4 emissions from 6B2 Domestic and Commercial Wastewater in France, Germany, Greece, Italy and Portugal in 1990[62]. Therefore and in response to the recommendation by the ERT (FCCC/ARR/2009/EC, para 84), more information about the development of CH_4 emissions from wastewater handling in these countries is presented.

CH_4 emissions from 6B2 Domestic and Commercial Wastewater account for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2012, corresponding CH_4 emissions decreased by 37 %. Large decreases in absolute terms are reported by Germany and Greece, contributing together to only 6 % of EU-15 emissions from source 6B2 in 2012, whereas France and Italy feature show significant emission increases (Table 8.8). Italy is responsible for 31 %, France for 24 % and Portugal for 15 % of EU-15 emissions from this source in 2012. Although two of these member states (Italy and France) increased their emissions between 1990 and 2012, the trend of EU-15 emissions is dominated by the large emission reductions in Germany and Greece.

French CH_4 emissions from domestic and commercial wastewater (6B2) show an increasing trend from 1990 to 2001 and remain at a rather constant level thereafter (with a slight increase since 2004). One driver influencing the trend is the share of population connected to different wastewater treatment systems. The share of the population connected to septic tanks increased from 1990 to 2000 (from 13 % in 1990 to 18 % in 2000), and remained almost constant thereafter (17 %). In the same period, the share of the population with direct discharge of wastewater decreased from 8 % in 1990 to 2 % in 2012. Wastewater treatment in collective systems increased slightly from 79 % in 1990 to 81 % in 2012.

Germany's reduction in CH_4 emissions from domestic and commercial wastewater (6B2) occurred mainly between 1990 and 1998. The decrease of 95 % in that period was due to the legal requirement to connect households to decentralised wastewater treatment plants. The basis for legal requirements for the collection and treatment of domestic and commercial wastewater is the Council directive 91/271/EWG concerning urban wastewater treatment from 1991. Many wastewater plants had to be built in the former GDR after the German reunification, as most households were not connected to a sewage system, but used septic tanks.

The Greek CH_4 emissions from 6B2 decreased mainly between 1999 and 2001 (-56 %) due to the increased number of wastewater handling facilities with aerobic conditions. Domestic wastewater handling in aerobic treatment facilities shows a substantial increase since 1999, while in the industrial sector only a few units exist where wastewater is handled under anaerobic conditions. The penetration of facilities with aerobic conditions increased from 32 % (share of population) in 1999 and to 91 % in 2012.

Italian CH_4 emissions from domestic and commercial wastewater handling have increased slightly throughout the time series, with the most prominent increase between 1999 and 2005. This is due to the fact that the organic load in wastewater increased substantially during the same period. CH_4 emissions from domestic and commercial wastewater handling in Portugal have decreased continuously during the time series, with emissions remaining at a stable level since 2007. Whereas the organic load remained rather constant, the share of different wastewater treatment types has changed significantly. In 1990, 37 % of the population did not have access to a sewage system. This share decreased significantly until 1999. By 2005, the whole population was connected to a kind of wastewater treatment system. Especially, the share of the population connected to secondary and tertiary treatment has increased significantly from about 11 % in 1990 to almost 60 % in 2012. Similarly, the share of population with private septic tanks has increased from 1.5 % to 21.0 % in the same period.

[62] Spain also has a significant share in EU-15 CH_4 emissions from wastewater handling. However, these are influenced predominantly by industrial wastewater treatment and are therefore not discussed here.

Table 8.8 6B2 Domestic and commercial wastewater: Member states' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	102	23	23	0.5%	0.1	0%	-79	-77%
Belgium	210	102	79	2%	-23	-22%	-132	-63%
Denmark	65	75	74	1%	-1	-1%	9	13%
Finland	131	101	97	2%	-4	-4%	-34	-26%
France	800	1 172	1 177	24%	6	0%	377	47%
Germany	1 483	25	22	0.5%	-2	-10%	-1 461	-98%
Greece	2 476	256	256	5%	-0.3	0%	-2 220	-90%
Ireland	13	13	14	0.3%	1	6%	2	13%
Italy	713	1 528	1 536	31%	8	1%	823	115%
Luxembourg	6	3	3	0.1%	-0.1	-3%	-3	-52%
Netherlands	190	176	176	4%	-0.2	0%	-15	-8%
Portugal	1 056	746	743	15%	-3	-0.4%	-313	-30%
Spain	75	125	125	3%	0.1	0.1%	50	66%
Sweden	284	293	296	6%	2	1%	11	4%
United Kingdom	300	361	359	7%	-3	-1%	58	19%
EU-15	**7 907**	**4 999**	**4 980**	**100%**	**-18**	**0%**	**-2 927**	**-37%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.9 provides information on the contribution of Member states to EU recalculations in CH_4 from 6B Wastewater handling for 1990 and 2011 and main explanations (if available in member states' inventories) for the largest recalculations in absolute terms.

Table 8.9 6B Wastewater Handling: Contribution of member states to EU recalculations in CH_4 for 1990 and 2011 (difference between latest submission and previous submission)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	-0.4	Statistics on the Austrian population have been revised downwards, leading to slightly re-vised emission data for 2007-2011 (recalculation 2011: - 1.1 Gg CO2e).
Belgium	0	0.0	0	0.1	Due to an update of the FAO statistics, from 2000 onwards, the protein consumption has been corrected during this 2014 submission in Belgium. As a result emissions in the category 6B2.
Denmark	-0.7	-1.1	-1.3	-1.7	The major reason for the observed reduction of the total emission from Sec-tor 6.B is due to the elimination of a correction factor that was not justified after verification of nitrogen effluent data with the newest reporting of efflu-ent data in the report series "point sources" published by the Danish EPA.
Finland	0	0.0	-0.1	-0.1	Corrected population data.
France	28	3.3	38	3.2	Taking into account new data : improved accuracy.
Germany	-743	-33.4	-36	-59.0	See Definition of Sludge in the NIR (Chap. 8.3.2.2.1). Sludge together with purified wastewater is the final product of waste water treatment. During the wastewater treatment the sludge (as a part of wastewater) has been treated in digestion towers and therefore does not contain any TOS (according to definition of the IPCC 1996 Guidelines, Reference Manual p 6.13+19). Change of MCF.
Greece	314	10.4	63	6.0	Updated Activity Data.
Ireland	-0.1	-0.4	2	13.8	Revised DC data based on new PE data for UWWT plants.
Italy	0	0.0	-8	-0.3	Update of industrial wastewater.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-11	-0.4	6B1 (2011): wastewater handling types updated/collected based on information from Environmental Licenses. 6B2: revision of population data (2008-2011).
Spain	-81	-14.4	-79	-11.2	The recalculation is motivated by the updating of the activity variable (Industrial Production Indices, according to new information published by the National Institute of Statistics (INE))
Sweden	0	0.0	4	1.3	Activity data on recovery of methane from sludge at municipal wastewater threatment plants has been updated.
UK	0	0.0	80	4.9	Revised activity data recevied for 6B1.
EU-15	**-483**	**-3.5**	**51**	**0.5**	

N_2O emissions from 6B2 Domestic and Commercial wastewater account for 0.3 % of total EU-15 GHG emissions. Between 1990 and 2012, emissions remained at the same level (Table 8.10). Comparably large decreases in absolute terms are only reported for France, whereas Austria, Italy and Spain feature relevant emission increases in absolute terms (Table 8.10). France increased the N efficiency of wastewater plants significantly since 1990, leading to decreasing N_2O emissions. Therefore, France contributes with a share of 8 % to EU-15 emissions in 2012, whereas this share amounted to 14% in 1990.

In the ARR 2013 para 87 the ERT recommends that the Party include European Union-level AD in the CRF tables. As not all MS report activity data in all categories, this would require gap filling by applying the IEFs. In the waste sector there are huge differences between the IEFs of those MS that report emissions and AD. E.g. for CH_4 from 6.B.1.a industrial wastewater the range is between 0.002 and 0.25 and this seems too large to calculate a reliable average IEFs and use this for the gap filling. Therefore gap filling and reporting of European Union-level AD in the CRF tables could only be applied in the category N_2O emission from human sewage. The AD for protein consumption in the European Union has been calculated as a weighted average of per capita consumption of 13 countries out of the EU-15, by ignoring activity data of Luxembourg and the Netherlands as they were using a different approach to calculate N_2O emissions from this category.

Table 8.10 6B2 Domestic and Commercial Wastewater: Member states' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	106	207	208	2%	1	0%	103	97%
Belgium	293	307	309	3%	2	1%	16	5%
Denmark	105	79	73	1%	-7	-8%	-32	-31%
Finland	105	76	78	1%	2	3%	-27	-26%
France	1 326	706	709	8%	3	0.5%	-617	-47%
Germany	2 224	2 262	2 268	24%	6	0.2%	44	2%
Greece	326	377	377	4%	-1	-0.2%	51	16%
Ireland	112	144	145	2%	0	0.2%	33	29%
Italy	1 761	1 884	1 879	20%	-5	-0.3%	118	7%
Luxembourg	9	11	7	0.1%	-3	-30%	-2	-19%
Netherlands	466	455	454	5%	-1	-0.2%	-12	-3%
Portugal	299	374	368	4%	-5	-1%	70	23%
Spain	1 072	1 267	1 269	13%	2	0.1%	197	18%
Sweden	173	134	134	1%	0	0%	-39	-23%
United Kingdom	1 158	1 144	1 174	12%	30	3%	15	1%
EU-15	**9 534**	**9 428**	**9 452**	**100%**	**24**	**0%**	**-82**	**-1%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from household wastewater are mainly driven by the daily per capita protein consumption. Germany was responsible for 24 %, Italy for 20 %, Spain and the United Kingdom for almost 13 % each of the emissions from this source in 2012.

Table 8.11 provides information on the contribution of member states to EU recalculations in **N_2O emissions** from **6B Wastewater** Handling for 1990 and 2011 as well as the main explanations.

Table 8.11 6B Wastewater Handling: Contribution of member states to EU recalculations in N_2O for 1990 and 2011 (difference between latest submission and previous submission)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-1	-0.4	Statistics on the Austrian population have been revised downwards, leading to slightly re-vised emission data for 2007-2011 (recalculation 2011: - 1.1 Gg CO2e).
Belgium	0	0.0	7	2.2	New data from FAO concerning "Protein consumption".
Denmark	0	0.0	0	0.0	
Finland	0	0.0	-0.1	-0.1	Improved activity data based on final protein consumption.
France	2	0.2	3	0.4	Taking into account new data : improved accuracy.
Germany	16	0.7	-28	-1.2	6.B.1 Industrial Wastewater \ Wastewater: Compared to the last Inventory Reporting, sugar and wheat starch production where added to the estimation. 6.B.2.2 Human sewage: New data on population figures.
Greece	0	0.0	0	0.1	Updated Activity Data.
Ireland	0	0.0	3	2.0	N2O emissions from human sewage (6.B.2) were revised for 2011 due to a change in population statistics.
Italy	0	0.0	5	0.2	Update of activity data.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	1	0.2	Improved activity data.
Portugal	-3	-0.7	-5	-0.8	6B1 (2011): wastewater handling types updated/collected based on information from Environmental Licenses. 6B2: a) 1990 and 2011: Separate accounting of N2O emissions from sewage sludge application on agriculture land b) 2011: revision of population data (2008-2011)
Spain	0	0.0	17	1.3	The recalculation is motivated by the updating of the activity variable (population).
Sweden	0	0.0	-1	-0.5	Activity data on protein consumtion updated.
UK	0	0.0	-54	-4.5	Removal of small double count with sewage sludge incineration. Also sewage sludge applied to agricultural land has been aligned with data in 4D.
EU-15	**16**	**0.2**	**-54**	**-0.5**	

8.2.3 Waste incineration (CRF Source Category 6C) (EU-15)

This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy use are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture.

Table 8.12 and Table Table 8.13 give an overview of greenhouse gas emissions from waste incineration by member state. CO_2 emissions from (non-biogenic) waste incineration account for 0.1 % of total EU-15 GHG emissions. CO_2 emissions decreased by 47 % between 1990 and 2012. All member states decreased their CO_2 emissions from waste incineration between 1990 and 2012, except for Belgium, Greece, Portugal and Sweden. The United Kingdom, France and Italy feature the largest decreases in absolute terms; these member states account for 72 % of CO_2 emissions from this source (non-biogenic waste incineration) in 2012.

Table 8.12 6C Waste Incineration: Member states' contributions to total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2012 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2012 (Gg)
Austria	27	2	27	2
Belgium	291	518	288	518
Denmark	0.21	0.29	NO	NO
Finland	IE	IE	IE	IE
France	1 899	1 318	1 789	1 222
Germany	NO	NO	NO	NO
Greece	0.35	4	0.22	3
Ireland	84	40	83	39
Italy	590	245	507	170
Luxembourg	IE	IE	IE	IE
Netherlands	IE	IE	IE	IE
Portugal	14	29	13	18
Spain	344	14	305	3
Sweden	45	66	44	60
United Kingdom	1 484	299	1 292	252
EU-15	**4 777**	**2 534**	**4 348**	**2 288**

CO_2 emissions of Denmark, Finland, Germany, Luxembourg and the Netherlands are included in the energy sector. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.13 6C Waste incineration: Member states' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
Austria	27	2	2	0.1%	0	0%	-25	-92%
Belgium	288	528	518	23%	-11	-2%	230	80%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	IE	IE	IE	-	-	-	-	-
France	1 789	1 402	1 222	53%	-180	-13%	-568	-32%
Germany	NO	NO	NO	-	-	-	-	-
Greece	0.2	3	3	0.1%	0	8%	3	1366%
Ireland	83	37	39	2%	2	6%	-44	-53%
Italy	507	173	170	7%	-3	-2%	-337	-66%
Luxembourg	IE	IE	IE	-	-	-	-	-
Netherlands	IE	IE	IE	-	-	-	-	-
Portugal	13	19	18	1%	-1	-3%	6	47%
Spain	305	3	3	0.1%	0.2	5%	-302	-99%
Sweden	44	60	60	3%	0.3	1%	16	37%
United Kingdom	1 292	269	252	11%	-17	-6%	-1 040	-80%
EU-15	**4 348**	**2 495**	**2 288**	**100%**	**-208**	**-8%**	**-2 060**	**-47%**

CO_2 emissions of Denmark, Finland, Germany, Luxembourg and the Netherlands are included in the energy sector. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.14 6C Waste incineration: Contribution of member states to EU recalculations in CO_2 for 1990 and 2011 (difference between latest submission and previous submission)

	1990		2011		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	-2	-0.8	3	0.5	Wallonia: re-allocation of the emissions of waste incineration between 1A1a and 6C.
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	53	3.0	33	2.4	6C1, 6C2.1, 6C2.2: updated data; improving accuracy. 6C2.4: consideration of new issues; improve completeness.
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	-16	-30.8	Revised activity data.
Italy	0	0.0	-62	-26.4	Update of activity data.
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	5	36.9	Industrial waste: 2004-2006 data revised on the basis of interpolation of 2003 and 2007. 2011: revision of the quantities incinerated based on the GDP data (data for 2011-12 not available).
Spain	227	289.6	0.1	2.9	6C2- Incineration of corpses: The recalculation is motivated by the updating of the activity variable. 6C2 - Incineration of hospital waste; Municipal waste burning: This item was mistakenly labeled as NO and thence, it has been updated to IE (included into category 1.A.1.A). 6C2 - Unmanaged Landfills (burning): Burning activity of waste in unmanaged landfills does not occurs.
Sweden	0	0.0	0	0.0	
UK	0	0.0	0.8	0.3	Updated activity data received for some clinical incineration sites from 2009 onwards.
EU-15	**277**	**6.8**	**-37**	**-1.4**	

8.3 Methodological issues and uncertainties (EU-15)

The following considerations address national methods and circumstances which are available in the member states' national inventory reports. The focus is laid on the reporting categories 6A1 CH_4 emissions from managed solid waste disposal sites and 6A2 CH_4 emissions from unmanaged solid waste disposal sites since they are EU-15 key categories and contribute 2 % and 0.1 % of total GHG emissions, respectively. CH_4 emissions from the reporting category 6B2 from domestic and commercial wastewater are a key source in the EU-15 as well and is also comprehensively analysed. Source categories 6B1, 6C and 6D are also discussed.

8.3.1 Managed Solid Waste Disposal (CRF Source Category 6A1) (EU-15)

For key sources in the source category 6A it is good practice to use the First Order Decay (FOD) method (Tier 2) to calculate the emissions and to display emissions trends over time. All EU-15 member states applied – in line with the IPCC Good Practice Guidance – Tier 2 methodologies in order to estimate CH_4 emissions from managed solid waste disposal sites, which means that 100 % of all EU-15 emissions are calculated using higher tier methods, see Table 8.2. Belgium used a country-specific emission model in accordance with the Tier 2 methodology. Most remaining member states applied the Tier 2 methodology proposed by the IPCC Good Practice Guidance and the IPCC Guidelines. Luxembourg applied the Tier 1 methodology from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, which is a first order decay model with default parameters, so, in the context of the Revised 1996 IPCC Guidelines and the IPCC good practice guidance the method could be classified as Tier 2. Table 8.15 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites (SWDS).

Table 8.15 6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions

Member State	Description of methods
Austria	For the calculation of emissions of solid waste disposal on land, IPCC Tier 2 method is applied. Where available and within the range of the IPCC guidelines, country-specific factors are used. If these are not available, IPCC default values are taken.
Belgium	The methodology used to calculate the emissions from solid waste disposal on land differs between the two regions in Belgium where these sites are located (Flanders and Wallonia). In the Flemish region, a combination of two models is used: a multiphase model for the estimation of emissions of the sites which are permitted and a first order decay model for all other, old waste disposal sites which are no longer permitted to dispose, but where still emissions occur after the ban of disposal on these sites (these are the solid waste disposal sites in after-care). In the Walloon region, CH_4 emissions from solid waste disposal on land are calculated with a first order decay model that considers separately emissions from industrial and municipal waste until 2007. Since 2010, Walloon waste statistics are given in another format which does not consider separately the amounts of industrial and municipal waste anymore. The overall methodology follows the Tier 2 IPCC methodology. No waste disposal site is located in the Brussels region.
Denmark	The calculation of CH_4 emissions at the Danish SWDSs is based on a First Order Decay (FOD) model according to an IPCC tier 2 approach. The model calculations are performed using national statistics on landfill site characteristics and amounts of waste fractions deposited each year. This year's submission is based on allocation of the old ISAG and the new waste data for which amount are reported according to the European waste codes into 18 defined waste types with individual content of degradable organic matter and half-life´s.
Finland	Finland uses the FOD model according to the IPCC Tier 2 method (with a slight modification) as a basis for the estimation of CH_4 emissions. Calculations are not made separately for each landfill but the total waste amount and the average common MCF value for each year have been used. It has been thought that the situation in year t defines the MCF to be used for the emissions caused by waste amounts landfilled in the previous years (and degraded later in year t) as well.
France	Country-specific first order decay method which uses a country-specific CH_4 production potential as key parameter. Quantities of waste landfilled are known from 1960 onwards and based on the surveys ITOMA of ADEME.
Germany	IPCC Tier 2 Method used partly with IPCC default parameters, partly with country-specific parameters where available.
Greece	IPCC Tier 2 Method used. The estimation of methane emissions from solid waste disposal on land is based on the application of the FOD method. The method was applied separately for the managed and unmanaged waste disposal, taking account of the different conditions in those sites and the detailed information available regarding the opening and closure years of the operation of the managed sites.
Ireland	The methodology for estimating CH_4 production given in the 2006 IPCC Guidelines has been applied for use in the 2010 and subsequent submissions. The model is a simple first-order decay spread sheet model that keeps a running total of the amount of degradable organic carbon (DOC) available in a landfill as the basis for calculating the amount of DOC converted to CH_4 and CO_2 annually. In the present model analyses undertaken for both individual sites and groups of landfills, annual MCF values show an increase over time to reflect the change from generally shallow, poorly-managed landfills before 1998 (and therefore pre landfill licensing) to well controlled and engineered landfills in subsequent years. The model was

Member State	Description of methods
	applied for the six largest landfills individually and to all other landfills by assigning them to seven separate groups according to annual waste amount and life cycle. Two additional runs were used to account for sewage sludge and street cleanings.
Italy	Emission estimates from solid waste disposal on land have been carried out using the IPCC Tier 2 methodology, through the application of the First Order Decay Model (FOD). It is assumed that all the landfills, both managed and unmanaged, started operation in the same year, and have the same parameters, although characteristics of individual sites can vary substantially.
Luxembourg	The spreadsheet implementing the Tier 1 methodology from the 2006 IPCC Guidelines for national greenhouse gas inventories has been used. Following the recommendations of the in-country review of 2008 and the centralized review of 2009, the calculation was made since 1950 and also taking into account the pre-treatment of waste before being landfilled. In 2009, the Environment Agency conducted two studies: 1) Composition of the high caloric fraction from SIDEC and 2) Emissions of the waste deposited at the MSW landfills. In 2011 the study "Emissions of the waste deposited at the MSW landfills" was refined for the period 2004-2007, calculated for the years 2008 and 2009 and extrapolated for the years 2010 to 2011.
Netherlands	In order to calculate the CH_4 emissions from all the landfill sites in the Netherlands, the simplifying assumption was made that all the wastes are assumed to be landfilled on one landfill site, an action that started in 1945. However, characteristics of individual sites vary substantially. CH_4 emissions from this 'national landfill' are then calculated using a first-order decomposition model (first-order decay function) with an annual input of the total amounts deposited and the characteristics of the land-filled waste and the amount of landfill gas extracted. This is equivalent to the IPCC Tier 2 methodology. Since the CH_4 emissions from landfills are a key source, the present methodology is in line with the IPCC Good Practice Guidance.
Portugal	To better take into account to the fact that CH_4 emissions from SWDS occur over a long period of time and not immediately after disposal of waste on land, the methodological approach considered was the First Order Decay Method (Tier 2).
Spain	IPCC Tier 2 Method is used. Estimation parameters are partly taken from country-specific data as provided by landfill operators (e.g. DOC, MCF, as well as from IPCC default parameters (DOC_F, .K, oxidation factor)
Sweden	The method used for estimating methane emissions from municipal solid waste is the Tier 2 methodology, the IPCC First Order Decay model, with a slightly different time factor and with some estimates on the national gas potentials.
United Kingdom	The UK approach for calculating emissions of methane from landfills uses a "Tier 2" methodology based on national data on waste quantities, composition, properties and disposal practices over several decades. The equations for calculating methane generation use a first-order decay (FOD) methodology.

Source: NIR 2014

The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. In the following, a detailed overview of the most important parameters and methodological aspects of the FOD method applied by the member states is presented. The main factors influencing the quantity of CH_4 produced are the amount of waste disposed of on land and the concentration of biodegradable carbon in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the member states are summarised in Table 8.16.

Table 8.16 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data

Member State	Data sources used for generating time series (6A1)
Austria	Data for 2008-2012 is taken from the EDM (Electronic Data Management), administered by the Federal Ministry of Agriculture, Forestry, Environment and Water Management. These data are available due to the fact that since 2009 landfill operators are obliged to register their data at the portal of http://edm.gv.at. From 1998 to 2007, data are taken from a database for solid waste disposals “Deponiedatenbank” (“Austrian landfill database”), a database administered and maintained by the Umweltbundesamt until 2008. From 1950 to 1997, the amounts of deposited residual waste are taken from national studies and the Federal Waste Management Plans. The quantities of non-residual waste from 1998 to 2007 are taken from the Deponiedatenbank. For the years 2008-2012, the quantities are taken from the EDM. Only the amounts of waste with biodegradable lots are considered. There are no data available for the years before 1998. Thus extrapolation was done using the Austrian GDP (gross domestic product) per inhabitant as indicator.
Belgium	In the Walloon region, the quantity of waste disposed comes from the statistics of OWD (Walloon Waste Office). Until 2008, the industrial and municipal waste disposed was published based on taxes declaration forms covering solid waste disposal sites of various sizes. For 2008, data on industrial and municipal waste were gathered including classification to main categories and subcategories. Those statistics are available on a yearly basis since 1994. For the years before, the amounts are estimated using available data and OWD expert judgement assumptions. In the Flemish region, input data of waste disposal sites are available since 1990. The main data source is the Flemish Institute for Waste Management (OVAM). For estimating emissions from old landfills with the first order model data is available from OVAM from the year 1981 onwards. For the period 1970-1980, the amounts of waste have been estimated by VITO [1] based on the 1981 data. From 2002, waste is no longer disposed at the older SWDS.
Denmark	The data used for the amounts of municipal solid waste deposited at managed solid waste disposal sites are worked out by the Danish Environmental Protection Agency (DEPA) in the ISAG database which provides landfill data for the years 1994-2009 and the new waste data system provides data for 2011 (DEPA, 2013). Data for 2010 and 2012 have not yet been published by the Danish EPA and was obtained by direct contact in the DEPA. Waste characterization data for the year 1985 and information on the total amount of waste deposited at SWDSs in 1970 reported by the Danish EPA in 1993 (DEPA, 1993) was used in the back calculation of the time series from 1994-1985. Data for 1971-1984 have been determined by assuming a linear development between 1970 and 1985. 1960-1969 data are assumed constant at the 1970 lev-el.
Finland	Activity data for the time series is taken from different sources: The VAHTI database contains data on the total amounts of waste taken to landfills from 1997 onwards. Corresponding data for the years 1992-1996 were collected to the Landfill Registry of the Finish Environment Institute. The activity data for municipal waste for the year 1990 is based on the estimates of the Advisory Board for Waste Management (1992) for municipal solid waste generation and treatment in Finland in 1989. The disposal data (amount and composition) at the beginning of 1990s for industrial, construction and demolition waste are based on surveys and research by Statistics Finland, VTT Technical Research Centre of Finland and National Board of Waters and the Environment. Estimated data on waste amounts before the year 1990 is based on a report by VTT. Estimated data on waste amounts before the year 1990 are based on the report of VTT (Tuhkanen 2002). In this report GDP has 30% weight and population has 70% weight for generated municipal solid waste. At the beginning

Member State	Data sources used for generating time series (6A1)
	of 1900's all the generated municipal solid waste was assumed to be landfilled and landfilling has linear development to 80% of the situation in the year 1990. Other waste groups develop according to the corresponding industrial or construction economical activities.
France	Quantities of waste landfilled are known from 1960 onwards and based on the surveys ITOMA of ADEME.
Germany	The amount of landfilled municipal waste is taken from the Federal Statistics Office (1975 – 2004). The surveys of waste quantities commenced in 1975 on the basis of the Environmental Statistics Act in 1974. Waste quantities for the period from 1950 to 1975 were extrapolated on the basis of population data. Landfilled wastes after 1 June 2005 must not, according to the legislation, contain biodegradable components and do not, therefore, contribute to the generation of landfill gas. Data for landfilled waste in the former GDR in the 1980s were provided by a national study. According to that study the amount of landfilled waste per capita was significantly lower than in the old German Länder (190 kg/capita versus 330 kg/capita). For the years 1990 and 1993 for the new German Länder detailed data about landfilled municipal solid waste is available. Since 1996, differentiated data is available on landfilled quantities of individual fractions of industrial waste. The amount of landfilled industrial waste between 1975 and 1996 was derived on the basis of the overall amount of landfilled waste. The amount of landfilled industrial waste is kept constant between 1950 and 1975. Data on landfilled sludges from municipal and industrial wastewater treatment is available since 1975 for the Old German Länder and was extrapolated for the time period before 1975 based on population data as well as on the assumption that the amount of sludges from industrial wastewater remained constant.
Greece	Estimates on solid waste quantities generated are included in various reports from research programmes and studies, but refer to specific points in time rather than to a whole period, while different assumptions have been applied in each case for the estimation of quantities generated. Therefore, data for some years are either missing or are unreliable. The quantities of municipal solid wastes for the period 1960-2000 was estimated on the basis of population figures and coherent assumptions regarding generation rates per capita and day, in order to derive complete time series for waste quantities generated. For the rest of the period 2001-2012 more accurate data for the quantities of municipal solid wastes was used as they were provided by the waste management sector of the Ministry of Environment, Energy and Climate Change (MEECC). For the estimation of the quantities of municipal solid wastes the method was used in previous submission were based on the assumption that MSW generation rates was in the order of 0.8 – 1.1 kg/ capita and day, depending on the type of region (rural, semi-urban, urban, large urban regions) in 1997. According to the Ministry of Environment, Energy and Climate Change (MEECC) the MSW generation rate was assumed to change annually by 0.028 kg/ capita and day, while a higher figure (annual increase by 0.035 kg/capita and day) was assumed for the regions of Athens, Central Macedonia, Crete and the islands of South Aegean. A higher figure for MSW generation rate (2.1 kg/ capita and day) was considered for foreign visitors. For the period 1960 – 1990 the rates of annual per capita waste increase are lower (0.8% - 1.5% depending on the region).
Ireland	The EPA commenced the development of the National Waste Database (NWD) in the early 1990s to address a severe lack of information on waste production and waste management practices in Ireland. The database was needed to support radical reform of national policy and legislation on waste pursuant to the Waste Management Act of 1996 and subsequent Government strategies on sustainable development and waste management. National statistics generated from this database published on a three-year cycle, and interim reports published on a yearly basis since 2001 by the EPA are the primary basis for establishing the historical time-series of municipal solid waste (MSW) placed in landfills from 1995 onwards. Identification and risk assessment of historical landfills serves as the main source of information on landfilling of waste prior to 1995. The results of other surveys undertaken in previous years have also been used to some extent in compiling the MSW time series. The NWD reports, published since 1995, provide a good starting point for assigning waste quantities to individual landfills and provide a representation of waste composition. However, assumptions on waste quantities and

Member State	Data sources used for generating time series (6A1)
	composition are still required to establish the basic historical information, given the extended time-frame that must be taken into account for a number of the models. The waste quantities for each of the 14 IPCC spread sheet model analyses are determined by adding up the amounts of household and commercial waste for the relevant landfills for each year where this is given by the NWD. The quantities of waste for other years, which are not available from the NWD, are estimated by using a variety of documents and published reports.
Italy	Basic data on waste production and landfills system used for the emission inventory are those provided by the Waste Cadastre. The Waste Cadastre is formed by a national branch, hosted by ISPRA, and by regional and provincial branches. The basic information for the Cadastre is mainly represented by the data reported through the Uniform Statement Format (MUD), complemented by those provided by regional permits, provincial communications and by registrations in the national register of companies involved in waste management activities. Since 1999, ISPRA yearly publishes a report, in which waste production data, as well as data concerning landfilling, incineration, composting and generally waste life-cycle data, are reported. It has been assumed that waste landfilling started in 1950. The complete database from 1975 of waste production, waste disposal in managed and unmanaged landfills and sludge disposal in landfills is reconstructed on the basis of different sources, national legislation and regression models based on population. Since waste production data are not available before 1975, they have been reconstructed on the basis of proxy variables. Gross Domestic Product data have been collected from 1950 and a correlation function between GDP and waste production has been derived from 1975; thus, the exponential equation has been applied from 1975 back to 1950. Consequently the amount of waste disposed into landfills has been estimated, assuming that from 1975 backwards the percentage of waste landfilled is constant and equal to 80%. The amount of waste disposed in managed landfills is yearly provided by the national Waste Cadastre since 1995. The time series has been reconstructed backwards on the basis of several studies reporting data available for 1973, 1988, 1991, 1994.
Luxembourg	Activity data were calculated in accordance to the MSW produced per capita/year. Data on the population are from STATEC. No national data on municipal waste production from 1950 to 1989 were available. Data from Germany for the years 1950 and 1975 were used. Data in-between were interpolated. Data for Luxembourg for the year 1990 were available (581 kg) which were nearly identical to the IPPC default values (560 kg). Data up to the year 2012 were from the Environment Agency taking into account the effect of aerobic decomposition at SIGRE since 1993 and at SIDEC since 2007.
Netherlands	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly. The following data is available from the monitoring protocols provided by NL under http://english.rvo.nl/topics/sustainability/national-inventory-entity/monitoring-protocols-0 Between 1945 and 1970 a number of municipalities already held detailed records of the collection of waste. In addition information was available about which municipalities hed their waste inciner-ated or composted. All other municipal waste was landfilled. Using this information in combination with data on landfilling of various sources data for the years 1950, 1955, 1960, 1965 and 1970 determined and published [Van Amstel et al , 1993] while it was assumed that during the Second World War hardly any waste was landfilled. These data are also used in the FOD-model, while missing years (1945-1950, 1951-1954, 1956-1959, 1961-1964 and 1966-1969) are linearly extrapolated. From 1970 on good data on production and waste treatment are available [Spakman et. al, 1997, elec-tronic update, 2003]

Member State	Data sources used for generating time series (6A1)
	Landfill site operators systematically monitor the amount of waste dumped (weight and composition) for each waste site. Since 1993 monitoring has occurred by weighing the amount of waste dumped, via weighing bridges (= compulsory environmental permits). Data concerning the amounts of waste dumped since 1991 are supplied by the Working Group for Waste Registration (WAR), included as part of the annual report 'Afvalverwerking in Nederland' (Waste processing in the Netherlands). Information concerning the way in which these data are gathered and the scope of the information used can be found in the annual publications 'Afvalver-werking in Nederland', available since 1991 from the WAR (Agentschap NL).
Portugal	Since 1999, data on MSW is available, including production amounts, final disposal and, to a less extent, waste composition. For previous years information was available from the Strategic Plan on Municipal Solid Waste which was approved by the Government in 1997. This plan includes data from annual municipal registries. Another source of information is a research study performed by Quercus. The data was based on a survey performed in 1994, which enabled the calculation of per capita generation rates for 1994, based on the amounts of waste collected and the population served by waste collection. Before 1994, data on landfill wastes had to be estimated based on expert judgment for waste generation growth rates. For the period 1960-1980 it was considered a per capita waste generation growth rate of 2.5% per year; for the following years (1980-1994) 3% per year. To take into account the fact that part of the population (rural areas) was not served by an organised waste collection and waste disposal system, values of annual production were multiplied by the percentage of population served by waste collection in each municipality. After 2000, it was assumed that all the population of the country is served by waste collecting systems. The total amount of waste disposed to SWDS was then calculated based on this estimated value minus the amounts of waste incinerated and composted. The share of final disposal destiny for the first years of the time series was calculated having as a basis the Quercus survey. Data for recent years (mainly since 1999) refer to data collected from management systems.
Spain	For the period 1990 to 2008, the information is provided directly by the Ministry of the Environment (MMA) in the publication, "The Environment in Spain" and is derived from questionnaires provided by the landfill operators. For large SWDS and those with biogas recovery, the activity data is derived from questionnaires provided by each landfill operator. For the period 2009 to 2011 the information has been compiled by the national focal point. The data for the most recent year are taken from the previous year. For the period from 1950 to 1990, the calculation of the waste deposited at managed SWDS without biogas capture and unmanaged SWDS has been estimated by multiplying the coefficient of MSW generation per inhabitant and day, by the population, the number of days in the year and the fraction of MSW generated that is deposited in each type of landfill. In 2011, 37 landfills operated with landfill gas capture.
Sweden	Household waste: A first national survey was elaborated by EPA in 1980, similar data in 1985 and 1990 and 1994 were provided by Statistics Sweden, since 1994 an annual survey on landfilled waste is carried out by Avfall Sverige – Swedish Waste Management. Figures on sludge from wastewater treatment and garden waste are available since 1990. Industrial waste: There is information on industrial waste from the 1980s but organic fractions were not specified. Studies on quantities and treatment of organic waste from industry in 1993 and 1996 were carried out by the Swedish EPA. Landfilled wastewater sludge from the pulp industry (important waste fraction) was yearly documented until 2000 by the Swedish EPA. Today the sludge from the pulp industry is incinerated and composted. Since 2006 waste statistics are reported to the EU. The treatment of waste is to be reported by treatment method for the different types of waste according to EWC-Stat. The method of treatment relates to various recovery and disposal operations ("R and D codes") are compiled into 5 different groups. Group 4, "Disposal operations: Land filling, deep injection, surface impoundment, permanent storage and others", is relevant for "Solid waste disposal on land, CRF 6A". So far, waste data has been reported for the reference years 2004, 2006, 2008 and 2010. No waste statistics on landfilling are compiled for the intermediate years by SEPA. In 2010,

Member State	Data sources used for generating time series (6A1)
	a study was carried out in order to analyse possibilities to use the reported waste data to WStatR for the calculations of CH_4 from solid waste land-fills. The study recommended implementation of WStatR-data from reference year 2006 and onwards. Historical data has been extrapolated five half-life periods back in time, which means that, for the calculations of 1990, all deposited gas potentials since 1952 are considered. All available historical information on national deposited quantities is used in the calculation. The quality of data on household waste is high since 1980, but data on organic industrial waste is scarce. The consequence is that many as-sumptions on historical deposited waste quantities have been made, which have greater impact on the calculated emissions in 1990 than in 2012. From 1980 statistics on household waste is available, whereas statistics on sludge from waste water treatment and garden waste becomes available from 1990 onwards. Interpolation is used for the intermediate years. Before 1990, park/garden waste and sludge from households are assumed to be directly proportional to the population, with the same proportion as in 1990.
United Kingdom	Estimates of waste composition and quantities have been taken from different sources – prior to 1995 they are from Brown *et al.* (1999), prior to 2000 they are based on the LQM (2003) study and from 1995 they are based on new information compiled by Eunomia (Eunomia, 2011). The new waste to landfill data indicates a significant decrease in the amount of LA-controlled and C&I waste sent to landfill since about 2002 and 2003.

Source: NIR 2014

Some member states explicitly describe the consistency of their time series (compare Table 8.17.

Table 8.17 6A1 Managed Solid Waste Disposal: Consistency of time series of activity data

Member State	Consistency of time series
Austria	The amount of waste from administrative facilities of businesses and industries is not considered in the data from 1950 to 1999, whereas it is included in the Deponiedatenbank, which is used for the activity data from 1998 onwards. To achieve a consistent time series, data of the two overlapping years (1998 and 1999) were examined and the difference, which represents the residual waste from administrative facilities of industries and businesses, was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly. There is no explicit description of time series consistency for non-residual waste.
Belgium	In the Flemish region, input data of waste disposal sites are available since 1990. In Wallonia, complete statistics on the amount of waste input in solid waste disposal sites are delivered on a yearly basis since 1994. For the previous years, the amounts are estimated using available data and expert judgment from the waste offices.
Denmark	Registration of the amount of waste has been carried out since the beginning of the 1990s in order to measure the effects of action plans. The activity data are, therefore, considered to be consistent through the time series to make the activity data input to the FOD model reliable. The consistency of the emissions and the emission factor is a result of the same methodology and the same model used for the whole time series. The parameters in the FOD model are the same for the whole time series.
Finland	In Finland, the historical waste amount is assessed starting from the year 1900. The uncertainties in historical activity data (estimated on the basis of different weighting of the population and GDP that are assumed to be good indicators of the amount of waste) are large but the amount of waste produced at the beginning of the 1900's was fairly small, thus reducing the significance of large uncertainties. The uncertainty estimates of the

Member State	Consistency of time series
	current amounts of waste are based on differences between different statistics and complemented with expert judgment. In the case of municipal sludge, the uncertainties in both historical and current activity data are quite large. On the other hand, the amount of industrial waste can be fairly accurately estimated based on industrial production, and therefore these uncertainties are the smallest in historical years. In Finland, the amount of landfill gas recovered is obtained from the Finnish Biogas Plant Register, and this figure is considered accurate. The time series' consistency of rejects from wood waste is imperfect considering the classification of these wastes. These rejects have been classified according to the origin (e.g. construction and demolition waste) of the wood waste since 2010 inventory. These EWC codes (191212 and 191211) were classified only as solid industrial waste in earlier inventories. If necessary this classification change could be done for earlier years in the next submission, also.
France	The statistical data sources are the same throughout the time series.
Germany	Over the long activity-data period involved, thirty years, time series inconsistencies are inevitable. In Germany, such inconsistencies are primarily a result of German reunification and the fusion of two different economic and statistical systems. Further aspects are changes of legislation and statistics in the waste sector.
Greece	The time-series consistency of emissions is controlled by applying consistent methodologies and verified activity data in line with IPCC guidelines. In case of changes or refinements in methodologies and EFs based on plant-specific data time-series consistency is ensured by performing recalculations according to the IPCC good practice guidance.
Ireland	The methodologies used in the derivation of emissions estimates from the waste sector are consistent over the time series. In the case of category 6.A, this consistency applies to all three components that determine the ultimate emissions, i.e. CH_4 generation, CH_4 flared and CH_4 utilised. Adoption of the model in the 2006 IPCC Guidelines is justified by the information available for its detailed application and brings Ireland into line with other Parties using this methodology well in advance of the expected mandatory use of these guidelines for inventory reporting post-2012.
Italy	No detailed description of time series consistency.
Luxembourg	No information available.
Netherlands	The estimates for all years are calculated from the same model, which means that the methodology is consistent throughout the time-series. The time-series consistency of the activity data is very good due to the continuity in the data provided.
Portugal	No detailed description of time series consistency.
Spain	Approaches in line with IPCC Good Practice Guidance are used for the activity data. Detailed descriptions are provided how some of the estimation parameters such as DOC have been interpolated.
Sweden	The times series in the waste sector are calculated consistently, and when statistics are not produced annually, interpolation and extrapolation have been necessary tools for imputation.
United Kingdom	The estimates for all years have been calculated from the MELmod model and thus the methodology is consistent throughout the time series.

Source: NIR 2014

The amount of waste disposed on SWDS depends on the total amount of waste generated and on the per capita waste generation rate, respectively. However, solid waste disposal in EU member states is not estimated based on the per capita waste generation rate; the waste generation rate is not a parameter used in the higher tier emission estimation. All member states use higher tier methods for the estimation of emissions from solid waste disposal, based on national statistics of solid waste disposal on waste disposal sites (see Table 8.2).

In the additional information box of the CRF tables, the waste generation rate is not very well defined. No clear definition is available on which waste fractions should be included for comparability; neither the UNFCCC reporting guidelines, nor the CRF, nor the IPCC Guidelines provide an exact definition which waste types and waste streams should be included in the estimation of the waste generation rate.

For instance, in Austria considerable amounts of composting are reported under 6D (other), which means that the composted waste is excluded from 6A. Between 2000 and 2012, the waste generation rate in Austria as reported in CRF table 6A,C decreased from 0.64 kg/capita/day to 0.05 kg/capita/day. This decline is due to a drop in the amount of annual municipal waste disposed on landfills (which is the basis for the calculation of the waste generation rate in Austria) by 92 % in the same period while the population only increased by 5 %. Since 2009, no further deposition of residual waste takes place on Austrian landfills, while there is still some non-residual waste landfilled (with a decreasing trend).

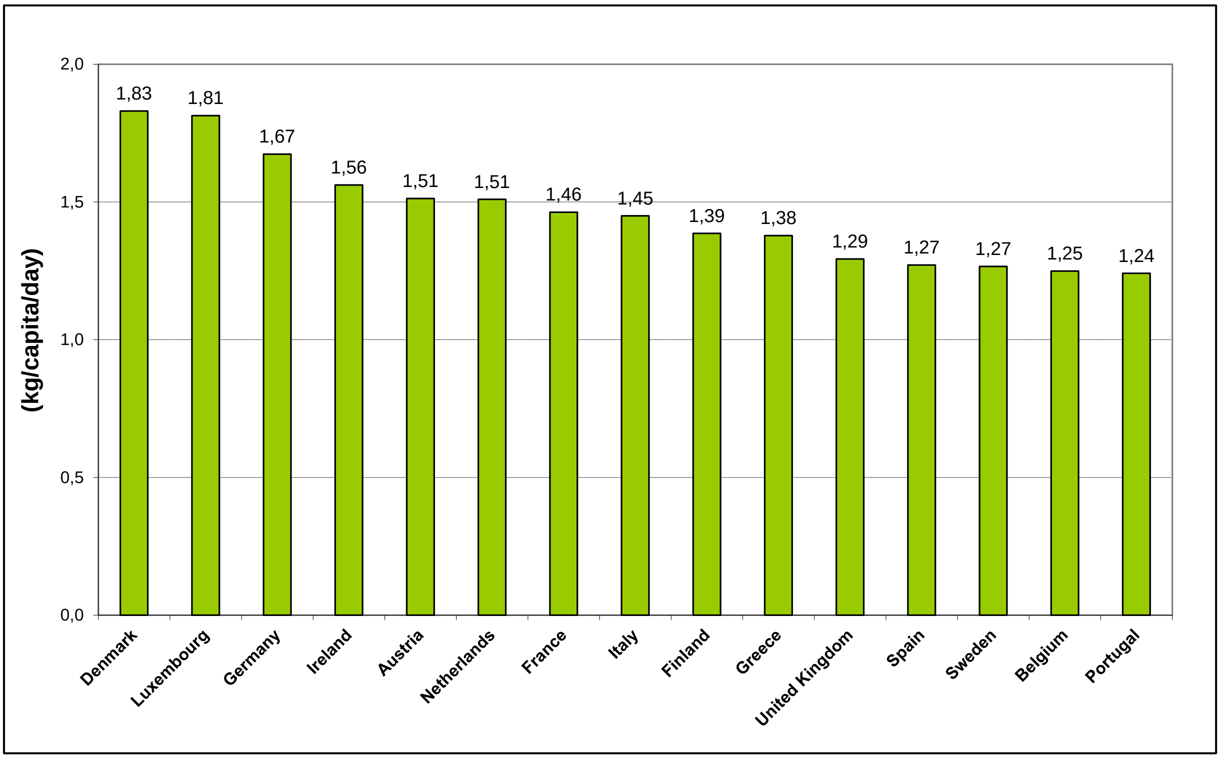
In Spain, tourists increase the amount of waste, but are not reflected in the population numbers.

It is difficult to explain the differences for all member states from the information available in the NIR. Because of the different coverage of wastes included, the waste generation rate reported does not reflect policies and measures to reduce waste generation.

To understand the background of the differences in the MS a decomposition analysis of this parameter would be necessary, but drivers are poorly monitored, such as the links between waste generation and public awareness on waste or the amount of waste generated by tourists.

Therefore, Figure 8.3 shows the waste generation rate for EU-15 member states for 2012 based on EUROSTAT data. On the basis of the Regulation on waste statistics (EC) No. 2150/2002, amended by Commission Regulation (EU) No. 849/2010, data on the generation and treatment of waste is collected from the member states. The information on waste generation has a breakdown in sources (several business activities according to the NACE classification and household activities) and in waste categories (according to the European Waste Classification for statistical purposes). The information on waste treatment is broken down to five treatment types (recovery, incineration with energy recovery, other incineration, disposal on land and land treatment) and in waste categories. The waste generation rate per capita ranges from 1.24 kg/capita/day for Portugal to 1.83 kg/capita/day for Denmark.

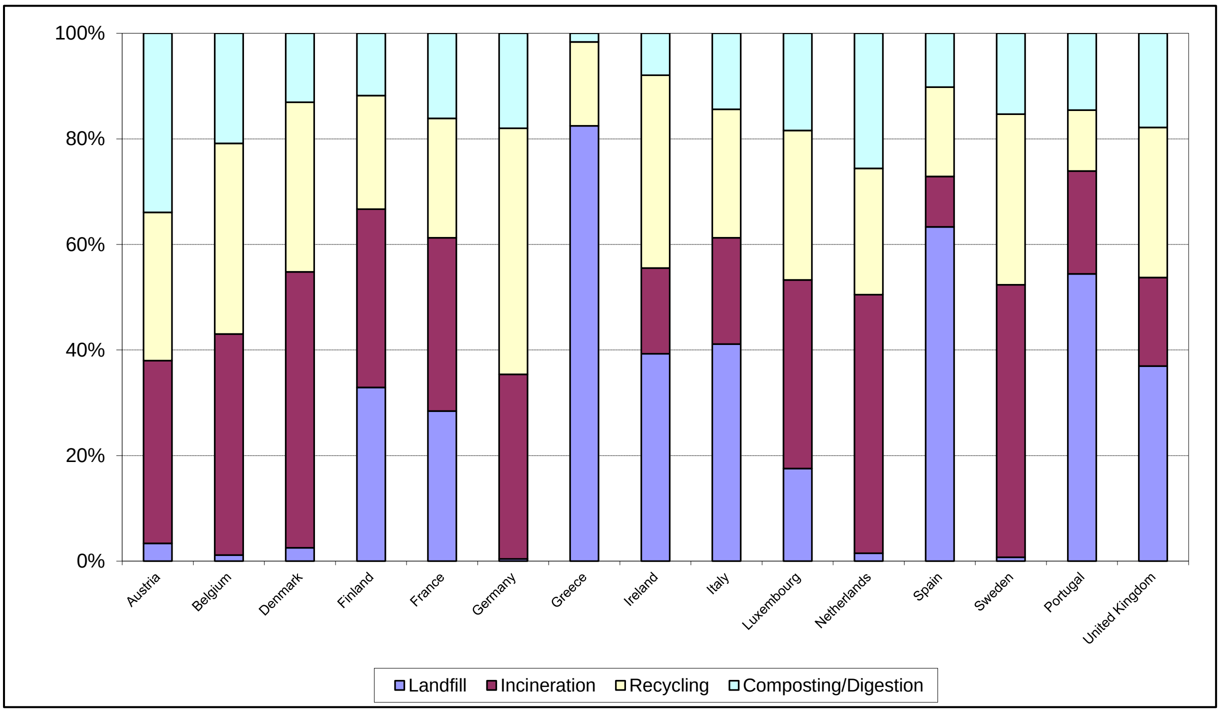
Figure 8.3 Waste Generation Rate, 2012



Source: EUROSTAT 2014, own calculations

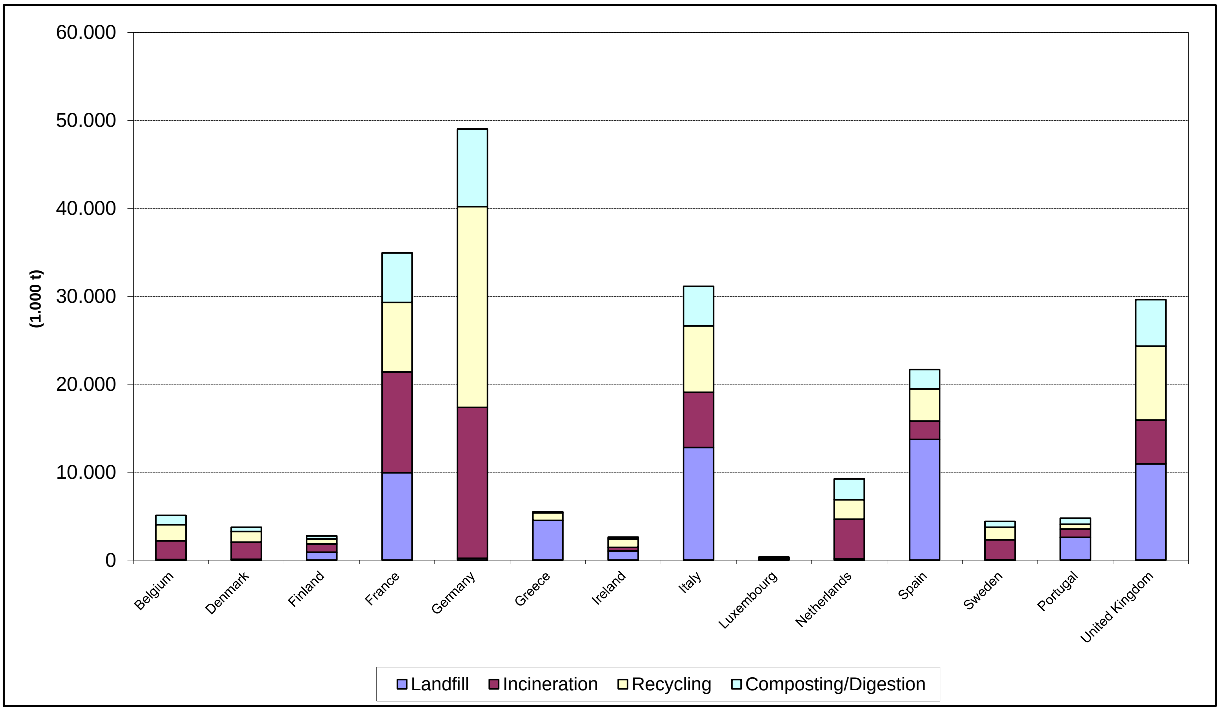
The amount of waste disposed on SWDS is also strongly influenced by the waste management practices in the member states: by the share of waste landfilled, incinerated, recycled and treated in other ways (including composting and digestion), compare Figure 8.4 and Figure 8.5.

Figure 8.4 : Waste management practices in the EU-15 (shares) in 2012



Source: EUROSTAT 2014, own calculations

Figure 8.5 : Waste management practices in the EU-15 (absolute values) in 2012



Source: EUROSTAT 2014, own calculations

Many member states experienced a reduction of waste landfilled and an increase of recycling, composting and landfill gas recovery. These trends have already taken place before the Landfill Directive and the Directive on packaging waste, but are further supported by these directives.

The waste management practices and policies which determine the fraction of municipal solid waste (MSW) disposed to SWDS, the fraction of waste incinerated and the fraction of waste recycled or composted differ significantly between the member states. For example, disposing waste on SWDS is the predominant waste disposal route in Greece and Spain with correspondingly fewer quantities of waste incinerated, recycled and composted. The low share of incineration is also due to public concern about the use of large-scale waste incineration. In Germany, Denmark and the Netherlands (also in Austria, Belgium and Sweden, (see Figure 8.4) it is vice versa. Since 2005, landfills in Germany remaining in operation may only store waste that conforms to strict categorisation criteria. Landfills also must reduce landfill gas formation from such waste by more than 90 % compared to gas production from untreated waste. In the Netherlands (also in Belgium), waste policy also has the aim of reducing landfilling by introducing bans for the landfilling of certain categories of waste, e.g. the organic fraction of household waste (in the early 1990s) and by raising the landfill tariff to comply with the incineration of waste.

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. While the first three parameters do not vary strongly among the member states, more information is provided on the DOC (Figure 8.6and Table 8.19) as well on waste composition of land filled waste (Table 8.18). The latter parameters are again strongly influenced by waste management practices and policies.

Table 8.18 6A1 Managed Solid Waste Disposal: Waste composition of landfilled waste

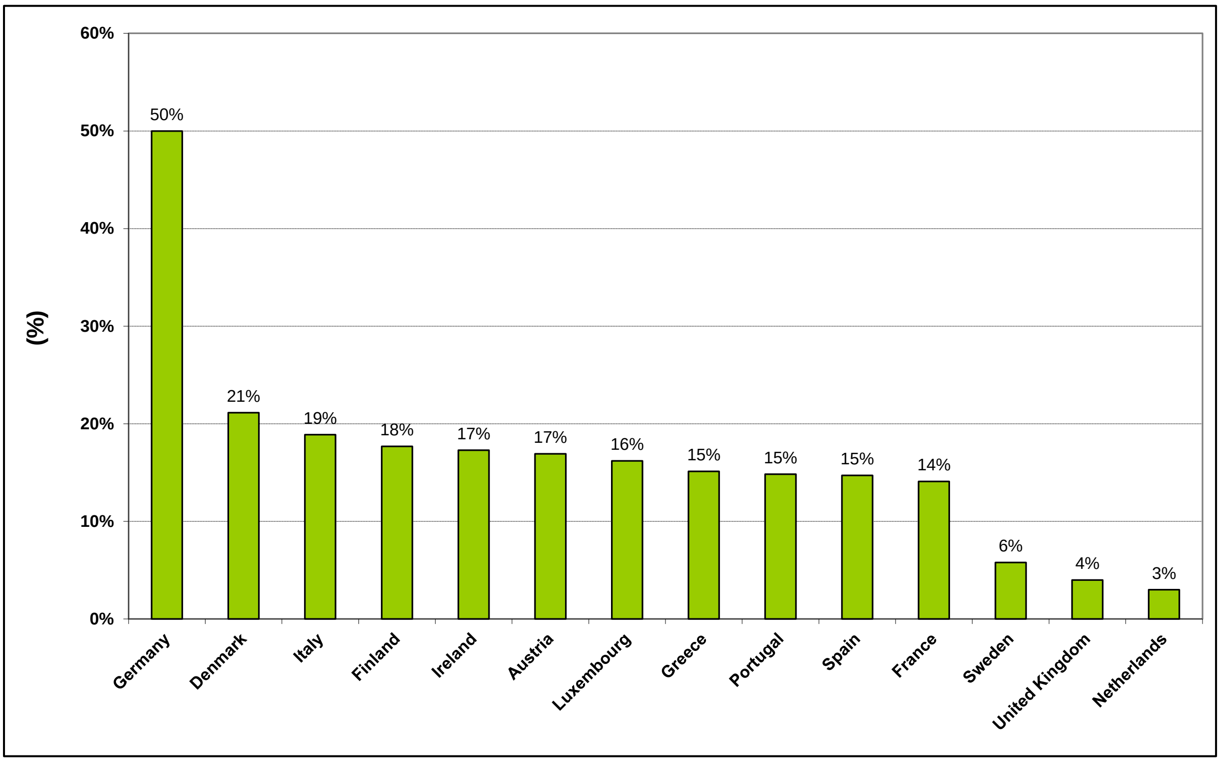
Member State	Composition of landfilled waste
Austria	Two main categories of waste are distinguished: residual waste and non-residual waste. Residual waste refers only to the part of municipal solid waste collected by the municipal system (mixed composition) that is directly deposited without any pretreatment. Non-residual waste comprises among others municipal solid waste having been pretreated, sludge from wastewater treatment and waste from industrial sources. Non residual waste includes wood, paper, sludges, sorting residues, biowaste, textiles, construction waste and fats. Residual waste includes paper, carboard; glass, metal; platic composite material; textlies, hygiene materials; biogenic components; hazardous household wastes; mineral components; wood, leather, rubber e.g..
Belgium	The Flanders multi-phase model distinguishes three categories of waste:1) household waste, 2)bulky waste and waste from municipalities and 3) industrial waste. In Wallonia waste types are differentiated into municipal and industrial waste until 2008 and now classified according to categories and subcategories according to the IPCC 2000 GPG.
Denmark	The amounts of waste deposited are registered and published in the national ISAG and new waste system (www.mst.dk) databases and have been allocated into 18 waste types: Food, Paper and cardboards; wood; plastic, textile, fur and leather; biodegradable garden waste; chemicals, inert; electric & hazardous; glass, metal; scrap vehicles; demolition, inert; soil & stone; particular matter and dust; sludge, inert; sludge, degradable; ash and slag; other not combustible waste. .
Finland	Solid municipal waste, municipal sludge, industrial sludge, solid industrial waste, construction and demolition waste, industrial and municipal inert waste, and other inert waste are considered as waste groups. These groups are further split into several subgroups. The composition of solid municipal waste is paper and paperboard, food, garden, plastics, glass, textiles, napkins, wood, other (inter) and other (organic). Detailed DOC values are provided in the NIR.
France	The method used differentiates between easily biodegradable, average degradable and weakly biodegradable waste.
Germany	Several studies on the waste composition were evaluated. The analysis for the Old German Länder was performed for different waste types: household waste (organic material, paper/cardboard, composites, textiles, diapers, and wood), commercial waste, and bulky waste (organic material, paper/cardboard, textiles, and wood). For the former GDR waste fractions were taken from a study. According to that study, household waste in the GDR was composed of vegetable waste, paper/cardboard, wood, rubber, composites as well as textiles.
Greece	Accurate data on the composition of municipal solid waste generated at national level are not available, as a comprehensive analysis at national scale covering a complete time period (so as to take into account seasonal variations because of tourist activity) has not been accomplished yet. However, measurements in some regions have been carried out, although they refer to different time periods. The composition of generated MSW comprises the following fractions: Food and non-food, textiles, wood, paper, plastics, metals, glass, and rest.
Ireland	Waste constituents of MSW that contribute to DOC are food waste, paper, wood, textiles and disposable nappies. Furthermore, street cleanings and sludge from municipal wastewater treatment are considered. Organic waste is now separated into food waste and garden waste.
Italy	An in-depth survey has been carried out, in order to diversify waste composition over the years. A fourth slot (2006-2009) has been individuated on the basis of the analysis of several regional waste composition

Member State	Composition of landfilled waste
	and the analysis of waste disposed into non-hazardous landfills specified by CER code for the year 2007, available from Waste Cadastre database. The following waste fractions are considered: organic, garden and park waste, paper and paperboard, nappies, textiles and leather, sludge and wood.
Luxembourg	Waste composition is exactly known since 1992. The data from the national waste composition analysis 1992/94 were used until 2003. For the years 2004 to 2009 the data from the 2011 study were used taking into account the aerobic pre-treatment before landfilling. For 2010-2012 values of the composition of the waste are as of 2009. For the years before 1992 no data are available. Luxembourg oriented its values near the IPPC default values but some changes were made: 1950-1974 it is assumed that the fractions “food”, “paper” and “wood” landfilled were lower. The difference was allocated to the fraction “plastics, other inert” waste. For the years before 1992 no data are available. Waste composition comprises the following fractions: food, garden, paper, wood, textile, nappies and plastics, other inert.
Netherlands	An average DOC value for waste as a whole is provided changing over time due to such factors as the prohibition of landfilling of combustible wastes.
Portugal	SWDS include solid municipal or urban waste (household, garden, commercial-services wastes) and industrial wastes. For the fermentable fractions of urban waste the following categories apply: paper and textiles, non-food fermentable materials, food waste, and wood or straw. For industrial waste several groups exist: paper and textiles, garden waste, park waste or other non-food organic putrescibles, food waste, wood or straw, fuels, plastics, sludge from natural origin, sludge from non-natural origin or hydrocarbons, synthetic fibres, and non-natural organic substances.
Spain	The composition of municipal solid waste comprises the following categories: organic matter, paper and cardboard, plastics, glass, ferrous metals, non-ferrous metals, wood, textiles, rubber and latex, disposable and rechargeable batteries, other. For waste from origins other than direct household collection, other categories apply: compost, waste water sludge and others. Specific information on the waste composition is provided based on questionnaires by plant operators.
Sweden	Landfilled waste includes household and similar waste, park and garden waste, industry- and non-industry specific waste (organic fractions), industry- and non-industry specific waste (organic and inorganic fractions), construction and demolition waste (organic and inorganic fractions) and sludge from wastewater handling and pulp industry.Deposited waste is further broken down into different waste fractions for household and industrial wastes, such as Household and similar wastes , Paper and cardboard wastes, Wood wastes, Textile wastes, Industrial effluent sludges: Dry matter eg.
United Kingdom	The UK method divides the waste stream into three categories of waste: rapidly degrading, moderately degrading, slowly degrading, and inert.

Source: NIR 2014

Fraction of Dissolved Organic Carbon (DOC) in MSW: The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste. Member states have MSW with widely differing waste compositions. While the average DOC value for different waste fractions in MSW for the year 2012 is illustrated in Figure 8.6, Table 8.19 provides corresponding detailed information on the DOC values extracted from the NIR.

Figure 8.6 6A1 Managed Solid Waste Disposal: Fraction of DOC in MSW, average for different waste fractions in 2012



Source: CRF 2014 Table 6A,C Additional information; CRF Belgium: NE.

Figure 8.6presents an average DOC, however usually different DOC values for individual waste fractions are used and since amounts of the different waste fractions vary over time, DOC-values also vary over time. In the case of the United Kingdom, a detailed review of waste composition with regard to materials, moisture content and dissimilable degradable organic carbon was carried out. For Austria composting of biodegradable waste is reported separately. Consequently, considerable amounts of waste with high DOC are excluded from category 6A which results in a lower DOC for the remaining MSW. In Italy, DOC values are based on different national studies. In addition the DOC reflects the considerable reductions achieved in diverting biodegradable waste to other waste management methods such as composting or mechanical-biological treatment.

Table 8.19 6A1 Managed Solid Waste Disposal: Further information on DOC values

Member State	Further information on DOC values
Austria	Detailed values for DOC_F and DOC differentiated with respect to the waste type are available in the NIR. The DOCs of the different waste categories under 'non residual waste' are constant for the entire time series. These categories are clearly defined (wood, paper, sludge, etc.) and can therefore be considered as quite 'homogenous'. Therefore there was no need to change the DOC over the years. The DOC of 'residual waste' has changed over the years in accordance with the changing composition due to the separate collection of biogenic waste, paper and cardboard, and glass, and the increase of food waste in recent years, etc. .
Belgium	In the Flanders multi-phase model the DOC value is further differentiated providing a single value of rapidly, moderately and slowly degradable for each of the different waste categories The DOC values in the Walloon region were calculated using the detailed waste types from OWD and the

Member State	Further information on DOC values
	IPCC Good Practice Guidance methodology.
Denmark	The DOC content is available for the waste categories food waste, cardboard, paper,wood; textile, fur and leather; biodegradable garden waste; demolition; degradable sludge.
Finland	DOC fractions of different types of waste are based on the IPCC 2006 default values and national research and measurements made in industry (revised DOC value for de-inking sludges). DOC values of groups (solid municipal waste, municipal and industrial sludge (from dry matter), solid industrial waste, construction and demolition waste, industrial inert waste, and other inert waste) and of subgroups are provided in the NIR.
France	An average DOC of 150 kg/t for the easily degradable waste (15% of waste deposited), 75 kg/ton is used for the average degradable waste (55% of waste deposited) and 0 kg/t for the weakly degradable wastes (30% of waste deposited). The annual average DOC varies between 99 and 114 kg/ton.
Germany	For the DOC, national and IPCC default factors were used. The following values were chosen: Organic material: 18%, garden and park waste: 20%, paper and cardboard: 40%, wood and straw: 43%, textiles: 24%, diapers: 24%, composites: 10%, sludges from wastewater treatment: 50%, waste from MBT facilities 2.3%.
Greece	Time series of total amounts of DOC for waste on managed and unmanaged waste disposal sites as well as of sludge are provided. Degradable organic carbon (DOC): 0.4 for paper and textiles (default value), 0.3 for wood (default value), 0.15 for food waste (default value), 0.17 for non-food waste and 0.4 for sewage sludge.
Ireland	The waste constituents of MSW that contribute to DOC are food waste, paper, wood, textiles and disposable nappies are identified in the available NWD breakdown for 1995, 1998, and 2001 through 2011. The IPCC default proportions of DOC content are used for all these constituents. Street cleansing composition data is available, and the DOC content is therefore calculated from its constituent components. In addition, a DOC content of 5 percent has been assumed for sewage sludge.
Italy	On the basis of data available on waste composition, the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream, the DOC contents and the methane generation potential values (L_0) have been generated.
Luxembourg	Waste analysis is being used to determine IPCC waste fractions to which default DOC contents are applied. The composition of the combustible fraction taken off the SIDEC waste and delivered to the MWI was analysed in 2009. This fraction having a higher C content than the average waste was taken into account for the calculation at the MWI.
Netherlands	The DOC changes over the time series. This change in DOC values over time is due to such factors as the prohibition of landfilling of combustible wastes.
Portugal	The estimation of DOC for urban waste is based on information on the waste composition from several sources and are national estimates. Furthermore, DOC values are available for the different groups of industrial waste. These DOC values resulted from weighted averages based on the quantities reported for each EWC category considered and the respective assigned DOC, and refer to disposal on land.
Spain	The degradable organic carbon content in MSW is obtained by applying equation 5.4 of the IPCC Good Practice Guidance to the composition information derived from the data evaluated in the corresponding questionnaires provided by landfills and from the publication “The Environment in Spain”. The average DOC

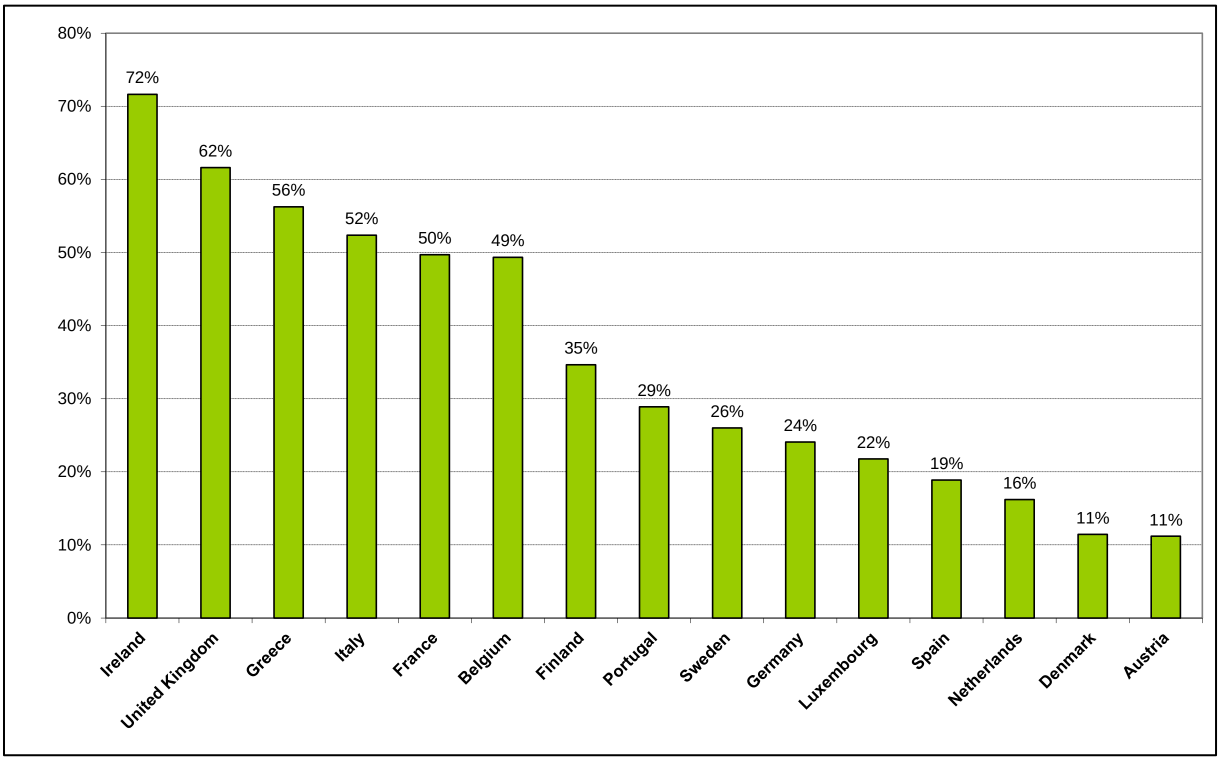
Member State	Further information on DOC values
	for 2012 derived from these sources is 13.42%. For waste from origins other than direct household collection, specific values based on the IPCC 2006 Guidelines have been used for compost plants (0.1), waste water sludge (0.175) and others (0.04).
Sweden	IPCC values for gas potentials are used for the different fractions of household waste, as well as garden waste. Estimated DOC contents for each waste category are provided.
United Kingdom	Three pools are described as Rapidly, Moderately, and Slowly Decomposing Organics (RDO, MDO and SDO, respectively). Allocation of DDOC in waste materials to these pools was described in a report produced by Eunomia Consulting and Research (2011). The new methodology calculates the DDOC content of various waste materials through reference to the lignin and non-lignin content.

Source: NIR 2014, CRF 2014, Table 6A,C Additional information

Besides lower quantities of organic carbon deposited on landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills.

Methane recovery: The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered, in Figure 8.7, varies among the member states between 11 % in Denmark and Austria and 72 % in Ireland and depends on the share of solid waste disposal sites that are able to recover CH_4 (see Table 8.20).

Figure 8.7 6A1 Managed Solid Waste Disposal: Methane recovery rates for 2012



*CH_4 recovery in % = CH_4 recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions 6A1 in Gg)*100*
CH_4 emissions from 6A2 unmanaged landfills are not included in this calculation
Source: CRF 2014 Table 6A,C

Compared to 2011 the methane recovery in 2012 increased for ten member states, out of which for two with a significant increase[63] (Greece: +7.9% and Luxembourg: +6.1%). For five MS, the share decreased.

The UK recalculated the methane recovery for 2011, therefore a significant decrease in the UK (-10.8%) can be observed compared to the previous submission.This decrease is due to changes in the methodology, as the UK estimates methane recovery for landfills with monitored data in this submission.

Recovery from UK landfills is financially driven, as the set minimum price given for the electricity generated in UK landfills results in a large financial incentive for recovery operators to collect all the gas produced. Furthermore, regulatory pressure exists to require a high level of gas collection in order to conform to the requirements of the 1993 Landfill Directive.

CH_4 recovery in EU-15 amounts to 47% of generated CH_4 from managed SWDS (only 6A1) in 2012. Methane recovery is further promoted by the Landfill Directive, and monitoring programs will need to be established. The recovery potential depends on the waste management strategies, e.g. diverting organic fractions to composting leaves more inert materials on landfills and reduces the potentials to recover and use CH_4 (as in the case of the Netherlands, Austria or Denmark). Compared to 2011, CH_4 recovery of generated CH_4 for the EU-15 increased by 0.5% in 2012.

Moreover, member states use different methods to determine CH_4 recovery. Several member states combine different methods and sources to estimate the amounts of CH_4 recovered for flaring of energy purposes, some member states are using only one method. Data on land fill gas recovery can be based on measured plant specific data, questionaires and survey or can be taken from the energy statistics. Dateiled information for the methods used by single Member States can be found in Table 8.20.

Table 8.20 6A1 Managed Solid Waste Disposal: Further information on methane recovery

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
Austria		Excavated soil material landfills: 475 (2008) Construction and demolition waste landfills: 82 Residual waste landfills: 42 (2010) Mass waste landfills: 34 (2010)	In 2004, the amount of annual collected landfill gas was investigated by questionnaires to landfill operators showing that in 2001, the amount of collected landfill gas was more than 5 times higher than in 1990. In 1990, only 9 landfills were equipped with landfill gas wells. In 2001, at all operating mass landfills landfill gas was collected. In 2008 and 2013, further studies were conducted sending questionnaires to landfill operators to get data on collected landfill gas and information on its use. Results show that from 2002 on the amount of landfill gas generated – and landfill gas recovered accordingly – decreased as a consequence of the reduced carbon content of deposited waste (despite a consistent recovery practice). The consideration of the results of the new study (UMWELTBUNDESAMT 2013b) has led to – compared to the values used for submission 2013 that were based on a mean value of the recovery rate of the years 2002 to 2007 – lower amounts of landfill gas recovered for the years 2008-2011. During the ICR 2013 the ERT questioned the assumption made on methane concentration in the recovered landfill gas to calculate the recovered CH_4. Unlike the methane concentration used for the years 2002-2007 (decreasing concentrations), this parameter was originally held constant for

[63] Changes in comparison to 2011 (2014 submission) refer to percentage points.

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			the subsequent years 2008 to 2011 (ARR 2013 para 67). Austria has taken in this submission the values for CH_4 recovery for 2008-2012 directly from the study (UMWELTBUNDESAMT 2013b). As these values already consider the (changing) methane concentration, no extra calculation had to be made and hence no assumptions are necessary any more.
Belgium			In Flanders, recovery is considered separately for flaring and valorisation, in accordance with the IPCC guidelines. For energetic valorisation, recovery of landfill gas (volume of CH_4) has been calculated based on measurements at the individual SWDS. These data are available from the Flemish Energy Balance from 2001 onwards. For flaring, recovery is assumed to be zero (IPCC default value), due to the absence of data based on measurements. In Wallonia, methane is recovered since 1993. The amount of CH_4 recovery is measured in all the SWDS which are equipped with recovery system. For Wallonia, the information is provided by the landfills owners under their environmental reporting: they declare each year the volume of biogas for motors or flaring and the fraction of CH_4 and CO_2. The CH_4 content is measured by landfill owners as it determines the possible use of the biogas (only "rich" biogas" is used in engines, the rest is flared). This information is precise (regular measures and counters data). Following a 1997 legal decree, a contract with the ISSEP (Scientific Institute for Public Service in Wallonia) also organises a close follow up of the environmental impacts of the Solid Waste Disposal Sites on Air, Water and Health. Twelve main sites are followed for the time being and the report includes biogas analysis. Details can be found on the website of DGARNE.
Denmark	26 - 29 (2012)	53 (still active; 2012)	Methane collections from 26 of these SWDS are reported to be used at energy-producing installations and 29 are included in the Energy statistics.
Finland	40		Data on landfill gas recovery are obtained from Finnish Biogas Plant Register.
France		310 (244 active)	Since 2013 monitored data is collected via annual declarations of emissions from landfill operators. Backward extrapolation was used for the years 1990-2008.
Germany		150	Until 1998, landfill gas capture is taken from expert judgments based on different data sources. From 1999 to 2005 a share of landfill gas capture of 19.3 % is assumed (based on landfill gas capture data in 2004). Similarly, landfill gas capture rates in 2006/2007, 2008/2009 and 2010/2010 are based on capture data in 2006, 2008 and 2010, respectively. For the years 2004, 2006, 2008 and 2010 statistical data on landfill gas capture is available.
Greece	4		According to data from the Ministry for Environment, recovery and flaring of biogas constitute management practices in the 4 major managed SWDS of Greece (in the cities of Athens, Patra, Thessalonica and Larissa). For two of these sites, Athens and Thessalonika, biogas is used for energy generation.

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			For the other two sites, Patra and Larissa, flaring of biogas constitutes management practice for environmental protection and not for energy recovery. From the National Energy balance, data are collected in Energy units, so for the transformation to methane mass recovered the proposed value of Net calorific value (50.4 TJ/Gg) by the IPCC 2006, is used. In Table 8.12 in NIR from Greece, quantities of waste disposed in these two sites for which the CH_4 recovery is based on assumptions and the amount of methane obtained by the energy balance, are presented. For the rest of the sites that biogas is only flared, no CH_4 recovery is considered following the recommendation by the 2000 IPCC guidelines, Page 5.10. According to this recommendation 'The default value for methane recovery is zero. This default should only be changed when references documenting the amount of methane recovery are available. Recovered gas volumes should be reported as CH_4 not as landfill gas, as landfill gas contains only a fraction of CH_4. Reporting based on metering of all gas recovered for energy utilisation and flaring is consistent with good practice. The use of undocumented estimates of landfill gas recovery potential is not appropriate, as such estimates tend to overestimate the amount of recovery.
Ireland	13		A survey of landfill sites in 2010 to collect data for the years 2008 and 2009 was undertaken. The study was aimed at validating the values for 2008 as there were known issues with the information presented in the previous study and collecting information on flaring and utilisation for 2009. The survey was sent to 49 sites (both open and closed sites) on which flaring and or utilisation of landfill gas is known to occur. The same survey was conducted in subsequent years to obtain data for 2010 and 2011 from all 49 sites. Information on the number of flares in use, together with data relating to flare capacity, run time and performance was used to estimate the volume of landfill gas flared at each site. The tonnage of CH_4 flared was calculated from landfill gas volume by accounting for gas temperature (assumed to be ambient air temperature) and pressure (provided in survey returns) and by using methane destruction efficiencies of 50 percent for open flares and 98 percent for closed flares. The study found that there were ten methane utilisation plants at landfills in Ireland in 2011 with a total of 27 engines. The amount of methane input to landfill gas utilisation plants is calculated from their known electricity outputs as obtained by SEAI from EIRGRID (Electricity Transmission System Operator) using an overall efficiency of 34.6 percent for the engines, which is considered typical of the engine types in general use.
Italy			The amounts of methane recovered and flared have been estimated taking into account the amount of energy produced, the energy efficiency of the methane recovered, the caption efficiency and the efficiency in recovering methane for energy purposes assuming that the rest of methane captured is flared. The total CH_4 recovered is the sum of methane flared and methane

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			used for energy purposes. The methane used for energy production is estimated starting from the electricity produced annually by landfills assuming an energy conversion efficiency equal to 0.3, typical efficiency value for engines that produce electricity from biogas. The methane flared has been estimated for the years 1990-1997 on the basis of information supplied by the plants; for the following years the methane flared has been estimated on the basis of information supplied by the main operators regarding the efficiency in recovering methane for energy purposes with respect to the total methane collected. This value increased from 60% of the total, in 1998, to 70% since 2002. Total methane collected is estimated, in 2012, equal to 50% of the total methane produced.
Luxembourg	2	2	At the SIGRE site, a methane recovery system is operated since 2000, and, since 2002, at the SIDEC site. Recovery of landfill gas started in 2002 (flaring) and 2000 (electricity and heat plant), respectively. Recovered CH_4, as determined from monthly reports of the landfill operators (measured quantities) is subtracted from the estimated emissions. Data on CH_4 recovery is also available (from 2001 onwards) from the annual reports from SIGRE and SIDEC being sent to the Environment Agency in accordance to their permits.
Netherlands	53 (2012)	22 operating landfills (2012) and a few thousand older sites that are still reactive	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly.
Portugal	26	37 (in exploration, 2011)	Data on landfill gas recovered and combusted is flared or used for energy purposes. The first quantities of biogas consumed for energy purposes reported by DGEG (the national energy authority) refer to 2004. This situation is related to the fact that the great majority of landfills have been implemented in the late 90s or the early 2000s. However, flaring (without energy recovery) started before. In order to account with this practice, the APA launched a questionnaire in 2012 with the aim of collecting the total amount of landfill gas combusted either in flaring (without energy recovery) or used for energy purposes. This inquiry is focused on the more recent years (since 2005) in order not to overload the waste systems managers. As regards the coverage of the APA´s questionnaire, it considered all managed SWDS, which totals, in 2011, 34 landfill sites in exploration (receiving waste) in Mainland, plus 3 closed landfill sites which do not receive waste anymore (but burn biogas). Landfill sites in the 2 Autonomous Regions do not burn biogas. Out of the 37 landfill sites (corresponding to 23 different management entities) considered, 11 landfills reported not to burn biogas. From the 26 sites burning biogas, only data referring to measured data and no extrapolation was done to consider estimates from models. CH_4 recovered in flares and valorised for energy purposes is estimated on the basis of average biogas flows (continuous measurement) and the

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			number of hours of burning. The concentration of CH_4 in biogas used in the estimates of the CH_4 quantities refer to monitoring plans (quarterly measurements) measuring the biogas quality at the entrance of the flares or the biogas energy recovery system. The annual quantities of biogas burnt (in flares and energy recovering units) reported by each landfill (in cubic meters) were converted into CH_4 amounts considering the CH_4 percentages in biogas (based on measurements) reported by management systems.
Spain	37		37 landfills in Spain have landfill gas recovery systems. Landfill gas is partly flared, partly utilized for energy purposes. The information is provided by landfill operators for the period 1990-2008 and for the period 2009-2012 by information provided by SGR. The most recent year is kept constant at the level of the previous year. A quality check is performed which consists in checking whether the amounts reported by the operator are between 20% to 70% of the CH_4 generation.
Sweden	55 (2012)	78 (2012)	In Sweden the first plant for biogas extraction from landfills was started in 1983. The business has increased until 2003 when gas was recovered in 72 plants. Since 2008, about 55-58 gas plants are in operation, and the amount of recovered gas is now decreasing because of the dramatic reduction of deposition of organic waste. Information on recovered gas (in energy units) is provided by Avfall Sverige and converted to use quantities by Statistics Sweden.
United Kingdom			A key factor in determining methane emissions is information on the amount of methane collected, either for utilisation or flaring. Data on utilisation is available and of good quality, but data on flaring is generally scarce and of poor quality. Current data on the amount of methane used for power generation in England, Scotland, Wales and Northern Ireland, calculated from the electricity generated from landfill gas as reported in the Digest of UK Energy Statistics (DECC, 2013). Methane used for power generation is supposed to be 52% of total methane generation.

Source: NIR 2014

Industrial waste: Data on industrial waste may be difficult to obtain in many countries. DOC default values for industrial waste are not provided by the IPCC. Table 8.21 illustrates how industrial waste is considered in the individual member states. Four member states (France, Ireland, the Netherlands and the UK) do not consider or provide very little information on industrial waste in the NIR.

Table 8.21 6A1 Managed Solid Waste Disposal: Methodological issues regarding industrial waste

Member State	Industrial waste
Austria	Industry is referred to as one source both for residual and non-residual waste. Several waste types with their respective waste identification numbers are described. These are not clearly referenced as industrial wastes, though.

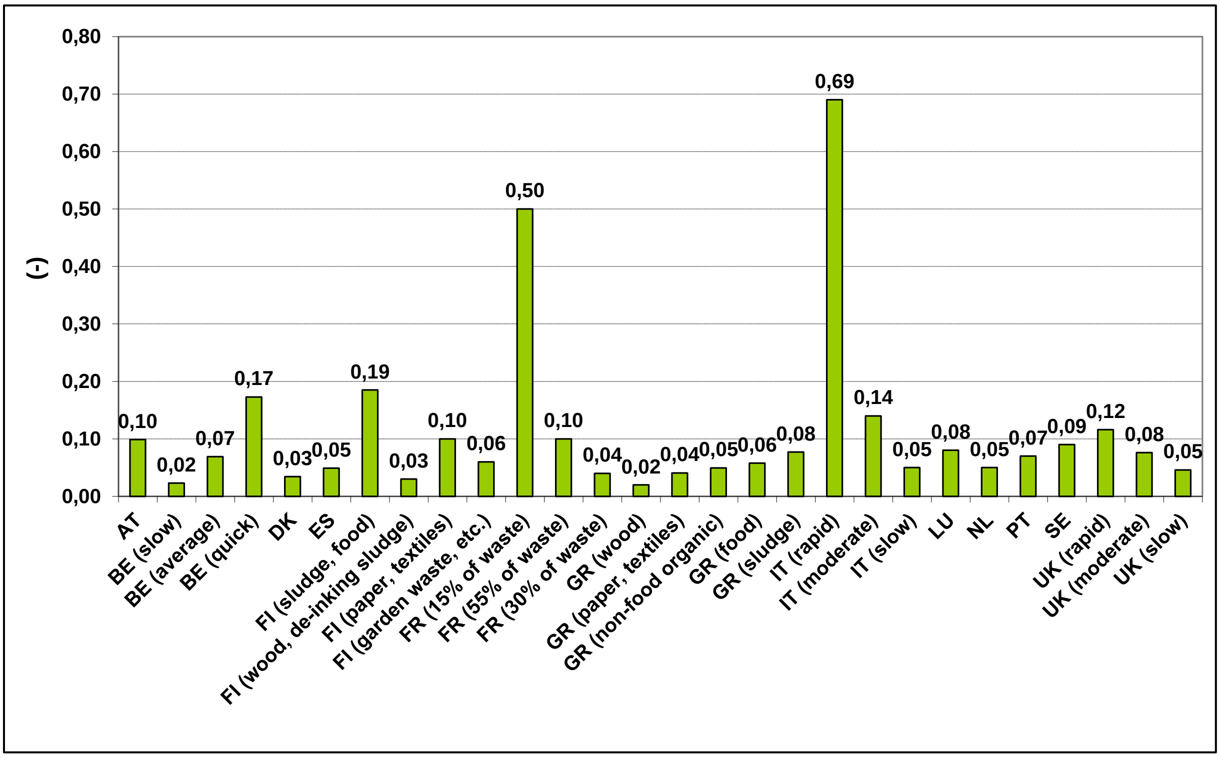
Member State	Industrial waste
Belgium	In the Flemish region, industrial waste is taken into account in the modelling. Values for the combination of organic carbon content and decay rate are available. In Wallonia, CO_2 and CH_4 emissions from solid waste disposal on land are calculated with a first order decay model that considers separately the emissions of industrial and municipal waste until 2008. After 2008, industrial and municipal wastes are reported together. Emissions from industrial waste are calculated with the same model as municipal waste. The DOC value for industrial waste was estimated calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology.
Denmark	Industrial waste is considered and data on its composition and amount deposited are used in the emission model.
Finland	Industrial solid waste and industrial sludge as well as industrial inert waste are considered as waste groups which are further broken down to waste types. Activity data and DOC values are provided in the NIR.
France	Industrial waste is included in the estimation.
Germany	The Federal Statistical Office provides detailed data about landfilling of industrial waste since 1996. In the inventory, waste quantities from the following industry branches are considered: wastes from agriculture, horticulture, forestry, fishery and food processing, wastes from wood processing, wastes from the production of cellulose, paper and cardboard, wastes from the textiles industry, packaging wastes as well as the wood fraction from construction and demolition wastes.
Greece	Industrial waste amounts disposed in land provided by ELSTAT are used. These amounts are collected by the experts of ELSTAT based on individual researches (e.g. questionnaires sent to industries, etc.). It must be noticed that these data are provided by ELSTAT only for the years 2004, 2006 and 2008. Thus, the historical data necessary for the rest of the years were estimated by using relative drivers i.e. the Greek GDP for the case of paper, wood and textiles and the Gross Production Value of livestock for the case of animal waste from food preparation and products, for the period 1960 to 2009. According to the data provided by the ELSTAT, industrial waste refers to animal waste from food preparation and products, paper, wood, textiles, mixed waste residues and sorting waste residues.
Ireland	Industrial waste neither mentioned nor considered explicitly.
Italy	In non-hazardous landfills industrial wastes assimilated to municipal solid waste (AMSW) could be disposed. Their composition must be comparable to municipal solid waste composition. From 2001, data on industrial waste disposed in municipal landfills are available from Waste Cadastre. For previous years, assimilated municipal solid waste production has been reconstructed, and the same percentage of MSW disposed in landfill has been applied also to AMSW. The complete database of AMSW production from 1975 to 2000 is reconstructed starting from data available for the years 1988 and 1991 with a linear interpolation, and with a regression model based on Gross Domestic Product. From 1975 back to 1950 AMSW production has been derived as a percentage of MSW production; this percentage has set equal to 15%, which is approximately the value obtained from the only data available (MSW and AMSW production for the years 1988 and 1991).
Luxembourg	Industrial waste is included in the calculation, IPCC default values are applied. Today, there are no landfill sites for purely industrial waste in Luxembourg. However, one site existed in the past and it has been closed down in the early 1990s (Ronnebierg site). The emissions of the closed industrial waste disposal on land site (Ronnebierg) are estimated for the period 2000 to 2012.
Netherlands	Industrial waste is neither mentioned nor considered explicitly.
Portugal	The fermentable part of industrial waste is considered. Historical time series are based on 1999 data which refer to annual registries relating to industrial unit declarations sent to the regional environment directorates which

Member State	Industrial waste
	have been estimated on expert judgment. For the period 1960-1990 it was considered a growth rate of 1.5% per year; for the following years (1990-1998) 2% per year. Data for the years 2000, 2002 and 2003 refer to annual registries. The year 2001 refer to estimates based on the average of 1999 and 2000 data. Data for period 2004 to 2006 are interpolated values based on the 2003 and 2007 figures. Data from 2007 onwards refer to data collected under the Waste Registry. All industrial waste generated was considered to be disposed in SWDS together with urban waste. However, as there is no available information concerning final industrial waste disposal, it was assumed that all estimated waste produced has followed the urban disposal pattern between uncontrolled and controlled SWDS. Except for DOC, the same parameters are used for industrial waste as for municipal waste.
Spain	The scope of the reported waste is classified as 'urban waste'. In questionnaires to landfill operators, information is collected also on "other non-classified waste", such as construction waste, ash from combustion processes and industrial wastes.
Sweden	Detailed description available in the NIR of how activity data and emissions of relevant industrial wastes and sludges are generated.
United Kingdom	Industrial waste is not mentioned explicitly in the NIR.

Source: NIR 2014

Methane generation rate constant: CH_4 is emitted on SWDS over a long period of time rather than instantaneously. The tier 2 FOD model can be used to model landfill gas generation rate curves for individual landfill over time. One important parameter is the methane generation rate constant. It is determined by a large number of factors associated with the composition of waste and the conditions at the site. Rapid rates which are associated with a high moisture content and rapidly degradable material can be found for example in part of the waste in Finland, France, Italy, Belgium and the United Kingdom. Figure 8.8 provides some CH_4 generation rate constants as reported by the member states in CRF table 6 A,C, while Table 8.22 summarizes information on the applied country-specific approach.

Figure 8.8 6A1 Managed Solid Waste Disposal: Methane generation rate constant



Source: CRF 2014 Table 6 A,C Additional information, NIR 2014

Table 8.22 6A1 Managed Solid Waste Disposal: Further information on the methane generation rate constant

Member State	Information on the half-time respectively the methane generation rate constant
Austria	Several values for the half-life period of different waste types (residual waste, wood, paper, sludges, sorting residues, output MBT, bulky waste, bio waste, textiles, construction waste and fats) are presented.
Belgium	Several values for the biodegradation rate are given. The multiphase model in the Flemish region uses three categories: rapidly degradation: k1=0.173 (t1/2=4), moderately degradation: k2=0.069 (t1/2=10), slowly degradation: k3 = 0.023 (t1/2 = 30). In Wallonia, the IPCC default value is chosen (k=0.05 which corresponds to t1/2=14 years).
Denmark	Decay rates (and half-life times) for individual waste types are available for food waste (k=0.17), cardboard and paper and textile, fur and leather (k=0.058), biodegradable garden waste (k=0,099); demolition (k=0,030); degradable sludge (k=0,058)
Finland	Methane generation rate constants are divided into four categories: k1= 0.185 for wastewater sludges and food waste, k2=0.03 for wood waste and de-inking sludge, k3=0.1 paper waste and textile waste, and k4=0.06 for garden waste, napkins, fibre and coating sludges.
France	NIR provides three values: k1=0.5 for 15 % of the waste (easily biodegradable), k2=0.1 (average biodegradability) for 55 % of the waste and k3=0.04 for 30 % of the waste (weakly biodegradable).
Germany	Several values for the half-life are provided (years): food waste: 4, garden and park waste: 7, paper and cardboard: 12, wood: 23, textiles/diapers: 12, composites: 12, sludges from wastewater treatment: 4, waste from MBT facilities 12.
Greece	The estimation of k is determined by the conditions in the disposal sites (e.g. moisture content,

Member State	Information on the half-time respectively the methane generation rate constant
	temperature, soil type) and by the composition of waste landfilled. Considering the fact that climate in Greece is dry temperate (the ratio of mean annual precipitation to potential evapotranspiration is around 0.5), half-life was estimated at 17 years for paper and textiles, 35 for wood, 12 years for food waste, 14 years for non-food-waste and 9 years for sewage sludge disposed on land.
Ireland	The 2006 IPCC Guidelines provide narrow ranges for the value of decay rate constant appropriate to the individual waste components under different climatic zones. Ireland has chosen the highest values given for the Western Europe wet temperate conditions for all waste constituents, as the value of the ratio MAP:PET (Mean Annual Precipitation: Potential Evapotranspiration) is greater than 2 in Ireland.
Italy	The methane generation rate constant k in the FOD method is related to the time taken for DOC in waste to decay to half its initial mass The maximum value of k applicable to any single SWDS is determined by a large number of factors associated with the composition of the waste and the conditions at the site. The most rapid rates are associated with high moisture conditions and rapidly degradable material such as food waste. The slowest decay rates are associated with dry site conditions and slowly degradable waste such as wood or paper. Thus, for each rapidly, moderately and slowly biodegradable fraction, a different maximum methane generation rate constant has been assigned. National half-life values are suggested in a study. Accordingly, waste streams have been categorized in three main types: rapidly biodegradable waste (food waste, sewage sludge, k1=0.69), moderately biodegradable waste (garden and park waste, k5=0.14) and slowly biodegradable waste (paper and paperboard, textile and leather, wood and straw, k15=0.05).
Luxembourg	IPCC default values are used for the different waste fractions.
Netherlands	Methane generation rate constant: 0.094 up to and including 1989, decreasing to 0.0693 in 1995. From 2000 to 2004, the value is decreasing to 0.05 (IPCC value) and constant thereafter. This corresponds to a half-life time of 14 years. The change in k-values is caused by a sharp increase in the recycling of vegetable, fruit and garden waste in the early 1990s.
Portugal	The value of CH_4 generation rate constant (k) depends on several factors as the composition of the waste and the conditions of the SWDS. In the absence of national studies to determine this parameter, and following the recommendations of the in-depth review, the values used in the previous submissions were revised in order to apply the guidance from IPCC 2000. The k value considered was 0.07 (half-life of about 10 years), which represents a higher decay rate compared to the k default value proposed by the IPCC 2000 (0.05 - half-life of about 14 years).
Spain	The constant rate of methane generation takes the value recommended by the IPCC Good Practice Guidance (0.05) with the exception of four managed landfills for which k values of 0.035, 0.08, 0.043 and 0.049 have been chosen.
Sweden	National value for half-life time of 7.5 years. The choice of the half-life factor has also been motivated by the rather wet climate conditions in Sweden (MAP/PET>1), and that the 2006 IPCC Guidelines recommends the default value of 7 for such climate conditions.
United Kingdom	The characteristic decay rates for these three pools are: 0.046 $year^{-1}$ (slowly degrading), 0.076 year-1 (moderately degrading) and 0.116 year-1 (rapidly degrading). These are within the range of 0.030 to 0.200 $year^{-1}$ quoted in IPCC, 2006. Fats, sugars and proteins are assigned to the rapidly degrading pool (RDO), lignin to the slowly degrading pool (SDO) and cellulose, hemicelluloses and remaining compounds are allocated to the moderately degrading pool (MDO).

Source: NIR 2014, CRF 2014 Table 6 A,C Additional information

Concerning the magnitude of the methane generation factor, Italy explains its high weighted average degradation rate with high moisture contents. The weighted averages of k should reflect the waste composition as well as the moisture content or average temperatures. In general, a comparison is difficult since many parameters have influence on the average value.

8.3.2 Unmanaged Solid Waste Disposal (CRF Source Category 6A2) (EU-15)

CH_4 emissions from unmanaged solid waste disposal were reported in only six member states in 2012 (France, Greece, Ireland, Italy, Portugal and Spain). Two of these six member states (Spain, Greece) still dispose MSW to unmanaged SWDS, although in small quantities, compare column 'Annual MSW to unmanaged SWDS' in Table 8.23, while in France, Ireland, Italy and Portugal waste disposals from the past still emits (see Table 8.4). 100% of all EU-15 emissions from this category are calculated using higher tier methods. The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation. According to the Revised 1996 IPCC Guidelines, the MCF for unmanaged disposal of solid waste depends of the type of site – shallow, deep or uncategorised. Table 8.24 gives an overview of the MCF applied by the relevant member states.

Table 8.23 6A2 Unmanaged Solid Waste Disposal: Selected parameters for calculating emissions from source category 6A2 in 2012

Member State	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS (Gg)	MCF CH_4		
			Unmanaged SWDS	Deep	Shallow
France	X	NO	0.50	NO	0.50
Greece	X	265	0.80	0.80	IE
Ireland	X	NO	NA	NA	NA
Italy	X	NO	0.60	NO	0.60
Portugal	X	NO	0.60	IE	0.60
Spain	X	25.12	0.60	0.80	0.40

Source: CRF 2014 table 6 and 6A,C

Table 8.24 6A2 Unmanaged Solid Waste Disposal: Further information

Member States	Unmanaged waste disposal on SWDS
France	The difference between managed and unmanaged MSWD is based on the degree of compaction of waste in MSWD. In French oversee territories, uncontrolled landfills are also considered. Uncompacted landfills were gradually closed in favor of compacted landfills. However, closed MSWD continue to emit methane because of the kinetics of the reaction.
Greece	Unmanaged wastes are considered to be landfilled in sites of similar characteristics concerning their composition and management (depth of sites), while the starting year of disposal and degradation of total unmanaged waste is assumed to be 1960. According to the Ministry of Environment, Energy and Climate Change (MEECC), 2182 unmanaged SWDS were still operating in 2000. Following the National and Regional Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is already in progress and is expected to be completed in the following years, along with the construction of managed SWDS, following to the standards set by the EU directives, in order to cover the needs of the country. Nowadays, there is a small number of unmanaged waste disposal sites which is planned to be eliminated until the end of 2013.
Ireland	In the 2006 IPCC guidelines the MCF varies from 0.4 for shallow unmanaged landfills to 1.0 for fully anaerobic deep and managed landfills. In the present model analyses undertaken for both individual sites and groups of landfills, annual MCF values show an increase over time to reflect the change from generally shallow, poorly-managed landfills before 1998 to well controlled and engineered landfills in subsequent years. The larger landfills that were in existence prior to the introduction of waste licensing were subject to some level of management but not to the extent of fully managed licensed sites after 1998. These large sites are assigned to the IPCC category of unmanaged deep sites for the years up to 1998 with MCF of 0.8 and to the managed category with MCF of 1.0 for the remainder of their lifetime. The 250 sites that operated primarily as small open town dumps and shallow uncontrolled disposal sites with significant aerobic conditions up to the introduction of waste licensing are assigned to the IPCC category of unmanaged shallow sites up to 1998, for which the appropriate MCF is 0.4. A transition from unmanaged shallow classification in 1960 to one-third unmanaged shallow and two-thirds unmanaged deep sites in 1998 is applied to the remainder of sites, giving an increasing MCF from 0.4 to 0.67 over this period.
Italy	The share of waste disposed of into uncontrolled landfills has gradually decreased due to the enforcement of new regulations, and in the year 2000 it has been assumed equal to 0; emissions still occur due to the waste disposed in the past years. The unmanaged sites have been considered shallow. The amount of waste disposed in unmanaged landfills has been estimated as a percentage of the waste disposed in managed landfills. The MCF value used for unmanaged landfill is the default IPCC value reported for uncategorised landfills: in fact, in Italy, before 2000 existing unmanaged landfills were mostly shallow, because they resulted in uncontrolled waste dumping instead of real deep unmanaged landfills. To be conservative, the default IPCC value reported for uncategorised landfills has been used. It is assumed that landfill gas composition is 50% carbon dioxide and 50% methane.
Portugal	The share of final disposal destiny (inter alia uncontrolled dumping sites) for the first years of the time series was calculated having as a basis the Quercus survey. Data for recent years (mainly since 1999) refer to data collected from management systems. There have been significant efforts at national level to deactivate and close all uncontrolled dumping sites. This effort was concluded in 2002 when all uncontrolled dumping sites had been closed. Concerning uncontrolled dumping sites, it was considered that there is gas burning when a dumping site has been closed and is associated with a managed landfill having recovery of CH_4. It was assumed that all estimated industrial waste produced have followed the urban disposal pattern between uncontrolled and controlled SWDS.

Member States	Unmanaged waste disposal on SWDS
Spain	No statistical information is available for unmanaged SWDS. It is assumed that 50% of unmanaged landfills are deep (depth > 5 m) and the remaining 50% are shallow (depth < 5 m). For unmanaged SWDS it is also assumed that the waste is partly burned to reduce the volume. The burning fractions have been decreased during the inventory period.

Source: NIR 2014.

8.3.3 Waste water handling (CRF Source Category 6B) (EU-15)

CH_4 emissions from domestic and commercial waste water handling (6B2) are a significant emission source in category 6B and key source in the EU. CH_4 emissions from waste water handling are calculated with the help of diverse methods (CR, CS, D, T1 and T2). For CH_4 emissions from domestic wastewater IPCC GPG describe a single method (equation 5.5) at different levels of disaggregation, but no disaggregation level is prioritized. It is considered to be 'good practice' to use the default values for COD and BOD. As there is no clear definition of higher tiers, MS can interpret in different ways what higher tier methods would be, therefore the % of EU-15 emissions calculated with higher tiers is no longer estimated. Table 8.25 provides an overview of the CH_4 emission sources in domestic and commercial wastewater handling identified by the member states. Furthermore, methods applied to determine CH_4 emissions from municipal wastewater and sludge handling are described in detail.

Table 8.25 6B2 Domestic and Commercial Waste Water Handling: CH_4 emission sources and methods for determining CH_4 emissions

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Austria	In 2010, 93.9% of the population was connected to municipal wastewater treatment plants. The remaining wastewater is treated either in septic tanks (3.8%), domestic wastewater treatment plants (2.1%), or other disposal facilities (0.3%). Wastewater treatment plants use aerobic procedures (resulting in N_2O emissions), whereas septic tanks are characterised by anaerobic conditions (resulting in CH_4 emissions). CH_4 emissions from cesspools and septic tanks are calculated according to the IPCC method. The following parameters were used: Average organic load: 60 g BOD_5/inhabitant/day, methane producing capacity B_o: 0.6 kg CH_4/kg BOD, methane conversion factor MCF: 0.27 (country-specific). Data on wastewater disposal routes and connection rates to the sewage system are taken from the Austrian reports on water pollution control. Data for the years 1971, 1981, 1991, 1995 and 1998, 2001, 2003, 2006, 2008 and 2010 are available. The missing data are interpolated. The share of inhabitants connected to septic tanks has to be extrapolated from the year 2000 onwards.
Belgium	For septic tanks, the methodology is based on an article which describes the characteristics and parameters of individual septic tanks. The IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 0.060kg BOD/day, whose 60 % eventually settles (IPCC fraction that readily settle). It is considered that only 25 % of the BOD loading is anaerobically degraded (0,060*0,6*0,25), because the septic tanks are regularly emptied and consequently the sludge is then treated aerobically. The annual emission factor becomes 1.971 kg CH_4/inhab*year (0.6*0.060*60%*25%*365 kgCH_4/kg BOD). The CH_4 emissions are estimated by multiplying these emission factors by the number of inhabitants not connected with a municipal wastewater treatment plant. No CH_4 emissions are accounted for municipal wastewater treatment plants in Wallonia and in Brussels. Most of the plants are conducted aerobically, and those who use anaerobical digestion of the sludge

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	recover the CH_4 for energy purposes. The emissions linked to the energy recovered by these anaerobical treatment plants are included in the energy sector, as biomass fuels. The energy balance in the Flemish region reports 29 installations of waste water treatment that use the biogas to produce electricity (15 installations with biogas of sewage sludge of municipal waste water treatment installations and 14 installations with anaerobical water treatment). The emissions linked to the energy recovered by these treatment plants are also included in the energy sector (category 1A1a, biomass fuels).
Denmark	Fugitive methane releases from the municipal and private WWTPs have been divided into contributions from 1) the sewer system, primary settling tank and biological N and P removal processes, 2) from anaerobic treatment processes in closed systems with biogas generation and combustion for energy production and 3) septic tanks. The methodology developed for this submission for estimating emission of methane from wastewater handling follows the IPCC Guidelines and the IPCC Good Practice Guidance. For the methane emissions from anaerobic digestion, the methane correction factor was decreased from 1 to 0.8, which is in accordance to the IPCC guidelines 2006, and which have been further justified by plant specific data as described in Thomsen and Hoffmann.
Finland	A national methodology that corresponds to the methodology given in the Revised 1996 Guidelines is used in the estimation of the CH_4 emissions. Emission sources cover municipal (domestic) and industrial wastewater handling plants and uncollected domestic waste water for CH_4 emissions. For uncollected domestic wastewaters, the check method with default parameters (IPCC Good Practice Guidance) has been used.
France	Emissions from wastewater treatment are calculated according to the IPCC tier 1 method, distinguishing between collective wastewater treatment plants and cesspools. It is assumed that 2.4% of the water of the residential/commercial sector is treated in natural lagoons (not the amounts treated in wastewater treatment plants and cesspools) and that only this treatment releases CH_4 emission. For this part of the emissions, the IPCC method was used.
Germany	Municipal wastewater treatment in Germany uses aerobic procedures (municipal wastewater-treatment facilities, small wastewater-treatment facilities), i.e. it produces no methane emissions, since such emissions occur only under anaerobic conditions. Treatment of human sewage from persons not connected to sewage networks or small wastewater treatment facilities represents an exception: in cesspools, uncontrolled processes (partly aerobic, partly anaerobic) may occur that lead to methane formation. Organic loads from cesspools are calculated pursuant to the IPCC method, in which the relevant population is multiplied by the average organic load per person.
Greece	CH_4 from waste water handling was estimated according to the default methodologies suggested by IPCC. Considering the fact that there are not sufficient data regarding all the wastewater handling facilities of the country and as a result methane emissions are calculated based on the total population served, emissions from wastewater treatment and the sewage sludge removed from wastewater are not considered separately. However, methane emissions from sewage sludge disposed in managed sites have been estimated. Therefore, in order to avoid double counting of emissions from sludge treatment, the organic load (in biochemical oxygen demand) of sludge that is actually disposed on land was subtracted by the organic load of wastewater treated. It is estimated that about 91% of Greek population in 2012 was served by domestic wastewater treatment systems in compliance with the Directive 91/271/EEC (3rd Programming Period). These systems consist of a primary treated effluent and an advanced secondary

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	biological treatment with activated sludge system for removing organic load and a significant reduction in nitrogen load. The remaining 9% of Greek population, mainly this in remote areas was not served by a wastewater treatment system and it is going to change during the 4th Programming period, thus, it is considered their wastewater discharges in sea, river etc.
Ireland	The only source of emissions from wastewater handling in Ireland is the anaerobic treatment of sludge. Approximately one-third of the population in Ireland is served by urban wastewater treatment plants, which are based on aerobic systems with no emissions of CH_4. The other one-third of the population uses septic tanks to treat wastewater mainly for individual houses in non-urban areas. CH_4 emissions from septic tanks are deemed not to occur in Ireland. The sludge arising from the secondary treatment of over half (58 per cent in 2012) of the population equivalent served by urban wastewater treatment plants is anaerobically digested. The CH_4 produced at these plants is used for electricity and heat generation for use on site since 2003. The quantities of CH_4 recovered are reported for the first time in the CRF tables 6.B for all years from 2003 to 2012 as recommended in the recent inventory review. The remainder of domestic/commercial wastewater sludge, the DOC is calculated using 60g BOD/capita/day population equivalent10 and SBF (the fraction of BOD that readily settles) of 0.395, which is a combination of 0.35 for conventional primary sedimentation and 0.045 for secondary sedimentation tanks. The emission factor for CH_4 is derived as for industrial sludge.
Italy	In Italy wastewater handling is managed mainly using a secondary treatment, with aerobic biological units. The stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery. It is assumed that domestic and commercial wastewaters are treated 95% aerobically and 5% anaerobically, whereas industrial wastewaters are treated 85% aerobically and 15% anaerobically. CH_4 emissions from sludge generated by domestic and commercial wastewater treatment have been calculated using the IPCC default method on the basis of national information on anaerobic sludge treatment system. Emissions from methane recovered, used for energy purposes, in wastewater treatment plants are estimated and reported under category 1A4a. CH_4 emissions from wastewater have been estimated assuming that 5% of domestic and commercial wastewater is treated anaerobically. This assumption may correspond to the Italian situation where wastewater is treated in aerobic biological units with the possibility of bad management cases. In the case of sludge, most of the CH_4 produced is recovered and not emitted because of the anaerobic digestion of sludge where the reactors are covered and provided of gas recovery and the efficiency of capture is equal to 100%. Only CH_4 produced in Imhoff tanks is emitted.
Luxembourg	Municipal wastewater treatment in Luxembourg uses mainly aerobic processes such as activated sludge or biofiltration. As a result, no or negligible methane emissions are produced, since such emissions only occur under anaerobic conditions. In these plants, sludge stabilisation is carried out in order to prevent uncontrolled putrefaction. In facilities with a treatment capacity smaller than 30.000 population-equivalents (p.e.) the stabilisation is usually carried out aerobically, with oxygen and energy consumption, while for facilities with a treatment capacity larger than 30.000 p.e., the stabilisation is normally carried out anaerobically with production of methane gas. The gas produced is usually used for energy recovery in combined heat/power generating systems or may be flared. In this emission inventory, methane emissions from these small anaerobic sludge treatments have been taken into account as there is no gas reuse and therefore methane emissions have been assumed. The methodology for these septic tanks is based on the IPCC method in which the relevant population (individual septic tanks) or population equivalents (for the small mechanical treatment plants) is multiplied by the average organic load per person. The 2006 IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 60 g BOD/day, and a MCF of 0.27 is assumed. According to the national expert judgment and based on a study, the MCF has been adapted to

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	the national situation in Austria which is also applicable for Luxembourg.
Netherlands	In general, the emissions are calculated according to the IPCC guidelines, with country-specific parameters and emission factors being used for CH_4 emissions from wastewater handling (including sludge). The calculation methods are equivalent to the IPCC Tier 2 methods. The treatment of domestic and commercial wastewaters and the resulting wastewater sludge is accomplished using aerobic and/or anaerobic processes in public wastewater treatment plants.
Portugal	CH_4 emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 Revised Guidelines and Good Practice Guidance, which follows three basic steps: determination of the total amount of organic material originated in each wastewater handling system, estimation of emission factors and calculation of emissions.
Spain	The methodology in Section 6.2 of the IPCC Good Practice Guidance has been applied. For domestic/commercial waste water, the organic load is the activity variable selected, expressed in mass of Biochemical Oxygen Demand (BOD_5). For the calculation of this variable, a new data source is used in the 2014 submission which is a study on the estimation of the production and treatment of sludge in wastewater treatment plants provided by CEDEX. This new study provides data for the years 1998-2008 for wastewater and sludge treatments systems and the share of population connected to these systems. For BOD5 300 mg/l wastewater, 200 l per inhabitant and 365 operation time were assumed.
Sweden	6B2a has been divided into three sections: a) Large wastewater treatment plant (treatment capacity: more than 2 000 pe); b) Small wastewater treatment plants (treatment capacity: 25 -2000 pe); c) Population not connected to wastewater discharge system. a) In Sweden, all large wastewater treatment plants are using aerobic wastewater treatment processes. No CH_4 is supposed to be generated because of the use of aeration in the wastewater treatment process. b) For small wastewater treatment plants, the situation is at the moment not well enough investigated and therefore Sweden is using the IPCC Good Practice Guidance method (Check method). Activity data on population connected to small wastewater treatment plants (700 000 people) is derived from background data from a survey in 2010. c) For population not connected to wastewater discharge system, the following applies: 1.) The sludge in the wastewater is collected in sand filters or infiltration beds, collected and transported to anaerobic digestion plants located at larger wastewater treatment plants. It is covered and reported in section CRF6B2b (sludge treatment). 2.) CH_4 emissions from the remaining waste water are likely to be NO (not occurring) or negligible. The waste water is rich in oxygen, and for biological processes to occur the water must not be too cold. Sweden has a rather cold climate with an average annual temperature of 4.8 (°C) 1991-2005.
United Kingdom	A UK-specific method is used, using activity data for the municipal waste water treatment volumes, organic content and sludge treatment and disposal routes. Emission factors are derived from water company reported data for recent years, extrapolated back to 1990.

Source: NIR 2014, CRF 2014 Tables 6, 6Bs1 and 6Bs2

Information on the methods applied for estimating CH_4 emissions from industrial wastewater and sludge handling are provided in Table 8.26.

CH_4 missions from industrial wastewater handling are reported by nine member states (Finland, France, Greece, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom); five member states indicate that emissions are not applicable (Austria, Belgium, Germany), not occurring (Ireland, Luxembourg) or are reported elsewhere (Denmark). In response to a recommendation from the ARR 2012 Belgium changed its notation key from NE to NA.

Emissions from sludge handling of industrial wastewater are reported by four member states (France, Greece, Ireland and Spain), other member states either reported emissions as not estimated (the Netherlands), not occurring (Germany, Luxembourg and Sweden) or not applicable (Austria and Belgium) or reported the emissions elsewhere (Denmark, Finland, Italy, the Netherlands, Portugal and the United Kingdom).

An overview of methodological issues regarding CH_4 emissions from industrial wastewater and sludge handling and methods applied is provided in Table 8.26.

Table 8.26 6B1 Industrial Waste Water Handling: CH_4 emissions and methods applied

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Austria	**NA**	**NA**	Industrial wastewater and sewage sludge treatment is carried out under aerobic and anaerobic conditions. As CH_4 gas is usually used for energy recovery or is flared, the amount of CH_4 emissions from industrial wastewater and sewage sludge treatment is negligible and therefore reported as “not applicable”. In the energy sector sewage gas is considered as an energy source. As industrial wastewater handling is an activity in Austria, but there are no CH_4 emissions in Austria from that activity because either the waste water handling is aerobic or in case it is anaerobic there is always CH_4 recovery installed that prevents CH_4 emissions. Given, that the activity occurs in Austria but does not result in emissions of CH_4 the notation key “NA” is used.
Belgium	**NA**	**NA**	CH_4 emissions from industrial wastewater handling and treatment are not included in the Belgian greenhouse gas inventory because most of the industrial waste water is treated in an aerobic way. Recovery of CH_4 occurs (flaring or energy production) for these installations that treat the waste water anaerobically. The notation key NA is used, because according to waste water specialists, about all industrial waste water is treated in an aerobic way i.e. without any emissions of CH_4. The very limited part of installations with anaerobic waste water treatment is using fermentation tanks that recovers mostly its emissions by flaring activities. Consequently no or negligible amounts of emissions take place in this subcategory.
Denmark	**IE**	**IE**	No distinction between emissions from industrial and municipal WWTPs is made, as Danish industries to a great extent are coupled to the municipal sewer system. Wastewater streams from households and industries are therefore mixed in the sewer system prior to further treatment at centralised WWTPs. The contribution from the industry to the influent wastewater at the centralised WWTPs has increased from zero to around 40% from 1987 to 2010 with the highest influent contribution occurring at the biggest and most advanced technological WWTPs in Denmark. Monitoring data on the biological oxygen demand (BOD) for the mixed household and industrial influent are available for all WWTPs with a capacity above 30 PE treating more than 90 % of the Danish wastewater.
Finland	**X**	**IE**	A national methodology that corresponds to the methodology given in the Revised (1996) Guidelines is used in estimation of the CH_4 emissions. The emissions from industrial

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			wastewater treatment are based on the COD load. The DC (Degradable Organic Component) values of wastewaters with shared methane conversion factors have been used for both wastewater and sludge handling. The emissions from sludge disposal on land are, however, estimated and reported in the Solid waste disposal on land (landfills) subsector. For the industrial wastewaters, the emission factor is the IPCC default for the maximum methane producing capacity Bo = 0.25 kg CH_4/kg COD and a country-specific emission factor based on expert knowledge for the methane conversion factor MCF = 0.005.
France	**X**	**X**	For the estimation of CH_4, it is considered that the industrial effluent received at the wastewater treatment plants are treated completely under aerobic conditions, unlike the effluent from the residential and commercial sector. However, some agro-food processing industries treating their waste water in situ are likely to use the natural lagoon. The IPCC equation for industrial water is then applied with Bo = 0.25 kg / kg COD.
Germany	**NA**	**NO**	The composition of industrial wastewater, in contrast to that of household wastewater, varies greatly by industrial sector. In Germany, the biological stage of industrial wastewater treatment is partly aerobic and partly anaerobic. Anaerobic wastewater treatment is especially useful for industries whose wastewater has high levels of organic loads. This treatment method has the advantages that it does not require large amounts of oxygen, produces considerably smaller amounts of sludge requiring disposal and generates methane that can be used for energy recovery. As in treatment of municipal wastewater, treatment of industrial wastewater releases no methane emissions into the environment. The processes include aerobic treatment and anaerobic digestion; gas formed in the latter is either used for energy recovery or is flared. No calculations for this source category are carried out at present.
Greece	**X**	**X**	The methodology for calculating methane emissions from industrial wastewater is similar to the one used for domestic wastewater. In order to estimate the total organic waste produced through anaerobic treatment, the following basic steps were followed: Collection of data regarding industrial production of approximately 25 industrial sectors / sub-sectors for the period 1990 – 2011. Calculation of wastewater generated, by using the default factors per industrial sector (m^3 of wastewater/t product) as suggested by the IPCC Good Practice Guidance. Calculation of degradable organic fraction of waste, by using the default factors (kg COD/m^3 wastewater) suggested by the IPCC Good Practice Guidance for each sector / sub-sector. The distribution between aerobic and anaerobic treatment of industrial wastewater for each industrial sector was estimated on the basis of data derived from a relevant project. The maximum methane production potential factors and the methane conversion factors for aerobic and anaerobic treatment, which were used for the final estimation of methane emissions, are similar to those used for domestic wastewater handling. For the first time in the current submission, country specific data were collected, thus additional industrial sectors with 100 % aerobic treatment of their wastewater were included in the estimation. In the previous submission, in case where 100% of sector was served by aerobic treatment, it was not taken into account, considering zero emissions. The additional sectors included in the wastewater were additional subsectors of food and beverage, and the sectors of paper and pulp, organic chemicals, soap and detergents, plastic and resins, paints and petroleum refinery in the already existing sectors of food and

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			beverage, and in the sugar and textiles sectors. For the estimation of CH_4 emissions from sludge generated industrial wastewater handling is being used a methodology similar to the one used for the estimation of CH_4 emissions from industrial wastewater handling using the same country specific and default factors.
Ireland	**NO**	**X**	The anaerobic stabilisation of sludge is a source of CH_4 emissions in Ireland. The amounts of industrial wastewater sludge produced are available from biennial reports on urban wastewater treatment and approximately three percent of this sludge is treated anaerobically. The average BOD of industrial wastewater sludge is 60 kg/t (40 percent of the typical BOD content of treated industrial wastewater) and DOC is estimated as the product of average BOD content and tonnes of dry solids of sludge. The emission factor for CH_4 is derived from the 1996 IPCC Guidelines using the IPCC default value of 0.6 for B_O, 0.3 for the fraction of sludge treated and 1.0 for MCF.
Italy	**X**	**IE**	In Italy industrial wastewaters are treated 85% aerobically and 15% anaerobically. The methane estimation concerning industrial wastewaters makes use of the IPCC method based on wastewater output and the respective degradable organic carbon for each major industrial wastewater source. No country-specific emission factors of methane per Chemical Oxygen Demand are available so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series. As recommended by the Good Practice Guidance for key source categories, data have been collected for several industrial sectors (iron and steel, refineries, organic chemicals, food and beverage, paper and pulp, textiles and leather industry). The total amount of organic material for each industry selected has been calculated multiplying the annual production by the amount of wastewater consumption per unit of product and by the degradable organic component. Moreover, the fraction of industrial degradable organic component removed as sludge has been assumed equal to zero. The yearly industrial productions are reported in the national statistics, whereas the wastewater consumption factors and the degradable organic component are either from Good Practice Guidance or from national references. National data have been used in the calculation of the total amount of both COD produced and wastewater output for refineries, organic chemicals, beer production, wine, milk and sugar sectors, the pulp and paper sector, and the leather sector.
Luxembourg	**NO**	**NO**	Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic conditions (activated sludge process). As for the municipal facilities there are no methane emissions.
Netherlands	**X**	**NE, IE**	The source category „wastewater handling" also includes the CH_4 emissions from anaerobic industrial wastewater treatment plants, but these are small compared to urban wastewater treatment plants (WWTP). For anaerobic industrial WWTPs, the CH_4 emission factor is expressed as 0.176 t/t DOC design capacity, assuming a utilization rate of 80%, a CH_4-producing potential (B_o) of 0.22 t/t DOC and a methane recovery (MR) of 99%. The \`NE\` refers to only 2 industrial waste water treatment plants with anaerobic sludge digestion facilities. Since there are no activity data available for these 2 plants, forthcoming CH_4 emissions cannot be estimated. Moreover, these emissions are assumed to be

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			negligable compared to other sources of GHG emissions from waste water, keeping in mind the uncertainty of 30% in annual CH_4 emissions from waste water handling. The `IE` refers to the industrial waste water from almost all companies that is discharged to the sewer system and treated at public WWTPs. The resulting CH_4 emissions of waste water and sludge handling are thus included in category 2. Domestic and commercial waste water handling.
Portugal	**X**	**IE**	Methane emissions from industrial wastewater handling also follow the default methodology proposed in the 1996 IPCC Guidelines and the Good Practice Guidance. The organic wastewater load (TOW) is estimated using statistical production data on industries (ton product/yr) multiplied by pollution coefficients (kg O_2/ton product). These coefficients result from a study specifically done for the estimate of the loads from the Portuguese Industry and had been developed from field monitoring data at installations in Portugal.
Spain	**X**	**X**	For industrial point sources, the emissions are based on data obtained from individualized questionnaires sent to each plant. The point source activity data comprise oil refineries and paper pulp manufacturing plants. Wastewater from food industry and chemical industry was estimates as area source based on the organic load. The methane emission factor selected, with regard to the volume of waste water treated, is derived from the EMEP/CORINAIR Guidebook. For the period 1990-2000 no data is available for the wastewater volume treated and the amount is derived by an extrapolation based on the driver production data. For the 2014 submission, some parameters were revised based on the 2006 IPCC Guidelines, in particular the ratio of discharge per production unit (in m3 discharge per unit of product or raw material principal) and the ratio of organic load discharge per unit (in kg of COD/m3) while it has not been possible to complete the collection of country-specific information related to these parameters.
Sweden	**X**	**NO**	The majority of the facilities in Sweden are using aerobic processes, where no CH_4 is supposed to be generated because of the use of aeration in the wastewater treatment process. In 2012, there were only five (5) facilities using anaerobic waste-water treatment processes in Sweden. These facilities were in the pulp industry and food industry. For methane emissions from industries with internal wastewater treatment, Sweden has chosen a national method to estimate the emissions based on data availability. According to wastewater treatment expertise, the loss of CH_4 in the energy recovery process should be within the range of 2 - 5 %. This factor can be combined with data on energy recovery from the anaerobic processes.
United Kingdom	**X**	**IE**	The default IPCC methodology is applied to UK waste water estimates of organic load from the food and drink and chemical industries.

Source: NIR 2014, CRF 2014 Tables 6, 6.Bs1 and 6.Bs2
According to table 6.Bs1in CRF 2014; X= emissions are reported; NA=not applicable; NE= not estimated; IE= included elsewhere; NO=not occurring

According to the IPCC Good Practice Guidance, the emission factor for determining CH_4 emissions from wastewater and sludge handling is composed of the maximum methane producing potential (B_0) and the methane conversion factor (MCF). There is an IPCC default value available for the maximum methane producing potential which is applied in most of the member states. In contrast, the MCF has to be determined country specifically and varies strongly among the member states depending on wastewater and sludge treatment systems used; Table 8.27 provides an overview of the MCF applied by the member states.

Table 8.27 6B Waste Water Handling: Methane Conversion Factors

Member State	MCF	Specification of MCF	Further information on MCF
Austria	**0.27**	Cesspools and septic tanks	Value is taken from a national study.
Belgium	0.25	Septic tanks-	For septic tanks, the methodology is based on an article which describes the characteristics and parameters of individual septic tanks. The IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 0.060kg BOD/day, whose 60 % eventually settles (IPCC fraction that readily settle). It is considered that only 25 % of the BOD loading is anaerobically degraded (0,060*0,6*0,25), because the septic tanks are regularly emptied and consequently the sludge is then treated aerobically.
Denmark	**0.003** **0.8** **0.5**	Wastewater treatment plants Anaerobic digestion. Septic tanks	The MCF for wastewater treatment plants equals 0.003 based on an expert judgement of a conservative estimate of the fugitive methane emission from the primary settling tanks and biological treatment processes is well below 0.1% of influent BOD, while the fugitive emission from the sewer system is unknown. For anaerobic digestion, the MCF equals 0.8 (IPCC 2006). For septic tanks, the MCF has been set equal to 0.5 assuming that degradation for the settled DOC occurs under 100% anaerobic conditions.
Finland	**0.01** **0.005**	Municipal (domestic) wastewaters Industrial wastewaters	The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions. The MCF is based on expert knowledge.
France	**0.23**	For natural lagoons	Only for natural lagoons CH_4 emissions occur.
Germany	**0** **0.173**	Municipal wastewater treatment Cesspools	Aerobic conditions Based on average temperatures.
Greece	**0** **1**	aerobic anaerobic	The default values for these factors are 0 for aerobic conditions and 1 for anaerobic conditions (and these values were applied in the calculations).
Ireland	**1**	Industrial wastewater sludge	The emission factor for CH_4 is derived from the 1996 IPCC Guidelines using the IPCC default value of 1.0 for MCF.
Italy	**1**	Industrial wastewater	In the case of wastewater, the lack of information has led to use the most conservative estimate considering MCF=1 again. Further investigations are planned.
Luxembourg	**0.27**	Septic tank	The 2006 IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 60 g BOD/day, and a MCF of 0.27 is assumed. According to the national expert

Member State	MCF	Specification of MCF	Further information on MCF
			judgment and based on a study, the MCF has been adapted to the national situation in Austria which is also applicable for Luxembourg. The MCF defines the portion of methane producing capacity (B0) that degrades anaerobically and may vary between 0.0 (completely aerobic) to 1.0 (completely anaerobic) according to the IPCC 2006 Guidelines.
Netherlands	**0.5**	Septic tank	For septic tanks, a methane correction factor (MCF) of 0.5 is assumed. In 2012, only 0.6% of the population was connected to a septic tank.
Portugal	**0.1** **0** **0** **0.3** **0.8** **0.5**	No treatment Primary Secondary (well managed) Secondary (not well managed) Secondary (anaerobic, no CH_4 recovery) Septic tanks	The new guidelines from IPCC that were recently published (IPCC,2006) present more detailed values, now specific of treatment systems and management conditions, and they were used to establish the new MCF values. In the case where the industrial effluent was discharged into the unitary municipal treatment system, the MCF was determined from the average situation in Portugal for the domestic wastewater system when there is any form of treatment, either primary, secondary or tertiary.
Spain			For industrial wastewater and industrial sludge, the MCF value was derived from table 6.3 of the IPCC 2006 Guidelines.
Sweden	**-**	-	No information available.
United Kingdom	**-**	-	No information available.

Source: NIR 2014

Most member states report N_2O emissions from waste water handling. Different methods are applied (CS, D, T1 and T2). No higher tiers are defined in the IPCC GPG. For N_2O emissions footnote 5 on page 5.13 of IPCC GPG states “Given the present state of data availability, the highly simplified method described in the IPCC Guidelines for direct N_2O emissions from wastewater disposal represents good practice as it stands. This is an area where future work is needed […]”.In Table 8.28 the methods for determining N_2O emissions from wastewater handling applied by the member states are described in detail.

Table 8.28 6B Waste Water Handling: Methods for determining N_2O emissions

Member State	N_2O emissions from wastewater		Description of methods used (N_2O)
	Industrial	Domestic	
Austria	**X**	**X**	N_2O emissions from domestic and commercial wastewater handling are calculated separately for households connected and for households not connected to the municipal sewage system. N_2O emissions resulting from households not connected to the public sewage system are calculated according to the IPCC default method, as described in revised 1996 IPCC Guidelines. The data for the daily protein intake per person are taken from FAO statistics. The number of inhabitants is provided by *Austria Statistics.* The emission factor (0.01) and fraction of nitrogen in protein (0.16) are IPCC default values. N_2O emissions arising from waste water treatment plants (that are connected) are calculated by using a country-specific method based on IPCC. According to a national study, the amount of wastewater that is treated in sewage plants and the amount of nitrogen that is denitrified should be considered. Finally the N_2O emissions arising from waste water treatment plants and other treatment are summed up. It is assumed that industrial wastewater handling additionally contributes 30% of N_2O emissions from municipal wastewater treatment plants. Data for the amount of wastewater that is treated in sewage plants as well as on the denitrification rate are taken from the Austrian reports on water pollution control and situation reports on the disposal of urban wastewater and sludge; missing data in between is interpolated.
Belgium	**NA**	**X**	N_2O emissions from human sewage are estimated by using the methodology described in the IPCC 1996 Guidelines by multiplying the protein consumption per capita with the population, the N fraction in the protein and the default emission factor. The default values for N fraction in protein (kg N / kg protein) and N_2O emission factor are 16 % and 0.01 kg N_2O-N / kg sewage-N produced. The figure of protein consumption originates from the FAO statistics. The population figures come from the National Institute of Statistics.
Denmark	**IE**	**X**	The emission of N_2O from wastewater handling is calculated as the sum of contributions from wastewater treatment processes at the WWTPs and from sewage effluents. The emission from effluent wastewater, i.e. indirect emissions, includes separate industrial discharges, rainwater conditioned effluents, effluents from scattered houses, from mariculture and fish farming. The methodology for estimating emission of methane and nitrous oxide from wastewater handling follows the IPCC 1996 Guidelines and the IPCC 2000 Good Practice Guidance.
Finland	**NE**	**X**	In Finland, the N input from fish farming and from municipal and industrial wastewaters into the waterways is collected into the VAHTI database. For municipal wastewaters the measured values have been considered more reliable than the N input according to population data. In addition to the IPCC approach, also nitrogen load from industry and fish farming were taken into account. For uncollected wastewaters the nitrogen load is based on population

Member State	N_2O emissions from wastewater		Description of methods used (N_2O)
	Industrial	Domestic	
			data and protein consumption. The assessed N_2O emissions cover only the emissions caused by the nitrogen load to waterways. In addition to the emissions caused by nitrogen load of domestic and industrial wastewaters also the emissions caused by the nitrogen load of fish farming have been estimated. N_2O emission calculations are consistent with the IPCC method for discharge of sewage nitrogen to waterways.
France	**X**	**X**	IPCC method is used for domestic wastewater. The final emission factor is 21 g N_2O/inhabitant/year. The wastewater treatment plants have been eliminating N and therefore the emission factor decreased between 1990 and 2011. For industrial waste the N_2O emission factor is 17 g N_2O/inhabitant/year.
Germany	**X**	**X**	For determination of nitrous oxide emissions from industrial wastewater treatment, a research project collected data on product-specific wastewater production, on nitrogen concentrations and on COD (chemical oxygen demand) for all industrial areas and then, on the basis of annual production figures, determined annual nitrogen loads.
Greece	**X**	**X**	N_2O from waste water handling were estimated according to the default methodology suggested by IPCC. N_2O emissions from domestic wastewater handling are estimated as the indirect nitrous oxide emissions from human consumption of food and their subsequent treatment through wastewater handling systems. Data on protein consumption are provided by FAO. N_2O emissions from industrial wastewater have been estimated on the basis of the emission factors equal to 0.25 g N_2O/m^3 of wastewater production. The waste water production is resulting from the model for the estimation of methane emissions from industrial waste water.
Ireland	**NA, NE**	**X**	Human consumption of food results in the production of sewage, which is processed in septic tanks or in wastewater treatment facilities and is then disposed of directly onto land, into the soil through percolation areas or discharged to a water body. N_2O emissions are estimated by taking the IPCC default value of 0.16 for the nitrogen content in protein and applying the default emission factor of 0.01 (kg N_2O-N/ kg sewage produced) to obtain the quantity of nitrogen in sewage ultimately entering the atmosphere as N_2O.
Italy	**X**	**X**	N_2O emissions from domestic and commercial wastewater treatment are reported in human sewage. The default approach suggested by the IPCC Guidelines and updated in the Good Practice Guidance, based on population and per capita intake protein has been followed. Fraction of nitrogen protein of 0.16 kg N kg^{-1} protein and an emission factor of 0.01 kg N-N_2O kg^{-1} N produced have been used, whereas the time series of the protein intake is from the yearly FAO Food Balance. N_2O emissions from industrial wastewater have been estimated on the basis of the emission factors equal to 0.25 g N_2O/m^3 of wastewater production. The waste water production is resulting from the model for the estimation of methane emissions from industrial waste water.
Luxembourg	**X**	**X**	Pursuant to the 2006 IPCC Guidelines, nitrous oxide emissions from household wastewater can be evaluated by taking into account the average per-capita

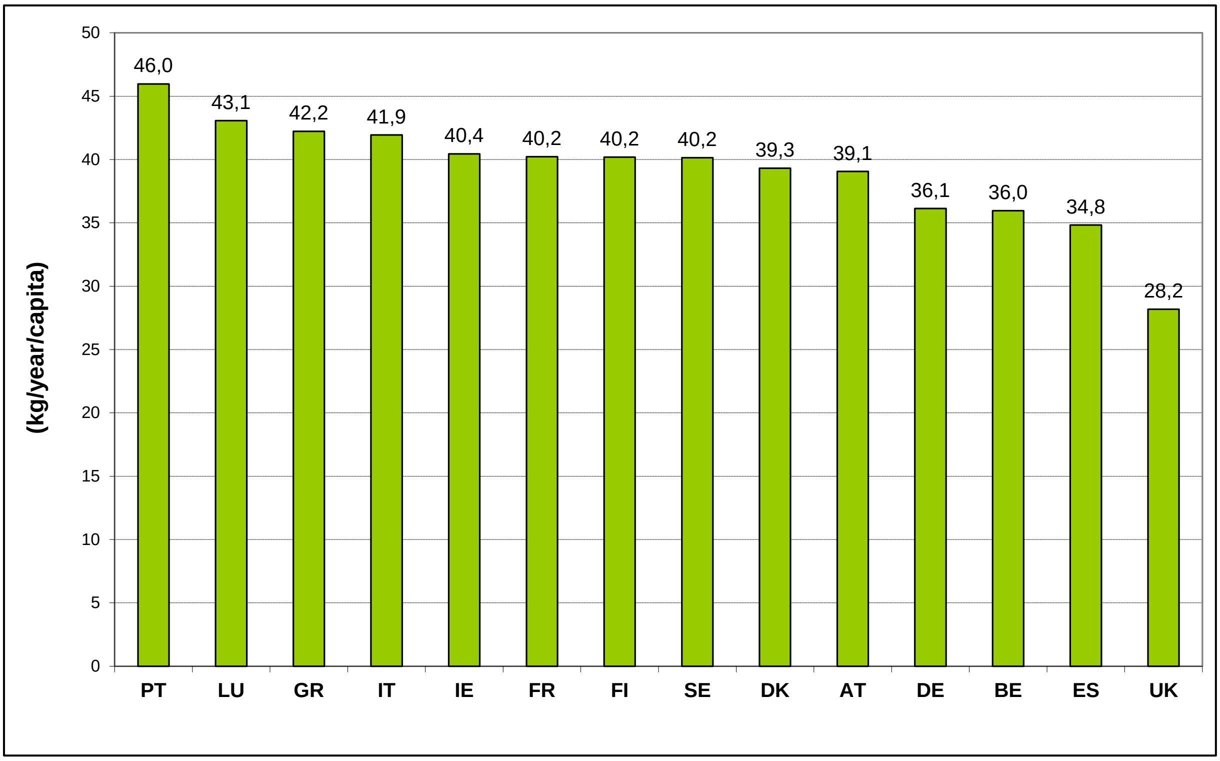
Member State	N_2O emissions from wastewater		Description of methods used (N_2O)
	Industrial	Domestic	
			protein intake. The IPCC default values are used in each case for the nitrous oxide emission factor per kg of nitrogen in wastewater and for the nitrogen fraction in protein. The number of inhabitants and the commuters are provided by the STATEC. N_2O emissions from industrial wastewater handling are issued from only one chemical plant that produces plastics and which releases N to aquatic environments. This industrial wastewater treatment plant (WWTP) is equipped with a biological treatment with denitrification. N_2O emissions are based on the measured inflow data in the WWTP. The data available since the year 2002 are the flow as well as the mean annual nitrogen concentration in the WWTP.
Netherlands	**NE**	**X**	N_2O emissions from the biological N-removal processes in urban WWTP as well as indirect N_2O emission from effluents are calculated using the IPCC default emission factor of 0.01 tons N_2O-N per ton N removed or discharged. N_2O emissions from domestic and commercial wastewater handling are determined on the basis of country-specific activity data on the total nitrogen loads removed from public WWTPs. The Netherlands does not use the standard IPCC method based on the per capita protein consumption. Influent and effluent loads of public WWTPs are monitored systematically by all the Dutch Regional Water Authorities in accordance with the rules of the EU Urban Wastewater Treatment Directive. Wastewater treated at public WWTPs is a mixture of household wastewater, run-off rainwater and wastewater from industries and services, so the forthcoming N_2O emissions are reported under the category 6B2 .Because of their insignificance compared to N_2O from domestic wastewater treatment, no N_2O emissions were estimated for industrial wastewater treatment. The N_2O emissions from septic tanks are calculated according to the default method provided in the IPCC 1996 revised Guidelines. For the calculation of the annual per capita protein uptake, data from FAO Statistics were used. For data on the % of people connected to septic tanks, the same time series is used as in the calculation of CH_4 emissions from septic tanks.
Portugal	**X**	**X**	Emissions of N_2O from domestic wastewater were estimated following the proposal of IPCC 1996 Revised Guidelines. Activity data results of protein intake, according to FAO database, multiplied by total population. For industrial wastewater, the methodology proposed in the CORINAIR/EMEP Handbook, based on the knowledge of total production of wastewater, expressed in equivalent inhabitants, and the use of a simple and unspecific emission factor, was chosen.
Spain	**NE**	**X**	N_2O emissions from waste water are calculated based on protein intake in accordance with the IPCC 1996 Guidelines. Values for the daily protein intake stem from the Ministry of the Environment (95.4 g/head, day).
Sweden	**X**	**X**	National activity data on nitrogen in discharged wastewater from municipal wastewater treatment plants and industries are used, in combination with a model estimating nitrogen in human sewage from people not connected to

Member State	N_2O emissions from wastewater		Description of methods used (N_2O)
	Industrial	Domestic	
			municipal wastewater treatment plants.
United Kingdom	**IE, NE**	**X**	The default IPCC methodology is applied to the UK time series of population and protein intake estimates from food surveys. . The most recent average protein consumption per person is based on the Expenditure and Food Survey (Defra, 2012). The UK GHGI estimate of protein consumption is derived from the Expenditure and Food Survey (Defra, 2012). This is a sample household survey in which households record the actual purchases of food they make. UK-specific conversion factors are then applied to these individual food items to estimate consumption of protein and other nutrients. The UK-specific conversion factors are based on a detailed analysis of the individual types of food purchased and contrasts to the more broad-brush factors used by the FAO. The Expenditure and Food Survey estimate is also net of any losses through the food chain through to retail as it is based on actual purchases. The only limitation to the Expenditure and Food Survey is that it may have an element of under-recording due to purchases of some food items not being included in the diary of survey participants, but the inventory agency considers that it is more representative of UK protein consumption per capita than the FAO estimate. For the purposes of the 2012 estimates within the inventory, the Expenditure and Food Survey 2013 was not available in time, and therefore the data for 2011 has been used as a best estimate. In previous years, the protein consumptions used to estimate emissions were "household intakes". However, Defra now produce a time series of the estimates of the small amount of additional protein from consuming meals eaten outside the home; this intake is called "eating out intakes". This time series is only available from 2000 onwards. For values between 1990 and 2000 an average of the data available is applied. The sum of the "household intakes" and "eating out intakes" then provides the total protein consumption per year per person.

Source: NIR 2014, CRF 2014 Tables 6, 6.Bs1 and 6.Bs2
According to table 6.Bs1in CRF 2014; X= emissions are reported; NA=not applicable; NE= not estimated; IE= included elsewhere; NO=not occuring

One important parameter for the determination of N_2O emissions from wastewater handling, the annual per capita protein consumption is country-specific and applied by almost all member states; an overview of the values is given in Figure 8.9. The Netherlands, however, does not determine N_2O emissions from wastewater handling via the average per-capita protein intake – as many countries do – but on basis of data on the total nitrogen loads removed in urban waste water treatment plants. Similarly, Denmark reports the indirect emissions from wastewater effluents under human sewage. The effluent considers discharged sewage nitrogen load consisting of contributions from municipal wastewater treatment plants, the separate industry, effluent from mariculture and fish farming, rainwater conditioned effluents and scattered houses not connected to the sewerage system.

Figure 8.9 6B Waste Water Handling: Protein consumption



Source: CRF 2014, Table6.Bs1

8.3.4 Waste Incineration (CRF Source Category 6C) (EU-15)

Emissions from waste incineration are reported by eleven member states in 2012 (Austria, Belgium, Denmark, France, Greece, Ireland, Italy, Portugal, Spain, Sweden and the United Kingdom), four member states indicate that emissions are not occurring (Germany) or are reported elsewhere (Finland, Luxembourg and the Netherlands).

According to the ARR 2012 para 106 and the ARR 2011 para 99 the notation keys should be used consistently in that category. It is the understanding of the EU that “IE” should be used in case there is incineration with and without energy recovery in the country (e.g. some incinerators with, others without energy recovery), but all three countries are reporting all emissions only in one category (probably energy). The issue of consistency of notation keys for waste incineration was discussed at WG 1 meeting in February 2013 and it was recommended that MS that have waste incineration with energy recovery and no waste incineration without energy recovery should report NO in category 6.C and report the emissions in the energy sector. In response to this discussion, some MS changed their notation key. During the review week, other Member States provided satisfactory explanations for the use of the notation keys.

The reason why Finland uses the notation key "IE" is that all waste incineration, with and without energy recovery" is reported in the energy sector. The waste incineration without energy recovery is very small in Finland, but has not been separated from the waste incineration with energy recovery (see our NIR, Section 8.4). An example, the only plant burning hazardous waste in Finland has three incinerators and one of them is without energy recovery (other two have energy recovery for district heating). The use of that third incinerator has been very limited and emission of all these three incinerators have been reported in the energy sector without trying to separate the emissions between energy sector and waste sector.

Luxembourg has only one incineration plant which recovers energy, consequently, this is reported in 1A1a. However Luxembourg choose to report "IE" in 6.C to be more transparent for the waste expert reviewer, thus indicating that waste incineration exists but is included in 1A1a as energy is recovered. Luxembourg reports emissions from a second incineration plant: a crematorium (human only, animals are exported), which from the Guidelines perspective should be reported in 6C, although this is not specifically mentioned in the IPCC GLs. Currently, there is no historical annual data on the energy consumption of this facility. So it will be difficult to report it exclusively under 6C. The CO_2 emissions are certainly covered in the GHG inventory due to the use of the energy balance, which probably reports the facility under 1A2f or 1A4a. Thus, to be consistent with the air pollution inventory, reporting "IE" in CRF 6C seems justified, also considering that the crematorium does not recover energy.

In Table 8.12 in the Danish NIR, Denmark reported CO_2 emissions from waste incineration as NO, while GHG emissions as a whole are reported. In response to a question raised by the ERT during the 2013 review, the Party explained that Denmark reports CO_2 emissions from biogenic waste incineration (corpses and carcasses) in CRF table 6.A,C, however emissions from fossil waste incineration do not occur since all incinerators work with energy recovery. Thus the CO_2 emissions are reported under waste incineration as “NO” but the CH_4 and N_2O emissions from the cremation of corpses and carcasses are accounted, therefore GHG emissions are estimated for incineration.

In Table 8.29 an overview of category descriptions and methodological issues is provided.

Table 8.29 6C Waste Incineration: Emissions reported and methodological issues

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category, emissions from incineration of waste oil are included as well as emissions from municipal waste incineration without energy recovery. In Austria waste oil is incinerated in especially designed so called “USK-facilities”. The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under fuel combustion. In 2002, the Austrian waste incineration regulation came into force, introducing strong limits (from 2005 on) for air pollution for all kind of waste incineration plants without any limit of size. The facilities which do have the allowance for incineration of waste oil other than cement plants and large waste incineration plants were only 5 in the year 2010. In general, municipal, industrial and hazardous waste are combusted for energy recovery in district heating plants or in industrial sites and therefore the emissions are reported under fuel combustion. There is only one waste incineration plant without energy recovery which has been operated until 1991 with a capacity of 22 000 tons of municipal waste per year. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions since the re-opening of this plant are reported under fuel combustion from 1996 onwards. CORINAIR methodology is applied: the quantity of waste is multiplied by an emission factor for CO_2, CH_4 and N_2O. National emission factors for CH_4 are derived from residual fuel oil VOC emission factors. N_2O emission factors are taken from a national study. For waste oil, the same CO_2 emission factor as for *1 A 1 a* heavy oil is used. For municipal solid waste and clinical waste the CO_2 emission factor is calculated by means of default assumptions from IPCC.
Belgium	X	Waste incineration includes incineration of municipal and industrial waste, incineration of hospital waste and incineration of corpses (crematoriums). Emissions originating from flaring activities are allocated partly to the sectors 1B2 (Flemish region, refineries), and partly to the sector 6C (Flemish and Walloon regions). The emissions of the waste incineration plants with energy recovery are allocated to the category 1A1a. The N_2O emission factor for municipal waste incineration has been recalculated using is situ measurements (stack emissions) combined with activity data, for some representative individual companies. This value was accordingly used for the complete time series in the 3 regions.

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		Emissions of CH_4 are not relevant here. To estimate CO_2 emissions, each region applies its own methodology according to the available activity data: In Flanders, only the fraction of organic-synthetic waste is taken into consideration (assuming that organic waste does not give any net CO_2 emissions). For the municipal waste, the institute responsible for waste management in Flanders (OVAM) is given the analysis of the different fractions in the waste. Based on this information, the amount of non-biogenic waste (excluding the inert fraction) is determined. The carbon emission factor is based on data from literature for the different fractions involved. For industrial waste, the amount of biogenic waste is considered to be the same as in municipal waste. The remaining amount is considered to be the non-biogenic part in which no inert fraction is present. For industrial waste, the content of C and is taken from a study which gives a content of C of the industrial waste of 65.5 %. In Wallonia, since 2004, the amount of incinerated waste (in ton) and the annual emissions (calculated on the basis of stack measurement) are reported annually by the operators in a software dedicated to environmental reporting. From 1990 to 2000, CO_2 emissions of municipal waste incineration are reported assuming that 68 % of the waste is composed of organic material. This is based on the average garbage composition in Wallonia and the use of IPCC equation on organic content of the various materials. Since 2001, the waste incineration plants provide each year the organic content of the incinerated waste in the context of their environmental reporting. The time-series was not recalculated from 1990 to 2000 because of the lack of data on the composition of the incinerated waste for these years. Due to a quick evolution of the policies regarding waste sorting, collection and composting, the composition of the incinerated waste has been modified. So, the organic content of the years 2001 to 2009 cannot be used to recalculate the time-series before 2001. In 2005 and 2010, the average organic content is respectively 31 % and 50%. The increase of the organic content between 2005 and 2010 is mainly explained by the stop of old plants where part of the waste was composted instead of being incinerated. In the early 1990s, about 45% of the waste was still incinerated without energy recovery. Since 2006, the 4 municipal waste incineration plants are fully equipped to produce electricity. The emissions with energy recovery are allocated in the energy sector. A small part of the emissions from municipal waste incineration is still allocated in the waste sector, category 6C, when waste is incinerated without energy recovery because of occasional problems in the energy recovery systems. In 2010, this represents 2% of the incinerated waste. The composition of the incinerated waste is: municipal solid waste, standard industrial waste, sewage sludge and some hospital waste. In the Brussels region, emissions from the waste incineration plant with energy recovery are allocated to the sector 1A1a. Another municipal waste incineration plant was also in activity until 1998, as well as two hospital waste incineration plants until 1997. No energy recovery occurs in these 3 plants. No flaring activities in the chemical industry take place in the Brussels region. The emissions of CO_2 from the flaring in the chemical industry are reported in category 6C according to the IPCC Guidelines. In absence of emission factors to estimate CH_4 and N_2O emissions from flaring activities, these emissions are not estimated in Belgium.
Denmark	X	The CRF source category 6.C. Waste Incineration, includes cremation of human bodies and cremation of animal carcasses. Incineration of municipal, industrial, clinical and hazardous waste takes place with energy recovery, therefore the emissions are included in the relevant subsectors under CRF sector 1A.

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		Emission factors for human cremation are based on literature. For animal cremation, it is assumed that humans and animals are similar in composition.
Finland	IE	Emissions of greenhouse gases CO_2, N_2O and CH_4 from Waste Incineration (CRF 6C) are reported in the energy sector (CRF 1A) in the Finnish inventory. There is no waste incineration on landfills in Finland and waste incineration for energy production is included in the energy sector. Waste incineration without energy recovery is nearly zero in combustion plants and it is also included in the energy sector. Waste incineration in households is quite small. In annual reporting of the recycling of wastepaper, the incineration of wastepaper is estimated to be only 23,000 tons. The incineration of paper and paperboard in households is estimated to be 31,000 tons together
France	X	Emissions from waste incineration are reported for the following categories: dangerous industrial waste incineration, municipal waste incineration without energy recovery, wastewater sludge incineration, (domestic) green waste burning, non-hazardous waste incineration, agricultural plastic film burning and hospital waste incineration. Emissions are estimated based on tier 1 and 2 methodologies using emission factors from different sources or emissions declaration by the facilities.
Germany	NO	Waste incineration is coupled with energy recovery. Therefore, corresponding emissions are reported in the energy sector (CRF 1).
Greece	X	CO_2, CH_4 and N_2O emissions from the incineration of clinical waste produced have been estimated. Incineration of clinical waste in a central plant is still limited, despite the fact that the facilities existed cover the total daily needs of hospitals in Athens. Moreover, emissions from the incineration of biogenic agricultural residues produced in slaughterhouses and from the incineration of small amounts of industrial chemical waste are estimated. For these estimations, data provided by the Hellenic Statistical Authority as waste incinerated without energy recovery in Greece. These data were obtained by individual researches of ELSTAT. For the estimation of CO_2 emissions from clinical and industrial waste, the default method suggested by the IPCC Good Practice Guidance was used. CO_2 emissions were not estimated for the agricultural residues taking into account that these were of biogenic nature. CH_4 and N_2O emissions were estimated using default methodology and country specific emission factors. Data related to the amount of clinical waste incinerated derive from the ACMAR, which is operating the incinerator. For the other categories, data were collected by the ELSTAT for the 2004, 2006, 2008 and 2010, while for the rest of the years similar figures were assumed. The relevant parameters and emission factor used are the ones suggested in the IPCC Good Practice Guidance.
Ireland	X	Emissions of CO_2, CH_4 and N_2O from waste incineration for all years from 1990-2012 have been estimated. The incineration of Clinical Waste is no longer carried out in Ireland. The bulk of hazardous clinical waste in Ireland is now treated using non-incineration technologies (namely sterilisation and shredding), with the remaining waste disposed of through landfilling, exported for incineration or used as a fuel in cement kilns. The category includes solvent waste incineration. Estimates of the quantity of hazardous waste incinerated at the relevant facilities are determined from returns to the National Waste Database. The methodology (including emission factors) corresponds to tier 1 in the IPCC 2006 Guidelines.
Italy	X	Existing incinerators in Italy are used for the disposal of municipal waste, together with some industrial waste, sanitary waste and sewage sludge for which the incineration plant has been authorized from the competent authority. Other incineration plants are used exclusively for

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		industrial and sanitary waste, both hazardous and not, and for the combustion waste oils, whereas there are few plants that treat residual waste from waste treatments, as well as sewage sludge. Emissions from waste incineration facilities with energy recovery are reported under category 1A4a, whereas emissions from other types of waste incineration facilities are reported under category 6C. For 2012, nearly 95% of the total amount of waste incinerated is treated in plants with energy recovery system.CH_4 emissions from biogenic, plastic and other non-biogenic wastes have been calculated. Regarding GHG emissions from incinerators, the methodology reported in the IPCC Good Practice Guidance has been applied, combined with that reported in the CORINAIR Guidebook. A single emission factor for each pollutant has been used combined with plant-specific waste activity data. Emissions have been calculated for each type of waste: municipal, industrial, hospital, sewage sludge and waste oils. A complete data base of these plants has been built, on the basis of various sources available for the period of the entire time series, extrapolating data for the years for which there was no information. For each plant a lot of information is reported, among which the year of the construction and possible upgrade, the typology of combustion chamber and gas treatment section, if it is provided of energy recovery (thermal or electric), and the type and amount of waste incinerated (municipal, industrial, etc.). Different procedures were used to estimate emission factors, according to the data available for each type of waste. As regards municipal waste, a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. On the other hand, CO_2 emissions from the incineration of sewage sludge were not included at all, while all emissions relating to the incineration of hospital and industrial waste were considered. CH_4 and N_2O emissions from agriculture residues removed, collected and burnt ‘off-site’, are reported in the waste incineration sub-sector. Removable residues from agriculture production are estimated for each crop type taking into account the amount of crop produced, the ratio of removable residue in the crop, the dry matter content of removable residue, the ratio of removable residue burned, the fraction of residues oxidised in burning, the carbon and nitrogen content of the residues. CO_2 emissions have been calculated but not included in the inventory as biomass. All these parameters refer both to the IPCC Guidelines and country-specific values.
Luxembourg	IE	This category is report under energy because in the only incinerator of the country (SIDOR site), energy from waste burning is recovered and injected in the electric public network.
Netherlands	IE	The source category Waste incineration is included in source category 1A1 Energy industries since all waste incineration facilities also produce electricity or heat used for energetic purposes. Total CO_2 emissions – i.e. the sum of organic and fossil carbon – from waste incineration are reported per facility in the annual environmental reports. The fossil-based and organic CO_2 emissions from waste incineration (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste is determined. For each of these types a specific carbon content and fossil carbon fractions are assumed, which will yield the CO_2 emissions. The method is described in detail in a national study and in a monitoring protocol.
Portugal	X	Waste incineration in Portugal includes combustion of municipal, clinical and industrial wastes. CO_2

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		emissions from incineration are calculated according to IPCC Guidelines, for each waste type (e.g. municipal solid waste (MSW), hazardous waste, clinical waste, and sewage sludge). Until 1999, incineration of solid wastes refers exclusively to incineration of hospital hazardous wastes. The figure for 1995 was used as an estimated for the former years. In 1999, two new incineration units started to operate in an experimental regime. Their industrial exploration started at the end of the same year or early January 2000. More recently another unit started operating. These units are dedicated to the combustion of MSW which is composed of domestic/commercial waste. Emissions associated with the components of fossil origin – plastics, synthetic fibres, and synthetic rubber – are accounted for in the net emissions, which include also the non-CO_2 emissions from the combustion of organic materials (e.g. food waste, paper). CO_2 emissions from the biogenic component are only reported as a memo item. Data on clinical waste incinerated refers only to Mainland Portugal and corresponds to data declared in registry maps of public hospital units (there is no incineration in private units). The quantities of clinical waste incinerated decreased strongly in recent years. 25 incinerators were closed in recent years in Mainland Portugal, only remaining at present one hospital incinerator. Other clinical wastes receive alternative treatment or are treated abroad. The non-biogenic components fractions are considered to be different for MSW, and clinical waste. Data refer to combustion of industrial solid waste in industrial units which were collected from INR. Data for the years 2000, 2002 and 2003 refer to industrial units declarations. Data for the period 1990-98 are based on the same assumptions used for Industrial Solid Waste Disposed on Land: a per year growth rate of 2%. Data from 2004 onwards refer to data collected under the Waste Registry (Mapa Integrado de Registo de Resíduos (MIRR)) on the framework of SIRAPA (APA website for the communication between APA and environmental stakeholders). Data provided by the different waste operators and industrials on the amounts of non-urban waste generated are statistical treated by the INE (Statistical Institute) in order to extrapolate the information for the universe of each economic branch. Therefore, data from 2004 onwards represent a break from previous years, as data in earlier years were not extrapolated to consider the non-responses. CH_4, N_2O and other emissions were estimated as the product of the mass of total waste combusted, and an emission factor for the pollutant emitted per unit mass of waste incinerated. Emission factors applied are either country-specific, being obtained from monitoring data in incineration units, or obtained from other references (US data, EMEP/CORINAIR).
Spain	X	Within this category, the emissions produced by the following activities have been estimated: incineration of corpses and clinical waste, municipal solid waste incineration without energy recovery and wastewater sludge incineration. For the cremation of corpses it was found that the AD source used was not completely covering all activities in Spain, therefore recalculations were performed for the period 2009-2011 to approximate the complete coverage. For the incineration of human corpses in crematories, the combustion of a supporting fuel and some other material elements incinerated during the process also account for emissions. Emission factors are derived from data of the crematories of the Municipality of Madrid. The estimation of the amount of this type of waste produced is calculated by considering the number of hospital beds and a waste production factor per bed and day. Activity data are derived from the Statistical Yearbook of Spain published by INE and from the Statistics on Health Establishments from Ministry of Health and Consumption. Since 2006, emissions from this clinical waste have become zero since, from this year , emissions from this type of waste were already accounted completely in the

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		Energy sector..
Sweden	X	Emissions from incineration of hazardous waste, and in later years also MSW and industrial waste, from one large plant are reported in CRF 6C. Reported emissions are for the whole time series obtained from the facility's Environmental report or directly from the facility on request. CO_2, SO_2 and NO_X are measured continuously in the fumes at the plant. In 2003 capacity was increased substantially at the plant by taking one new incinerator into operation. The new incinerator incinerates a mixture of MSW, industrial waste and hazardous waste. Only a minor part (less than 0.5%) of the total amount of MSW incinerated for energy purposes in Sweden are incinerated in the facility included in 6C. All other emissions from incineration of MSW are reported in CRF 1.Emissions reported are CO_2, NO_X, SO_2 and NMVOC.
United Kingdom	X	Incineration of chemical wastes, clinical wastes, sewage sludge and animal carcasses is included here. There are approximately 70 plants incinerating chemical or clinical waste or sewage sludge and approximately 2600 animal carcass incinerators. Animal carcass incinerators are, typically, much smaller than the incinerators used to burn other forms of waste. This source category also includes emissions from crematoria. Emissions are taken from research studies or are estimated on literature-based emission factors, IPCC default values, or data reported by the Environment Agency's Pollution Inventory.

X = Emissions are reported in source category 6C, IE = included elsewhere, NO=not occurring
Source: NIR 2014, CRF 2014.

8.3.5 Waste – Other (CRF Source Category 6D) (EU-15)

Under CRF source category 6D, eleven member states report emissions for 2012. Emissions from composting have been reported by ten member states (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg and the Netherlands). Denmark, France and Spain determine emissions from biogas production, where CO_2 emissions are reported as a memo item in the energy sector and emissions of CH_4 from due to unintentional leakage can be reported under 6D. Spain and Italy report emissions from sludge spreading, Germany from mechanical-biological waste treatment plants. In addition Denmark reports emissions of CO_2, CH_4 and NO_X from accidental fires; compare Table 8.30.

Table 8.30 6D Other: Reported emissions, 2012

Member State	Specification of "other waste"	6 D CO_2 (Gg CO_2)	6 D CH_4 (Gg CH_4)	6 D N_2O (Gg N_2O)	6 D NO_X (Gg NO_X)
Austria	Compost production	NA	2.59	0.35	NA
Belgium	Compost production	NA	1.14	NA	NE
Denmark	Gasification of biogas	NO	NO	NO	NO
Denmark	Accidental fires	16.36	0.07	NE	0.03
Denmark	Compost production	NA	4.31	0.41	NA
Finland	Compost production	NO	2.78	0.19	NO
France	Compost production	NA	7.75	1.51	NA
France	Biogas production	NA	1.48	NA	NA
Germany	Composting	NO	27.40	0.70	NO
Germany	Mechanical-biological waste treatment	NO	0.25	0.45	NO
Greece	Composting	NA	0.80	0.06	NA
Italy	Compost production	NA	0.27	NA	NA
Italy	Sludge spreading	NA	NA	NA	1.69
Luxembourg	Compost production	NO	0.33	0.02	NE
Netherlands	Compost production	NA	1.11	0.11	0.05
Netherlands	Recycling activities	NA	NO	NO	0.00
Spain	Anaerobic digestion at biogas facilities	NA	0.03	0.00	0.00

Spain	Sludge spreading	NE	0.71	NA	NA

Source: CRF 2014 Table 6

In Table 8.31 the source category is described further in detail.

Table 8.31 6D Other: Description and methodological issues

Member State	Waste – Other
Austria	This category includes CH_4 and N_2O emissions from mechanical-biological treatment of residual waste and composted waste. Two waste fractions are considered: waste from households and similar establishments covered by the municipal waste collection system, undergoing bio-technical treatment. To a smaller extent also waste from industrial sources is included; biogenic waste composted (both in centralised composting and home composting). Emissions are estimated by multiplying the quantity of waste by the corresponding emission factor based on national references, using a simple country-specific methodology according to the 2006 IPCC Guidelines.
Belgium	CH_4 emissions from composting of organic waste are estimated using regional activity data combined with a default emission factor of 0.75 kg CH_4/ton waste entering in the compost centres. The emission factor of 0.75 kg CH_4/ton waste composted is used after consultation with colleagues in the Netherlands who use this factor as a result of measurements carried out since 2009. In Wallonia, new figures are available for the activity data of 2010. The activity data figures are based on the quantities of waste coming out of the compost centres. According to experts' judgement, the rate between the output of the compost centres (i.e. the amount of compost production) and the input (i.e. the amount of fresh organic waste that is composted) is around 35 %. The amount of waste composted can be calculated accordingly.
Denmark	In the Danish inventory emissions from compost production, sludge spreading, biogas production and other combustion without energy recovery and accidental fires are included in this category. Emissions from composting have been calculated according to a country-specific method. Activity data for the years 1995-2009 are collected from ISAG data for the categories: "sludge", "organic waste from households and other sources" and "garden and park waste". Activities for 2010-2012 are calculated by using the trend from previous years. Emission factors for composting are based on literature. Emissions from building fires are calculated by multiplying the number of building fires with selected emission factors. Six types of buildings are separated with different emission factors: detached houses, un-detached houses, apartment buildings, industrial buildings, additional buildings and containers. Emissions from vehicle fires are calculated by multiplying the number of vehicle fires with selected emission factors.
Finland	Emissions from composting have been calculated using the methods given in the 2006 IPPC Guidelines for Greenhouse Gas Inventories. Activity data are based on VAHTI database and the Water and Sewage Works Register. The activity data for composted municipal biowaste for the year 1990 are based on the estimates of the Advisory Board for Waste Management for municipal solid waste generation and treatment in Finland in 1989. Data on 1997, 2004 and 2005 are from the VAHTI database and the intermediate years have been interpolated. In addition, composted solid biowaste in the years 1991-1996 has been interpolated using auxiliary information from the National Waste Plan until 2005. The new composting treatment code and composting plant code in Vahti registry have been used in the calculation of the years 2006-2012.
France	CH_4 and N_2O emissions from composting as well as CH_4 emissions from biogas production are considered. Emissions are estimated by multiplying emission factors with the amount of waste composted and the amount of

Member State	Waste – Other
	waste used for the production of biogas, respectively (tier 1). Activity data for composting is derived from periodic surveys ITOM performed by ADEME. For CH_4 emissions and for N_2O emissions, the emission factor applied depends on the waste type. Activity data for the estimation of CH_4 emissions from biogas production is also derived from periodic surveys ITOM from ADEME; an emission factor of 2,678 g/t waste is used.
Germany	In Germany, yearly increasing amounts of organic waste are composted. For this purpose, CH_4 and N_2O emissions from composting of municipal solid waste are estimated using a national method. Activity data is provided by the National Statistical Agency. Emission factors stem from a national study. Composting of garden and organic waste in individual households is not considered in this category. Since 1 June 2005, landfilling of biologically degradable waste is not permitted in Germany anymore. MSW has to be treated, therefore, prior to landfilling. Mechanical-biological treatment of waste is one of the options. A national method has been developed for the calculation of CH_4 and N_2O emissions in which the amount of waste treated in mechanical-biological treatment plants is multiplied with emission factors from a national study. Activity data is provided by the National Statistical Agency.
Greece	For the estimation of CH_4 and N_2O emissions from biological treatment (composting) of solid waste, a Tier 1 approach was used (according to the IPCC 2006 Guidelines), emission factors are IPCC default values.
Italy	Under this source category CH_4 emissions from compost production have been reported. The composting plants are classified in plants that treat selected waste (food, market, garden waste, sewage sludge and other organic waste, mainly from the agro-food industry) and the mechanical-biological treatment plants, that treat the unselected waste to produce compost, refuse derived fuel (RDF), and a waste with selected characteristics for landfilling or incinerating system. It is assumed that 100% of the input waste to the composting plants from selected waste is treated as compost, while in mechanical-biological treatment plants 30% of the input waste is treated as compost on the basis of national studies and references. Information on input waste to composting plants are published yearly by ISPRA since 1996, including data for 1993 and 1994, while for 1987 and 1995 only data on compost production are available; on the basis of this information the whole time series has been reconstructed. Since no methodology is provided by the IPCC for these emissions, literature data have been used for the emission factor, 0.029 g CH_4 kg^{-1} treated waste, equivalent to compost production.
Luxembourg	Compost production sites generate N_2O and CH_4 emissions. The IPCC Tier 1 method has been applied to estimate both methane and nitrous oxide emissions from compost production. Default EFs have been used. Activity data is taken from STATEC Statistical Yearbook and from Soil-Concept annual reports transmitted to the Waste Division of the Environment Agency.
Netherlands	This source category consists of the CH_4 and N_2O emissions from composting separately collected organic waste from households. A country-specific methodology for this source category is used with activity data based on the annual survey performed by the Working Group on Waste Registration at all the industrial composting sites in the Netherlands and emission factors based on the average emissions (per ton of composted organic waste) of some facilities in the late 1990s (measured during a large-scale monitoring programme in the Netherlands). Emissions from small-scale composting of garden waste and food waste by households are not estimated as these are assumed to be negligible. Since this source is not considered as a key source, the present methodology level complies with the IPCC Good Practice Guidance.
Portugal	CH_4 and N_2O emissions from landfill gas and other biogas burning: The capture and burning of landfill gas and biogas (e.g. from sewage sludge) is used for energy purposes or flaring (without energy recovery). For practical reasons all information related to the estimates of emissions from biogas combustion (with and without energy recovery) is presented here. However, the emissions related to energy recovery situations are accounted in sector 1A1a, and the emissions resulting from flaring are considered in category 6D. Emissions from the combustion of landfill gas and biogas with and without energy recovery have been estimated using emission

Member State	Waste – Other
	factors based on the energy of the biogas consumed (combusted).In the year 2012 there is no capture and burning of landfill gas without energy recovery, but from 2005 to 2011 CH_4 and N_2O emissions are reported in this sub category.
Spain	This category includes emissions from the spreading of sludge from waste water treatment plants and from flaring from biogas plants. For sludge spreading, the 2013 submission revised the fraction of sludge which was spread for the entire time series (2.2% in 2012, the share decreases continuously since 1990 (11.1%)). CH_4 emissions are estimated by applying an emission factor of 29 kg per tonne of dried sludge as derived from the "Report on Complementary Information in the Frame of the Assistance provided for CORINAIR 90 Inventory, CITEPA". Flaring from biogas plants is included since 2002 when the first plant started operation. Updated information on the amounts of biomass treated, CH_4 generated were incorporated in the most recent submission.

Source: NIR 2014

8.4 EU-15 uncertainty estimates (EU-15)

Table 8.32 shows the total EU-15 uncertainty estimates for the sector Waste and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for CO_2 from 6D Other and the lowest for CO_2 from 6C. With regard to the uncertainty on trend N_2O from 6D shows the highest uncertainty estimates, CH_4 from 6A, N_2O from 6B and CO_2 from 6C the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 8.32 Sector 6 -Waste: EU-15 uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2012	Emission trends 1990-2012	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
6.A Solid Waste Disposal	CO_2	0	0		0%	0.0%
6.A Solid Waste Disposal	CH_4	142 806	77 010	-46%	24%	0.1%
6.A Solid Waste Disposal	N_2O	0	0		0%	0.0%
6.B Waste Water Handling	CO_2	0	0		0%	0.0%
6.B Waste Water Handling	CH_4	13 145	10 657	-19%	58%	0.2%
6.B Waste Water Handling	N_2O	10 077	10 017	-1%	138%	0.1%
6.C Waste Incineration	CO_2	4 033	2 298	-43%	19%	0.1%
6.C Waste Incineration	CH_4	179	57	-68%	20%	0.4%
6.C Waste Incineration	N_2O	102	87	-14%	133%	0.3%
6.D Other	CO_2	18	16	-7%	261%	0.2%
6.D Other	CH_4	117	841	618%	36%	2.0%
6.D Other	N_2O	71	653	821%	36%	3.0%
Total - 6	**all**	**170 547**	**101 636**	**-40%**	**23.6%**	**11.7%**

Note: *Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions of the EU-NIR because uncertainty estimates are not available for all source categories in each of this 15 EU Member States;*

8.5 Sector-specific quality assurance and quality control (EU-15)

Under the Climate Change Committee a workshop was conducted in Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop were: (1) to provide an opportunity to learn about the methods used for inventories and projections in the different member states, to share information, experience and best practice; (2) to compare the parameters chosen in the estimation methodologies across EU-15 member states; (3) to compare emissions and methods used for GHG inventories with data and methods for EPER; and (4) to strengthen links between assessment of air pollution under the IPPC and emissions under the UNFCCC. In addition, the workshop provided an opportunity to discuss potential methodological changes or improvements of the draft 2006 IPCC inventory guidelines. The recommendations and presentations of this workshop can be downloaded from the Internet under the following link: **http://air-climate.eionet.eu.int/docs/meetings/050502_GHGEm_Waste_WS/meeting050502.html**. Clarifications from discussions of individual parameters used in the estimation of emissions from waste were incorporated in this report.

A second expert meeting under the Climate Change Committee on the estimation of CH_4 emissions from solid waste disposed to landfills was conducted in March 2006. This meeting was targeting in particular those EU member states that do not yet use the IPCC FOD methods for their inventories (mostly new EU member states). The objective of the expert meeting was to use the new default model provided by draft 2006 IPCC Guidelines for national GHG inventories in order to calculate CH_4 emissions for the participants' countries. 11 member states, 2 EEA Member countries, and one accession country participated. 9 of the 14 countries had previously not estimated CH_4 emissions with a FOD method. The meeting enabled those member states that still used Tier 1 method to use the FOD model with national/default data as available. Other member states used the IPCC FOD model as quality check and for comparison with the results of the country-specific model with usually minor differences compared to the national model. The meeting also contributed to the exchange of experiences of specific circumstances regarding waste generation, composition and solid waste disposal in new member states and on the estimation of CH_4 recovery in the absence of monitored data. In addition, the meeting provided recommendations to IPCC for further improvement and corrections of the draft default model.

In 2012 a comprehensive review was carried out for all sectors and all EU Member States in order to fix the base year 2020 under the EU Effort Sharing Decision. (ESD review 2012). This review also covered the waste sector of the MS GHG inventories (peer review).

Every year before and during the compilation of the EU GHG inventory several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency.

In 2014, additional quality checks of the EU NIR chapter waste were carried out in order to improve the consistency between the CRF tables and the EU NIR and consistency of tables and figures with text in the EU NIR.

8.6 Sector-specific recalculations (EU-15)

Table 8.33 shows that in the waste sector the largest recalculations in 1990 and 2011 were made for CH_4.

Table 8.33 Sector 6 Waste: Recalculations of total GHG and recalculations of GHG emissions for 1990 and 2011 by gas (Gg CO_2 equivalents and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	-2 695	-0.1%	5 153	1.2%	2 343	0.6%	-50	-0.2%	-54	-0.3%	212	2.0%
Waste	50	1.2%	-907	-0.6%	2	0.0%	NO	NO	NO	NO	NO	NO
2011												
Total emissions and removals	-11 579	-0.4%	8 425	2.9%	5 586	2.1%	-441	-0.6%	-233	-6.7%	-78	-1.3%
Waste	-38	-1.5%	3 906	4.4%	82	0.7%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 8.34 provides an overview of member states' contributions to EU-15 recalculations. The large recalculations reported for the UK are due to a methodological change in estimating CH_4 recovery. The large recalculation for Spain of the CH_4 emissions in 2011 is due to incoporated ammounts of waste burned and the application of changes in waste compositon in sector 6A. UK's large recalculations are explained by the use of methane recovery data for landfills that is now taken from monitored data also in sector 6A.

Table 8.34 Sector 6 Waste: Contribution of member states to EU-15 recalculations for 1990 and 2011 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2011					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	0	32	-4	NO	NO	NO
Belgium	-2	-164	0	NO	NO	NO	3	-83	7	NO	NO	NO
Denmark	-1	-111	1	NO	NO	NO	0	37	74	NO	NO	NO
Finland	IE,NO	0	0	NO	NO	NO	IE,NO	-0.1	-0.1	NO	NO	NO
France	53	218	-12	NO	NO	NO	33	47	27	NO	NO	NO
Germany	NO	-743	16	NO	NO	NO	NO	8	3	NO	NO	NO
Greece	0	314	0	NO	NO	NO	0	169	13	NO	NO	NO
Ireland	0	-0.1	0	NO	NO	NO	-16	39	3	NO	NO	NO
Italy	0	0	0	NO	NO	NO	-62	-771	3	NO	NO	NO
Luxembourg	IE,NA,NO	0	0	NO	NO	NO	IE,NA,NO	-1	-1	NO	NO	NO
Netherlands	IE,NA,NO	0	0	NO	NO	NO	IE,NA,NO	0	1	NO	NO	NO
Portugal	0	0	-3	NO	NO	NO	5	-23	-4	NO	NO	NO
Spain	0	-309	0	NO	NO	NO	-2	-1 026	16	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	0	4	-1	NO	NO	NO
UK	0	-110	0	NO	NO	NO	1	5 475	-54	NO	NO	NO
EU-15	**50**	**-907**	**2**	**NO**	**NO**	**NO**	**-38**	**3 906**	**82**	**NO**	**NO**	**NO**

NO: not occurring; NE: not estimated; NA: not applicable; IE: included elsewhe

9 OTHER (CRF SECTOR 7)

This sector does not include any emissions in 2012.

10 RECALCULATIONS AND IMPROVEMENTS

10.1 Explanations and justifications for recalculations

Table 10.1 to Table 10.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2011 for each EU-15 Member State, which provided the relevant information, and by source categories, for the largest recalculations (>+/- 500 Gg CO_2 equiv.). For more details see the information provided by the Member States' submissions in Annex 1.12.

Table 10.1 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries N_2O	Germany	-1077	-25	Correction of some emission factors in order to increase time series consistency. Final data available from the National Energy Balance.
1A2_Manufacturing Industries and Construction CO_2	France	-952	-1	Updated energy balance SOeS statistics for several years (decrease of the quantity of petroleum products) and revision of the fuel split of petroleum products (-> impact on the consumption of petroleum coke and LPG). - Correction of a double counting of the new fuel category ``GNR`` (for off road machineries), i.e. non-road diesel oil, for the first introduction year 2011 (impact for all sector in the CRf code 1A2)
1A2_Manufacturing Industries and Construction CO_2	Spain	-2314	-5	Activity included (fuel consumption) in the revision of the inventory fuel balance.
1A2_Manufacturing Industries and Construction CO_2	UK	1216	1	National energy statistics revised for many sectors from 2008 onwards. 1A2c: New source: refinery gas combustion in chemical industry. National energy statistics revised for many sectors from 2008 onwards. 1A2f: Correction to EUETS data has caused a change to OPG CEF for all years. Correction to allocation of petcoke to lime sector. Reallocation of reinery gas to chemical sector.
1A3_Transport CO_2	Spain	3339	6	Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
4B_Manure management CH_4	UK	5527	161	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for deep litter (previously solid storage and dry lot) in response to ERT 2013. Updated feed digestibility for dairy cows from 75.0 to 74.5234142710097.
4B_Manure management N_2O	UK	1388	71	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for deep litter (previously solid storage and dry lot).

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
6B_Waste water handling CH_4	Germany	-743	-33	See Definition of Sludge in the NIR (Chap. 8.3.2.2.1). Sludge together with purified wastewater is the final product of waste water treatment. During the wastewater treatment the sludge (as a part of wastewater) has been treated in digestion towers and therefore does not contain any TOS (according to definition of the IPCC 1996 Guidelines, Reference Manual p 6.13+19). Change of MCF.

Table 10.2 Main recalculations by source category for 2011 and Member States' explanations for recalculations given in the CRF or in the NIR

		2011		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	Belgium	1056	5	1A1a solid fuels: Flemish region: difference mainly due to wrong allocation between solid fuel and biomass of one electric power installation in 2011. 1A1a other fuels: Flemish region: by finalizing the definitive energy balance for 2011, 1,1 PJ more other fuels was reported (+112 kton CO_2) + RBC: AD revision (waste incinerated).
1A1_Energy Industries CO_2	France	-1106	-2	1A1a: Completeness of data: improved accuracy and temporal coherence. 1A1b: Filtering method and improved allocation of emissions.
1A2_Manufacturing Industries and Construction CO_2	Austria	726	5	Revised energy balance.
1A2_Manufacturing Industries and Construction CO_2	France	-1921	-3	Updated energy balance SOeS statistics for several years (decrease of the quantity of petroleum products) and revision of the fuel split of petroleum products (-> impact on the consumption of petroleum coke and LPG). - Correction of a double counting of the new fuel category ``GNR`` (for off road machineries), i.e. non-road diesel oil, for the first introduction year 2011 (impact for all sector in the CRf code 1A2)
1A2_Manufacturing Industries and Construction CO_2	Germany	2241	2	Final data available from the National Energy Balance.
1A2_Manufacturing Industries and Construction CO_2	Spain	-11076	-19	Activity included (fuel consumption) in the revision of the inventory fuel balance.
1A2_Manufacturing Industries and Construction CO_2	UK	-3164	-5	National energy statistics revised for many sectors from 2008 onwards. 1A2c: New source: refinery gas combustion in chemical industry. National energy statistics revised for many sectors from 2008 onwards. 1A2f: Correction to EUETS data has caused a change to OPG CEF for all years. Correction to allocation of petcoke to lime sector. Reallocation of reinery gas to chemical sector.
1A3_Transport CO_2	France	1845	1	1A3a, 1A3c + 1A3d: Updated data: improved accuracy. 1A3b: Recalculation is due to revision of biofuels dataset : present use of actual volumes incorporated into the fuels (new available statistics from customs vs previous estimated ratios as energy).

		2011		Main explanations
		Gg CO_2 equiv.	Percent	
1A3_Transport CO_2	Spain	-648	-1	Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
1A4_Other sectors CO_2	Austria	-556	-5	Revised energy balance.
1A4_Other sectors CO_2	Belgium	-1029	-4	Energy balance update (final values 2011) 1A4a liquid fuels: reallocation of off-road activities in harbours, airports and transhipment companies in 1A3e and 1A5b (defence) instead of 1A4a before 1A4b liquid fuels: Flanders: for fuel oil, the data from 2002 were based on an estimate of the number of households from the latest census of 2001 using heating oil as main energy source, corrected with newly built homes (+) and demolished houses (-). The switch in existing houses from fuel oil to natural gas was so far not taken into account, leading to an accumulated overestimation of households using fuel oil as main energy source. This correction was made during the 2014 submission for the years 2002-2012. 1A4b biomass: Flanders en Wallonia: new methodology to estimate the woodconsumption for households.The methology uses the urbanisation degree and unweighted average uses of biomass as main heating source or as secondary heating source from the Eurostat survey to calculate the total biomass used for the period 1990 -2011. 1A4c liquid fuels: RBC : Offroad AD revision (energy)
1A4_Other sectors CO_2	France	1512	2	Recalculations performed are due to changes in activity data : - update of energy balance statistics, - update of fuel type split for petroleum products (data from CPDP statistics).
1A4_Other sectors CO_2	Germany	9831	8	Final data available from the National Energy Balance.

		2011		Main explanations
		Gg CO_2 equiv.	Percent	
1A4_Other sectors CO_2	Spain	7792	23	Light differences due to a revision of the significant digits of the emission factor for diesel/gas-oil. Activity data have been revised due to the adoption in the current submission of the national energy balance published by the international entities (IEA and EUROSTAT) and the international questionnaires submitted to the said international agencies by the Ministry of Industry, Energy and Tourism, as the reference sources for this category.
1A4_Other sectors CO_2	UK	3189	4	National energy statistics revised for many sectors from 2008 onwards. 1A4b: Revision to carbon balance apprach to use AD and EFS from ISSB/Tata in preference to DUKES stats and historic EF defaults.
1B2_Oil and natural gas CO_2	France	1057	36	1B2a: Error correction: improved accuracy. New data: improving completeness. Change of use: improving transparency. 1B2b: Refinement of reporting: improving the completeness and transparency. 1B2c: Filtering method that takes into account new data: improved accuracy.
2F_Consumption of halocarbons HFC	France	902	6	2F1 + 2F9: New data considered: improving comprehensiveness. Updated data : improved accuracy. 2F2: Consolidation of data : improved accuracy (data from the previous edition are provisional data) . 2F3: Correction: improving accuracy. 2F4: Updated data and refinement of the allocation method : improved accuracy. 2F7: New data considered: improving comprehensiveness.
2F_Consumption of halocarbons HFC	Italy	-503	-5	Leakage rates in manufacturing and in use have been revised for the whole time series
2F_Consumption of halocarbons HFC	UK	-769	-5	Updated activity data.
4B_Manure management CH_4	UK	4098	163	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for deep litter (previously solid storage and dry lot) in response to ERT 2013. Updated feed digestibility for dairy cows from 75.0 to 74.5234142710097.
4B_Manure management N_2O	UK	1033	63	Dated AWMS values in response to ERT 2013. Decreased allocation to daily spread; changed SSDL to Deep litter. Updated MCF value from 1% to 39% for

		2011		Main explanations
		Gg CO_2 equiv.	Percent	
				deep litter (previously solid storage and dry lot).
4D_Agricultural soils N_2O	France	832	2	Besides the recalculation implemented in response to the last 2013 Saturday Paper (addition of imported manure and addition of emissions from cultivated histosols), the emission factor for volatilisation of sludges has been corrected to be consistent with the GPG 2000 (20% instead of 10%) and the results were adjusted because of updated data on agricultural statistics.
4D_Agricultural soils N_2O	Spain	583	3	FRACgasm modified due to new methodologies for estimating NO_X and NH_3 emissions.
4D_Agricultural soils N_2O	UK	617	2	Updated AWMS values in response to ERT 2013. Scottish Government supplied updated timeseries for 2008 to 2011. Some crop production values updated from 2006 from data supplied by DEFRA. Updated sewage sludge timeseries data to agree with 6B.
6A_Solid waste disposal on land CH_4	Italy	-763	-6	Update of activity data. Correction of a mistake regarding CH_4 flaring.
6A_Solid waste disposal on land CH_4	Spain	-931	-8	Ammounts of waste burned have been incorporated and Changes in waste compositon have been applied
6A_Solid waste disposal on land CH_4	UK	5395	38	Methane recovery data for landfills now taken from monitored data.

10.2 Implications for emission levels

Table 10.3 provides the differences in total EU-15 GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EU-15 1990 GHG emissions excluding LULUCF have increased in the latest submission compared to the previous submission by 7 596 Gg (0.2 %). EU-15 GHG emissions for 2011 increased by 19 310 Gg (0.5 %) due to recalculations.

Table 10.3 Overview of recalculations of EU-15 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Total CO_2 equivalent emissions including LULUCF (absolute)	4 909	16 333	10 876	-3 204	14 991	15 385	-7 401	-13 122	-14 456	1 680
Total CO_2 equivalent emissions including LULUCF (percent)	0.1%	0.4%	0.3%	-0.1%	0.4%	0.4%	-0.2%	-0.4%	-0.4%	0.0%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	7 596	24 690	18 860	10 307	18 828	19 860	17 558	11 545	12 975	19 310
Total CO_2 equivalent emissions excluding LULUCF (percent)	0.2%	0.6%	0.5%	0.2%	0.5%	0.5%	0.4%	0.3%	0.3%	0.5%

Table 10.4 provides an overview of recalculations for the EU-15 key categories for 1990 and 2011 (see Section 1.5 for information on identification of EU-15 key categories). The table shows that the largest recalculations in absolute terms were made in the key category CH_4 from 4B ‘Manure Management’ for 1990 and in the key category CO_2 from 1A4 ‘Other Sectors’ for 2011.

Table 10.5 and Table 10.6 give an overview of absolute and percentage changes of Member States’ emissions due to recalculations for 1990 and 2011. Large recalculations in absolute terms were made in Germany, France, the UK, Belgium and Spain. Recalculations in relative terms of more than 1 % were made in Germany, Portugal, Spain, Sweden and the UK.

Table 10.4 Recalculations for the EU-15 key source categories 1990 and 2011 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2011	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1A1 Energy Industries	CO_2	-23	-0.002%	1105	0.1%
1A1 Energy Industries	N_2O	-1093	-12%	59	1%
1A2 Manufacturing Industries	CO_2	-2452	-0.4%	-13695	-3%
1A3 Transport	CO_2	3284	0.5%	465	0.1%
1A3 Transport	CH_4	-18	-0.4%	-35	-3%
1A3 Transport	N_2O	-20	-0.3%	37	0.5%
1A4 Other Sectors	CO_2	-216	0.0%	20284	4%
1A4 Other Sectors	CH_4	-33	-0.3%	330	5%
1A5 Other	CO_2	-0.5	-0.002%	-121	-2%
1B1 Solid Fuels	CH_4	7	0.02%	62	1%
1B2 Oil and Natural Gas	CH_4	-261	-1%	29	0.1%
2A Mineral Products	CO_2	163	0.1%	-57	-0.1%
2B Chemical Industry	CO_2	160	1%	-58	-0.2%
2B Chemical Industry	N_2O	45	0.05%	44	0.5%
2C Metal Production	CO_2	161	0.3%	-502	-1%
2C Metal Production	PFC	-57	-0.4%	-1	-0.1%
2C Metal Production	SF_6	-11	-1%	39	11%
2E Production of Halocarbons and SF6	HFC	0	0%	-2	-0.2%
2F Consumption of Halocarbons and SF6	HFC	-50	-25%	-433	-1%
2E Production of Halocarbons and SF6	PFC	223	3%	-117	-2%
2F Consumption of Halocarbons and SF6	SF_6	223	3%	-117	-2%
4A Enteric Fermentation	CH_4	257	0.2%	739	1%
4B Manure Management	CH_4	5720	15%	4406	12%
4B Manure Management	N_2O	1953	8%	1645	8%
4D Agricultural Soils	N_2O	957	0.4%	1624	1%
6A Solid Waste Disposal on Land	CH_4	-212	-0.1%	3804	5%
6B Waste-water Handling	CH_4	-483	-3%	51	0.5%
6B Waste incineration	CO_2	277	7%	-37	-1%

Note: Many of these source categories are more aggregated than the EU-15 key source categories identified in Section 1.5.

Table 10.5 Contribution of Member States to EU-15 recalculations of total GHG emissions without LULUCF for 1990–2011 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	-70	15	79	-314	-381	-279	-80	192	-204	-81
Belgium	-143	-81	-135	-1206	-163	-230	-822	-1259	-1171	-26
Denmark	-59	-1	314	149	176	195	138	228	185	269
Finland	-109	-117	-141	-124	-178	-168	-84	-47	-139	-158
France	909	1663	1581	464	757	1662	1634	1371	2 247	4 467
Germany	-2 215	-748	-228	-3 470	2 039	638	4 810	1298	2 870	12 199
Greece	340	429	354	390	451	450	424	476	600	-317
Ireland	-1	-83	13	205	140	-35	412	487	402	237
Italy	71	92	-64	-172	-295	-289	-557	-667	-955	-2 191
Luxembourg	0.03	0.01	2	-1	-2	2	1	-6	-3	27
Netherlands	0.3	-34	17	-26	16	1	0.4	-78	110	685
Portugal	-186	-205	-203	-351	-361	-241	-450	-362	-748	-670
Spain	960	9 411	1228	-1442	-459	102	-432	-3 054	-1460	-4 597
Sweden	-37	-220	-339	-355	-386	-273	-393	-240	-415	-695
UK	8 134	14 569	16 382	16 559	17 473	18 325	12 956	13 207	11 659	10 159
EU-15	**7 596**	**24 690**	**18 860**	**10 307**	**18 828**	**19 860**	**17 558**	**11 545**	**12 975**	**19 310**

Table 10.6 Contribution of Member States to EU-15 recalculations of total GHG emissions without LULUCF for 1990–2011 (difference between latest submission and previous submission in percentage)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Austria	-0.1	0.0	0.1	-0.3	-0.4	-0.3	-0.1	0.2	-0.2	-0.1
Belgium	-0.1	-0.1	-0.1	-0.8	-0.1	-0.2	-0.6	-10	-0.9	0.0
Denmark	-0.1	-0.001	0.5	0.2	0.2	0.3	0.2	0.4	0.3	0.5
Finland	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.2	-0.2
France	0.2	0.3	0.3	0.1	0.1	0.3	0.3	0.3	0.4	0.9
Germany	-0.2	-0.1	-0.02	-0.3	0.2	0.1	0.5	0.1	0.3	13
Greece	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.5	-0.3
Ireland	-0.001	-0.1	0.0	0.3	0.2	-0.1	0.6	0.8	0.7	0.4
Italy	0.01	0.02	-0.01	-0.03	-0.1	-0.1	-0.1	-0.1	-0.2	-0.4
Luxembourg	0.0003	0.0001	0.02	-0.01	-0.01	0.01	0.01	-0.1	0.0	0.2
Netherlands	0.00	-0.02	0.01	-0.01	0.01	0.0002	0.0002	-0.04	0.1	0.4
Portugal	-0.3	-0.3	-0.2	-0.4	-0.4	-0.3	-0.6	-0.5	-10	-10
Spain	0.3	3.0	0.3	-0.3	-0.1	0.02	-0.1	-0.8	-0.4	-13
Sweden	-0.1	-0.3	-0.5	-0.5	-0.6	-0.4	-0.6	-0.4	-0.6	-11
UK	11	2.1	2.4	2.5	2.7	2.8	2.1	2.3	2.0	18
EU-15	**0.2**	**0.6**	**0.5**	**0.2**	**0.5**	**0.5**	**0.4**	**0.3**	**0.3**	**0.5**

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that neither the 1990 nor 2011 emissions have been recalculated significantly the emission trend in the EU-15 did hardly change. In the previous submission the trend of GHG excluding LULUCF between 1990 and 2011 was – 14.7 %. In the latest submission the trend is -14.4 %.

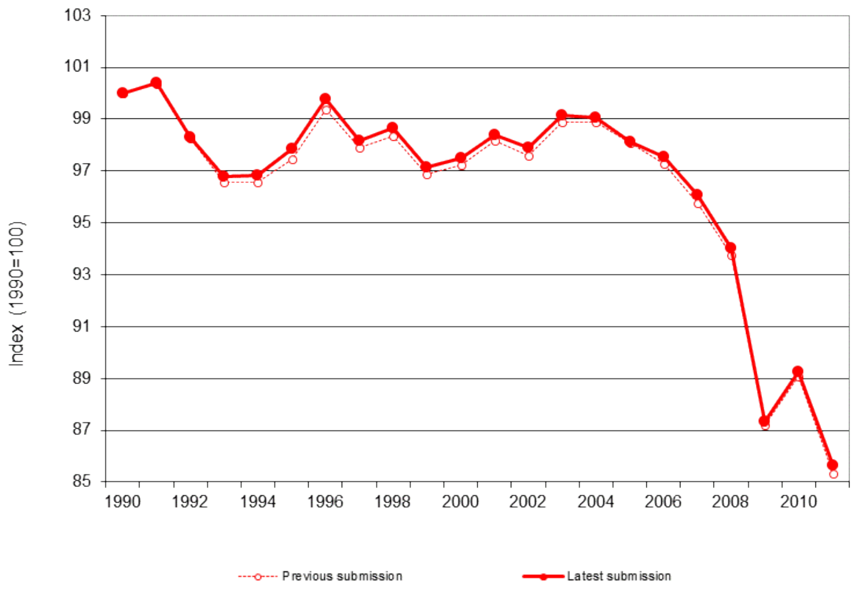


Figure 10.1: Comparison of EU-15 GHG emission trends 1990–2011 (excl. LULUCF) of the latest and the previous submission

10.4 Recalculations, including in response to the review process, and planned improvements to the inventory

10.4.1 EU response to UNFCCC review

A list of recommendations and improvements is presented in (). The table focuses on UNFCCC recommendations from the review reports 2012 and 2013

Table 10.7 Improvements in 2013 including in response to UNFCCC review findings

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
General	Completeness/geographical coverage	The ERT recommends that the European Union provide further clarification of the difference from the national annual submissions of Denmark and the United Kingdom in the NIR of its next annual submission. (para 10)	ARR 2012	Implemented: This was implemented by providing additional information on the use of of abbreviations (e.g. DNM, DNK, etc) and adding references to the UNFCCC and EEA websites where the submissions of Denmark and the UK are available.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
General	Completeness / consistency	Strengthen the system to check whether a category is really not estimated as opposed to not occurring, and if the activity occurs, report emissions for the respective member State to ensure complete reporting Review the use of the notation keys for “not estimated” and either revise the notation key or ensure emissions are estimated Improve the quality assurance/quality control (QA/QC) of the NIR, considering both internal consistency and consistency with the CRF tables (Table 3)	ARR 2013	Implemented: Checks related to NE have been reinforced in 2014; some MS changed the use of notation keys Additional QA loop of the NIR implemented for the first time in 2014 (see below)
General	inventory planning	Ensure that all contracts and agreements are in place and that continuity is assured (para 12)	ARR 2013	Implemented: Information is included in the NIR 2014.
General	inventory planning	The ERT recommends that the Party continue its efforts to ensure that any errors identified during the compilation of the European Union inventory from the inventories of the	ARR 2013	Implemented: All findings are inlcuded in the web communication tool; in urgent/important cases e-mail alerts were sent to MS; MS responded very quickly

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		member States be addressed in a timely manner.		
General	inventory preparation	Check tables containing information on tiers and sources of emission factors (EFs) and ensure that: all member States' methods are correctly and consistently classified where tiers are provided in the Revised 1996 IPCC Guidelines or the IPCC good practice guidance; all codes used in the table are explained in the section Units and abbreviations; and references to sources such as CORINAIR are included (para 22)	ARR 2013	Mostly implemented: Sector experts checked the classification of methods and emission factors in 2014 and consulted MS via the web based communication tool; abbreviations are inlcuded in the annex; references to CORINAIR are not provided because of limited time available.
General	inventory preparation	Improve the reporting of AD by using data representing the Party as a whole and, together with total Party emissions, estimate the Party's implied emission factors (IEFs) (para 23)	ARR 2013	Implemented: AD was estimated for the EU-15 for the following categories: CO_2 from 2A1, 2A2 and 2B1 & N_2O from 6B human sewage. A description of the approach is included in the NIR.
General	inventory preparation	Use a single official UN language in a future NIR of the European Union (para 24)	ARR 2013	Implemented: French and Spanish text in the EU NIR was translated or summarized

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
General	inventory preparation/QA/QC	The ERT commends the European Union for this QA activity (ESD review 2012) and encourages the Party to follow up on the relevant recommendations made. (para 29)	ARR 2012	Implemented: It was checked during the initial checks 2014 if the recommendations from the ESD review 2012 have been implemented by MS.
General	inventory preparation/transparency	However, the ERT encourages the European Union to provide better summary information and explanations of the use of the notation keys “IE” and “NE” by member States in the CRF tables (e.g. listing the notation keys with the member States using each of them) in its next annual submission (see para. 13 above). (para 31)	ARR 2012	Implemented: This is done in Table 9. All NE and IE are listed and explanations of MS are provided. We provided a revised Table 9 including the long list and the list of NEs / IEs relevant at EU level
General	inventory preparation/uncertainties	There was no uncertainty analysis for the KP-LULUCF activities. The ERT encourages the Party to develop such an analysis for the next annual submission. (para 24)	ARR 2012	Implemented: Excel, @Risk tool available
General	Key category analysis	During the previous review, the European Union indicated its intention to include the LULUCF sector in the tier 2 key category analysis to be prepared for	ARR 2012	Implemented: Tier 2 key category analysis was provided in 2013 and also LULUCF was included

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		the 2012 annual submission; however, this was not carried out. The ERT encourages the Party to proceed with the planned improvement for its next annual submission. (para 18)		
General	Key category analysis	The key categories for KP-LULUCF activities for member States are provided in the NIR and in table NIR-3, but are not calculated at the European Union level. The ERT noted that not all member States provided data on KP-LULUCF key categories. The ERT recommends that the Party complete the information and include the results of the analysis at the European Union level in its next annual submission. (para 20)	ARR 2012	Partly implemented: The key category for KP LULUCF is now based on correspondence with EU15's LULUCF inventory. Next submission will inlcude a KC analisis by comparing Emission/removals with smallest key category in the EU inventory
General	QA/QC	The ERT has still detected some QA/QC issues (see paras. 46, 47, 60, 63, 75, 87, 101 and 114 below) and recommends that the European Union further enhance the implementation of	ARR 2012	Implemented: In 2014 a new QA loop was implemented between 15 April and 8 May. EEA and VITO quality checked the NIR chapters energy, IP and waste. JRC organized the QA loop in-house.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		its QA/QC procedures for its next annual submission. (para 27)		
General	Recalculations	The ERT commends the European Union for this transparent reporting of recalculations and recommends that the Party expand the explanations of recalculations for the LULUCF sector. (para 25)	ARR 2012	Implemented: Information was included in the NIR
General	Transparency	The ERT noted some minor transparency issues, such as not updated (see paras. 47, 87 and 114 below) or missing (see para. 73 below) member States' information, incorrect references (e.g. to non-existent tables (see para. 75 below)) and lack of justification of emission trends (see para. 54 below). The ERT recommends that the European Union further improve the transparency of its NIR and address the transparency issues raised in the sectoral chapters of this report in its next annual submission. (para 30)	ARR 2012	Implemented : In 2014 a new QA loop was implemented between 15 April and 8 May. EEA and VITO quality checked the NIR chapters energy, IP and waste. JRC organized the QA loop in-house.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
General	uncertainty analysis	The ERT recommends that the Party make efforts to collect all data for all categories and conduct a full uncertainty analysis for its next annual submission. The ERT also recommends that the European Union provide a short discussion of the cause of the increase in uncertainty in its next annual submission. (para 21)	ARR 2012	Implemented: Austria provided uncertainty estimates for the complete inventory; only Luxembourg is missing but this is negligible. Short discussion provided on changes of Tier 2 uncertainty anaylsis
General	Follow up to previous reviews	Encourage all member States to improve the completeness of their inventories, particularly for the LULUCF sector and KP-LULUCF activities (para 27)	ARR 2013	Implemented: This was implemented via the initial checks, the JRC workshops and the MS assistance project.
General	Follow up to previous reviews	Make efforts to summarize the country-specific subcategories reported by the member States and report a list of the subcategories reported under the category other in the CRF tables (para 28)	ARR 2013	Implemented: This is a lot of manual work. Therefore, we focused on specific categories: information was included in the NIR 2014 (1A2f, 1B1c, 1B2d) and in the CRF tables (4D).
Energy	Sector overview	Continue efforts to ensure consistent reporting across member States regarding methods and EFs (para 31)	ARR 2013	Implemented: Sector experts checked the classification of methods and emission factors in 2014 and consulted MS via the

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
				web based communication tool; abbreviations are inlcuded in the annex; references to CORINAIR are not provided because of limited time available.
Energy	Sector overview	Strengthen QA/QC procedures to ensure that member States' information is updated and correctly represented in the NIR	ARR 2013	Implemented: This is implemented by a new QA loop between 15 April and 8 May. VITO has quality checked the NIR chapter energy. Results are considered in the resubmission of 27 May.
Energy	Sector overview	Further encourage consistency of reporting of fuels across member States and, where relevant (e.g. where there are deviations of the IEFs due to the misallocation of a fuel by different member States), include a table summarizing the allocation of fuels across subcategories and sectors among member States (e.g. allocation across the energy and industrial processes sectors, and allocation of biomass across member States) (para 33)	ARR 2013	Implemented: All striking IEF outliers have been explained
Chapter 3 / Energy	1A2/Transparency	The ERT recommends that, in its next annual submission, the	ARR 2012	Implemented: We included a table with an extraction of MS reporting similar to

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		European Union clearly specify in the NIR and CRF table 1.A(a) which industries are included in the category other (manufacturing industries and construction). (para 45)		2A7 and 2B5.
Chapter 3 / Energy	1Ab/Reference approach, QA/QC	The ERT recommends that the European Union use the correct notation keys and include the missing values for refinery feedstock in the next annual submission. (para 46)	ARR 2012	Implemented: This was corrected
Chapter 3 / Energy	Comparison of the reference approach with the sectoral approach and international statistics	Explain why the weighted average of the carbon stored fractions of the member States is not used for all fuels Use a consistent methodology for the entire time series or further justify the current approach (para 35)	ARR 2013	Implemented: Weighted averages were used for all fuels for the complete time series
Chapter 3 / Energy	1B1	The ERT observed that the quantity of coal mined in 2010 as reported to IEA (278.4 Mt) is higher than the value reported in CRF table 1.B.1 (267.7 Mt). In response to a question raised by the ERT during the review, the	ARR 2012	Implemented: This was inlcuded in NIR 2014

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		European Union clarified that the main reason for the difference is that the coal mining data reported to IEA include also peat extraction, which is not included in the CRF table. The ERT recommends that the Party include this information in the NIR of its next annual submission. (para 55)		
Chapter 3 / Energy	1B2/Transparency	The ERT recommends that the Party increase the transparency of the reporting (e.g. by including separate lines in order to clearly report the individual emission categories and the relevant AD for them) in CRF table 1.B.2 in its next annual submission. (para 56)	ARR 2012	Implemented: The NIR 2014 inlcudes an additional table for transparency resons.
Chapter 3 / Energy	Completeness	The ERT recommends that the European Union improve the explanations of the actions taken to handle specific not reported categories and further justify in the NIR the instances where “NE” is reported for categories with existing methodologies and	ARR 2012	Implemented: Detailed explantion was included in the NIR 2014.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		default EFs. (para 43)		
Chapter 3 / Energy	International bunker fuels	The ERT recommends that the Party continue to verify member States' data with Eurocontrol data and that the European Union also investigate potential significant discrepancies between the Eurostat data and the data reported in the CRF tables during that QA exercise. (para 52)	ARR 2012	Implemented: To support the 2013 inventory process, MS received fuel and emissions data for the year 2011 as calculated by EUROCONTROL using a TIER 3 methodology applying the Advanced Emisssions Model (AEM) as well as documentation on how these data have been calculated (available upon request). This is a follow up of ERT recommendations made to perform QA exercises and to make data from EUROCONTROL available to member states on a regular basis. The European Environment Agency prepared an overview of the methodologies used by MS to calculate emissions from civil and international aviation and made a comparison between EUROCONTROL data and MS data on fuel consumption, CO_2 emissions and implied emission factors. The findings and the EUROCONTROL and MS methodology descriptions results have been shared with MS (documentation

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
				available upon request). Comments by Member States on the methodology were discussed during WG1 in the fall of 2013. During Q1 of 2014 Eurocontrol provided data for the years 2011 and 2012, taken into account comments by Member States in the last WG1 meeting. Next steps include the evaluation by the EEA and its ETC/ACM of this data, and the preparation of a background document as in 2013, which can then be used by Member States for QA/QC of the data reported in their 2014 EU GHG inventory submissions.
Chapter 3 / Energy	QA/QC	The ERT noted an issue in the NIR regarding the documentation of the member States' information. For example, in the table explaining the methods/models used for estimating emissions from road transportation, the NIR states that Sweden uses ARTEMIS, but Sweden actually began to use HBEFA 3.1 in 2012. The ERT recommends that the European Union strengthen the QA/QC	ARR 2012	Implemented: This was corrected for the 2013 submission

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		procedures to ensure that the member States' information is updated and correctly represented in the NIR. (para 47)		
Chapter 4 / Industrial Processes	Sector overview	Explore ways to replace the use of notation keys with actual values in background data (para 44)	ARR 2013	Implemented: AD was estimated for the EU-15 for the following categories: CO_2 from 2A1, 2A2 and 2B1. A description of the approach was included in the NIR.
Chapter 4 / Industrial Processes	2B/Transparency	The ERT noted a substantial decrease in N_2O emissions from adipic acid production (by 9.2 Mt CO_2 eq or 85.3 per cent) between 2009 and 2010, owing mainly to a decrease in the emissions reported by Germany, from 8,570 Gg CO_2 in 2009 to 716 Gg CO_2 in 2010. The ERT strongly recommends that the European Union add a short description of the reason for this decrease in emissions between 2009 and 2010 in its next annual submission. (para 65)	ARR 2012	Implemented: Implemented as noted in ARR 2013 (par 43)
Chapter 4 / Industrial Processes	2.B.1.	ERT considered that the subtraction of the CO_2 emissions from ammonia	ARR 2013	Implemented: EU has asked Belgium to adjust this calculation to conform to the Revised 1996

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		production that are used to produce lime was a potential underestimation of emissions and this issue was included in the list of potential problems and further questions		IPCC Guidelines.
Chapter 4 / Industrial Processes	2.B.1.	The ERT noted that a potential underestimate was resolved because the carbon stored the lime product used as soil conditioner, at which point the carbon is emitted as CO_2 and that these emissions are accounted in LULUCF. However the ERT recommended that the Party ensure this is transparently reported in the NIR by providing a more detailed description of the amount of CO_2 recovered during the ammonia production process, its allocation in the inventory, and how the completeness of the reporting is ensured.	ARR 2013	Implemented: EU has asked Belgium to provide a description of the amount of CO_2 recovered during the ammonia production process, its allocation in the inventory, and how the completeness of the reporting is ensured
Chapter 4 / Industrial Processes	2.B.1.	In UK, CO_2 IEF from ammonia production is decreasing from 1990 to 2011 (-25%) and CO_2	ICR 2013 IP Presentation ARR 2013	Implemented: Further information was provided on the IEF trend and the kind of chemical feedstocks produced. EU

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		emissions are assumed to be stored in chemical feedstocks and products.		anticipates that UK will include this additional information in this year's submission so that the EU provide these more detailed explanations in the NIR
Chapter 4 / Industrial Processes	2.B.5. Other Chemicals	Spain reports CH_4 emissions, however, CO_2 emissions are reported as NA and methodologies are not explained in the NIR.	ICR 2013 IP Presentation	Partly implemented: Information requested on the kind of activities included and the non reporting of CO_2 emissions under this sub-category in Spain. During the in-country review, the activities were provided and the non reporting was justified by the lack of methodologies in 1996 IPCC Guidelines and 2000 GPG.
Chapter 4 / Industrial Processes	2.B.5. Other Chemicals	The Netherlands applies an oxidation factor of 20 per cent for industrial gases and 5 per cent for carbon electrodes, but the NIR does not clearly provide the rationale behind these values. In response to questions raised by the ERT during the review, the Party provided the ERT with further information regarding how the oxidation factors are derived and explained the method and the data on which these estimates are based (a carbon balance	ESD TERT 2012 ICR 2013 IP Presentation , ARR 2013	Implemented: Information on oxidation factors, methods and data verification have been requested for inclusion the 2014 NIR.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		using data from the producers). The ERT considers this clarification useful and recommends that the Party present this information in the NIR.		
Chapter 4 / Industrial Processes	2E	Ensure that Italy includes HFC-23 emissions from HCFC-22 production in its subsequent annual submissions (para 56)	ARR 2013	Implemented: This is included in the CRF 2014
Chapter 4 / Industrial Processes	2E	Ensure the most accurate estimate possible is developed for 2010 for Spain and time series consistency is ensured (para 57)	ARR 2013	Partly implemented: Several inconsistencies had been discussed with Spain in the QA/QC tool. Some of them have already been resolved or partly resolved for 2F1. The discussion process will go on in preparation of the next submission for the remaining categories.
Chapter 4 / Industrial Processes	2F	Document in the NIR the non-existence of HFC emissions from fire extinguishers in Denmark and Luxembourg (para 58)	ARR 2013	Implemented: In the QA/QC tool Denmark stated that HFCs in fire extinguishers are not allowed and do not exist in their country. Luxembourg explained that these extinguishers are not considered to be \`best available technology\` by the authorities which authorize such installations. Luxembourg will also check if they could add a list of the agents

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
				used, mostly: CO_2, \`Argonite\` (IG-55) and \`Novec 1230\` (GWP = 1). We consider this issue to be resolved.
Chapter 4 / Industrial Processes	2F	Implement planned improvements to estimate HFC emissions from solvents for France and the United Kingdom for 2011 or provide a justification as to why the current estimates are an accurate assessment of emissions (para 60)	ARR 2013	Implemented: Resolved in the QA/QC tool.
Chapter 4 / Industrial Processes	2G	Reallocate CO_2 emissions from coke use for food and drink from lime production to other production for 2011 (para 60)	ARR 2012	Implemented: Emissions were re-allocated in the submission by the Netherlands as requested
Chapter 5 / Solvents and other product use	3A-D/QA/QC	The ERT welcomes this plan and recommends that the European Union describe any QA/QC procedures implemented in its next annual submission. (para 63)	ARR 2012	Implemented: This was already implemented in 2013
Chapter 6 / Agricultur e	4A	The ERT encourages the European Union, in the context of implementing its verification activities, to include in the NIR the results of the comparison of	ARR 2013	Implemented: A brief section on comparing relavant actity data reported with data from FAO and CAPRI has been included in the submission 2014.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		livestock population data used in the inventory with similar data reported to FAO and Eurostat, together with the description of the potential reasons for differences. (para 69)		
Chapter 6 / Agriculture	Transparency	The ERT recommends that the information on recalculations include numerical information per member State, followed by explanations of the rationale for the recalculations and the impact of the recalculations on the sector. (para 71)	ARR 2012	Implemented: The section on recalculation in the agriculture chapter was improved for the submission 2014.
Chapter 6 / Agriculture	Transparency	In addition, the ERT identified some transparency issues linked to the reporting of the tier method used to estimate CH_4 emissions from enteric fermentation in tables 6.2, 6.14 and 6.15 of the NIR for sheep and cattle for some member States. The ERT recommends that, in the next annual submission, the Party improve the transparency of the reported	ARR 2012	Implemented: Transparency with respect to the reporting of the Tier levels has been improved in the NIR2014 by omitting the table providing country estimates and focussing on the presentation/discussion of the Tier levels estimated with the EU-wide approach as explained in the sectoral chapter.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		information. The ERT welcomes the information provided by the Party on the thorough update of the tables on the basis of the data in the NIRs for the next annual submission. (para 74)		
Chapter 6 / Agriculture	4E	Provide information in the NIR on the occurrence of prescribed burning of savannas within the Party (para 64)	ARR 2013	Implemented: Savanna does not occur in Europe
Chapter 6 / Agriculture	Cross cutting	Strengthen the QC activities, update the procedures for completing the NIR from the data and information provided by member States, and strengthen the collaboration between the European Commission and member States (para 65)	ARR 2013	Partly implemented: In 2014 a new QA loop was implemented between 15 April and 8 May. With regard to emissions from field burning of crop residues, information on the non-occurrence of this emissions source in the mentioned countries was included. With regard to the characterization of small contributors to total emissions of a specific emission category, care has to be taken to not overload the report with information of little relevance in view that data from many countries have to be covered.
Chapter 6 / Agriculture	Uncertainties	Include in the NIR uncertainty data for all member States and for the European Union at	ARR 2013	Implemented: No information on the uncertainty estimates from France and Spain was available from the

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		the category level, as well as category-specific planned improvements (para 66)		national IRs. This information has been added for the NIR2014. Category-specific planned improvements, as available from the national IRs are included.
Chapter 6 / Agriculture	Cross cutting	Further support and encourage member States to develop country-specific AD and EFs in order to allow for increased use of higher-tier approaches (para 67)	ARR 2013	Implemented: The European Union is organizing a workshop to discuss with countries the development of country-specific methods; information on this activity has been included in the submission 2014.
Chapter 6 / Agriculture	Recalculations	Include in the NIR information on recalculations for all member States that conduct recalculations, including numerical information per member State, and include the rationale and impact of the recalculations Include a specific section in the NIR on the recalculations performed for CH_4emissions from field burning of agricultural residues and resolve the error in reporting of recalculations in the agricultural soils section (para 68)	ARR 2013	Implemented: For the NIR 2014, the section on recalculation (chapter 6.8) has been completely revised. It contains now a direct link to the data reported in the CRF tables in form of summary graphics, showing the impact of the recalculations from 1990 to the last year before the current last reporting year as well as the contribution of countries to total EU15 changes due to recalculation. For each source category, a table giving details on the recalculations as described in the national IRs is given.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Chapter 6 / Agriculture	4A	Ensure completeness of reporting of background data for the Netherlands for milk production (para 70)	ARR 2013	Implemented: Missing background data are identified and countries have been asked to provide the data using the EU-QA/AC web tool.
Chapter 6 / Agriculture	4B	Continue efforts to develop and implement country-specific data for animal waste management systems Report in the NIR on the status and results of further progress in collecting farm-level data (para 71)	ARR 2013	Implemented: Cooperation with EUROSTAT on data collection (SAPM) and methodological issues with high relevance for GHG emissions estimation (RegNiBal project, LiveDate project) is ongoing. A brief section on this topic was included in the NIR 2014.
Chapter 6 / Agriculture	4B	Continue the analysis on the distribution of livestock by Intergovernmental Panel on Climate Change climate regions, through the collaboration between the JRC, member States, DG CLIMA and EEA, focusing on the differences revealed As appropriate, update the member States' livestock allocation to climate regions and associated parameters and report in the NIR on the status and results of any further analysis (para 72)	ARR 2013	Implemented: A dedicated report on this issue has been provided to Member States early 2013 and been included in the NIR2013. Consistency in the reporting of climate regions has been improved for the NIR2014.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Chapter 6 / Agriculture	4D	Resolve inconsistencies between the NIR and CRF tables, clarifying whether emissions arise from cultivation of histosols Include in the NIR clarifications provided to the expert review team during the review regarding the meaning of the term "cultivated", together with the results of the related workshop discussion (para 73)	ARR 2013	Implemented: In 2014 a new QA loop was implemented between 15 April and 8 May. Additional information on cultivation of histosols is included in the NIR. A comparison of the area of cultivated organic soils as reported by the NIRs, the FAO and a calculation made by JRC is provided in the EU-IR2014.
Chapter 6 / Agriculture	4D	Include the correct value for the fraction of livestock nitrogen excreted and deposited onto soil during grazing and improve the implementation of QC procedures (para 74)	ARR 2013	Implemented: The data series have been checked on completeness of the time series as part of the improved QA/QC procedures.
Chapter 7 / LULUCF	5A1/QA/QC	The ERT noted that the text in the Party's NIR describing the overall sink trend, the reasons for it and the direction of the trend is not consistent with the data provided in the CRF tables. The ERT recommends that the European Union accurately describe the data that it reports in	ARR 2012	Implemented. : To ensure this match a new step was introduced in the QAQC cycle which consists in stronger checking of last versions of CRF and NIR.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		subsequent NIRs. (para 88)		
Chapter 7 / LULUCF	5A1/Time-series consistency	The ERT commends the European Union for providing more information on this in the 2012 NIR and recommends that the Party continue to detect deviations in the trend or in the member States' values for carbon stock change per area per given pool and report on the analysis and planned improvements in its next annual submission. (para 89)	ARR 2012	Implemented. : More information on trends was introduced in EU's NIR text to explain major fluctutations.
Chapter 7 / LULUCF	5A2/accuracy, consistency	The ERT reiterates recommendations made in previous review reports that the European Union continue to work with member States to improve the accuracy of the methods used and to increase the consistency of the reporting approaches among member States. (para 91)	ARR 2012	Implemented. : Ongoing work over EU's completeness and QAQC annual cycle, as well as annual supporting on LULUCF reporting through workshops and LULUCF MRV projects
Chapter 7 / LULUCF	5B/Completeness	The Netherlands has reported N_2O emissions from disturbance associated with conversion to cropland as "NE"	ARR 2012	Implemented: Explanantion provided by MS based on scientific report, mentioned in EU's NIR.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		but reports AD for land converted to cropland. The ERT recommends that the Party work with the Netherlands to enhance its reporting on this category, in order to improve completeness and consistency across member States. (para 95)		
Chapter 7 / LULUCF	5B2	Given the importance of this key category for the European Union, the ERT reiterates the recommendation made in previous review reports that the Party continue to encourage the member States that contribute the greatest share of the emissions reported for this subcategory (i.e. Finland, Germany and United Kingdom) to improve their reporting in this area by using higher-tier methods where possible, as well as by improving the completeness of the reporting (i.e. Netherlands). (para 92)	ARR 2012	Implemented: Under implementetion under post-2012 reporting obligations of EU's MS and an workshops to be organized by JRC on these issues in 2014. KP LULUCF workshop 2013 dedicates one day for improved reporting of CM, GM and other activities relevant for the 2nd commitment period.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Chapter 7 / LULUCF	5C2/Completeness	The ERT recommends that the European Union continue to support its member States in improving the consistency of their assumptions and methods and the completeness of the reporting of this category, whenever appropriate. (para 94)	ARR 2012	Implemented: Under implementetion under post-2012 reporting obligations of EU's MS and an workshops to be organized by JRC on these issues in 2014. KP LULUCF workshop 2013 dedicates one day for improved reporting of CM, GM and other activities relevant for the 2nd commitment period.
Chapter 7 / LULUCF	Completeness	The ERT reiterates the recommendation made in the previous review report that the European Union continue its efforts to encourage all member States to improve the completeness of their inventories. (para 86)	ARR 2012	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.
Chapter 7 / LULUCF	Completeness	Continue to work with member States with a view to reporting pools which are currently not estimated (para 76)	ARR 2013	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.
Chapter 7 / LULUCF	QA/QC	The ERT recommends that the Party update the text and tables for each annual submission and provide updated explanations for the relevant year's data in its future annual submissions. The ERT also	ARR 2012	Implemented: Text and tables are updated in the NIR and an additional QA loop of the EU NIR was introduced in 2014

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		recommends that, to increase transparency, the Party report in its NIR specific examples of the performed QA/QC activities and report specifically that the text and tables have been updated and contain information on the current year's CRF data, in order to provide evidence of the improvements made to the QA/QC process for the inventory. (para 87)		
Chapter 7 / LULUCF	QA/QC	Continue QA/QC work (para 77)	ARR 2013	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project; additional QA loop of the EU NIR was introduced in 2014
Chapter 7 / LULUCF	Transparency	The ERT recommends that the Party improve its documentation at the category level of the specific rationale for and effect of each recalculation in the NIR of the next annual submission. (para 85)	ARR 2012	Implemented: Information included in the NIR 2014

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Chapter 8 / Waste	6B – CH_4, N_2O, tier methods	The ERT reiterates the recommendation made in the previous review report that the Party continue to encourage member States to move to a higher-tier method to estimate emissions for the next annual submission, in order to improve the accuracy of the emission estimation for this key category. (para 104) Also in the ARR 2013 the ERT recommends that emissions from wastewater handling are estimated using a higher-tier method for the key categories, at least among the countries with the highest share of emissions (FR, GR, IT, PT, ES, UK). (para 89)	ARR 2012 ARR 2013	Implemented: IPCC GPG 2000 does not differenciate different tiers. IPCC GPG recommend to use the check method for non-key categories and the IPCC method for key categories. NIR includes information which MS use the check method and which MS use the IPCC method
Chapter 8 / Waste	6B/CH_4 and N_2O	The ERT recommends that the Party include explanations for the use of the notation keys to improve the transparency of its report. (para 90)	ARR 2013	Partly Implemented: Information for some countries inlcuded under table 8.26 in the EU NIR.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Chapter 8 / Waste	6C - CO_2, notation keys	The ERT noted that the European Union reported CO_2 emissions from waste incineration as "NO" for Denmark in table 8.12 of the NIR, however, in the same table GHG emissions as a whole are reported for incineration in Denmark. In response to a question raised by the ERT during the review, the Party explained that Denmark reports CO_2 emissions from biogenic waste incineration (corpses and carcasses) in CRF table 6.A,C, however emissions from fossil waste incineration do not occur since all incinerators work with energy recovery. Thus the CO_2 emissions are reported under waste incineration as "NO" but the CH_4 and N_2O emissions from the cremation of corpses and carcasses are accounted, therefore GHG emissions are estimated for incineration. The ERT recommends that the Party	ARR 2013	Implemented: Explanation for DK included in the NIR.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		include this information in the NIR. (para91)		
Chapter 8 / Waste	6C - CO_2, notation keys	The ERT reiterates the recommendation made in the previous review report that the Party encourage the member States to be consistent in using the notation keys "IE" and "NO" for this category and to revise the information provided in the next annual submission. (para 106)	ARR 2012	Implemented: Information included in the NIR
Chapter 8 / Waste	6D/transparency	The ERT recommends that, in its next annual submission, the Party increase the transparency of the reporting by including information on the subcategories covered under other in CRF table 6 (e.g. in the documentation box to the table). (para 107)	ARR 2012	Implemented: See NIR tables 8.29 and 8.30 of the NIR where this is explained. References to these two tables were inserted in the CRF documentation box.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
	6D/transparency	In the ARR 2013 the ERT reiterates the recommendation made in the previous review report that the European Union use the documentation box in CRF table 6 to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.(para 92)	ARR 2013	Implemented: See NIR tables 8.29 and 8.30 of the NIR where this is explained. References to these two tables were inserted in the CRF documentation box.
Chapter 8 / Waste	Recalculations	The ERT recommends that the Party further improve the consistency of the inventory by ensuring consistency between the NIR and the CRF tables. (para 98)	ARR 2012	Implemented: This is implemented by a new QA loop between 15 April and 8 May. VITO has quality checked the NIR chapter waste. Results have been considered in the resubmission of 27 May.
Chapter 8 / Waste	Transparency	The ERT recommends that the Party include European Union-level AD in the CRF tables and provide detailed information of AD at the member State level in the NIR. (para 87)	ARR 2013	Partly implemented: Tables and graphs on DOC, MCF e.g. already provided, also information included on heterogenity of data in the NIR. AD data on MS level is too heterogenious to be aggregated to EU level and included in the CRF tables. Only in the categoy N_2O from human sewage aggregate activity data could be applied. Information is provided

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
				in the NIR.
Chapter 8 / Waste	Transparency	To improve the transparency of the reporting, the ERT recommends that the Party try to collect information on the differences between waste generation rates reported by the member States and include information on the reasons behind the differences in the NIR. (para 102)	ARR 2012	Implemented: Some information on the differences of waste generation rates included in the NIR, but as waste generation rate per capita is no parameter for the tier methodologies so it is not so relevant.
Chapter 8 / Waste	6A – CH_4, consistency	The ERT recommends that the Party improve the consistency of the tables in the NIR, including information for Luxembourg. (para 88)	ARR 2013	Implemented: Explanation included, tables changed to tier 2 method to be consistent.
Chapter 11 / KP-LULUCF	Afforestation / Reforestation	Work with Italy on estimating emissions, in particular Italy's current method to split the sink proportional to the areas of forest land remaining forest land and land converted to forest land (para 95)	ARR 2013	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
Chapter 11 / KP LULUCF	Completeness	The ERT also recommends that the European Union continue to work with its member States to report emissions for these activities, even when emissions are negligible, or at least to provide evidence that any omitted pool is not a net source. For pools that are reported as "IE", where there are AD and methods, the ERT encourages the Party to report emissions/removals under the required pools. (para 111)	ARR 2012	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.
Chapter 11 / KP LULUCF	Cropland management	Work with Spain to determine whether there are CO_2 emissions from lime application and, if so, under which KPLULUCF activity (or activities) or sector the remaining 90 per cent of lime should be allocated (para 99) Work with Spain to provide more transparent and verifiable information in the NIR that litter and dead wood pools are not a net source of emissions (para	ARR 2013	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		99)		
Chapter 11 / KP LULUCF	Deforestation/Completeness	Work with member States to improve the completeness of their reporting (para 96)	ARR 2013	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.
Chapter 11 / KP LULUCF	Forest management	Work with member States to prepare more complete information on the justifications for “not a net source” provided by each member State (para 97)	ARR 2013	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.
Chapter 11 / KP LULUCF	Forest management	Work with France and Greece to ensure that emissions from the forest management activity are not underestimated due to part of forest land being considered unmanaged (para 98)	ARR 2013	Implemented: Implemented via the QA/QC communication tool, the JRC workshops and the MS assistance project.
Chapter 11 / KP LULUCF	Key category analysis	The ERT encourages the European Union to make efforts to provide a complete list of the key category analyses of all member States as well as a key category analysis for the KP-LULUCF activities at the European Union level. (para	ARR 2012	Implemented: The key category for KP LULUCF is now based on correspondence with EU15's LULUCF inventory. Next submission will inlcude a KC analisis by comparing Emission/removals with smallest key category in the EU inventory

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		115)		
Chapter 11 / KP LULUCF	Transparency	The ERT recommends that the European Union improve transparency by enhancing the documentation of the specific reasons for and effects of the recalculations for each member State in the NIR of its next annual submission. (para 110)	ARR 2012	Implemented: Documentation of recalculations improved in the NIR 2014
Chapter 11 / KP LULUCF	Transparency	The European Union has reported all supplementary information required, except for "the year of the onset of an activity, if after 2008" (decision 15/CMP.1, annex, paragraph 6(d)). The Party explained that this information is implicitly included in table NIR-2. The ERT recommends that the Party include this explanation in its next annual submission. (para 112)	ARR 2012	Implemented: Information provided in the NIR
Chapter 11 / KP LULUCF	Transparency	The ERT recommends that the Party continue to work with the	ARR 2012	Implemented: Implemented via the QA/QC communication tool, the JRC

NIR chapter / Sectors	Source category / Issues	Reccomendation/ improvements planned	References	Status
		member States to report the correct and consistent areas of activities in CRF table NIR-2 in its next annual submission. (para 116)		workshops and the MS assistance project.
Chapter 11 / KP LULUCF	Transparency/QA/QC	The ERT could not find sufficient documentation in the NIR on the use of the notation keys "IE" and "NE" and recommends that the Party improve its reporting of the explanations for using "IE" and "NE" for pools required to be reported under KP-LULUCF activities. (para 114)	ARR 2012	Implemented: Information provided in the NIR

10.4.2 Member States' responses to UNFCCC review

Since the improvement of the EU inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 10.8 provides an overview of Member States' responses to the UNFCCC review ([64]). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

([64]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Table 10.8 General improvements related to national inventory system made by EU-15 Member States in response to the UNFCCC review

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
Austria	Perform additional checks to reduce inconsistencies or incorrect use of notation keys **(para 13)**	Inconsistencies detected during the ICR 2013 have been removed for this years' submission. For future submissions Austria's will strive to follow its 3-step procedure for QC as stipulated in the Quality Manual.
	Perform additional checks to reduce inconsistencies or incorrect use of notation keys **(para 14)**	Austria has assessed uncertainties for all the categories of the inventory and will report on the result of its uncertainty analysis in the NIR 2014.
	Perform additional checks to reduce inconsistencies or incorrect use of notation keys **(para 17)**	In the Table at hand an additional column has been added to show where the information can be found in the NIR.
Belgium **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The improvement of the transparency of the reporting across all sectors regarding the assumptions used for the recalculations, the inclusion of a discussion on the selection of the methodologies and EFs, the enhancement of the description of the sector specific QA/QC checks performed, and the provision of a clear explanation for the differences between the data sets used;	Not for all sectors addressed. For example: "Tier 1 quality control checks are performed in the 3 regions for the Belgian key source categories and can be provided by the Belgian experts on request." [NIR 2012, p. 163], *not addressed in NIR 2013*
	(b) The intensification of the harmonization process for the methodologies, EFs and data sets used, as well as the improvement of overall cooperation and internal QA procedures between the three regions, in order to avoid inconsistencies in the emission estimates and to increase the transparency of the reporting;	*not further addressed in NIR 2013*
	(c) The inclusion of a discussion of time-series consistency in the appropriate sections of the NIR;	"The LULUCF issue on the past 20 years is planned to be investigated in the next submission." [NIR 2012, Chapter 9.1.2, p. 179] "Emissions of CO_2 from petroleum refining are the verified emissions from the ETS-Directive and are consistent for the complete time series. Monitoring protocol and monitoring plans are obliged performed by these companies. (see 3.2.6.2. petroleum refining (1A1b) in NIR)." [NIR 2012, Chapter 9.1.2, p. 179] "Belgium did enhance the reporting of the emissions in the iron & steel sector. A recalculation for the complete

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		time series was performed during the 2011 submission in the Flemish region. (see 3.2.7.2. and 4.4.2. in NIR)." [NIR 2012, Chapter 9.1.2, 179]
	(d) The implementation of category-specific QC procedures at the national level, particularly where different methodologies are used for the same categories across the regions and ensuring that the QC procedures are consistently applied across all sectors during the preparation of the NIR, in order to avoid errors, and providing updated information;	"Tier 1 QC checks are applied in the 3 regions in Belgium and can be provided on request. QC activities: Tier 1 QC checks (see 1.6.1.5 in NIR)." [NIR 2012, Chapter 9.1.2, p. 179] *"The quality management system used in the Flemish region with the more technical procedures and an example of the forms used to control the data and the calculation of the emissions ("QMS Flanders")."* *"Belgian QA/QC-plan of April 2010" [NIR 2013, Annex 3, p. 291]*
	(e) The strengthening of efforts in the implementation of sector-specific recommendations in the previous review report that have not yet been addressed. **(FCCC/ARR/2011/BEL, para. 132)**	*"A copy of the model used to calculate the CH_4 emissions from enteric fermentation en manure management (category 4A en 4B(a)) in Flanders (CH_4model_2010_Flanders.xls), Wallonia (15th April submission) and Brussels (agri_RBC_database_130115.xls)"* *"A copy of the model used to calculate the direct and indirect N_2O emissions (category 4D) and the N_2O emissions from manure management (category 4B(b)) in Flanders (N_2Omodel_2010_Flanders.xls), Wallonia (15th April submission) and Brussels (agri_RBC_database_130115.xls)"* *"Information related to the calculation of the Manure Balance in Flanders (2010)"* *[NIR 2013, Annex 3, p. 291]*
Denmark **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The provision of a complete set of CRF tables in the next annual submission, including CRF tables 7 and 8(b), in accordance with the UNFCCC reporting guidelines;	"By mistake the recalculation explanations in CRF Table 8(b) had not been included in the aggregated submission of Denmark and Greenland for 2011. This will be corrected in the 2012 submission." [NIR, May 2012, Table 10.6, p. 562] *Table 8(b) in DNM – 2013 – 2010-v1.3.xls includes recalculation explanations with references to the NIR 2013*
	(b) The improvement of the transparency of documentation for several categories (see para. 42 above) and the improvement of the	For cement industry: "The ERT has been informed that no further information is available for the years1990-1997. The work with including CKD in the emission

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	transparency of the reporting on the industrial processes sector, in particular for cement industry (see para. 72 above) and consumption of halocarbons and SF_6 (see paras. 74 and 77 above), on the agriculture sector (see paras. 81, 83, 89, 91 and 93 above), on the LULUCF sector (see paras. 102 and 106 above) and on the waste sector (see para. 112 above);	estimates is on-going." [NIR May 2012, Table 10.6, p. 565] *"The work is ongoing." [NIR 2013, Table 10.6, p. 568]* For consumption of halocarbons and SF_6: "Corrections have been made for activity data for consumption of HFCs for hard foam.. (Chapter 4.7.3)… The presentation of activity data, emission factors and expected lifetimes has been improved in the present NIR. The work with improving description of QA/QC in the NIR is still on-going… (Chapters 4.7.2. – 4.7.5.) ….. This improvement was carried out in the 2012 submission…(Chapter 5)". [NIR, May 2012, Table 10.6, p. 566] *"The presentation of activity data, emission factors and expected lifetimes has been improved in the present NIR. The work with improving description of QA/QC in the NIR is still on-going." [NIR 2013, Table 10.6, p. 570]* For agriculture: for para 81:"Chapter 6.4 of the NIR describing the estimation of lower emission of CH_4 and N_2O includes more information and furthermore another table in Annex 3E showing the basic data from Sommer et al. (2001) is provided." [NIR, May 2012, Table 10.6, p. 567] For para 83: "During the in country review in September 2010 an extra quality control process was provided for some emission sources, among these the calculation of lower emission as a consequence of biogas treated slurry. Unfortunately, an error concerning the basic data for CH_4 reduction potential was found and corrected in submission 2011. Thus, the methodology is unchanged and the calculation is still based on the same reference (Sommer et al., 2001). Unfortunately this recalculation was not mentioned in the 2011 NIR submission." [NIR, May 2012, Table 10.6, p. 568]

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		Chapter 6.4 of the NIR describing the estimation of lower emission of CH_4 and N_2O includes more information and furthermore another table in Annex 3E showing the basic data from Sommer et al. (2001) is provided. [NIR 2013, Table 10.6, p. 572] For para 89: CRF table 4.B(a), concerning the allocation and MCF values for animal waste management systems (AWMS) per animal type provides information. For para 91: “Denmark has included this table in the NIR for the 2012 submission. …(Annex 3E)” [NIR, May 2012, Table 10.6, p. 569] For para 93: “The table has been modified specifying the N excretion by grazing animals. (chapter 6.5.2.)” [NIR, May 2012, Table 10.6, p. 569] For LULUCF: For para 102: “Information on tree species composition and age structure has been included in the NIR reporting. Due to the late reception of the draft review report, it was not possible to implement information on area and volume of clear cuttings or disturbance in the 2012 submission. The recommendation has been noted as a planned improvement and will be implemented in the 2013 submission based on the available data. (Chapter 7.2)” [NIR, May 2012, Table 10.6, p. 569] For para 106: “A figure with total input data has been included in the NIR as well as description. (see chapter 7.4)” [NIR, May 2012, Table 10.6, p. 570] *“The QA/QC procedure has been increased with by using independent* *people in the inventory process as quality controllers.” [NIR 2013, Table 10.6, p. 573]* For waste: For para 112: “A Tier 2 approach with a first order decay model is introduced for estimation of emissions

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		of CH_4 from the solid waste disposals. For this purpose the activity data in Table 16.8.2 are estimated back to 1960 (not shown) based on the methodology described in connection to Table 16.8.2. Combining these activity data and the composition data in Table 16.8.3 time series for 1960-2010 with amounts of waste in waste fractions are calculated." [NIR, May 2012, p. 693]
	(c) The further development of the QA/QC procedures, in particular for fluorinated gases (see paras. 77 and 78 above), the agriculture sector (see paras. 84, 87 and 89 above) and KP-LULUCF activities (see para. 115 above). **(FCCC/ARR/2011/DNK, para. 158)**	For F-gases: "The presentation of activity data, emission factors and expected lifetimes has been improved in the present NIR. The work with improving description of QA/QC in the NIR is still on-going…" (Chapters 4.7.2. – 4.7.5.) [NIR, May 2012, Table 10.6, p. 566] For agriculture: see above For KP-LULUCF: "A recalculation for KP-LULUCF has been performed for all areas as a consequence of the new data and the review process." [NIR, May 2012, p. 543]
Finland	QA/QC: Check the description in the NIR against the information and figures reported in the CRF tables **(para 15)**	NIR tables and figures are produced based on CRF data to ensure consistency between CRF Tables and NIR. This is continuously improved in order to avoid any discrepancies.
France **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The enhancement of general transparency for all sectors, in particular where country-specific methods, EFs and parameters are used, by providing more detailed explanations of the trends, and by continuing the efforts to better balance the share of information between the main part of the NIR and the OMINEA report (see para. 42 above);	Not yet addressed.
	(b) The application of a tier 2 key category analysis, and the inclusion of the KPLULUCF activities under the key category analysis (see paras. 32-33 above);	Realized. [NIR, April 2012, part 2, p. 1360] *"Réalisé pour le secteur 4D. Réflexions à mener pour d'autres secteurs selon les possibilités." [NIR 2013, Table 81, p. 1547]*
	(c) The restructuring of the plan for the uncertainty analysis, by adjusting the level of aggregation of categories and subcategories, so that uncertainty values represent the real	Partly realized for 4D. Chapter NIR 1.7 and 6.5.3. [NIR, April 2012, part 2, p. 1360]

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	accuracy of the methodologies and data (see para. 35 above);	
	(d) The improvement of the reporting of recalculations, with clearer explanations of the reasons for the recalculations for individual categories (see para. 38 above);	Realized. [NIR, April 2012, part 2, p. 1360]
	(e) The enhancement of the QA/QC plan, by integrating more automatic checks and tier 2 QC checks;	*Ongoing process. [NIR 2013]*
	(f) Increasing the timeliness of the availability and approval of the detailed energy balance (see para. 57 below);	Not yet addressed.
	(g) Increasing the consistency of estimates for related categories in the agriculture sector (see para. 97 below);	Realized. [NIR, April 2012, part 2, p. 1360]
	(h) The collection of monitored data for CH_4 recovery from all landfills (see para. 133 below);	Contacts have been made. On the other hand, actions will be initiated. [NIR, April 2012, part 2, p. 1360]
	(i) The improvement of the cooperation with data providers for the LULUCF sector, and ensuring a consistent representation of land use over the whole time series (see para. 30 above). **(FCCC/ARR/2010/FRA, para 50)**	This recommendation was followed this years in particular by strengthening our collaboration with IFN (the statistical office French forestry) to take account their latest important statistical revisions. NIR chapter 7.5 [NIR, April 2012, part 2, p. 1360]
Germany	Enhance the effective implementation of the tier 1 QC checks for transcription errors **(table 3)**	Not yet addressed.
	Enhance the effective implementation of the tier 1 QC checks for transcription errors **(table 3)**	Not yet addressed.
	Fully implement the recommendations made in the previous review reports **(para 16)**	Not yet addressed.
Greece	Strengthen the QC procedures to ensure the consistency of the data in the NIR and the CRF tables and to improve the explanations provided in the documentation boxes **(table 3)**	Not yet addressed.
	Provide background information on the AD actually used for the estimates **(table 3)**	Not yet addressed.
	Fully implement the recommendations made in the previous review reports **(para 15)**	Not yet addressed.
Ireland **(late availability of 2013 ARR)**	The ERT identified a number of cross-cutting issues for improvement, and recommends that Ireland: (a) Provide more precise and transparent descriptions of methodologies for some categories in the energy, industrial	"Sector specific QA\QC for the Industrial Processes sector is now documented in NIR 2011. Additional information on the use of EU ETS data is provided for the Power Generation sector of Energy Industries. Chapter 4, section 4.6. Chapter 3, section 3.2.1.1."

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	processes and waste sectors (see paras. 51, 56, 64, 68, 69 and 103 below);	[NIR. April 2012, Annex I, p. 299]
	(b) Improve the transparency of the reporting on the national system by including more detailed information on its archiving system;	“Additional information is provided in NIR 2011. Chapter 1 section 1.3.2” [NIR. April 2012, Annex I, p. 299]
	(c) Improve the transparency of the reporting by including more information on implemented QA/QC activities for all sectors, particularly for the industrial processes and LULUCF sectors;	“Sector specific QA\QC for the Industrial Processes sector is now documented in NIR 2011. Additional information on the use of EU ETS data is provided for the Power Generation sector of Energy Industries. Chapter 4, section 4.6. Chapter 3, section 3.2.1.1.” [NIR. April 2012, Annex I, p. 299]
	(d) Improve the uncertainty analysis by the use of a higher level of category disaggregation for the LULUCF sector, in accordance with the IPCC good practice guidance for LULUCF;	“This will be considered for the 2012 submission. The timing of Ireland's draft ARR 2010 did not allow sufficient time for this recommendation to be implemented in submission 2011.” [NIR. April 2012, Annex I, p. 298]
	(e) Improve the completeness of the inventory, in particular by reporting estimates for the remaining emissions reported as “NE” in the LULUCF sector (see para. 89 below);	“Notation Keys have been revised in CRF Submission 2011. Chapters 7 and 11” [NIR. April 2012, Annex I, p. 307]
	(f) Reconcile the AD from the energy balance used to estimate emissions from the energy sector with the EU ETS data; (f) Reconcile the AD from the national energy balance used to estimate emissions from the energy sector with the EU ETS data (see para. 53 below);	“The inventory agency will work with the energy Balance provider to improve the allocation of fuels in the EB for peat briquette production for the fuel: Gasoil. The timing of Ireland's draft ARR 2010 did not allow sufficient time for this recommendation to be implemented in submission 2011. ” [NIR. April 2012, Annex I, p. 300]
	(g) Improve the methodological tier level used to estimate emissions for categories in the LULUCF sector other than forest land, in particular for grassland, in accordance with the recommendations in the IPCC good practice guidance for LULUCF;	“Additional information on Grassland is provided in NIR 2011. Chapter 7 section 7.5.1” [NIR. April 2012, Annex I, p. 308]
	(h) Improve the consistency of the information reported for the LULUCF sector under the Convention and on KP-LULUCF activities, and provide more detailed information on forest-related land-use changes that occurred prior to 2006 (see paras. 92 and 115 below). **(FCCC/ARR/2010/IRL, para 39)**	“Significant improvements have been made in submission 2011 for Convention and KP LULUCF reporting. Chapter 7, section 7.11 and Chapter 11, section 11.1.5. ” [NIR. April 2012, Annex I, p. 308]
Italy	<u>Key category analysis (KP-LULUCF):</u> Provide additional information in the NIR to document why lands converted to settlements and grassland, and hence deforestation, are not identified as key under	Not yet addressed.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	Kyoto Protocol reporting **(table 4)**	
Luxembourg	Annual submission and other sources of information: Include the uncertainty and key category (and all other) annexes in the annual submission **(para 7, table 4)**	Not yet addressed.
	Include the uncertainty and key category (and all other) annexes in the annual submission **(para 13)**	Not yet addressed.
	Include the uncertainty and key category (and all other) annexes in the annual submission **(para 15)**	Not yet addressed.
Netherlands	QC: Enhance the effective implementation of the tier 1 QC checks for all sectors **(table 3)**	Not yet addressed.
	Key categories: Document how the results of the key category analysis have been used for the improvement of the inventory **(table 4)**	Not yet addressed.
	Inventory management: Provide additional information in the NIR on the archiving procedures for the inventory **(para 17)**	The RIVM database holds, as of the 2012 submission, storage space where the Task Forces can store the crucial data for their emission calculations. The use of this feature is voluntary, as storage of essential data is also guaranteed by the quality systems at the outside agencies.
Portugal **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) Increase the completeness of reporting by including estimates for categories reported as "NE", giving priority to missing categories for which the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF provide estimation methodologies;	"Biogas flaring is no longer reported as NE in this submission"
	(b) Increase the accuracy of estimates by using higher-tier methods with country specific EFs and parameters for key categories and increase the consistency by replacing the use of surrogate or forecast data with national statistics in the industrial processes sector;	"Under Development" [NIR, April 2012, p. 9-3, 9-4]
	(c) Enhance the transparency of reporting by improving the description of international bunkers estimates, reporting in the NIR category-specific QC and verification activities for all categories, including the rationale for the choice of AD, parameters and EFs in the agriculture sector, and including the description of methods and	"Implemented/Under Development" [NIR, May 2012, p. 9-5]

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	assumptions made for estimates in the LULUCF sector;	
	(d) Enhance the completeness and transparency of the reporting of KP-LULUCF by completing the calculations for 1990, reporting consistent land area representation figures and calculating carbon stock changes for the unaccounted pools or providing a clear description that these pools are not net sources of GHG emissions. **(FCCC/ARR/2010/PRT, para 32)**	“Implemented” [NIR, May 2012, p. 9-6]
Spain **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement, namely that the Party: (a) Prepare emission estimates for the remaining categories reported as “NE” for which there are estimation methodologies available in the Revised 1996 IPCC Guidelines or in the IPCC good practice guidance, namely N_2O emissions from use of gaseous fuels in road transportation and N_2O emissions from flaring of oil;	Implemented. [NIR, April 2012, Table 3.2.1, p. 3.13]
	(b) Continue with its efforts to increase the transparency of its reporting, including in relation to the use of the notation keys and explanations of the underlying reasons for trends and inter-annual variations;	In General: Under the respective sub chapters “Realización de nuevos calculus” written.
	(c) Continue with its efforts to implement a tier 2 uncertainty analysis and to broaden the coverage of sectors in that analysis;	Not yet addressed.
	(d) Improve its reporting of the results of QA/QC activities during the preparation of the annual inventory submission in the NIR, in order to facilitate the assessment of the inventory and its accuracy by review teams;	Not yet addressed.
	(e) Implement QA activities on a regular basis;	Not yet addressed.
	(f) Undertake, as a matter of urgency, a review of the energy balance (see paragraph 52 below), including to ensure consistency between the energy balance used to prepare the inventory and those submitted to the International Energy Agency (IEA) and Eurostat, and include the energy balance in the NIR;	Not yet addressed.
	(g) Use EU ETS data to improve the accuracy of the inventory with country specific data and to enhance the QA/QC	Not yet addressed.

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
	procedures;	
	(h) Improve the reporting on feedstocks and non-energy use of fuels, by providing clarity on where these fuels are used;	Not yet addressed.
	(i) Find alternative ways to report confidential AD and emission estimates without violating the existing rules on confidentiality. **(FCCC/ARR/2010/ESP, para 42)**	Regarding the question about alternatives to disaggregate on steel production without violating the confidentiality restriction raised by the review team that conducted the review SCMNUCC in the country (in-country review) on (17-22 October 2011) for the 2011 inventory, it is worth noting here that, although indeed in the case of electric steel plant the number is high (over 20 in 2010). To report information for this block would mean to quantify the corresponding oxygen steel production information. But in this case it occurs only in one company. [NIR, April 2012, p. 4.22]
Sweden	National system: Improve the national system in a way that would enable it to implement the recommendations provided in the annual review reports in time for the next annual submission **(para 12)**	Not yet addressed.
	Uncertainty: In the waste sector, further investigate the uncertainty of country-specific parameters and EFs used and improve the uncertainty analysis **(table 4)**	Not yet addressed.
	Follow-up to previous reviews: Implement all pending recommendations from the 2011 and 2012 annual review reports and include the relevant information **(para 16, 17 and 18)**	Not yet addressed.
United Kingdom **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) Strengthen the efforts to implement the recommendations of previous review reports, especially those that had already been reiterated from the review before (see para. 30); (see para 30: complete discussion of completeness, allocating emissions from fuels used in the manufacturing industries, reporting emissions of F-gases by species, improving the reporting of OTs and CDs, undertaking a qualitative analysis of categories identified as key categories, information on the time frame for addressing the recommendations of the review team, estimating emissions from the wildfires on deforestation land).	"As well as the completeness table in Annex 5, a short discussion on completeness is now included in each methodological chapter." "Emissions from fuels used in manufacturing industries are now reported in the appropriate categories where possible. See Section 3.2.7 for more details." "Included in 2012 submission." "Where available, speciated emissions of f-gases are reported. Unspeciated emissions are reported for some of the emissions of fugitive PFCs from manufacture, where speciated data are not available, and for the Overseas Territories and Crown Dependencies. Estimates for these locations are made at an aggregated level. The investigation of reporting further speciated emissions will be added to the improvement programme although this is a low priority." "More description has been included in the NIR on the methods and data used for estimating these

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		emissions. Where it is possible to include OT and CD emissions within main sectors (not reporting as 'other') this has been done and stated as such in the main chapters. Further information has been included in the 2012 submission. Reporting will be reviewed and improved for the 2013 submission." "A qualitative analysis is now done to ensure significant categories are identified. No additional key categories were identified. Description of qualitative analysis included in Section 1.2.2.4." "Where possible, the time frame for addressing recommendations is included in the NIR. The assessment of a fire incidence dataset and the potential of remote sensing for reporting wildfires is now underway. New data for UK wildfires is being examined and we will report emissions for this category in the 1990-2011 inventory. To be reported in 2013 submission." [NIR 2012, Table 10-4, p. 274]
	(b) Improve reporting of KP-LULUCF to ensure complete, accurate and unbiased reporting of KP-LULUCF activities on all lands in the United Kingdom (see para. 140);	"We have used new activity data to update the deforestation estimates for all countries in the UK. Methods are fully explained in Annex 3.7. We have used NFI data in the latest submission where available, but estimates of woodland loss from the NFI are still being assessed by the Forestry Commission. There is very limited forest area information for the OTs and CDs and the FAO Forest Resource Assessment 2010 reports that there has been no change in the forest area of these territories since 1990 (section 11.2.1). If/when new data becomes available we will include it in the next submission. Part complete - more information to be included in 2013 submission." [NIR 2012, Table 10-4, p. 275]
	(c) Improve the description of recalculations by providing clear documentation and explanations on the justifications used for the changes made in methodologies, assumptions, data and parameters, and also ensure that any recalculation performed leads to a real improvement of the inventory (see para. 22);	"All method changes feed into the inventory through the improvement programme and are approved by the NISC at the pre-submission review. Additional descriptions have been included within the main chapter of the NIR on the reasons for recalculations and additional checks have been performed to ensure these descriptions are consistent in chapter 10 as in the methodology chapters. Improvements have been made to the text in the 2012 submission." [NIR 2012, Table 10-4, p. 275]
	(d) Continue to strengthen QC procedures at the stage of inventory compilation to avoid erroneous entries in CRF tables and mistakes in the text of the NIR (see para. 24);	"All submissions now undergo a 'knowledge leader check' where a senior member of the team who has not had the responsibility of compiling the CRF, or performing any of the initial cross checks, checks the outputs to ensure consistency with the NIR and our

Member State	General recommendations as identified by the expert review team	Improvements in response to UNFCCC review as indicated in the NIR
		internal database. Additional checks have been implemented for the 2012 submission.” [NIR 2012, Table 10-4, p. 275]
	(e) Improve the transparency of the inventory regarding the presentation of information on OTs and CDs in the CRF (e.g. include distinct AD and emissions from OTs and CDs under waste incineration) and the description of the geographical coverage for each reported category in the NIR (see para. 26);	“More description has been included in the NIR on the methods and data used for estimating these emissions. Where it is possible to include OT and CD emissions within main sectors (not reporting as 'other') this has been done and stated as such in the main chapters. The improvement programme includes trying to obtain more detailed information, particularly for the waste sector for the 2013 submission.” [NIR 2012, Table 10-4, p. 275]
	(f) Continue to improve the consistency and appropriateness of notation keys usage (see para. 10). (**FCCC/ARR/2011/GBR, para 171)**	“All submissions now undergo a 'knowledge leader check' where a senior member of the team who has not had the responsibility of compiling the CRF or carrying out initial cross checks, checks the outputs to ensure consistency with the NIR and our internal database. Additional checks have been carried out for the 2012 submission.” [NIR 2012, Table 10-4, p. 276]

Note: Review findings of submission 2012, which were also commented in the NIR 2014 were added in italics.

10.4.3 Improvements planned at EU level

The following activities are planned at EU level with a view to improving the EU GHG inventory:

- Further implement the recommendations from the past reviews;
- Continue sector-specific QA/QC activities within the EU internal review;
- Further develop the EU QA/QC activities on the basis of the experience in 2013/2014

PART 2: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

For each Art. 3.3 and Art. 3.4 activities, estimates reported for KP-LULUCF activities in the EU GHG inventory result from summing up all GHG emissions and CO_2 removals reported in the NIR chapter 11 by MS of the EU-15. For Art. 3.4 activities, estimates are included only for those MS which elected these activities (see table 1.1). It is important to note that the EU will neither issue nor cancel units based on the credits and debits accounted for by any EU-15 or EU-28 MS for its KP-LULUCF activities. Therefore, all the estimates on GHG emissions and CO_2 removals and any information on KP-LULUCF activities presented here are shown for information purpose only, with a focus on EU-15 MS. The chapter follows the annotated outline of the National Inventory Report as provided by the UNFCCC[65], and specifically includes:

- The activities under Art. 3.4 and the accounting frequency elected by EU-15 MS.
- An overview of estimates of GHG emissions and CO_2 removals reported by EU-15 MS for the 2008 -2012 time series.
- A synthesis of supplementary information required for Art. 3.3 and any elected 3.4 activities, as reported by EU-15 MS.
- A short overview of estimates and supplementary information on KP-LULUCF activities as reported by 11 additional EU MS (Cyprus and Malta do not have commitments under the 1st commitment period of the Kyoto Protocol).

A main assumption when reporting under the KP is that the consistency of information reported in the EU GHG inventory with good practices is ensured when all MS GHG inventories are consistent. Consistency of MS GHG inventories with good practices is checked by both: each MS own QA/QC procedures and by EU QA/QC procedures.

As shown in Table 11.1, 18 MS of the EU-28 have elected Forest Management (FM), 3 have elected Cropland Management (CM), 2 have elected Grazing land Management (GM) and only 1 has elected Revegetation (RV). 3 MS have elected annual accounting frequency, all others have elected to account at the end of the commitment period.

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65 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/reporting_requirements/application/pdf/annotated_nir_outline.pdf

Table 11.1 Activities elected under Art. 3.4 and accounting frequency. FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation, CP: commitment period.

Member State		Art 3.4 elected activities	Accounting frequency
EU-15 Member States	Austria	-	end of CP
	Belgium	-	end of CP
	Denmark	FM, CM, GM	annual
	Finland	FM	end of CP
	France	FM	annual
	Germany	FM	end of CP
	Greece	FM	end of CP
	Ireland	-	end of CP
	Italy	FM	end of CP
	Luxemburg	-	end of CP
	Netherlands	-	end of CP
	Portugal	FM, CM, GM	end of CP
	Spain	FM, CM	end of CP
	Sweden	FM	end of CP
	United Kingdom	FM	end of CP
EU-13 Member States	Bulgaria	-	end of CP
	Croatia	FM	end of CP
	Cyprus	na	na
	Czech Republic	FM	end of CP
	Estonia	-	end of CP
	Hungary	FM	annual
	Latvia	FM	end of CP
	Lithuania	FM	end of CP
	Malta	na	na
	Poland	FM	end of CP
	Romania	FM, RV	end of CP
	Slovakia	-	end of CP
	Slovenia	FM	end of CP

11.1 Overview of estimates of GHG emissions and CO_2 removals reported by EU-15 MS for the 2008 -2012 time series

11.1.1 Coverage of carbon pools and other GHG reported (KP CRF table NIR-1)

EU-15 MS report GHG emissions and CO_2 removals for all mandatory and elected activities (Table 11.2). Carbon stock changes are always estimated and reported for living biomass pools, whereas for other pools notation keys are sometimes used. GHG emissions are estimated and reported mostly by applying default IPCC methods.

Despite continuous improvements of MS GHG inventories, both the EU QA/QC procedures and the latest UNFCCC Annual Review Reports highlighted the need for providing more transparent information, particularly when notation keys are used or the “not a source” provision is applied, including when justification is provided for pools that are merged.

“NE” is exceptionally used in table NIR 1 when GHG sources were considered being “negligible”. For instance, The Netherlands reports GHG emissions from biomass burning in wildfires on ARD as NE since no data was available for recent year but argued that those GHG emissions are negligible based on historical records of wildfires.

Under the ARD and FM activities, the notation key “IE” is used by several MS. For instance, below ground biomass is reported along with above ground biomass by Spain and UK. Also, Portugal and UK report litter (LT) and dead wood (DW) as a unique pool. Because of model and data type, Finland and Luxembourg report mineral soils (SOM) and LT and DW merged. Further, Denmark, Ireland and Portugal reported N_2O Emissions from N fertilization as IE (i.e., under Agriculture).

MS report individual estimates for GHG emissions from biomass burning under 5(KP-I) A.1.1 and B.1, whenever relevant.

When NR (not reported) is used for a C pool in table NIR 1 (e.g. in few cases litter and dead wood or mineral soil), ‘not a source’ demonstration is provided in the NIR (see Table *11.2*). Whenever “not a source” is applied the MS reports NR in NIR-1 and NE (as suggested by JRC to MS) or NO in the relevant background table. It is noted that irrespective of the notation key used, the key issue is to provide adequate information in the documentation box.

Table 11.2 Synthesis of C pools and other GHG coverage for KP LULUCF forest activities in EU-15 MS, based on table NIR 1 and sectorial tables (for the year 2012)

MS	Change in carbon pool reported						Greenhouse gas sources reported						
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil Min	Soil Org	Fertilization	Drainage of soils under forest management	Disturbance associated with land-use conversion to Croplands	Liming	Biomass burning		
							N2O	N2O	N2O	CO2	CO2	CH4	N2O
Afforestation/Reforestation													
Austria	R	R	R	R	R	NO	NO			NO	NO	NO	NO
Belgium	R	R	NR	NR	R	NO	NO			NO	NO	NO	NO
Denmark	R	R	R	R	R	R	IE			IE	NO	NO	NO
Finland	R	R	IE	IE	R	R	NO			NO	R,NO	R,NO	R,NO
France	R	R	R	R	R	NO	NO			NO	R	R	R
Germany	R,NO	R,NO	R,NO	R,NO	R	R	NO			IE	IE,NO	IE,NO	IE,NO
Greece	R	R	NR	NR	NA,NE	NA,NO	NO			NO	IE	R	R
Ireland	R	R	R	R	NA,NO	R	IE			NO	R	R	R
Italy	R	R	R	R	R	NO	NO			NO	IE	R	R
Luxembourg	R	IE	IE	NO	R	NO	NO			NO	NO	NO	NO
Netherlands	R	R	NR	NR	R	R	NO			NO	NE	NE	NE
Portugal	R	R	R	IE	R	NO	IE			NO	R	R	R
Spain	R	IE	R	R	R	NA	NO			NO	R, NO	R, NO	R, NO
Sweden	R	R	R	R	R	R	NO			NO	NO	NO	NO
UK	R	IE	R	IE	R	R	R			NO	R	R	R
Deforestation													
Austria	R	R	R	R	R	NO			R	R	NO	NO	NO
Belgium	R	R	R	R	R	NO			R	R	NO	NO	NO
Denmark	R	R	R	R	R	NA			R	IE	NO	NO	NO
Finland	R	R	IE	R,IE	R	R			R	R	NO,IE	NO,IE	NO,IE
France	R	R	R	R	R	NO			R	R	R	R	R
Germany	R	R	R	R	R	R			R,IE	NO	NO	NO	NO
Greece	R	R	R	R	R	NO			R	NO	NO	NO	NO
Ireland	R	R	R	R	R	R			NO	R	NO	NO	NO
Italy	R	R	R	R	R	NO			NO	NO	NO	NO	NO
Luxembourg	R	IE	IE	R	R	NO			NO	NO	NO	NO	NO
Netherlands	R	R	R	R	R	R			R	R	NE	NE	NE
Portugal	R	R	R	IE	R	NO			R	NO	R	R	R
Spain	R	IE	R	R	R	NA			R	R	NE	NE	NE
Sweden	R	R	R	R	R	R			R	NO	NO	NO	NO
UK	R	IE	R	IE	R	IE			R	R	R	R	R
Forest management													
Austria	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Belgium	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Denmark	R	R	R	R	NA	R	IE	R		IE	NO	NO	NO
Finland	R	R	IE	IE	R	R	R	R		NO	R	R	R
France	R	R	R	R	R	NO	NO	NO		NO	R	R	R
Germany	R	R	R	R	R	R	NO	R,NO		R,IE	IE,NO	R,NO	R,NO
Greece	R	R	NR	NR	NA,NE	NA,NO	NO	NO		NO	IE	R	R
Ireland	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Italy	R	R	R	R	NE	NO	NO	NO		NO	IE	R	R
Luxembourg	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Netherlands	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Portugal	R	R	R	IE	R	NO	IE	NO		NO	R	R	R
Spain	R	IE	R, NR	R, NR	R	NA	NO	NO		NO	R	R	R
Sweden	R	R	R	R	R	R	R	NE		NO	R	R	R
UK	R	IE	R	IE	R	R	NO	R		NO	R	R	R
Cropland management													
Denmark	R	IE	NR	NR	R	R			R	R	NO	NO	NO
Portugal	R	R	R	IE	R	NO			R	R	NR	R	R
Spain	R	IE	R	R	R	NA			R	R	NE, IE	NE, IE	NE, IE
Grassland management													
Denmark	R	IE	NR	NR	R	R				IE	R	R	R
Portugal	R	R	R	IE	R	NO				IE	NR	R	R

Notation keys: R – C stock change or emissions from source is reported; NR – the pool is not reported (under assumption of not a source); NE – removal/emission is not estimated; IE – included elsewhere; NO –not occurring; NA – not applicable, MS does not account the activity.

11.1.2 Areas and changes in areas reported under KP-LULUCF activities (KP CRF table NIR-2)

Total land area reported under KP-LULUCF activities by EU-15 is 147.359 kha, which corresponds to 34% of the EU-28 area[66], with the largest portion of area reported under Forest Management (76%), followed by Cropland Management (17%), Afforestation/Reforestation (5%), Deforestation (2%) and Grazing land Management (1%).

Most of AR area is reported in Italy, France and Spain (together they account for some 63% of total area reported in EU-15), while most of D area is reported by France, Finland and Portugal (that represent together 66% of EU-15 deforested area). In Finland, Netherlands, Sweden and Luxemburg the deforested area is larger or almost equal to afforested/reforested area.

Table 11.3 Synthesis of total area (kha) reported under KP-LULUCF activities by EU-15 MS at the end of 2012, based on the CFR sectorial tables. Grey cells indicate that the activity has not been elected.

Member State	Art. 3.3 activities		Art. 3.4 activities			
	AR	D	FM	CM	GM	RV
Austria	196	69				
Belgium	27	25				
Denmark	94	6	538	2.644	286	
Finland	167	324	21.827			
France	1.346	1.055	21.525			
Germany	491	255	10.758			
Greece	33	5	1.229			
Ireland	287	17				
Italy	1.670	40	7.471			
Luxembourg	9	7				
Netherlands	50	53				
Portugal	592	342	3.751	2.335	601	
Spain	1.226	105	14.445	20.157		
Sweden	232	228	28.138			
United Kingdom	327	54	2.321			
EU-15	**6.749**	**2.584**	**112.004**	**25.135**	**886**	
EU-13	1.472	238	28.026			103
EU-28	8.221	2.823	140.030	25.135	886	103

Notation: AR: Afforestation/Reforestation, D: Deforestation, FM: Forest Management, CM: Cropland Management, GM: Grazing land Management, RV: Revegetation.

Portugal and Ireland included in table 5(KP-I) A.1.2, 18,6 and 5,60 Kha respectively that are not included in Table 11.1

France's estimate includes deforested areas in overseas territories.

11.1.3 Key categories for KP-LULUCF activities (KP CRF table NIR-3)

EU-15 key category analysis relies on MS NIR-3 tables (Table 11.4). Only Luxembourg did not perform the key category analysis for 2008 – 2012. All key categories relate only to CO_2 emissions or removals. In most cases, AR and FM are key categories, whereas D is key category in six MS. CM and GM, when elected, are always key categories.

[66] The total area of EU-28 is 438.138 kha

Table 11.4 Synthesis of KP-LULUCF activities being key category as reported by EU-15 MS (from table NIR-3) of 2014 submission. "KC" indicates a key category. Grey cells indicate that the activity has not been elected.

MS	AR	D	FM	CM	GM	RV	Comments
Austria	KC	KC					Key category analysis is not only based on emissions/removals from deforestation areas but also from LUC between other
Belgium		KC					Corresponding land category is key under GHG inventory
Denmark			KC	KC	KC		Corresponding land category is key under GHG inventory
Finland	KC	KC	KC				Corresponding land category is key under GHG inventory
France	KC	KC	KC				Corresponding land categories are key under GHG inventory, with mention that D is key category for both CO2 and N2O
Germany	KC		KC				Corresponding land categories are key under GHG inventory
Greece	KC		KC				Corresponding land categories are key under GHG inventory
Ireland	KC						Level assessment
Italy	KC		KC				AR category identified only for trend assessment with Tier2
Luxembourg							KC analysis is not available in the NIR 3
Netherlands							
Portugal	KC	KC	KC	KC	KC		Corresponding land categories are key under GHG inventory
Spain	KC		KC	KC			Corresponding land categories are key under GHG inventory
Sweden	KC	KC	KC				Corresponding land categories are key under GHG inventory, a qualitative approach is used
UK	KC		KC				The associated GHG inventory category is a key category and the Forest Management category contribution is greater than the smallest UNFCCC key category

11.1.4 Summary of net emissions/removals (Gg CO_2 eq) and accounting quantities for KP-LULUCF activities reported by EU-15 MS (KP CRF table "Accounting")

Table 11.5 shows accounted amount for each KP activity for each MS and the sum for EU.

Total net accounted amount for 2008-2012 is -292.992 GgCO_2eq (Table 11.6).

Emissions from D represent in absolute amount 66% of removals accounted in AR. By far, the largest contributor to D emissions is France, responsible of 46% of total GHG emissions from D in EU-15. Because of the cap, the largest accounting quantities for FM are reported by Italy and France.

Countries offsetting debits under Art 3.3 with net removals from FM are Denmark, Finland, France (largest offset) and Sweden.

The largest amounts of credits to be accounted from LULUCF activities are reported by France and Italy, followed by Portugal and Spain. For Belgium and Netherlands KP-LULUCF is a net source resulting in debits.

Compared to 2011, the amount estimated for 2012 is 4 % larger, due to net removals reported under AR, 28%, as well as net emissions reported under D, 34%. Accounted credits under CM decreased as well as under GM because of recalculations of areas over the commitment period.

Table 11.5 KP-LULUCF activities annual accounting quantities for 2008-2012, as reported by EU-15 MS (notation keys reported in this table are: NE – removals/emissions are not estimated; IE – removals/emissions are included elsewhere; NO – removals/emissions are not occurring; NA – MS does not account for the activity)

MS	Net emissions (+) and removals (-), Gg CO2eq														
	A. Art 3.3 activities														
	A.1 AR										A.2. D				
	A.1.1 Lands not harvested					A.1.2 Lands harvested									
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
Austria	-1.948	-2.033	-2.039	-2.045	-2.052	NO	NO	NO	NO	NO	1.071	583	571	559	546
Belgium	-261	-273	-284	-296	-307	NO	NO	NO	NO	NO	506	499	499	499	499
Denmark	393	-216	-280	-119	38	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	81	81	82	85	110
Finland	-62	-74	-94	-112	-135	NA	NA	NA	NA	NA	3.413	3.057	2.832	2.727	2.486
France	-8.000	-8.516	-8.921	-9.372	-9.860	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	18.068	15.100	13.147	13.373	13.434
Germany	-5.332	-5.400	-5.652	-5.893	-6.134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	2.072	2.304	2.327	2.346	2.366
Greece	-110	-131	-166	-144	-145	NA	NA	NA	NA	NA	53	48	44	46	100
Ireland	-3.181	-3.473	-3.630	-3.713	-3.693	6	44	-29	-78	-154	461	382	210	333	224
Italy	-6.352	-7.088	-7.708	-6.310	-6.594	0	0	0	0	0	1.930	1.940	1.951	1.957	1.965
Luxembourg	-79	-79	-94	-108	-123	NO	NO	NO	NO	NO	27	27	26	25	25
Netherlands	-414	-435	-633	-645	-656	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	760	983	1.006	1.036	1.066
Portugal	-7.023	-6.982	-6.609	-6.543	-6.117	588	525	462	399	335	1.736	1.891	1.978	1.957	2.026
Spain	-8.661	-8.725	-8.720	-8.683	-8.558	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	729	729	655	653	651
Sweden	-1.375	-1.397	-1.220	-1.338	-1.370	NO	NO	NO	NO	NO	3.137	3.203	2.666	3.777	3.900
UK	-2.211	-2.396	-2.584	-2.766	-2.911	IE	IE	IE	IE	IE	1.098	1.133	1.066	1.065	1.080
EU-15	-44.614	-47.219	-48.634	-48.088	-48.619	594	569	433	320	182	35.143	31.960	29.060	30.438	30.479
total EU	-50.207	-53.069	-54.975	-54.702	-55.813	569	522	349	187	-5	42.508	36.059	33.030	34.299	36.131

MS	B. Art. 3.4 activities																						
	B.1 FM					B.2 CM						B.3 GM						B.4 RV					
	2008	2009	2010	2011	2012	1990	2008	2009	2010	2011	2012	1990	2008	2009	2010	2011	2012	1990	2008	2009	2010	2011	2012
Austria	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Belgium	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Denmark	-6.097	259	-3.755	-6.180	-4.479	4.845	3.768	2.663	3.388	3.196	2.958	177	235	223	213	245	523	NA	NA	NA	NA	NA	NA
Finland	-37.958	-48.884	-33.235	-33.577	-35.598	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
France	-65.016	-56.868	-51.201	-54.624	-59.309	0	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Germany	-46.759	-46.697	-46.660	-46.610	-46.566	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Greece	-1.832	-1.831	-1.837	-1.839	-1.834	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Ireland	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Italy	-27.191	-29.779	-30.869	-23.564	-24.735	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Luxembourg	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Netherlands	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Portugal	-10.172	-10.427	-9.652	-11.179	-8.979	3.687	259	261	241	253	276	1.174	192	145	82	1	-32	NA	NA	NA	NA	NA	NA
Spain	-23.976	-23.802	-23.759	-23.697	-23.595	-1.036	-1.285	-569	-1.041	-1.338	-1.517	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sweden	-39.976	-39.390	-39.093	-40.104	-39.558	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
UK	-15.611	-15.484	-15.325	-15.049	-14.523	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
EU-15	-274.589	-272.902	-255.387	-256.423	-259.177	7.495	2.742	2.356	2.588	2.111	1.716	1.351	427	368	295	246	491	0	0	0	0	0	0
total EU	-381.018	-380.152	-354.538	-361.230	-360.060	7.495	2.742	2.356	2.588	2.111	1.716	1.351	427	368	295	246	491	-1.586	-1.217	-1.191	-1.182	-1.192	-1.198

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Table 11.6 Accounting quantities for 2008-2012 of KP-LULUCF activities as reported by EU-15 (Gg CO_2eq), based on MS CRF accounting tables*

MS	Accounting quantity							
	Article 3.3		Article 3.4				3.3 Offset	MS accounting amount on LULUCF activities (RMUs)
	AR	D	FM	CM	GM	RV		
Austria	-10.117	3.330						**-6.787**
Belgium	-1.422	2.503						**1.081**
Denmark	-184	440	-1.173	-8.249	552		256	**-8.614**
Finland	-476	14.516	-16.973				14.040	**-2.933**
France	-44.669	73.122	-44.586				28.453	**-16.133**
Germany	-28.411	11.416	-22.733					**-39.728**
Greece	-696	290	-1.650					**-2.056**
Ireland	-17.901	1.610						**-16.291**
Italy	-34.053	9.743	-50.967					**-75.277**
Luxembourg	-482	130						**-353**
Netherlands	-2.783	4.851						**2.068**
Portugal	-33.276	9.587	-4.033	-17.143	-5.481			**-50.347**
Spain	-43.347	3.417	-12.283	-568				**-52.781**
Sweden	-6.700	16.683	-20.616				9.983	**-10.633**
United Kingdom	-12.868	5.443	-6.783					**-14.209**
EU-15	-237.384	157.080	-181.798	-25.961	-4.929		52.731	**-292.992**

Information on accounting quantities included, when reported, credits from table 5(KP-I) A.1.2

*******any information on EU KP-LULUCF activities presented here is shown for information purpose only*

11.2 Synthesis of supplementary information on KP-LULUCF activities reported by EU-15 MS

This chapter provides an overview of EU-15 relevant supplementary information for KP-LULUCF activities as reported by EU-15 MS. Although most MS followed the structure suggested by the annotated NIR, the approach used to include the supplementary information sometimes differed among countries, as well as the amount of information provided; this made it difficult to include everything in an exhaustive and short manner. For more detailed information, it is suggested to refer to the individual MS NIR.

11.2.1 General information

11.2.1.1 Definition of forest land and any other criteria

The parameters used to define “forest” under the Kyoto Protocol by EU-15 MS are summarized in Table 11.7.

Table 11.7 Parameters selected to define "forest" under the Kyoto Protocol

Member State	Minimum crown cover (%)	Minimum height (m)	Minimum area (ha)	Minimum width (m)
Austria	30	2	0.05	10
Belgium	20	5	0.05	-
Denmark	10	5	0.5	20
Finland	10	5	0.05	20
France	10	5	0.05	20
Germany	10	5	0.01	-
Greece	25	2	0.03	-
Ireland	20	5	0.01	20
Italy	10	5	0.05	-
Luxemburg	10	5	0.05	-
Netherlands	20	5	0.05	30
Portugal	10	5	1	20
Spain	20	3	0.01	25
Sweden	10	5	0.05	10
UK	20	2	0.01	20

With two exceptions, parameters and definitions used for reporting forest areas under the Kyoto Protocol are identical to those used under the Convention. Finland reports minimal area of 0.5 ha under KP, whereas two different values are used for reporting under Convention i.e. 0,25 in Southern and 0.5 ha in Northern Finland). Furthermore, the Netherlands reports under Kyoto Protocol only the lands classified as FAD ("Forests according to the Kyoto definition"), but does not report TOF ("Trees outside Forest") which is only included under Convention reporting.

11.2.1.2 Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

The Art. 3.4 activities elected by EU-15 MS are listed above in Table 11.1.

11.2.1.3 Description of how definitions of each activity under Art. 3.3 and each elected activity under Art. 3.4 have been implemented and applied consistently over time

Lands subject to KP-LULUCF activities have been generally identified under a broad interpretation of direct human induced action, assuming that the entire national territory is subject to direct anthropogenic influence. For instance, some countries considered "directly human induced AR" any expansion in forest area since 1990 (see following chapters for more details). For FM, most countries considered all national forest area as subject to "forest management" activity, a few considered it only partially subject to FM (e.g. France reports ~3% of forests as unmanaged and Greece reports under FM only one third of its forest land areas).

Consistency of land representations (i.e., identification and tracking) is ensured by the implementation, in each MS, of methodologies consistent with IPCC GPG for LULUCF (2003)

Some MS have also performed comparison and internal verification of the activity data with other national datasets, (e.g. Finland compared AR and D data generated from NFI with statistics from the forest authority).

11.2.1.4 Description of precedence conditions and/or hierarchy among Art. 3.4 activities, and how they have been consistently applied in determining how land was classified

MS that have elected activities in addition to FM under Art.3.4, i.e. Denmark, Portugal and Spain, have assigned higher priority to FM, in sequence FM-CM-GM (driven by the intensity of human intervention on land and other environmental considerations).

National systems ensure that once the land started to be accounted, it cannot leave the accounting in subsequent years (i.e. it has to be continuously estimated, reported and accounted for across commitment periods).

For forest related activities, MS implement methods aimed at avoiding double counting of lands under different activities (ranging from ground repeated assessments to ground verification of the automatic procedures like remote sensing based mapping). Among forestry related land activities all MS implement the rule that D has precedence over AR and FM, and then AR over FM, following the KP reporting rules.

The KP-NIR 2 table implicitly fulfills the obligation to demonstrate that emissions by sources and removals by sinks resulting from activities elected under Art. 3.4 are not accounted for under activities under Art. 3.3: as long as the total area reported in table NIR 2 is correct and constant over time, no double counting of lands (and thus no double counting of GHG emissions and CO_2 removals) may occur.

11.2.2 Land-related information (EU-15)

11.2.2.1 Spatial assessment unit used for the area of the units of land under Art. 3.3

The spatial assessment unit applied for identifying and tracking lands under Deforestation is the same applied for lands under Afforestation/Reforestation and Forest Management and it corresponds to the minimum area, and minimum width, of the forest definition selected by the MS.

11.2.2.2 Methodology used to develop the land transition matrix

Areas of land activities have to be fully consistent with areas of correspondent land categories reported in the Convention GHG inventory. This is an issue subject to checks by EU JRC before the final EU's CRF are compiled.

The land transition matrix reported in the NIR for Convention land use categories and the KP tables NIR-2 allow checking the consistency of land area reporting across categories and time. In order to ensure consistency along the entire time series, additional procedures were implemented for previous NFIs datasets to become compatible with latest NFI (i.e. ground assessments to fully identify ARD areas in Austria or studying the effect of various averaging approaches for most updated NFI data to obtain accurate D area estimates in Sweden).

Annual areas for KP activities are estimated by MS either based on extrapolation/interpolation from datasets with time interval (e.g. remote sensing based mapping) or based on annual estimates provided by specific land surveys (i.e. sampling grids, subsidies records, land registries/cadaster). Sometimes, MS combine several sources of data, involving expert judgment (i.e. Italy's assumption that conversions to forest can only occur on grasslands).

Methodologies for land identification and tracking are shortly described in Table 11.8. For more detailed information on data sources and methods see MS submissions.

11.2.2.3 Maps and/or databases to identify the geographical locations, and the system of identification codes for the geographical locations

The majority of EU-15 MS reported a single geographical boundary at country level, which corresponds to the sum of outputs from country-scale, designed monitoring systems and underpinning datasets (i.e. data collecting systems, databases, QA/QC and verification procedures). Consequently, any further breakdown of the country area into several reporting regions, followed by re-aggregation at national scale, would likely result in larger uncertainty for the GHG estimates. Few large countries report two (e.g. Finland) or more geographical boundaries (e.g. France, Greece, Italy, Spain and UK, all of them with geographical boundaries of reported units corresponding to administrative regions).

MS rely on various methods and approaches to identify and track “units of land” under Art 3.3 and “lands” under Art 3.4 of the Kyoto Protocol, according to availability of data and resources (Table 11.8).

Table 11.8 Methodologies for land identification and tracking by the EU-15 MS (for more detailed information on data sources and methods see Ch.7)

MS	Methods			Land identification and tracking features for the “lands” or “units of lands”
	NFI	Mapping by Earth Observations methods	Land registry systems, including surveys	
Austria	X			Statistical methods
Belgium	X	X		Statistical methods
Denmark	X	X		Statistical methods
Finland	X			Statistical methods
France			X	Statistical methods
Germany	X	X		Wall-to-wall mapping approach
Greece			X	National land registry and forest mapping database
Ireland		X		Sectorial ARD land registry, GIS database
Italy	X		X	NFI plots coordinates (AR), thus random distribution of units of land and land statistics for D for each region
Luxembourg		X		Geo-processing based on successive land use maps
Netherlands	X	X		Wall-to-wall mapping approach
Portugal	X	X		Statistical methods
Spain	X	X	X	AR data is based on land registry system. FM, D is based on CLC maps and forest map (in parallel with NFI)
Sweden	X			Statistical methods
UK			X	Statistics by forest authorities

Different approaches for land identification and ‘reporting methods’ are applied by MS to comply with reporting requirements (Table 11.9).

Reporting method 1 is based on use of grid based assessments, usually by Approach 3 or sometimes Approach 2 with supplementary information. Most of the national systems rely on NFI grids to identify and track lands under AR, D and FM, very often complemented by remote sensing datasets (especially to derive 1990). National systems sometimes rely on land parcel identification systems (e.g. as used for subsidy payments or licensing), which allow recording and tracking individual parcels in time and space since the onset of the subsidized activity (often digitized and available in GIS, like in Ireland). Such systems are supported by adequate verification and validation/audit procedure at the country level as they are under public funding (e.g. Ireland, Greece, Spain). When Approach 2 is used, additional information is provided (i.e. license database, payment scheme database, forest management planning related databases, expert judgment), to allow land identification and tracking.

Reporting method 2 is used in only few cases, when, each single area subject to a KP activity is identified and tracked on a geographical information system. In these cases wall-to-wall datasets are derived from remotely sensed data.

Table 11.9 Information on reporting methods and approaches used (elaboration based on the information available from MS NIRs)

MS	Reporting Method used for identifying the geographical locations	Approach used for land representation
Austria	1	2/3
Belgium	1	3
Denmark	1	3
Finland	1	3
France	1	3
Germany	2	3
Greece	1	2
Ireland	2	3
Italy	1	2
Luxembourg	1	3
Netherlands	2	3
Portugal	1	3
Spain	1	2
Sweden	1	3
UK	1	2

11.2.3 Activity-specific information

11.2.3.1 Methods to estimate carbon stock changes and other GHG emissions

Methods used for the estimation of emissions/removals related to the Art 3.3 and Art 3.4 activities are consistent with those used for reporting the corresponding land use subcategories in the Convention GHG inventory, as described under Chapter 7 of this NIR. In that chapter, methods and datasets are described in detail for each of the relevant land use subcategories (5A2, 5B2.1, 5C2.1, etc). The appropriateness of the Tier used (e.g. higher tier for key categories) is checked by the QA/QC procedures implemented at country and EU levels.

11.2.3.2 Description of the methodologies used and underlying assumptions

The main source of data for ARD and FM are national forest inventories. In few cases annual net CO_2 removals are modeled based on non-NFI data (modeling based on yield table and age-distribution of plantations from national statistics). Emissions from mineral soils associated with any conversion to/from forest land are estimated by modeling or by using the IPCC default methodology together with country specific reference C stocks. The reporting of C stock changes in litter, dead wood and in mineral soils is improved considerably in the last years, with fewer MS reporting notation keys (actually demonstrating they are not a source).

For Afforestation/Reforestation, litter, dead wood and mineral soils are sometimes not accounted on the basis of the “not a source” provision since they are proved to be sinks, with few exceptions: e.g. soils for Finland, Germany and Sweden. The range of the Implied Emission Factors (IEF of C stock changes) reported for Afforestation/Reforestation (Table 11.10) is similar to those reported in the Convention CRF tables for land converted to forest land. Among MS, there are notable differences between IEF on net biomass increment reported, caused by the type of species, climatic conditions and other characteristics (e.g. non-uniform rate of harvesting, different management). One additional reason for large differences is the use of either time averaged or actual annual growth data, depending on the methodology applied by the MS. DW and LT are also in some case reported as “not a source” with justification provided in the MS’s NIR.

Table 11.10 IEF for net C stock changes (MgC ha-1yr-1) by pool reported under AR activity in EU-15 (for the year 2012), based on MS NIRs.

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	0,96	0,26	1,01	0,02	0,60	NO
Belgium	1,62	0,32	NO	NO	1,21	NO
Denmark	-0,13	-0,06	0,02	-0,03	0,15	-0,34
Finland	0,63	0,22	IE	IE	-0,05	-1,39
France	1,08	0,48	0,20	0,04	0,21	NO
Germany	2,80	0,52	0,44	0,03	-0,36	-0,68
Greece	1,00	0,19	NA,NE	NA,NE	NA,NE	NA,NO
Ireland	2,33	0,73	0,55	0,16	NA,NO	-0,45
Italy	0,77	0,16	0,01	0,01	0,15	NO
Luxembourg	3,19	IE	IE	NO	0,67	NO
Netherlands	3,40	0,45	NE	NE	0,18	-6,46
Portugal	2,02	0,38	0,01	IE	0,55	NO
Spain	1,12	IE	0,09	0,15	0,57	NA
Sweden	1,14	0,36	0,27	0,01	-0,11	-0,57
UK	1,22	IE	0,07	IE	1,05	2,49

Notation keys for all tables below: IE – data is reported elsewhere i.e. included in other pools. NO – no net carbon stock change. NA- not applicable, NE-not estimated (the MS using NE, NA, NO justify these pools as "not a source" or negligible; although the correct notation key would be NE with information explaining that the pool is not a net source of CO_2 reported in the documentation box).

Noted that the value reported by Netherlands in CRF tables regarding IEF for Org Soils under AR is an error, however as informed by Netherlands, the error has no effect on the total net CO_2 emission/removals reported. In this table the correct value is provided.

For Deforestation, reporting is complete for all C pools (Table 11.11). Both Germany and Denmark reported a sink in mineral soil caused by conversions to grasslands, as estimated based on country specific data.

Table 11.11 IEF for net C stock changes (MgC ha-1yr-1) by pool reported under Deforestation activity in EU-15 (for the year 2012), based on MS NIRs.

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	-0,73	-0,18	-0,56	0,00	-0,68	NO
Belgium	-3,17	-0,63	-0,28	-0,07	-1,35	NO
Denmark	-3,56	-0,77	-0,83	-0,08	0,09	NA
Finland	-0,74	-0,22	IE	-0,01	-0,23	-4,16
France	-1,91	-0,47	-0,23	-0,07	-0,72	NO
Germany	-1,56	-0,19	-0,75	-0,09	0,30	-4,20
Greece	-1,58	-0,61	-0,65	-0,05	-2,46	NO
Ireland	-2,06	-0,51	-0,22	-0,56	-0,37	-0,34
Italy	-4,35	-0,92	-0,27	-0,14	-7,58	NO
Luxembourg	-0,58	IE	IE	-0,01	-0,36	NO
Netherlands	-2,99	-0,49	-1,53	-0,08	0,00	-6,52
Portugal	-0,26	-0,02	-0,03	IE	-1,17	NO
Spain	-1,08	IE	-0,07	-0,11	-0,40	NA
Sweden	-2,02	-0,62	-1,07	0,00	-0,89	-1,32
UK	-2,48	IE	-0,40	IE	-0,69	IE

For Forest Management (Table 11.12), more carbon pools are reported with notation keys than for AR. Whichever notation key is used, a justification to demonstrate that the pool is not a net source of CO_2 is provided in the NIR. Mineral soils, litter and dead wood are reported as sink in almost all cases. Differences in the IEFs among MS is mainly caused by the different increment rates (determined by species, ecological conditions, management, etc), the proportion of annual increment which is harvested, and for some country by the occurrence of natural disturbance events.

Table 11.12. IEF for net C stock changes (MgC ha-1yr-1) by pool reported under Forest management activity in EU-15 (for the year 2012), based on MS NIRs

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	NA	NA	NA	NA	NA	NA
Belgium	NA	NA	NA	NA	NA	NA
Denmark	1,46	0,33	0,47	0,04	NA	-0,34
Finland	0,37	0,08	IE	IE	0,13	-0,35
France	0,60	0,21	0,00	-0,04	0,00	NO
Germany	0,90	0,13	-0,05	-0,05	0,27	-0,68
Greece	0,30	0,11	NA,NE	NA,NE	NA,NE	NA,NO
Ireland	NA	NA	NA	NA	NA	NA
Italy	0,74	0,18	0,00	0,00	NE	NO
Luxembourg	NA	NA	NA	NA	NA	NA
Netherlands	NA	NA	NA	NA	NA	NA
Portugal	0,63	0,13	0,00	IE	0,00	NO
Spain	0,45	IE	0,00	0,00	0,00	NA
Sweden	0,23	0,08	-0,05	0,07	0,16	-0,60
UK	1,24	IE	0,22	IE	0,22	0,79

11.2.3.2.1 Direct N_2O emissions from N fertilization (Table 5(KP-II) 1)

Few MS report fertilization of old forests (e.g. Sweden) or young plantations (e.g. UK). For the majority of MS, N fertilization of forests does not occur or, if any, emissions are expected to be extremely low and are in any case reported under the Agriculture sector.

11.2.3.2.2 N_2O emissions from drainage of soils (Table 5(KP-II) 2)

Several MS did not report N_2O emissions from drainage of soils under FM, as the method of estimation is included only in the Appendix 3a.2 of the IPCC GPG for LULUCF (i.e. the reporting is not mandatory). Total area of drained organic soils for which N_2O emissions are reported under FM is 5.611 kha (Finland alone reports 77% of the total area). Additional difficulty in reporting these emissions was the lack of slots in the CRF tables for reporting N_2O emissions from AR lands (e.g. Germany reports it within FM drained area). Emissions are estimated based on IPCC default factors (e.g. UK) or country specific factors (e.g. Finland, Germany). Estimation methods are consistent with those described under Chapter 7 of this report.

11.2.3.2.3 N_2O emissions from disturbance associated with land use conversion to Cropland (Table 5(KP-II) 3)

Reported EU-15 forest areas converted to Cropland covers 383 kha with an emission of 0.5 Gg N_2O. Currently, consistency among KP and Convention tables has been specifically checked by the EU QA/QC procedures. Estimation methods are consistent with those described under Chapter 7 of this report.

11.2.3.2.4 Carbon emissions from lime application (Table 5(KP-II) 4)

With the exception of Germany, liming is generally not much applied to forest as it is not economically reasonable at the rates required (e.g. UK's NIR 2014); so that for FM and AR it is generally not reported or reported as included under cropland management for those Parties that elected it (Portugal Spain and Denmark). Generally, liming is separately reported for D areas (e.g. Finland, Netherland). There are no separate reliable statistics for lime application on D areas, thus it is commonly assigned to D land a portion of the lime applied to agricultural lands on the basis of the deforested area proportion to total agricultural land. Estimation methods are consistent with those described under Chapter 7.

11.2.3.2.5 GHG emissions from biomass burning (Table 5(KP-II)5)

Estimation methods are consistent with what described under Chapter 7. In general monitoring systems are not able to discriminate whether the fire occurred on an AR land or on a land under FM so that burnt areas are assigned to the 2 activities on the basis of their area proportion to total forest land.

11.2.3.3 Justification when omitting any carbon pool from reporting

As explained in Chapter 7, a decision tree guiding the use of the “not a source” provision was elaborated by JRC and MS were encouraged to follow it (http://forest.jrc.ec.europa.eu/activities/lulucf/workshops/).

Accordingly, during the EU QA/QC process, MS have been recommended to use the notation key “NR” in NIR-1 CRF table for pools reported under the “not a source” provision and to use the notation key NE in the background tables. Further, information should be provided in the CRF documentation box on the application of the “not a source” provision.

In Table 11.13 different demonstrations provided by the MS when omitting a pool are summarized.

Table 11.13 Overview of information provided to demonstrate that a pool is not a source.

MS	Activity	Pool	Demostration/reasoning
Belgium	AR	DW, LT	Belgium opted for a conservative approach in its 2014 submission, considering IPCC GPG 2003 tier 1, where no change in carbon stock is considered in these pools in the case of afforestation/deforestation.
Denmark	FM	SOCmin	NFI monitoring was supplemented by an additional forest soil inventory in order to document that forest soils is not an overlooked source for CO_2 emissions.
		DW, LT	Assumed not occurring.
Greece	AR	DOM	Areas under AR activity include only cropland areas that have been afforested by planting in the context of EEC Regulations 2080/92 and 1257/99. Considering that in any forest land, including plantations, the carbon stock in dead organic pool cannot be classified as negligible, any conversion from cropland to forest land, as in the case of Greece, leads to an increase in dead organic matter, and therefore the litter and the dead wood pools cannot be a source. Furthermore, a comparison with some neighbouring countries with similar ecological conditions is presented in the NIR.
	FM	DOM/SOCmin	Based on forest management practices set up by law in Greece it is assumed that these pools uner FM activity are not a net source of emissions.
Ireland	AR	SOCmin	Statistical supported data that this pool is not a source of emissions.
Italy	FM	SOC min	Demostration based on country specific datasets and estimates.
Luxembourg	AR	DW	Deadwood is assumed not to occur on AR areas, assumption verified in different sample plots of the second forest inventory (IFL2). Due to the young age of the forests at AR areas (since 1990) and the assumed lack of dead wood at areas of all other land uses it is assumed that a stock change of dead wood does not occur at AR areas. If there was any in the young forests of AR areas it would represent a C stock increase due to the lack of dead wood in the previous land uses. So, this assumption is conservative.
Netherlands	AR	DW, LT	It is assumed that no other land use has carbon in litter and dead wood. Adequate data are lacking to quantify litter, accumulation of carbon in re/afforestation is conservatively set to zero, although expert judgment on forest age and ecosystem processes suggests a small sink. Also, the conversion of non-forest to forest involves a build-up of carbon in dead wood. However, as it is unlikely that much dead wood will accumulate in very young forests (having regeneration years in 1990 or later), accumulation of carbon in dead wood in re/afforested plots is most likely a very tiny sink that is too uncertain to quantify reliably, also reported as not a source. There is no practice of biomass burning at ARD areas in Luxembourg. Furthermore, forests are not fertilised in Luxembourg. So, fertilisation at AR areas and liming at ARD areas do not occur.
Spain	CM	DW	Assumed to be a sink, however due to the lack of data estimations are not provided.
Austria, Germany, Finland, France, Portugal, Sweden, United Kingdom			All pools are estimated and accounted (although individual change pools are often reported as included IE)

For a consistent demonstration of ‘not a source’, MS have been encouraged by JRC to avoid simple assumptions following Tier 1 of IPCC, but to demonstrate, based on qualitative information, reasoning and, to the extent possible, quantitative estimates from any available documentation (scientific papers, scientific reports). Since 2010, EU has performed annual assessments of the implementation of the ‘not a source’ provision and has provided support for improving and harmonizing the information provided by MS to justify any omission of carbon pools.

11.2.3.4 Information on whether or not indirect and natural CO_2 removals have been factored out

In general, it is recognized that: (i) for Article 3, paragraph 4 activities, the issue of “factoring out” was solved during negotiations with the cap for Forest Management and with the net-net accounting for the other Article 3, paragraph 4 activities; (ii) for Article 3, paragraph 3 activities, the dynamic effect of age is not relevant since all these activities have occurred after 1990; (iii) for the elevated CO_2 concentration and the indirect nitrogen deposition, there are neither methodologies adopted by the UNFCCC nor dataset and methods to separate the contribution to C stock gains of CO_2 and N fertilization.

11.2.3.5 Changes in data and methods since the previous submission (recalculations)

Following improvements started in previous years there were recalculation in 2014 submissions compared to previous submission (Table 1.11.14). They were caused by availability of new data and parameters that have increased the overall accuracy and the completeness of the reporting.

Table 1.11.14.Synthesis of reasons for recalculations as reported by EU MS

MS	AR	D	FM	CM	GM	RV	Comments
Austria	x	x					The areas of the ARD activities were changed on basis of the ARD assessment that was finalized in 2013. Due to this assessment the areas of both, AR and D, are smaller than in previous submissions. The biomass stock gains and losses at the ARD lands and dead wood stock changes at the ARD lands in the Kyoto-Period were for the first time measured accurately. These changes in the ARD activity data led also to different mean soil C stocks to be used for the estimates of the soil C stock changes at the ARD lands. Furthermore, in response to a re-view finding the soil C stock changes in the AR- and D-categories with WL were assumed to be 0. AR lands from WL are more than D lands to WL, so this approach is conservative because it underestimates the net removals of both subcategories in the mineral soil pool. In addition, in response to a review finding the emissions due to liming at D lands to CL and GL were estimated for the first time. So, the emission estimates for the ARD lands and for the whole Kyoto-Protocol-period were changed on basis of these new activity data and emission factors. While the emissions and removals in the single activities of AR and D changed significantly, the net result of ARD represents 10 % higher average annual net removals compared to previous submissions.
Belgium		x					Emissions and removals from liming in land deforested and converted to cropland or grassland (deforestation) were recalculated. As a result a complete harmonization between LULUCF and KP-LULUCF is achieved.
Denmark	x	x	x	x	x		A recalculation for KP-LULUCF has been performed for all areas as a consequence of the new land area matrix, see the section on LULUCF.
Finland	x	x	x				The areas of ARD activities were recalculated due to the changes in the area estimation and due to updated NFI data. Weather data from 2012 were added to climate average calculation, producing also new steady state estimation for soil carbon. The N2O emissions from drained organic AR and D lands were estimated and reported under biomass burning in CRF tables. The areas of FM activities were recalculated due to changes in the area estimation. New NFI data were used for litter input estimates. The N2O emissions form drained organic FM lands were estimated.
France	x	x	x				Adding the results of a study completed in 2013. Adding reported areas under the Kyoto Protocol since 2008.
Germany	x	x	x				The activity data had to be recalculated for all time series from 1990 through 2012, since the following new data sets had been taken into account in derivation of relevant areas: o Map data, derived from CIR data, and originating from mapping of biotopes and land-use types for 1992, for the Länder Schleswig-Holstein, Saxony and Saxony-Anhalt o The data of the 2012 National Forest Inventory o The current data set of the Basic Digital Landscape Model (Digitales Basis-Landschaftsmodell; Basis-DLM) (2012) For biomass, use of results of the third National Forest Inventory (BWI 2012) led to derivation of different EF for afforestation and deforestation (KP 3.3) and for forest management (KP 3.4). For dead wood as well, use of results of the third National Forest Inventory (BWI 2012) led to derivation of other emission factors (EF) for afforestation and deforestation (KP 3.3) and for forest management (KP 3.4) The biomass recalculations have had an impact on determination of emissions from forest fires. The mass of available combustible fuel (biomass) enters into derivation of such emissions The changes in the biomass values made it necessary to recalculate the emission factors for the period 1990 through 2012.
Greece	x	x					Estimation and reporting for the first time of CO2 and non-CO2 greenhouse gas emissions resulted from biomass burning in Cropland converted to Forest land category (Afforestation/Reforestation activity under KP). Estimation and reporting for the first time on N2O emissions from disturbance associated with land use conversion to cropland, namely N2O emissions arising from Forest land converted to Cropland (Deforestation activity under KP), and Grassland converted to Cropland
Ireland	x	x					Numerous changes have been implemented to the KP LULUCF 2008, 2009, 2010 and 2011 inventories following comments from the UNFCCC expert reviewers, availability of new activity data and internal QA/QC checks, these include: 1) Emissions from deforested areas now include mineral soil emissions for other lands and settlements. All mineral soils in this category are assumed to lose 20% of the SOC over a 20 year. A mean SOC values for mineral soils is assumed to be 110 t C/ha. 2) The deforested areas have been re-estimated using the latest NFI 2012. 3) Emissions from application of lime to deforested grasslands have been recalculated due to changes in the deforestation areas as determined using the NFI 2006 and 2012. 4) The deforestation emissions from forest biomass, litter and deadwood have also been recalculated using the latest NFI information. 5) Harvest data for AR land has been re-estimated using the latest NFI information. 6) The areas under sub-category KP.A.1.1 has changed due to use of new activity data from the NFI 2006 and 2012 and the allocation of areas between sub-categories KP.A1.1, A1.2 and A.
Italy	x	x	x				Concerning the ARD activities under art. 3.3 of the Kyoto Protocol, the main driver for the deviations from the previous sectoral estimates is the update of the coefficients used to estimate the carbon stock changes in the litter pool; the remaining deviations are resulting from updating of activity data (the new available data from the III NFI) and from the detection and correction of computation errors. Remarkable deviations affected the deadwood and litter pool resulting from the detection and correction of computation errors and from updating of activity data; in addition, for litter pool, the coefficients used in the estimation process have been updated.
Luxembourg			x				The calculation formula for N2O emissions from disturbance associated with land-use conversion to cropland was corrected to reflect the country-specific C/N ratio (which equals to 12). This value is derived from a study done by ASTA. This revision reflects a recommendation by the ERT during the last centralized UNFCCC. The category affected is KP Article 3.3 - Deforestation for the years 2008-2010.

Netherlands	x	x	x				An update of the liming statistics increased the estimated CO2 emissions from the liming of deforested land now used as cropland. For the end of period reporting of KP-LULUCF an effort was made to have new land-use map with date 1-1-2013 to allow inclusion of actual land-use changes until 2012. Previously the rate of land-use change observed between 2004 and 2009 was extrapolated until 2011.The availability of a new national forest inventory (NBI6) that was carried out in 2012 and 2013 allowed the calculation of actual carbon stock changes between 2000 (previous national forest inventory, MFV) and 2012. These changes were linearly interpolated for the years in between these two dates. Emissions from wild fires on land subject to deforestation were included.
Portugal	x	x	x	x	x		Several recalculations have been done as a result of the implementation of the improvements suggested by the ERT.
Spain	x	x	x	x			New methodology for estimating biomass accumulation rate in AR. Deforested areas were updated as a result of a new data source available (i.e. Fotofija09). Improvements of methodologies for estimating soil emissions under CM
Sweden	x	x					The major difference between submissions under the KP is found for living biomass and AR and D respectively. This is mainly be explained by that: new sample plots have been inventoried, in submission 2013 nearly 20 plots have been incorrectly reported under ARD (land use conversion in 1989 should not be considered ARD) and due to the fact that the National Forest Inventory have revised biomass estimates for a small proportion of so called sample trees. The uncertainty of estimates increases by decreasing number of sample plots and Table 11.4 illustrate the need of annual recalculations of the most recent years to increase the accuracy. In the current submission, the living biomass pool and activity areas have been recalculated for the most recent years to improve accuracy and each estimate are now based on 6000 more measured sample plots. To avoid an increasing uncertainty of estimates by decreasing number of sample plots Sweden has introduced extrapolation for inventory cycles without a full record of sample plots until 2012. Inconsistencies in the reporting of direct N2O emissions for N fertilization and N2O emissions from disturbance associated with land-use conversion to cropland between the UNFCCC-reporting and the KP-LULUCF reporting have been taken care of.
UK	x	x	x				Several recalculations were as a result of a change to using the CARBINE carbon accounting model under all the activities. New activity data has been used for afforestation and emissions from wildfires are now split between Afforestation and Land Management. This has caused a small decrease in Carbon emissions and an increase in CH4 and N2O emissions. Emissions from Deforestation in Northern Ireland; deforestation to cropland and liming on deforested land have been included for the first time. Forest Management areas have been adjusted to take into account new deforestation activity data and emissions from wildfires are now split between Afforestation and Land Management.

11.2.3.6 Improvement status and plan

Status of implementation of the recommendations (Table 11.15) from the Annual Inventory Review Reports 2013 made to the member states by ERTs was checked in latest submissions to UNFCCC (available as 15.04.2014). For MS for which the ARR 2013 was not available at that date, information on the status of implementation of recommendations is based on the ARR 2012. In addition, whether information on the implementation of recommendations was not available on MS NIRs, the information provided in Table 11.15 is based on assessment by the JRC.

Table 11.15 Recommendations by the UNFCCC's ERT in ARR 2013 and implementation status according to NIR 2014 by MS and EU-15

Activity	Recommendations	Status	Improvements by MS, including checks by EU QAQC 2014
Status of implementation of the issues raised on the KP list of the EU by ERT 2013			
Afforestation and reforestation	Italy use a forest model called "Forest". Under the Convention reporting the split between FL-FL and L-FL sinks is proportional to the FL-FL and L-FL forest areas. How can this be justified given that L-FL are forests establishing themselves as new forest areas while FL-FL are established forests? Does Italy calculate the sink in the same way under the KP reporting for afforestation? It appears to the ERT that the KP sink is split between FM and AR proportionally to their areas and that the total forest area is FM+AR?	Implemented	For Italy, during the EU's QA/QC by JRC it was found a mistake in how total forest area was split between FL-FL and L-FL. This mistake was the reasons of the very low sink in L-FL reported by Italy last year. The mistake in forest area has been corrected, and the approach to estimate the sink in L-FL by Italy has changed: now the forest model ("Forest") is run for the whole forest area and the total sink is split between FL-FL and L-FL proportionally to the area (same approach for FM and AR). The JRC considers that this approach is not satisfactory because the assumption of equal sink between FL-FL and L-FL has no strong justification (increments and harvest values likely very different).
Afforestation and reforestation	Litter reported as NE (NLD, ESP)	Implemented	MS provide demonstrations in their NIR 2014 that these pools are "not a source".
Afforestation and reforestation	DW reported as NE (NLD, ESP)	Implemented	MS provide demonstrations in their NIR 2014 that these pools are "not a source".
Afforestation and reforestation	Blanks in the reporting tables for litter and deadwood for Greece on units of land not harvested since beginning of commitment period	Implemented	MS provide "not a source" demonstration in NIR 2013, although CRF are wrongly filled in with Notation keys.
Deforestation	Belowground biomass reported as NE (FIN)	Implemented	Finland conservatively does not report "Gains", but "loss". It is explained in Finland's NIR 2014.
Deforestation	Litter reported as NE (FIN)	Implemented	Finland argues that there is no method available in GPG 2003 for estimation in LT in conversion from forest on peatlands (conflict with D16/CMP1). In the current version it is reported as included in the SOC change.
Forest management	Litter reported as NE (GRC, ESP)	Implemented	MS provide "not a source" demonstrations in their NIR 2014.
Forest management	Mineral soils reported as NE (GRC, ITA, ESP)	Implemented	MS provide "not a source" demonstrations in their NIR 2014.
Cropland management	Litter and Dead wood reported as NE (ESP)	Implemented	Spain stated that data for reporting DOM are not available, however it justifies that since all the living biomass is considered lost (i.e. without any transfer from LB to DOM) in cases where woody crops are converted to annual crops or in conversions within woody crops, it considered this approach as a conservative.
Forest management	Drainage of soils NE (FIN)	Implemented	Finland argued that no method available in GPG IPCC for LT in conversion on peatlands (conflict with D16/CMP1). Finland estimated and reported such emissions in the submission 2014.
Deforestation	N2O emissions from disturbance associated with land-use conversion to cropland on mineral and organic soils NE (BEL, FRA)	Implemented	Both MS estimated and reported these emissions.
Afforestation and reforestation- units of land not harvested since the beginning of the commitment period	Biomass burning NE (NLD)	Implemented	MS assumes these emissions are negligible (NE), by justifying with time series of historical data.
Deforestation	Biomass burning NE (FIN, NLD)	Ongoing/ Implemented	Finland performs an on-going examination of methods for consistent reporting of emissions from wildfires. NLD justifies wildfires area is negligible and report it as NE.
Forest management	Biomass burning NE (ESP)	Implemented	In 2014 submission GHG emissions from controlled burning are estimated and reported.
Article 3.3 and 3.4 lands	The ERT believes that additional documentation may be needed to justify the use of the notation key "NO" on some lands, in some Member States (e.g. AUT, BEL, FRA, GRC, ITA, LUX, PRT, ESP is reported for ARD on organic soils).	Implemented	Lack of emissions from organic soils under ARD could be a potential understimation of emisisons mainly for northern countries. In most cases information on how organic soils area was considered as NO, it is not added in the NIR. However, since reporting of this pool under 5A2, 5B2 and ARD is consistent there is no reason for understimation of emissions. Further on, EU introduces additional checks in its QAQC program to cover such cases.
Afforestation and reforestation, Deforestation, Forest management, Cropland management	Carbon emissions from lime application (ESP). Spain accounts for 10% of the CO2 emissions from lime production in sugar mills, 90% is assumed to be applied on agricultural soils. Research is underway so as to close the carbonate cycle starting from the use of limestone in the kiln for sugar production to application of the lime on the fields. During the review, the Party was unable to identify the destination of the end use of the lime, and if applied to Article 3.3 or 3.4 lands, it would lead to an underestimate in KP-LULUCF emissions. Carbon emissions from lime application (ESP- see above)	Implemented	IN 2014 submission Spain estimated and reported split CO2 emissions in according the use.

Category	Recommendations	Status	Improvement made
		AUSTRIA (ARR 2013, NIR 2014)	
Overview	The ERT recommends that Austria implements its improvement plan using the NFI 2011/2013 to show how all the requirements will be met.	Implemented	Improvement plan was implemented for submission 2014
Overview	Define time period threshold applied to "oscillating change areas" and if the time period threshold is exceeded or there is clear indication of land use change, report these areas under Article 3 paragraph 3 of the Kyoto Protocol– deforestation activities and retain under this activity for the remaining and subsequent commitment period.	Implemented	Time period threshold definition of ARD was thoroughly controlled for the ARD areas within the ARD NFI 2011/13. Previous ARD areas due to short time land-use change oscillations below these thresholds were deleted as ARD areas.
Overview	Improve data and methodologies used for the calculation of activities under Article 3, paragraph 3, of the Kyoto Protocol based on best available data and ensure that the time-series data for the first commitment period are re- constructed to meet the reporting requirements.	Implemented	Data and methodologies used for the calculations of ARD activities were improved and re-constructed to meet the reporting requirements (e.g. on basis of the ARD NFI 2011/13)
Overview	Include uncertainty analysis for activities elected under Article 3, paragraph 3 of the Kyoto Protocol.	Implemented	Uncertainty analysis was carried out and results of this analysis described in NIR
AR	Estimate emissions for the deadwood pool or demonstrate and reforestation that the pool is not a source.	Implemented	The ARD NFI finalized in 2013 included measurements of the dead wood stock changes, biomass stock changes and biomass harvest at the ARD lands. So, the emissions/removals due to these changes were completely estimated for submission 2014
AR	Report biomass losses associated with afforestation of settlement areas or demonstrate that this pool is not a source.	Implemented	The biomass losses of this activity were estimated for submission 2014
AR	Refine and report the methodology used for determining soil organic carbon (SOC) stocks of drained water-bodies to ensure that SOC removals in afforested mineral soils are not overestimated.	Implemented	C stock changes in mineral soils of LUC lands to and from WL were assumed to be 0. AR lands from WL are more than D lands to WL, so this approach is conservative because it underestimates the net removals of both subcategories in the mineral soil pool.
D	Estimate and report emissions from lime application to deforested crop and grassland	Implemented	These emissions were estimated for submission 2014
		BELGIUM (ARR 2013, NIR 2014)	
Overview	Report information that demonstrate the consistency of its land representation and in particular of areas reported under afforestation/reforestation and deforestation activities	Implemented/Ongoing	Land use change monitoring is presented in section 10.2 (8 pages) and 7.1.1. Further information will be included in the next submission.
Overview	Explain the basis for the assumption that all fires took place in forest land remaining forest land and not in areas of KP-LULUCF activities in its NIR or assign a portion of those emissions to afforestation/reforestation activities	Implemented	This has been explained in the April 2014 submission. See documentation box and NIR, chapters 10.3.1.2 andd 7.2.2.1 (E).
Overview	Improve the transparency of the information provided in its NIR, provide further information to satisfy the mandatory reporting element of paragraph 6(a) of the annex to decision 15/CMP.1 and clearly specify, in the NIR, the methods used to report the emissions from each carbon pool under afforestation and reforestation, and deforestation	Implemented	Section 10.3.1.1. of the NIR has been further elaborated in the 2014 submission, with a more detailed information on the methodologies and assumptions regarding ARD carbon pools estimates.
AR	For carbon stock changes in dead wood and litter, report estimates for these pools using the country-specific data available, and if this is not possible, include the available verifiable information to demonstrate that these pools are not a net source of emissions	Implemented	Regarding deadwood and litter, Belgium opted for a conservative approach in its 2014 submission, considering IPCC GPG 2003 tier 1, where no change in carbon stock is considered in these pools in the case of afforestation/reforestation. Instead of a zero value, notation key NR was reported in the KP-LULUCF table to express that the pool is not reported, as this pool is not a source. (see chapter 10.3.1.2. in the NIR of April 2014).Although no change is assumed, the carbon stocks in these pools are estimated using country-specific data, as explained in the NIR, section 7.2.2.1 (B), page 188 : "The data on deadwood were updated in the 2012 submission, using the value of 1,9 t C/ha calculated in a recent article ARwritten in the framework of the study by Gembloux University (Gembloux Agro Bio Tech)[N. Latte, in 55]. For the carbon in litter pool, the values were also updated using the same study as for deadwood. The litter C stock is assumed stable over the period, with 7,56 t C/ha.."
AR	For carbon stock changes in living biomass and soils, disaggregate the reporting of afforestation and reforestation in the CRF tables according to the three regions estimate and report the carbon stock changes from biomass losses for any orchard land (reported as cropland) converted to forest land.	Implemented	The recommendation regarding orchards has been included in April submission 2014. See section 7.3.2.1 for the methodology description and section 10.3.1.1. for the conversion of orchard land to forest land. KP-LULUCF tables "Carbon stock change" (5(KP-I) A.1.1 to 5(KP-I) A.1.3.) due to afforestation have been disaggregated according to the 3 regions in the 2014 submission
D	Report emissions from liming for deforestation	Implemented	This recommendation has been included in April submission 2014 (See NIR, chapter 10.3.1.4 and 7.2.5)
		DENMARK (ARR 2012, NIR 2014)	
AR	Provide further and verified information on the rationale for changing the method used to estimate the carbon pools	Implemented	The methods for the estimations have not been changed since the NFI was started in 2002. Prior to this it was not possible to give precise estimates. The NFI and the data have been reviewed in 2012/2013. The updated land use matrix influences the overall estimates
AR	Provide any available data on harvested areas and the associated the estimation of emissions and removals	Implemented	The method use to estimate forest carbon pools is based on stock change approach, and hence there is no need for direct estimation of harvested areas and related emissions/removals, as they are reflected directly in the measured carbon pools in the forests.
FM	Provide further and verified information on the rationale for changing the method used to estimate the carbon pools	Implemented	The methods for the estimations have not been changed since the NFI was started in 2002. Prior to this it was not possible to give precise estimates. The NFI and the data have been reviewed in 2012/2013. The updated land use matrix influences the overall estimates.
CM	Provide all relevant information on the selection of appropriate EFs	Implemented	Further information has been implemented in the NIR. More detailed data with examples have been included in Annex3.F_LULUCF

FINLAND (ARR 2013, NIR 2014)			
AR	Finland is planning to further develop the methods for area estimation as well the methods for estimating the emissions and removals of GHGs for each Article 3, paragraph 3, activity. The ERT noted from the 2013 NIR (section 11.3.1.5) that Finland intends by the 2014 annual submission to have enhanced the estimation of afforestation and reforestation areas, and to use the NFI data for 2009–2012 to improve the increment estimates for the growing stock on afforestation and reforestation areas. The ERT commends Finland on its efforts to significantly enhance its KP-LULUCF inventory and recommends that the Party report thereon in its annual submission.	Implemented	Descriptions of enhancement of estimation methods are given in the NIR in proper sections.
D	The emissions from liming, including limestone, dolomite and briquette lime, have been reported under deforestation. The method and EFs used are in line with the IPCC good practice guidance for LULUCF. However, the ERT could not reconcile easily why AD are not obtained/derived from the same sources. The description provided in the NIR (section 7.3.2.3) differs from the corresponding description provided in CRF table 5(KP-II)4, which indicates that the data are based on using an average amount of 19 t/ha of lime. The ERT recommends that Finland in its annual submission clearly explain the source of liming data and/or how they are derived and any differences in its treatment in reporting deforestation under the Convention and under the Kyoto Protocol.	Implemented	In section 7.3.2.3 the data source is sales statistics and thus the amount of lime applied on CL and GL is based on the total amount of lime products sold. In KP we report the liming of new fields. The amount of lime applied on recently cleared fields is higher than the annual lime application in the later years of cultivation. The amount 19 tonnes per ha is based on an expert judgment on the amount of liming needed in the first year after the clearance of a new field
FRANCE (ARR 2012, NIR 2014)			
Overview	To report information demonstrating that unaccounted pools (litter and mineral soils under forest management) were not a net source of GHG emissions	Implemented	Estimates are provided for most of the subcategories or otherwise explanations are provided.
Overview	To report information on uncertainties for the KPLULUCF activities	Not implemented	No specific information on uncertainties for each mandatory activity are reported.
AR	To enhance the transparency of the assumptions used to justify that all agricultural areas converted to forest land are human-induced forests	Implemented	Information is provided in the NIR
D	To ensure the consistency of the reported values for the area of forest land converted to cropland or explain the use of the different EFs	Implemented	Corrected
FM	To improve and correct the reporting of areas under forest management in CRF table NIR-2	Implemented	Corrected
GERMANY (ARR 2013, NIR 2014)			
Overview	Use correct notation keys in CRF table NIR-1	Implemented	Correction of the notation keys in the CRF tables.
GREECE (ARR 2013, NIR 2014)			
AR	Estimate and report the emissions and removals from grassland converted to forest land by mapping the grassland converted to forest land areas and include these in the emissions and removals from the	Implemented	Grassland areas converted to Forest land constitute a natural forest expansion and therefore there are no associated emissions by sources and removals by sinks, since that kind of conversion is not direct human induced, but rather
D	Provide transparent information on how deforestation is distinguished from harvesting and forest disturbance. Specify how local Forest Service track lands that have temporarily lost forest cover but are not classified as deforested	Implemented	It has been resolved. The necessary information is provided in chapter 10. KPLULUCF.
D	Report the N2O emissions from disturbance associated with land-use conversion to cropland under deforestation	Implemented	It has been resolved. The necessary information is provided in chapter 10. KPLULUCF.
FM	Apply the IPCC gain–loss method to verify the results of the carbon stock change method and report the results	Implemented	It has been resolved. The necessary information is provided in chapter 10. KPLULUCF.
IRELAND (ARR 2012, NIR 2014)			
Overview	Improve the accuracy of the time series of AD for afforestation and reforestation activities and report a consistent land representation of areas subject to afforestation and reforestation, and deforestation	Implemented	Corrected
D	Provide estimates of the carbon stock changes in soil organic matter for mineral soils in forest land converted either to settlements or to other land, or demonstrate that this pool is not a net source	Implemented	More information has been added.
ITALY (ARR 2013, NIR 2014)			
Overview	Complete and implement the IUTI in the 2014 submission so as to provide the necessary additional spatial data required to meet the reporting requirements of decision 16/CMP.1	Implemented	The ERT's recommendation has been addressed and an updated methodology to assess land uses and land use changes has been used, on the basis of the IUTI data, as detailed in the NIR
Overview	Report cropland plantations as forest in the appropriate activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol	Implemented	The ERT's recommendation has been addressed and plantations, previously not included in area subject to art. 3.3 and 3.4 activities, have been classified as forest and reported in the appropriate Art. 3.3 and 3.4, categories as described in the NIR
AR	Improve the explanation and justification for abandoned arable lands which are "naturally forested" to be reported as afforestation/reforestation consistent with decision 16/CMP.1	Implemented	Implemented A description of legislative Italian context and the consequent implications for the direct human induced afforestation and reforestation activities has been provided in the NIR
D	Monitor land-use change in the plantation areas to be reported as forest land, as deforestation may occur or may have occurred in the past	Implemented	The ERT's recommendation has been addressed and updated data related to deforestation activities have been used, as described in the NIR
D	Provide information in the next submission on how deforestation of plantations is identified and reported	Implemented	The ERT's recommendation has been addressed and updated data related to deforestation activities have been used, as described in the NIR
FM	Provide further documentation on the adequacy of the linear relation with above-ground biomass approach for estimating change in soil organic carbon	Implemented	In the NIR (§10.3.1.2) a detailed description of the methods and data used to estimate soils carbon stocks (and the consequent carbon stock changes) is reported. These SOCs have been used to assess the carbon stock changes in AR activities.

LUXEMBOURG (ARR 2013, NIR 2014)			
Overview	Include information on the method used to identify land subject to activities under Article 3, paragraph 3, of the Kyoto Protocol from 1990 to the current inventory year	Implemented	Detailed information has been reported in NIR 2014.
AR	Improve the transparency of reporting under the Kyoto Protocol and separately report the carbon stock changes for the living biomass pools (above-ground and below-ground) using the information already available within the national inventory system	Not implemented	Earliest in 2014, LU is able to make a study to determine the carbon stock in below ground biomass of the year 1999 (ground samples from IFL1, in IFL2 no ground samples were taken).
AR	Provide information from the second NFI, as appropriate, to demonstrate that the dead wood pool is not a net source	Implemented	Detailed information has been reported in NIR 2014.
AR	Transparently report the results of the uncertainty analysis in the NIR	Ongoing	An uncertainty assessment of emissions/removals for AR is foreseen in 2015, depending on the availability of financial resources.
D	Separately report the below-ground and above-ground living biomass pools	Not implemented	Earliest in 2014, LU is able to make a study to determine the carbon stock in below ground biomass of the year 1999 (ground samples from IFL1, in IFL2 no ground samples were taken).
NETHERLANDS (ARR 2013, NIR 2014)			
Overview	Justify the fact that the conversions between the TOF and FAD categories are direct and human-induced activities, and that they correspond to the definitions of afforestation, reforestation and deforestation outlined in the annex to decision 16/CMP.1	Implemented	Further explanation has been included in the NIR.
AR	Provide the verifiable information that demonstrates that the pools unaccounted for under the conversions between TOF and FAD are not the net sources of emissions, as required by the annex to the decision 15/CMP.1.	Implemented	Further explanation has been included in the NIR.
PORTUGAL (ARR 2012, NIR 2014)			
Overview	Implement the sixth National Forest Inventory in a timely manner, in order to ensure the accurate identification of forest areas under Article 3, paragraph 3, of the Kyoto Protocol	Implemented	The sixth National forest Inventory was implemented for 2013 submission. However, the data source on LULUCF has been changed from IFN6 to COS for the 2014 submission.
Overview	Conduct an uncertainty analysis of the estimates for the KP-LULUCF activities for the next annual submission	Ongoing	The information on LULUCF has been changed from IFN6 to COS. The uncertainty estimates will be revised accordingly.
Overview	Report the N2O emissions from N fertilization of afforestation and reforestation, and forest management activities, or include the emissions under the agriculture sector in the next submission	Implemented	N2O emissions from N fertilizers are included under agriculture sector because there is no available data to separate forest from agriculture N fertilization
ARD	The ERT noted that the removals from afforestation and reforestation activities and the emissions from deforestation activities under Article 3, paragraph 3, of the Kyoto Protocol may have been overestimated, owing to: (a) The assumption that the carbon stock in living biomass and soil organic matter in wetlands, settlements and other land is zero; (b) The inappropriate choice and application of default BEF values and the root–shoot ratio from the IPCC good practice guidance for LULUCF. Improve the accuracy of the reporting	Not implemented/ implemented	a) There is no data to support the attribution of a C stock to wetlands or settlements. Annual losses of area are very small and it is not considered cost-effective to develop estimates for those land uses b) BEF have been corrected. Consistency between Convention and KP-LULUCF have been improved (non-tillage activity and biodiversity sowing of pasture activity are now considered in both reporting)
ARD	The ERT also noted that the removals from afforestation and reforestation activities and the emissions from deforestation activities under Article 3, paragraph 3, of the Kyoto Protocol may have been underestimated, owing to the omission of dead wood in forest land. The ERT recommends that Portugal improve the accuracy of its reporting by addressing this issue, as well as those described in paragraph 173 above. Revise the choice of parameters and describe the reasons for choosing them in the next annual submission	Implemented	Dead wood is considered and reported as Included Elsewhere.
CM	a) Provide detailed information on the methods and procedures used to derive the value of the soil carbon accumulation rate, including peer-reviewed documents b) Provide information on the identification of non-tillaged land, the reporting and verification system, the QA/QC procedures, and the monitoring and reporting system, and document how these procedures are effectively implemented, in line with the methods and practices described in chapter 4 of the IPCC good practice guidance for LULUCF c) Apply IPCC tier 1 or tier 2 methods by developing land-use, management and input factors based on observations and other data sources, or use the IPCC default factors, and compare the results with those derived from the use of the mean accumulation rate. d) Transparently demonstrate that the non-tillage of cropland did not occur in 1990	Implemented/Ongoing	The LULUCF related chapters have been revised according to the new sources of data, and more detailed explanations provided aiming the improvement of transparency
GM	Transparently describe the practice related to the sowing of pasture in the NIR of the next annual submission	Implemented/Ongoing	The LULUCF related chapters have been revised according to the new sources of data, and more detailed explanations provided aiming the improvement of transparency
GM	a) Provide detailed information in the NIR on the methods and procedures used to identify the pasture sowed, the reporting and verification system, the QA/QC procedures, the post-sowing monitoring and reporting system, and document how these procedures are effectively implemented; b) if the SOM model is used, disaggregate the model according to the different climate and soil conditions, or include climate and soil parameters in the model, and compare the results of the model with results of the IPCC tier 1/tier 2 methods; c) demonstrate that the common practices related to the pasture-sowing project are consistent with the activities conducted under the experiment from which the SOM model was built; d) ensure that the SOM model is applied within five years after the start of the pasture-sowing activities; e) demonstrate that the sowing of pasture occurred after 1990 (i.e. that pasture-sowing activities did not occur in 1990); f) transparently describe the method used in the NIR, especially how the average soil carbon accumulation rate is derived based on the results of the SOM model	Implemented/Ongoing	The LULUCF related chapters have been revised according to the new sources of data, and more detailed explanations provided aiming the improvement of transparency
SPAIN (ARR 2012, NIR 2014)			
AR	Revise the identification of areas of land afforested and reforested, so that areas are not converted to land under forest management after 20 years	Implemented	Corrected
D	Include the cumulative area of land under deforestation since 1990 in CRF table 5(KP-I)A.2	Implemented	Corrected
D	Continues efforts to improve the estimates for deforestation	Implemented	With the new available cartography, this issue has been solved.

SWEDEN (ARR 2012, NIR 2014)			
Overview	The rationale for the recalculations per activity and their impact are not explained in the NIR. The ERT recommends that Sweden include this information in the next annual submission.	Implemented	Done, NIR 11.3.1.4
Overview	as “NE” in table NIR-1 but as “NA” in CRF table (KP-II)2…	Implemented	Corrected
Overview	The ERT reiterates the recommendations that Sweden make further efforts to reduce the uncertainties and report on the progress made in its next annual submission.	Implemented	To keep accuracy and to make the UNFCCC and KP reporting consistent, average extrapolation based on the five former years has been made for each cycle with no full measured record. Last year extrapolation for AR and D areas was based on trend but is now based on average. E.g. NIR 7.2.2.2 and 11.1.
Overview	The ERT noted that the KPLULUCF activities are not included in the chapter of the NIR on recalculations…	Implemented	Corrected, see NIR 11.3.1.1.3 and 11.3.1.4
AR	The ERT simply wants Sweden to better explain how e.g. land converted to Forest land under the UNFCCC correspond to AR under the KP	Implemented	Done, see NIR 11.3.1.1.3
UK (ARR 2012, NIR 2014)			
Overview	Report the required information on units of land subject to activities under Article 3, Paragraph 3 of the Kyoto Protocol which would otherwise be included in land subject to elected activities under Article 3, paragraph 4 of the KP in CRF table 5(KP-I)A.1.3	Not implemented	Table 5(KP-I)A.1.3 has not been updated with the individual country areas in the 2013 submission. This will be considered for the next submission.
Overview	Include information in Section 11.2.1 of the NIR describing the spatial assessment unit used and, in accordance with the annex to decision 16/CMP.1, on how it corresponds to the minimum land area and width requirements defined by the United Kingdom’s forest definition, and hence the detection of land-use change at the scale consistent with the United Kingdom’s forest definition (reiteration of recommendation in the previous review report)	Implemented	The data sources and methodology can detect a land use change at a resolution consistent with the forest definition in Section 11.1.1 (0.1 ha). ARD and FM are reported at the level of the four countries of the UK: England, Scotland, Wales and Northern Ireland, and the combined area of the Overseas Territories and Crown Dependencies (GPG LULUCF Reporting Method 1). There is sufficiently detailed data to allow UK carbon stock changes for Article 3.3 AR and Article 3.4 FM land to be reported for 20x20km units, but not for the reporting of other emissions or Article 3.3 Deforestation carbon stock changes.
AR	Meet the planned deadline in order to report carbon stock changes estimates using the FC CARBINE model in the 2014 submission.	Implemented	2014 submission
D	Differentiate between soil organic matter carbon stock changes for mineral and organic soils and estimate the emissions associated with the drainage of organic soils if this practice occurs. Use country specific values to estimate the carbon stocks contained in each pool prior to deforestation or provide justification for using a unique biomass factor	Not implemented	Completed as part of CARBINE modelling. Note that soil organic matter carbon stock changes have not yet been separated into organic and mineral soils. Drainage is estimated from both soil types (started for 2013 submission). Country specific values for carbon stocks prior to deforestation are used (started for 2013 submission).
FM	Meet the planned deadline in order to report the carbon stock change estimates using the FC CARBINE model in the 2014 submission	Implemented	2014 submission

The Plan of improvement for next year EU GHG inventory cycle and submission includes:

- To restructure the NIR according to new reporting guidelines
- To restructure the QA/QC procedures according to new reporting requirements
    - New checks to be implemented for the new mandatory activities under the 2nd CP.
    - Develop specific check and outlier tools according the new KP CRF tables.
    - Develop specific procedures to check the consistency among the new KP CRF tables and UNFCCC KP tables.

11.2.3.7 Uncertainty estimates

Table 11.16 provides Information on % uncertainty of net CO_2 emissions/removals for different C pools of mandatory and elected KP activities in EU15, as available from MS NIRs.

Table 11.16 Uncertainty assessment of the annual EU-15 KP LULUCF activities

Country	KP activity	Below-ground biomass	Above-ground biomass	Litter	Dead wood	Min. soils	Org. soils	Source
Austria	AR	116% for the whole activity						NIR 2014, chap. 10.3.1.4, par. 3, p. 492
	D	116% for the whole activity						NIR 2014, chap. 10.3.1.4, par. 3, p. 492
Belgium	AR	59% for the whole activity						NIR 2014, chap. 10.3.1.5, p.254
	D	49% for the whole activity						NIR 2014, chap. 10.3.1.5, p.255
Denmark	AR	17%	17%	15%	15%	52%	52%	NIR 2014, chap. 11.3.6, tab. 11.3, p.581
	D	17%	17%	15%	15%	52%	-	NIR 2014, chap. 11.3.6, tab. 11.4, p.582
	FM	15%	15%	15%	15%	52%	95%	NIR 2014, chap. 11.4.6, tab. 11.5, p.583
	CM	51%	51%	-	-	76%	91%	NIR 2014, chap. 11.5.6, tab. 11.7, p.584
	GM	51%	51%	-	-	51%	76%	NIR 2014, chap. 11.6.5, tab. 11.10, p.586
Finland	AR	249% for the whole activity						NIR 2014, chap. 11.3.1.4, tab. 11.3-1, p.432
	D	64% for the whole activity						NIR 2014, chap. 11.3.1.4, tab. 11.3-1, p.432
	FM	33% for the whole activity						NIR 2014, chap. 11.3.1.4, tab. 11.3-1, p.432
France	AR	58% average for whole LULUCF						NIR 2014, Annex 7, tab. 92, CITEPA/Mars 2014
	D	58% average for whole LULUCF						NIR 2014, Annex 7, tab. 92, CITEPA/Mars 2014
	FM	58% average for whole LULUCF						NIR 2014, Annex 7, tab. 92, CITEPA/Mars 2014
Germany	AR	29%	41%	7%	49%	44%	181%	NIR 2014, chap. 11.3.1.5, tab. 354, p. 707
	D	27%	41%	9%	57%	84%	36%	NIR 2014, chap. 11.3.1.5, tab. 354, p. 707
	FM	63%	50%	125%	107%	65%	181%	NIR 2014, chap. 11.3.1.5, tab. 354, p. 707
Greece	AR	113% for the whole activity						NIR 2014, chap. 1.7.2, tab. 1.10, p. 37
	D	51% for the whole activity						NIR 2014, chap. 1.7.2, tab. 1.10, p. 37
	FM	34% for the whole activity						NIR 2014, chap. 1.7.2, tab. 1.10, p. 37
Ireland	AR	17%	-	3%	22%	90%	-	NIR 2014, chap. 11.6, tab. 11.9, p.262
	D	59%	-	58%	58%	90%	-	NIR 2014, chap. 11.6, tab. 11.9, p.262
Italy	AR	33% for the whole activity						NIR 2014, chap. 7.2.5, tab. 7.12, p.204
	D	33% for the whole activity						NIR 2014, chap. 7.2.5, tab. 7.12, p.204
	FM	33% for the whole activity						NIR 2014, chap. 7.2.5, tab. 7.12, p.204
Luxembourg	AR	58% average for whole Forest land						NIR 2014, chap. 1.7.5, table 1–11 - tab. 6.1, p.87
	D	58% average for whole Forest land						NIR 2014, chap. 1.7.5, table 1–11 - tab. 6.1, p.87
Netherlands	AR*	63% for the whole activity						NIR 2014, Annex 7, tab. A7.3, p.249
	D*	56% for the whole activity						NIR 2014, Annex 7, tab. A7.3, p.249
Portugal	AR	41% average for whole Forest land category						NIR 2014, ANNEX B: Uncertainty Analysis Methodology, tab. B3 Tier 1 Uncertainty Estimates: 2012, p. B-12
	D	41% average for whole Forest land category						NIR 2014, ANNEX B: Uncertainty Analysis Methodology, tab. B3 Tier 1 Uncertainty Estimates: 2012, p. B-13
	FM	41% average for whole Forest land category						NIR 2014, ANNEX B: Uncertainty Analysis Methodology, tab. B3 Tier 1 Uncertainty Estimates: 2012, p. B-14
	CM	57% average for whole Cropland category						NIR 2014, ANNEX B: Uncertainty Analysis Methodology, tab. B3 Tier 1 Uncertainty Estimates: 2012, p. B-15
	GM	172% average for whole Grassland category						NIR 2014, ANNEX B: Uncertainty Analysis Methodology, tab. B3 Tier 1 Uncertainty Estimates: 2012, p. B-16
Spain	AR	70% for the whole activity						NIR 2014, chap. 11.3.1.5, tab. 11.3.11, p.11.22
	D	100% for the whole activity						NIR 2014, chap. 11.3.1.5, tab. 11.3.11, p.11.23
	FM*	52% for the whole activity						NIR 2014, chap. 7.1.5, tab. 7.1.7, p.7.22
	CM	31% for the whole activity						NIR 2014, chap. 11.3.1.5, tab. 11.3.11, p.11.25
Sweden	AR	42%	-	70%	70%	35%	-	NIR 2014, chap. 11.3.1.4, tab. 11.6, p. 466
	D	82%	-	70%	70%	35%	-	NIR 2014, chap. 11.3.1.4, tab. 11.6, p. 466
	FM	22%	-	50%	50%	35%	-	NIR 2014, chap. 11.3.1.4, tab. 11.6, p. 466
United Kingdom	AR	25% for the whole activity						NIR 2014, chap. 11.3.1.5, par. 2, p. 526
	D	50% for the whole activity						NIR 2014, chap. 11.3.1.5, par. 2, p. 526
	FM	25% for the whole activity						NIR 2014, chap. 11.3.1.5, par. 2, p. 526

Note: * in these cases the values of uncertaintes are taken from the corresponding categories under the Convention, i.e. AR = land converted to FL, D = FL converted to Other land, FM = FL remaining FL

When uncertainty estimates reported by EU-15 MS for the various mandatory and elected KP activities are aggregated using IPCC tier 1 (simple propagation of errors), the following uncertainties are estimated at EU-15 level: 20% for AR, 27% for D, 18% for FM, 154% for CM and 53% for GM. By comparing these EU-15 aggregated uncertainties with those for various MS shown in the table above, it should be noted that: (i) for forest activities, the average uncertainty in various MS is often significantly higher that the EU-15 aggregated value (i.e. most MS show uncertainties within the range of 30-60% for AR and D, and within 25-50% for FM); (ii) for CM, the average uncertainty in various MS is often lower that the EU-15 aggregated value (approximate range 30-70%) – this is due to the fact that total net EU-15 emissions for CM (summing sink and source from various MS) are close to zero, and therefore the % impact of the uncertainties is higher.

Additional information and discussion on uncertainty analysis is provided in Chapter 7 of this report.

11.2.3.8 Information on other methodological issues

The EU QA/QC process is performing a large number of checks, it is designed to ensure accuracy, transparency, completeness and consistency (e.g. among KP and UNFCCC inventory, within and amongst KP tables and UNFCCC tables). The checks also ensure that estimate is prepared by applying methodologies that are consistent with IPCC methods and adequate to the significance of the pool, subcategory and or category to be estimated.

11.2.3.9 The year of the onset of an activity, if after 2008

This information is implicitly achieved by each individual MS, and consequently by EU-15, through the provision of the estimates in the NIR-2 CRF table of KP, as discussed in Ch. 11.1.2 (Areas and changes in areas between KP-LULUCF activities). The onset of any activity on any land is reported according to the year when the land is reported as subject to the activity for the first time.

11.2.4 Article 3.3

11.2.4.1 Information that demonstrates that activities under Art. 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

Land representation methods, implemented at national level, are able to determine the onset for any time series starting from 1990 for concerned KP activities.

For example, planting year is mentioned as the AR starting year (e.g. DK, UK, GR, IE) when MS relies on statistics or the year when the encroaching woody vegetation meets the definition of forest, as detected by NFI or remote sensing, in case of natural assisted afforestation (in the latter case techniques for interpolation/extrapolation are applied since those datasets are usually not annual).

For D, information come from direct field assessment (when national statistics are based on license for clear-felling and change in use) or datasets on land cover/land use compiled by sampling or wall-to-wall techniques with ground data and/or remotely sensed data (in the latter case techniques for interpolation/extrapolation are applied since those datasets are usually not annual).

Some MS planned to have a complete dataset on land cover/land use, and tracked changes, by 2012 to achieve the highest accuracy of accounted quantities for the first commitment period.

According to the IPCC GPG LULUCF (Chapter 4.2.5.2) "*It is good practice to provide documentation that all afforestation and reforestation activities included in the identified units of land are direct human-induced. Relevant documentation includes forest management records or other documentation that demonstrates that a decision had been taken to replant or to allow forest regeneration by other means"*. Table 11.17 shows a synthesis of current information reported by EU-15 MS on the direct-human induced origin of AR lands.

Table 11.17 Summary of current information reported by EU-15 MS aimed at demonstrating that Afforestation/Reforestation activities are direct human-induced

MS	Type of information / justification provided					
	Areas converted have been verified and reported in registries for authorization	Areas converted, either subject to subsidies or not, have been reported in registries either for authorization or compilation of land use changes	Whole national territory covered by legal instruments for Land planning and/or management, therefore any change in land use is directly human-induced	Where a conversion results in a land use subject to management practice, the conversion is considered directly human-induced	As all land area is under management (i.e. subject to some kind of human interactions), all changes are considered as directly human-induced	A decision to change the use of a land or a decision not to continue the previous management practices has been made, which allow for conversion
Austria			x			
Belgium					x	
Denmark					x	
Finland						x
France				x		
Germany			x			
Greece	x					
Ireland	x					
Italy			x			
Luxembourg			x			
Netherland					x	
Portugal					x	
Spain		x				
Sweden				x		
UK		x				

In general a rather "broad" interpretation of "direct human induced AR" is applied so that 93% of the total area reported by EU-15 under conversion to forest land (5A2) is assumed as directly human induced AR; in particular, France reports a share of 93%, Sweden 40% and UK 96%, of 5A2 as directly human induced. For instance, UK does not report under AR the areas of planting that are not state-owned or grant-aided (i.e. whether these woodlands are explicitly managed is unknown). Where not included under AR, MS included the natural forest expansion under forest management, if elected; Hungary represents an exception putting the so-called "found forests", i.e. new forest originated in the period between two consecutive forest inventories, out of the KP lands, although those lands are subject to any legal and technical instrument regulating and implementing the management of forests in the country.

Some MS differentiate also among direct human induced and indirect/natural deforestation. In such case, areas naturally converted from forest to other land uses (e.g. wetlands or other land) are kept under the FM reporting.

11.2.4.2 Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

Although the loss of forest cover is often readily identified (by the land monitoring system), the classification of an area as deforested is more challenging. MS provided information on the criteria by which temporary removal or loss of tree cover can be distinguished from D and how these criteria are consistently applied (Table 11.18). The simple combination of NFI data with remote sensing data may not be fully adequate to assess the areas which can be classified as deforested, and thus these data are often complemented by other type of information (i.e. a D typically requires a specific permit or specific visible changes of the use of land). For instance, in the absence of detailed information of the future use of land, some MS defined the expected time periods (in years) within which the removal of tree cover has to be followed by natural regeneration or planting, once such time period is passed and trees are not yet growing again on the land, the land is considered deforested, unless the lost of forest cover is the consequence of a natural disturbance. Most MS reported that there are legal obligations to restore the forest on harvested areas or on areas burnt, so that such kind of forest cover lost are never identified and deforestation. More information is available in MS NIRs.

Table 11.18 Information on differentiation between temporary forest cover loss and deforestation (from MS NIRs)

MS	Short description
Austria	Differentiation of temporarily un-stocked areas (e.g. harvested area, disturbances) and deforestation is made by actual procedures implemented by NFIs (e.g. handbooks and guides for field assessment, training of field staff to rightly distinguish between them). For deforestation field assessment procedure involve identification of the significant visible changes in soil structure or ground vegetation which may not represent the natural succession of a forest (e.g. consequences of anthropogenic activities like plowing, crop production, mowing or construction activities or natural abortion of the forest and its stand by e.g. landslides). *Temporarily unstocked areas* by forest management or forests with biotic and abiotic reduction of their crown coverage (windfall, fire, beetles) maintain the natural succession of ground vegetation and soil and therefore remain part of the forest
Belgium	Deforestation permits released by the regional forestry authorities (usually only for settlements purpose)
Denmark	Deforested land is detected by analysis of satellite images, further on confirmed by additional sources (i.e. documentations). Mandatory period for reforestation of cut areas is 10 years
Finland	If a NFI sample plot is on a clear-cut area, the field assessor assesses if there are signs for permanent conversion or only cut. Maximum period allowed for regeneration is 3 years, with a usual delay in reforestation of 2 years
France	Land use/cover and ground assessment are able to identify the land use and activity change on annual basis
Germany	Law and observance of its implementation ensure that cut or natural disturbance area is reestablished as forest
Greece	Only legally executed deforestations are considered under deforestation while the land that has lost illegally the forest cover is not classified as deforested, but as areas that temporary loss of woody vegetation
Ireland	NFI identifies if the lands are un-stocked or deforested (5 years periodicity)
Italy	Implementation of different legal procedure for harvesting and deforestation
Luxembourg	Legal obligation that the owner has to ensure the regeneration of forest in 3 years after a clear cut
Netherland	Mapping method used to ensure differentiation between deforestation and non-deforested tree cover loss
Portugal	With current methodology if in 5 years the forest is not restored then the land is considered as deforested
Spain	NFI captures any areas which did not regenerated and the reasons for it (e.g. after forest fires). NFI is performed every 10 years
Sweden	Missing forest cover identified for two consecutive inventories is not enough to classify the plot as deforested, but additional observable changes (as presence of infrastructure)
UK	Felling licenses system, in the near future doubled by new NFI, ensures the relevant activity areas are fully captured

11.2.4.3 Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

Methodology adopted by each MS ensures consistent reporting in time and space of KP lands declared as temporary un-stocked areas. Such post-disturbance[67] areas corresponds to all areas reported as harvested under clear-felling and all those areas where natural disturbances caused a complete loss of forest cover, e.g. windfall, destructive fires that are kept under AR or FM reporting. In general, the distinction between deforested areas and temporarily un-stocked areas is achieved by national methodologies, which implement multiple assessment criteria and hierarchical phases (including precise guidelines for field checks or plot data processing). Supplementary arguments for correct classification of the land status are given by law requirements and enforcement. More information is available in MS NIRs.

11.2.4.4 Information on GHG emissions and CO_2 removals from lands harvested during the first commitment period following AR on these units of land since 1990

Most MS report that for AR, due to normative technical rules or economic constraints, harvest do not usually occur before plantations are 20 – 25 years old, with the exceptions of some fast growing species. The majority of the MS interpret this requirement as clear cut done on short rotation forests or woody biomass crops (e.g. Ireland reports a small sink under A.1.2 while Portugal estimates

[67] either natural or man-made

emissions of 335 $GgCO_2$ thus excluding from the accounting these lands according to the provision of para 4 of the Annex to Decision 16/CMP1). In any case not distinguishing this subcategory within AR lands result in a conservative accounting since debits associated with harvesting are not excluded from accounting.

11.2.5 Article 3.4

11.2.5.1 Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

Because FM, CM and GM are management activities they qualify as human-induced.

11.2.5.2 Information relating to Forest Management

Forest management is understood as the set of forest practices and operations, which occur at the stand-level: harvesting, natural and artificial/planting regeneration, site and soil preparation (including drainage, burning of slash), seeding, thinning, pruning, fertilization and liming, conservation of important habitats, and fire prevention.

Sustainable forestry has a long tradition in Europe, with earliest management planning dating hundreds years back. Currently, each MS has in force its own legislation on forest lands, as well as other laws supporting in general the sustainable management and protection of forests. At the EU level, forestry is not regulated directly by specific laws, but there are strong requirements for sustainable management of forests via European regulations on environmental obligations (on nature protection, biodiversity protection etc.), sustainable rural development and renewable energy policies. Some MS report forest certification as an additional tool to highlight the sustainability of the whole chain of forestry and wood products.

EU-15 MS apply rather broad definition of “Forest management”, with only few MS reporting some areas of forest not falling under the FM definition. In few cases there are strict assumptions, e.g. that only the forests with a landscape or/and forest management plan since 1990 are under FM (e.g. Greece considers under FM only about one third of forest land area reported under the 5A1).

Data reported under different international processes (e.g. FAO, MCFPE, CBD) may be different due to the different reference time and definitions applied underlying different reporting obligations. Thus, any comparisons have to be done cautiously.

11.2.5.3 Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year

Only three MS of EU-15 - namely Denmark, Portugal and Spain - elected Art. 3.4 activities.

Definitions implemented by the MS follow GPG for LULUCF 2003. Cropland and Grazing land management activities (CM, GM) consist in the implementation of specific practices and operations, which differ substantially from country to country. CM is dedicated to agricultural crops, perennial and annual, woody and non woody, including lands temporary under reserve or out of the productive activity. GM is the system of practices consisting in manipulating site features and the amount of vegetation on lands for livestock production (include e.g. drainage of organic soils, vegetation improvement).

The area under CM corresponds to the area reported under Cropland minus the cropland area originated from forest conversion since 1990, while GM areas may likely not correspond to GL since usually not the entire area of grassland of a country is managed for grazing. In Denmark and Portugal CM was a source for entire time series, while in Spain a sink. GM was a source in Denmark and it has turned from source to sink in Portugal.

Activity data for the reference year 1990 and 2008-2012 are compiled based on remote sensing or NFIs grid coupled with remote sensing as ancillary data, sometimes enhanced by sectorial statistics or surveys. Enhanced activity data will be available in future from the monitoring tools supporting the implementation of Common Agricultural Policy (e.g. LPIS – land parcel information system of each MS).

MS includes also some types of wooded vegetation areas as subject to CM or GM. E.g. Denmark includes under grazing land management "grassland having some wooden vegetation that does not meet the forest definition" and "wooded perennial fruit plantations and hedgerows" in the cropland management area.

11.2.6 Other information (EU-15)

11.2.6.1 Key category analysis for Art. 3.3 activities and any elected Art. 3.4 activity

MS apply mainly quantitative criteria for the assessment of key categories among KP-LULUCF activities (see Table 11.4), based on the correspondence between KP activities and land categories in the Convention GHG inventory. When elected, FM, CM and GM are always key categories, while ARD in most of the cases. Further information regarding KC analysis can be found in section 1.1.3.

11.2.6.2 Information relating to Article 6

There is no JI project developed by EU-15 member states.

11.3 Overview of GHG emissions and CO_2 removals reported by the additional 13 MS of the EU in the KP-LULUCF tables

Within the thirteen additional EU MS that together with EU-15 MS form the EU-28 (the group is hereafter called EU-13), eight have elected Forest Management and only one has elected Revegetation (Romania). Among them, only Hungary has chosen annual accounting. Cyprus and Malta are not included in this analysis since they do not have commitments in the 1st commitment period of the Kyoto Protocol.

Forest land definition adopted by EU-13 MS is in line with national legislation and within the range defined by FAO and UNFCCC. Criteria applied by EU-13 for forest land classification are shown in Table 11.19.

Table 11.19 Parameters selected to define “forest” under the Kyoto Protocol

Member State	NIR 2014			
	Crown cover (%)	Height (m)	Minimum area (ha)	Minimal Width (m)
Bulgaria	10	5	0.01	-
Croatia	10	2	0.10	
Czech Republic	30	2	0.05	20
Estonia	30	2	0.05	-
Hungary	30	5	0.05	10
Latvia	20	5	0.01	20
Lithuania	30	5	0.01	10
Poland	10	2	0.01	10
Romania	10	5	0.25	20
Slovakia	20	5	0.03	-
Slovenia	30	2	0.25	-

11.3.1 Coverage of carbon pools and other GHG reported (KP CRF table NIR-1)

All MS report carbon stock changes under living biomass pool while for other pools either report estimates or a notation key justified by the “not a source” provision (Table 11.20). The “not a source” provision is mostly used for FM and mainly for mineral soils (only Poland report C stock changes from this pool). Emissions from C pools and other sources associated with D have been completely reported.

Litter pool is sometimes included together with soils organic carbon because of data availability (e.g. Czech Republic).

Table 11.20 Synthesis of C pools and other GHG coverage for KP LULUCF activities in EU-13 MS, based on table NIR 1 (for the year 2012)

MS	Change in carbon pool reported						Greenhouse gas sources reported						
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil Min	Soil Org	Fertilization	Drainage of soils under forest management	Disturbance associated with land-use conversion to Croplands	Liming	Biomass burning		
							N2O	N2O	N2O	CO2	CO2	CH4	N2O
Afforestation/Reforestation													
Bulgaria	R	IE	R	NR	R	NO	NO			NO	NO	NO	NO
Croatia	R	IE	IE	NO	R	NO	NO			NO	IE	IE	IE
Cyprus													
Czech Republic	R	R	IE	R	R	NO	NO			NO	NO	NO	NO
Estonia	R	R	R	R	R	R	NO			NO	R	R	R
Hungary	R	R	NR	NR	NE	NO	IE			NO	IE	R	R
Latvia	R	R	NR	R	NO	R	NO			NO	NO	NO	NO
Lithuania	R	R	R	NO	R	R	NO			NO	IE	R	R
Malta													
Poland	R	R	R	R	R	R	NO			NO	R	R	R
Romania	R	R	R	NR	R	NO	IE			NO	R	R	R
Slovakia	R	R	R	NO	R	NO	NA			NO	R	R	R
Slovenia	NO	NO	NO	NO	NA	NA	NO			NO	NO	NO	NO
Deforestation													
Bulgaria	R	IE	R	R	R	NO			NO	NO	NO	NO	NO
Croatia	R	IE	IE	IE	R	NO			NE	NO	NO	NO	NO
Cyprus													
Czech Republic	R	R	IE	R	R	NO			R	NO	NO	NO	NO
Estonia	R	R	R	R	R	R			NO	NO	NO	NO	NO
Hungary	R	R	R	R	R	NO			R	NO	IE	R	R
Latvia	R	R	NR	R	R	R			NO	NO	NO	NO	NO
Lithuania	R	R	R	R	R	R			NO	NO	NO	NO	NO
Malta													
Poland	R	R	R	R	R	NO			NO	NO	NO	NO	NO
Romania	R	R	R	R	R	NO			NO	NO	NO	NO	NO
Slovakia	R	R	R	R	R	NO			R	NO	NO	NO	NO
Slovenia	R	IE	IE	R	R	NO			R	NO	NO	NO	NO
Forest management													
Bulgaria	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Croatia	R	IE	NO	NO	NO	NO	NO	NO		NO	R	R	R
Cyprus													
Czech Republic	R	R	IE	R	NE,NO	NO	NO	NO		R	R	R	R
Estonia	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Hungary	R	R	NR	NR	NE	R	IE	NO		NO	IE	R	R
Latvia	R	R	NR	R	NO	R	NO	R		NO	R	R	R
Lithuania	R	R	R	R	NO	R	NO	R		NO	IE	R	R
Malta													
Poland	R	R	R	R	R	R	NO	R		NO	R	R	R
Romania	R	R	NR	NR	NO	R	IE	R		NO	R	R	R
Slovakia	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Slovenia	R	R	NR	R	NO	NO	NO	NO		NO	R	R	R
Revegetation													
Romania	R	R	R	NO	R	NO				NO	NO	NO	NO

Notation keys: R – C stock change or emissions from source is reported; NR – the pool is not reported, NE – removal/emission is not estimated (could be either negligible or truly not estimated); IE – included elsewhere; NO –not occurring; NA – MS does not account the activity.

Total land area reported under KP-LULUCF activities by EU-13 is 29.840 kha, with the largest portion of area reported under FM (94%), followed by AR (5%), D (1%) and RV (<1%) (Table 11.21).

The largest area of AR is reported by Bulgaria and Poland, together 62% of EU-13 AR area. D areas are small in all countries, with few countries showing practically very general small land conversions.

Table 11.21 Synthesis of total area (kha) reported under KP-LULUCF activities by EU-13 MS at the end of the 2012, based on the CFR sectorial tables. Grey cells indicate that the activity has not been elected.

Member State	Art. 3.3 activities		Art. 3.4 activities			
	AR	D	FM	CM	GM	RV
Bulgaria	226	4				
Croatia	22	12	2.335			
Cyprus						
Czech Republic	48	14	2.561			
Estonia	29	21				
Hungary	143	10	1.655			
Latvia	219	38	3.128			
Lithuania	35	1	2.150			
Malta						
Poland	687	13	8.667			
Romania	28	110	6.345			103
Slovakia	36	8				
Slovenia	NO	7	1.185			
EU-13	**1.472**	**238**	**28.026**			**103**
EU-15	6.749	2.584	112.004	25.135	886	
EU-28	8.221	2.823	140.030	25.135	886	103

Notation: AR: forestation/Reforestation, D: deforestation, FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation

FM is a key category for each MS that elected it (Table 11.22). D is often not significant. There is general agreement between the significance of the category and methodological tier applied for the estimation.

Table 11.22 Synthesis of KP-LULUCF activities being key category as reported by EU-13 MS (from tables NIR-3) of 2014 submission. “KC” indicates a key category. Grey cells indicate that the activity has not been elected.

MS	AR	D	FM	CM	GM	RV	Comments
Bulgaria	KC						Corresponding land category is Key under GHG inventory
Croatia	KC	KC	KC				Corresponding land category is Key under GHG inventory
Cyprus							
Czech Republic			KC				Level assessment incl. LULUCF
Estonia	KC	KC					Quantitative Tier 2 method was used
Hungary	KC		KC				Corresponding land category is Key under GHG inventory
Latvia	KC	KC	KC				Corresponding land category is Key under GHG inventory
Lithuania			KC				Corresponding land category is Key under GHG inventory
Malta							
Poland	KC		KC				Corresponding land category is Key under GHG inventory
Romania	KC		KC				Key category level assessment including LULUCF
Slovakia	KC	KC					Level assessment
Slovenia		KC	KC				Key category level assessment including LULUCF

11.3.2 Summary of net emissions/removals (Gg CO_2 eq) and accounting quantities for KP LULUCF activities reported by EU-13 MS (KP CRF table "Accounting")

Table 11.23 shows accounted amount for each KP activity for each MS and the sum for EU-13. Total net accounted amount for 2008-2012 is -87.884 GgCO_2eq (Table 11.24). Slovenia reports no AR net emissions/removals. Estonia reports net debits from LULUCF activities since emissions from D are higher than removals from AR and no offset has been applied since Estonia did not elect FM.

Emissions from D represent in absolute amount 77% of removals accounted in AR. By far, the largest contributors to D emissions are Romania and Latvia, responsible of 61% of total GHG emissions from deforestation in EU-13. Because of the cap, the FM largest accounted quantity is reported by Romania.

Countries offsetting debits under Art 3.3 with net removals from FM are Romania, (largest offset), Slovenia, Latvia and Croatia.

The largest amounts of credits to be accounted from LULUCF activities are reported by Poland, followed by Romania

Compared to 2011, the amount estimated for 2012 is slightly larger, 1%, due to net removals reported under AR, decreased by 15%. as well as net emissions reported under D, increased by 86%.

Table 11.23 KP-LULUCF activities annual accounting quantities for 2008-2012 submission, as reported by EU-13 MS (notation keys reported in this table are: NE – removals/emissions are not estimated; IE – removals/emissions are included elsewhere; NO – removals/emissions are not occurring; NA – MS does not account for the activity)

Net emissions (+) and removals (-), Gg CO2eq

MS	A. Art 3.3 activities														
	A.1 AR										A.2. D				
	A.1.1 Lands not harvested					A.1.2 Lands harvested									
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
Bulgaria	-615	-696	-829	-972	-1.110	NO	NO	NO	NO	NO	222	65	117	72	99
Croatia	-178	-182	-179	-191	-217	NO	NO	NO	NO	NO	260	248	237	225	206
Cyprus															
Czech Republic	-262	-284	-310	-347	-370	NO	NO	NO	NO	NO	156	166	202	160	170
Estonia	-60	-81	-103	-120	-131	0	0	0	0	0	753	707	528	466	437
Hungary	-1.130	-1.103	-1.206	-1.120	-1.042	-25	-47	-84	-133	-187	51	90	49	70	178
Latvia	-226	-253	-277	-302	-327	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	1.318	1.272	1.229	1.216	1.190
Lithuania	-116	-136	-146	-167	-196	0	0	0	0	0	29	18	46	18	66
Malta															
Poland	-2.339	-2.420	-2.554	-2.642	-2.778	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	351	376	323	353	290
Romania	-314	-329	-337	-341	-587	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	4.004	809	759	805	2.666
Slovakia	-353	-366	-400	-413	-436	0	0	0	0	0	59	48	140	201	129
Slovenia	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	0	0	0	0	162	301	340	273	222
EU-13	-5.594	-5.851	-6.341	-6.614	-7.194	-25	-47	-84	-133	-187	7.365	4.099	3.970	3.861	5.652
Total EU	-50.207	-53.069	-54.975	-54.702	-55.813	569	522	349	187	-5	42.508	36.059	33.030	34.299	36.131

MS	B. Art. 3.4 activities																						
	B.1 FM					B.2 CM						B.3 GM						B.4 RV					
	2008	2009	2010	2011	2012	1990	2008	2009	2010	2011	2012	1990	2008	2009	2010	2011	2012	1990	2008	2009	2010	2011	2012
Bulgaria	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Croatia	-8.504	-8.733	-8.539	-7.623	-7.449	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA
Cyprus																							
Czech Republic	-4.081	-6.119	-4.799	-6.631	-6.911	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Estonia	0	0	0	0	0	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Hungary	-2.768	-1.876	-1.664	-1.507	-2.354	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Latvia	-17.106	-15.052	-10.909	-11.204	-12.448	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Lithuania	-9.033	-11.657	-10.611	-10.865	-9.212	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Malta																							
Poland	-36.192	-34.807	-34.114	-40.404	-36.450	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Romania	-22.452	-22.711	-22.221	-20.290	-19.808	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-1.586	-1.217	-1.191	-1.182	-1.192	-1.198
Slovakia	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
Slovenia	-6.294	-6.294	-6.295	-6.284	-6.250	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA
EU-13	-106.429	-107.249	-99.152	-104.807	-100.882	0	0	0	0	0	0	0	0	0	0	0	0	-1.586	-1.217	-1.191	-1.182	-1.192	-1.198
Total EU	-381.018	-380.152	-354.538	-361.230	-360.060	7.495	2.742	2.356	2.588	2.111	1.716	1.351	427	368	295	246	491	-1.586	-1.217	-1.191	-1.182	-1.192	-1.198

*****any information on EU KP-LULUCF activities presented here is shown for information purpose *only*

Table 11.24 Accounting quantities for 2008-2012 of KP-LULUCF activities as reported by EU-13 (Gg CO_2eq), based on MS CRF accounting tables

MS	Accounting quantity							
	Article 3.3		Article 3.4				3.3 Offset	MS accounting amount on LULUCF activities (RMUs)
	AR	D	FM	CM	GM	RV		
Bulgaria	-4.223	576						**-3.647**
Croatia	-948	1.175	-5.086				227	**-4.858**
Cyprus								
Czech Republic	-1.572	854	-5.867					**-6.584**
Estonia	-495	2.891						**2.396**
Hungary	-6.079	438	-5.317					**-10.957**
Latvia	-1.385	6.224	-11.073				4.839	**-6.233**
Lithuania	-760	178	-5.133					**-5.716**
Malta								
Poland	-12.733	1.692	-15.033					**-26.074**
Romania	-1.907	9.044	-27.303			1.948	7.137	**-18.218**
Slovakia	-1.969	578						**-1.391**
Slovenia	0	1.298	-7.898				1.298	**-6.600**
EU-13	**-32.070**	**24.947**	**-82.709**			**1.948**	**13.501**	**-87.884**

*****any information on EU KP-LULUCF activities presented here is shown for information purpose *only*

11.4 EU-13 overview of C stock changes reported for each MS for KP-LULUCF activities

Methodologies adopted by the EU-13 MS are consistent with those used for reporting GHG inventory under the Convention. For AR (Table 1.23), D (Table 1.24) and FM (Table 1.25) IEFs for C stock change are within the ranges reported by EU-15 MS.

Table 11.25 IEF for net C stock changes (MgC ha-1yr-1) by pool reported under AR activity in EU-13 (for the year 2012), based on MS NIRs.

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	2,09	IE,NO	0,24	NO	-1,00	NO
Croatia	2,10	IE,NO	IE,NO	NO	0,59	NO
Cyprus	0,00	0,00	0,00	0,00	0,00	0,00
Czech Republic	1,65	0,33	IE	NO	0,13	NO
Estonia	1,14	0,45	0,30	0,00	-0,71	-0,57
Hungary	1,59	0,40	NE	NE	NE	NO
Latvia	0,26	0,06	0,10	0,01	NO	-0,68
Lithuania	1,13	0,26	1,10	NO	-0,71	-2,24
Malta	0,00	0,00	0,00	0,00	0,00	0,00
Poland	0,85	0,20	NO	NO	0,09	-0,68
Romania	4,01	1,00	0,06	IE,NO	0,89	NO
Slovakia	1,24	0,28	0,41	NO	1,36	NO
Slovenia	NA	NA	NA	NA	NA	NA

Notation keys for all tables below: IE – data is reported elsewhere i.e. included in other pools. NO – no net carbon stock change. NA- not applicable, NE-not estimated (the MS using NE, NA, NO justify these pools as "not a source" or *negligible; although the correct notation key would be NE with information explaining that the pool is not a net source of CO_2 reported in the documentation box).*

NE (often NO) is used for reporting, when the pool is "not a source" (when it is demonstrated by quantitative and qualitative information, as reported in the NIRs), or the pool does not occur on the territories (i.e. organic soils). NA is mainly reported when activity does not take place in the country (i.e. Slovenia for AR).

IEFs values from living biomass in D range widely depending from difference in standing biomass among different forests and from the accumulation of areas reported, since 1990, under the activity.

Table 11.26 IEF for net C stock changes (MgC ha-1yr-1) by pool reported under Deforestation activity in EU-13 (for the year 2012), based on MS NIRs

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	-3,33	IE,NO	-0,33	-0,17	-3,34	NO
Croatia	-0,85	IE	IE	IE	-3,64	NO
Cyprus	0,00	0,00	0,00	0,00	0,00	0,00
Czech Republic	-2,61	-0,52	IE,NA	-0,07	-0,05	NO
Estonia	-2,91	-0,69	-1,07	-0,10	-0,76	-1,63
Hungary	-2,83	-0,71	-0,68	-0,19	-0,36	NO
Latvia	-1,57	-0,38	-0,39	-0,02	-6,21	-3,39
Lithuania	-5,10	-1,17	-1,97	-0,27	-5,91	-5,91
Malta	0,00	0,00	0,00	0,00	0,00	0,00
Poland	-2,75	-0,63	-1,07	-0,08	-1,74	NO
Romania	-3,70	-0,03	-0,83	-0,08	-1,99	NO
Slovakia	-3,51	-0,79	-0,01	-0,07	-0,03	NO
Slovenia	-5,68	IE	IE	-0,90	-2,01	NO

Under FM, the LT, DW and mineral soils pools are mainly reported as "not a source". For CO_2 emissions from organic soils, NA or NO means that there are not organic soils.

Table 11.27 IEF for net C stock changes (MgC ha-1yr-1) by pool reported under Forest management activity in EU-13, (for the year 2012), based on MS NIRs

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	NA	NA	NA	NA	NA	NA
Croatia	0,90	IE,NO	NO	NO	NO	NO
Cyprus	0,00	0,00	0,00	0,00	0,00	0,00
Czech Republic	0,68	0,14	IE,NO	NO	NE,NO	NO
Estonia	NA	NA	NA	NA	NA	NA
Hungary	0,30	0,10	NE	NE	NE	-0,68
Latvia	0,95	0,23	NO	0,02	NO	-0,68
Luxembourg	NA	NA	NA	NA	NA	NA
Malta	0,00	0,00	0,00	0,00	0,00	0,00
Poland	0,85	0,26	0,00	-0,04	0,11	-0,68
Romania	0,64	0,23	NO	NO	NO	-0,68
Slovakia	NA	NA	NA	NA	NA	NA
Slovenia	1,17	0,28	NO	0,00	NO	NO

11.4.1 Justification when omitting any carbon pool or any GHG emissions/removals for reporting *Afforestation/Reforestation and Forest management*

For the countries "that apply not a source" on SOC, DW and LT pools in the 2013 submissions, the demonstration is based on: q*ualitative" information from scientific literature or other sources, including various statistics*; c*ombination of qualitative and quantitative information* (including some data on C stock changes, although non-representative for the entire country) and d*emonstration of 'not a source' by a simulation exercise* with a model (peer reviewed in scientific papers), assuming country specific data and circumstances.

12 INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1 Background information

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2013 for the Community registry is submitted together with this report (Annex 1.13). The data in the Community registry reflect only the transactions to and from the Community registry, but not the sum of all Member States' transactions. Member States' separately submit information on Kyoto units in SEF tables to the UNFCCC.

12.2 Summary of information reported in the SEF tables for the Community registry

The standard electronic format tables for the Community are included in the submission. The SEF reporting software has been used for this purpose. The tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Community registry at 31.12.2013 as well as information on transfers of the units in 2013 to and from other Parties of the Kyoto Protocol.

The assigned amount for the EU, calculated pursuant to Article 3 paragraphs 7 and 8 as described in the EU's initial report, exceeds the sum of Member States' assigned amounts by 19,357,531 tonnes CO_2-equivalent. This arithmetical difference is due to the fact that the joint agreement under Article 4 of the Kyoto Protocol was formulated in percentage contributions based on base-year data available in 1998. As the Member States have revised their base-year emissions, the adopted percentage contributions under the burden sharing agreement no longer exactly match EU's 92 % commitment. As each assigned amount unit (AAU) can only be issued into a national registry once, the assigned amount of each Member State should be issued into its respective national registry after being recorded in the compilation and accounting database. The remaining assigned amount for the EU, amounting to 19,357,531 tonnes CO_2-equivalent (which is the arithmetical difference between the Community's assigned amount and the sum of the Member States' assigned amounts), was issued in the registry of the EU in 2011.

The total quantities of AAUs acquired and transferred during the reporting period are provided in SEF table 2b and 2c.

12.3 Summary of information reported in the SEF tables of Member States

SEF tables for the Community registry, EU-15 are provided in Annex 1.13. The SEF tables for EU-15 include aggregated information for EU-15 Member States. Note that the EU-15 SEF tables also include transactions between the Community registry and the new EU Member States and non-EU Member States. Table 12.1 provides an overview of transactions included in Table 2(b) in the Community registry and EU-15 SEF tables.

Table 12.1 Transactions included in Table 2(b) in the Community registry and EU-15 SEF tables

Table 2(b)		Community registry SEF tables	EU-15 SEF tables	EU-25 SEF tables
From	To			
Community registry	EU-15 MS	Yes		
Community registry	new MS	Yes	Yes	
Community registry	Non-EU MS	Yes	Yes	Yes
EU-15 MS	Community registry	Yes		
EU-15 MS	new MS		Yes	
EU-15 MS	Non-EU MS		Yes	Yes
new MS	Community registry	Yes	Yes	
new MS	EU-15 MS			Yes
new MS	Non-EU MS			Yes

12.4 Discrepancies and notifications

With respect to the respective paragraphs of decision 15/CMP.1 the following information is provided for the Community registry:

- **Paragraph 12:** No discrepancies identified by the transaction log.
- **Paragraph 13**: No notifications directed to the Party to replace ICERs in accordance with Paragraph 49 of the annex to decision 5/CMP.1.
- **Paragraph 14:** No notifications directed to the Party to replace ICERs in accordance with para 50 of the annex to decision 5/CMP.1.
- **Paragraph 15:** No issue of non-replacement.
- **Paragraph 16**: No KP Units that are not valid.
- **Paragraph 17:** No actions were necessary to correct any problem causing a discrepancy.

12.5 Publicly accessible information

The information based on the requirements in the annex to decision 13/CMP is publicly available on the European Commission website: **http://ec.europa.eu/environment/climat/gge_registry.htm**

In accordance with Decision 13 of the first Meeting of the Parties to the Kyoto Protocol (COP/MOP 1), the following information is made publicly available from the Community Registry[68].

[68] The list of information that is made publicly available has not changed compared to previous submissions

List of accounts

TYPE	COMM PRD	ACCOUNT HOLDER	REPRESENTATIVE ID	REPRESENTATIVE	TEL	FAX	EMAIL
Holding account	0	European Commission	EU100000000002312	Ronald Velghe	+32-229-84052	-	ronald.velghe@ec.europa.eu

Article 6 project information

No ERUs have been issued in the Community Registry in 2008

No ERUs have been issued in the Community Registry in 2009

No ERUs have been issued in the Community Registry in 2010

No ERUs have been issued in the Community Registry in 2011

No ERUs have been issued in the Community Registry in 2012

No ERUs have been issued in the Community Registry in 2013

The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year

This information is confidential.

The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8

No AAUs have been issued in the Community Registry in 2008

No AAUs have been issued in the Community Registry in 2009

No AAUs have been issued in the Community Registry in 2010

19,357,532 AAUs have been issued in the Community Registry in 2011

No AAUs have been issued in the Community Registry in 2012

No AAUs have been issued in the Community Registry in 2013

The total quantity of ERUs issued on the basis of Article 6 projects

No ERUs have been issued in the Community Registry in 2008

No ERUs have been issued in the Community Registry in 2009

No ERUs have been issued in the Community Registry in 2010

No ERUs have been issued in the Community Registry in 2011

No ERUs have been issued in the Community Registry in 2012

No ERUs have been issued in the Community Registry in 2013

The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring accounts and registries

YEAR	Registry	AAU	ERU	RMU	CER
2008	AT	159,153	0	0	0
2008	CZ	1,884,071	0	0	0
2008	ES	10,229,902	0	0	0
2008	FI	792,678	0	0	0
2008	LU	72,000	0	0	0
2008	PT	2,235,418	0	0	0
2008	SK	2,684,303	0	0	0
2010	GB	633,525	0	0	303,069
2011	GB	377,706			653,402
2012	AT	0	19177	0	923258
2012	BE	0	205373	0	962439
2012	BG	0	827103	0	175000
2012	CDM	0	0	0	704658
2012	CH	651085	230236015	0	80719055
2012	CZ	0	809880	0	104266
2012	DE	0	21137172	0	45288186

2012	DK	0	998198	0	741811
2012	ES	0	2856255	0	10025533
2012	FI	0	0	0	478440
2012	FR	220	19057046		24521632
2012	GB	84925	71693964	0	97314896
2012	GR	0	0	0	47229
2012	HU	0	411316	0	395001
2012	IE	0	0	0	1343136
2012	IT	0	426396	0	18216467
2012	JP	35803	0	0	3742415
2012	LT	0	71065	0	0
2012	NL	0	4932818	0	23695975
2012	NO	38896	49999	0	939356
2012	PL	0	518379	0	24107
2012	PT	0	1400727	0	772000
2012	RO	0	0	0	788650
2012	RU	993770	1215412	0	0
2012	SE	0	232084	0	607249
2012	SI	0	449545	0	076531
2012	SK	0	12871	0	0
2013	CH	1065430	165315550	0	73089175
2013	PL	47558904	8990555	0	611003
2013	LT	7839577	755858	0	155149
2013	SI	198715	368272	0	14538
2013	RO	28326526	3845269	0	2597671
2013	NO	5058809	153225	0	1262174
2013	EE	8633959	7269552	0	12996
2013	BE	37450347	2032305	0	71286
2013	DK	16020508	282197	0	2500523
2013	JP	0	113533	0	19138150
2013	LV	9362047	42900	0	298434
2013	GR	7216337	201064	0	782784
2013	AT	24670834	0	0	488081
2013	SE	14637314	3081878	0	8397544
2013	NL	154706988	31928720	0	29479042
2013	DE	322046263	7237993	0	28202094
2013	LU	1011957	0	0	82355
2013	HU	11922250	435454	0	223148
2013	FI	28960810	3260515	0	1916485
2013	IE	3854805	554972	0	561807
2013	ES	85175131	3151621	0	31555460
2013	CZ	64464212	275062	0	1011984
2013	PT	19831911	1127653	0	746684

2013	GB	454177263	64909812	0	61360613
2013	SK	17569739	11743	0	138720
2013	AU	0	0	0	347544
2013	CDM	0	0	0	2743775
2013	FR	264062073	16626405	0	20600504
2013	IT	98251977	6879693	0	21156288
2013	NZ	0	5	0	0
2013	BG	16291272	4476827	0	811689
2013	RU	0	5516674	0	0
2013	LI	223501	0	0	0
2013	UA	0	108915	0	0

No unit has been acquired from another registry in 2009.

The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4

No RMUs have been issued in the Community Registry in 2008

No RMUs have been issued in the Community Registry in 2009

No RMUs have been issued in the Community Registry in 2010

No RMUs have been issued in the Community Registry in 2011

No RMUs have been issued in the Community Registry in 2012

No RMUs have been issued in the Community Registry in 2013

The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring accounts and registries

YEAR	Registry	AAU	ERU	RMU	CER
2008	BE	162,019	0	0	0
2008	DK	2,593,754	0	0	0
2008	FR	5,664,238	0	0	0
2008	HU	131,000	0	0	0
2008	IT	579,204	0	0	0
2008	NL	3,062,720	0	0	0
2008	PL	90,000	0	0	0
2008	SE	18,429	0	0	0
2008	GB	5,627,661	0	0	0
2008	IE	128,500	0	0	0
2010	GB	508,009	0	0	0
2011	GB	65,000	0	0	0
2011	DK	5,000,000	0	0	0
2012	AT	0	0	0	148768
2012	BE	0	34257	0	293710
2012	BG	0	8427	0	0

2012	CH	615093	54194442	0	47274080
2012	CZ	0	52585	0	91335
2012	DE	0	25461755	0	6198252
2012	DK	0	287511	0	741811
2012	EE	0	24837	0	0
2012	ES	0	1457136	0	3669141
2012	FI	0		0	
2012	FR	0	11948162		8289170
2012	GB	412722	33504305	0	42047871
2012	GR	0	0	0	50000
2012	HU	0	6496	0	0
2012	IT	0	970262	0	3134513
2012	JP	0	56619	0	1952486
2012	LV	0	42900	0	0
2012	NL	59881	2018355	0	6164713
2012	NO	568536	190010	0	652559
2012	NZ	0	2989000	0	882000
2012	PL	0	518379	0	24107
2012	PT	0	1400727	0	772000
2012	RO	0	0	0	788650
2012	SE	0	232084	0	607249
2012	SI	0	119731	0	0
2012	SK	0	5400	0	0
2013	CH	0	53262295	0	38955418
2013	PL	0	22725822	0	16861746
2013	LT	0	1667611	0	785732
2013	SI	0	3630330	0	69386
2013	RO	0	10070260	0	5247284
2013	NO	535	2128612	0	9157633
2013	EE	0	2131376	0	424474
2013	BE	0	4733129	0	7079615
2013	DK	0	5366847	0	3156052
2013	JP	0	10943683	0	2765553
2013	LV	0	1823924	0	359981
2013	GR	0	8582694	0	5113256
2013	AT	0	4946228	0	4757048
2013	SE	58312	3335264	0	6759282
2013	NL	0	12618101	0	21533881
2013	DE	142	74292898	0	61660174
2013	LU	0	8066	0	249495
2013	HU	0	1502153	0	1443800
2013	FI	0	3665849	0	5234855
2013	IE	0	1635668	0	942579

2013	ES	220	13429683	0	27692842
2013	CZ	2	14896480	0	7392213
2013	PT	0	4300770	0	2814442
2013	GB	1064895	30320311	0	49630354
2013	SK	0	179533	0	1016211
2013	AU	0	0	0	397544
2013	FR	0	14624697	0	20021395
2013	IT	0	25265799	0	25785173
2013	NZ	0	24188232	0	3256536
2013	BG	1	8321108	0	1908386
2013	RU	993770	0	0	0
2013	IS	0	5087	0	0

No unit has been transferred to another registry in 2009.

The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4

YEAR	AAU	ERU	RMU	CER
2008	0	0		
2009	0	0		
2010	0	0		
2011	0	0	0	0
2012	0	0	0	0
2103	0	0	0	0

The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2103	0	0	0	0

The total quantity of other ERUs, CERs, AAUs and RMUs cancelled

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2103	0	0	0	0

The total quantity of ERUs, CERs, AAUs and RMUs retired

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2103	0	0	0	0

12.6 Calculation of commitment period reserve (CPR)

The EU commitment period reserve is 17,659,243,358 tonnes CO_2eq. as indicated as revised estimate in the report of the review of the initial report of the European Community (FCCC/IRR/2007/EC). The commitment period reserve for the EU is calculated as 90 per cent of its assigned amount pursuant to article 3, paragraphs 7 and 8 of the Kyoto Protocol and therefore remains unchanged during the first commitment period.

12.7 KP-LULUCF accounting

Each EU Member State will account for net emissions and removals for each activity under Article 3, paragraphs 3 and 4, if elected, by issuing RMUs or cancelling Kyoto Protocol units based on the corresponding reported emissions and removals from these activities and the specific accounting rules. The EU will neither issue nor cancel units based on the reported emissions and removals from activities under Article 3, paragraph 3 and paragraph 4. The EU will report the sum of Member States' cumulative accounting quantities for these activities at the end of the commitment period, representing the Member States' cumulative additions to or subtractions from their assigned amount at the end of the commitment period.

13 CHANGES TO THE NATIONAL SYSTEM

There have been no major changes to the structure and functioning of the EU national system. However, in the meanwhile there have been some important developments, which are reflected below. Still, they do not majorly change the structure and functioning of the national system, which remains essentially the same (see Figure 13.1).

Accession of Croatia

The European Union has enlarged and Croatia officially joined from 1 July 2013. The accession of Croatia has not brought about a change to the structure and functioning of the EU national inventory system. Instead, Croatia was smoothly integrated into the EU annual inventory preparation cycle, being fully compliant with the internal deadlines and procedures. As a result, the main change is that the EU inventory submission under the UNFCCC now covers the EU-28 aggregate instead of the EU-28 aggregate used until the last inventory submission in 2013.

Adoption of the Monitoring Mechanism Regulation, replacing the Monitoring Mechanism Decision

The legal basis for the national inventories on EU level, which also establishes the Union inventory system, has been updated. The previous Decision 280/2004/EC[69] on a mechanism for monitoring greenhouse gases has been repealed and replaced by Regulation (EU) 525/2013[70], also known as the Monitoring Mechanism Regulation (MMR). Article 6 of the MMR establishes the Union national system, whose main objective is to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of national inventories with regard to the Union greenhouse gas inventory. The European Commission continues to be the single entity with overall responsibility, with the task to administer, maintain and continuously improve the Union inventory system.

The substantive requirements for the Union inventory system have been further set out in secondary legislation under the so called Commission Delegated Regulation.[71] Article 6(2) of Regulation (EU) No 525/2013 empowers the Commission to set in a delegated act the substantive requirements for a Union inventory system in order to fulfil the obligations pursuant to Decision 19/CMP.1 of the Conference of the Parties to the UNFCCC serving as the meeting of the Parties to the Kyoto Protocol on national systems for inventories. This secondary act establishes provisions for the Union quality assurance and quality control programme, the gap-filling procedures in cases of missing data from Member States and the timescales for cooperation and coordination during the annual reporting process and the UNFCCC reviews.

New framework partnership agreement between the EEA and its ETC/ACM

The European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM) is a major partner under the Union inventory system, supporting the technical work of the European Environment Agency. The ETC/ACM is a consortium of 14 European organisations with the Netherlands Institute for Public Health and the Environment (RIVM) as its lead organisation. The Framework partnership agreement was signed by the EEA and RIVM in August 2013.

[69] Decision 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol, O.J. L 49 of 19.2.2004

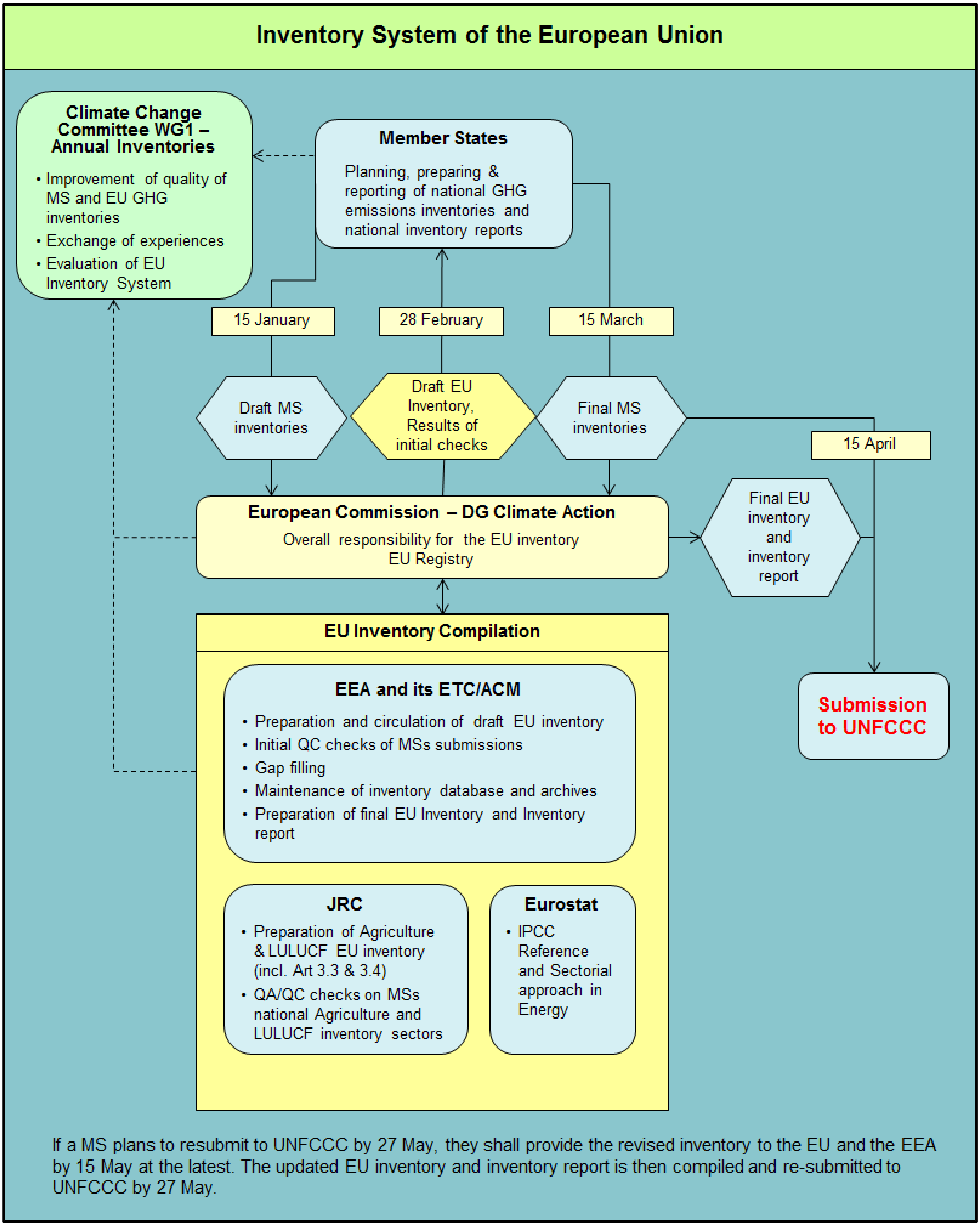
[70] Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change, O.J. L 165 of 18.06.2013, p.13

[71] Commission Delegated Regulation establishing substantive requirements for a Union inventory system and taking into account changes in the global warming potentials and internationally agreed inventory guidelines pursuant to Regulation (EU) No 525/2013 of the European Parliament and of the Council, not published in the Official Journal yet, pending the scrutiny period by the European Parliament and the Council but available here: http://ec.europa.eu/clima/policies/g-gas/monitoring/docs/c_2014_1539_en.pdf

The new consortium includes the following partners: Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu, RIVM), Norwegian Institute for Air Research (NILU), Umweltbundesamt Vienna (UBA-V), Czech Hydrometeorological Institute (CHMI), Öko-Institute Germany, Öko-Recherche Germany, Netherlands Environmental Assessment Agency (PBL), Aether UK, Emisia Greece, Institut National de l'Environnement Industriel et des Risques (INERIS) France, Institute of Environmental Assessment and Water Research (CSIC/IDAEA) Spain, 4sfera Innova Spain, Universitat Autónoma de Barcelona (UAB) and the Flemish institute for technological research (VITO). The new ETC/ACM retains the main partners involved in the inventory preparation work, namely Umweltbundesamt Vienna (Austria), Oeko Institute (Germany) and Emisia (Greece). In addition, the EU inventory team was enlarged to include Oeko Recherche (Germany) and VITO (Belgium) to further support the QA/QC of the EU inventory. Throughout the process, the European Commission and the EEA worked in cooperation to ensure the smooth and seamless transition with sustained business continuity regarding the inventory.

In sum, while there have been important developments, the core structure and functioning of the EU national inventory system remain the same. Figure 13.1 provides schematic information about the main elements of the national inventory system of the European Union.

Figure 13.1 Inventory system of the European Union



14 INFORMATION ON CHANGES IN NATIONAL REGISTRY

The following changes to the national registry of EU have therefore occurred in 2013.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	None
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	An updated diagram of the database structure is attached as Annex A. Iteration 5 of the national registry released in January 2013 and Iteration 6 of the national registry released in June 2013 introduces changes in the structure of the database. Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. However, each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (see Annex B). Annex H testing was carried out in February 2014 and the successful test report has been attached. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	No change of security measures occurred during the reporting period
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change to the list of publicly available information occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission; the report is attached as Annex B. Annex H testing was carried out in February 2014 and the successful test report has been attached.

15 INFORMATION ON MINIMIZING ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

15.1 Information on how the EU is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement the commitments mentioned in Article 3, paragraph 1, of the Kyoto Protocol in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention

Editorial comment: The EU is only required to report changes related to the information on minimizing adverse impacts in accordance with Article 3, paragraph 14. However for an improved understanding, text from the last year's inventory report was included and additional and new information is marked in bold.

In this section the EU provides information on how it is implementing its commitment under Article 3, paragraph 14 of the Kyoto Protocol, i.e. how it is striving to implement its commitment under Article 3, paragraph 1 of the Kyoto Protocol in such a way as to minimize potential adverse social, environmental and economic impacts on developing countries. In order to strive for such a minimization, an assessment of potential positive and negative impacts – both of direct and indirect nature - is necessary with a double objective to maximize positive impacts and to minimize adverse impacts. The EU is well aware of the need to assess impacts, and has built up thorough procedures in line with our obligations. This includes bilateral dialogues and different platforms in which we interact with third countries, explain new policy initiatives and receive comments from third countries.

Impacts on third countries are mostly indirect and can frequently neither be directly attributed to a specific EU policy, nor directly measured by the EU in developing countries. Therefore, the reported information covers potential adverse social, environmental and economic impacts that result from complex assessments of indirect influences and that are based on accessible data sources in developing countries.

Impact assessment of EU policies

In the EU a wide-ranging impact assessment system accompanying all new policy initiatives has been established. This regulatory impact assessment is a key element in the development of the Commission's legislative proposals. The Commission is required to take the impact assessment reports into account when taking its decisions, while the impact assessments are also presented and discussed during the scrutiny of legislative proposals from the Council and the Parliament. This approach ensures that potential adverse social, environmental and economic impacts on various stakeholders (in the case on developing country Parties) are identified and minimized within the legislative process. In general, impact assessments are required for all legislative proposals, but also other important Commission initiatives which are likely to have far-reaching impacts. Below the impact assessment process implemented in the EU policy making is explained in more detail in order to better demonstrate how the EU is striving for all strategies and policies to minimize their adverse impacts. Specific guidelines for the impact assessment have been adopted (European Commission 2009).

The Impact Assessment Guidelines specifically address impacts on third countries and also issues related to international relations. In this area the following questions have to be assessed:

- Trade relations with third countries: some policies may affect trade or investment flows between the EU and third countries; the impact assessment should analyse how different groups (foreign and domestic businesses and consumers) are affected, and help to identify options which do not create unnecessary trade barriers.

- Impact on WTO obligations: it should be analysed which impact each proposed policy option has on the international obligations of the EU under the WTO Agreement; the impact assessment should examine whether the policy options concern an area in which international standards exist.
- Impacts on developing countries: initiatives that may affect developing countries should be analysed for their coherence with the objectives of the EU development policy. This includes an analysis of consequences (or spill-overs) in the longer run in areas such as economic, environmental, social or security policies.

Key economic questions to be assessed in relation to third countries are:

- How does the policy initiative affect trade or investment flows between the EU and third countries? How does it affect EU trade policy and its international obligations, including in the WTO?
- Does the option affect specific groups (foreign and domestic businesses and consumers) and if so in what way?
- Does the policy initiative concern an area in which international standards, common regulatory approaches or international regulatory dialogues exist?
- Does it affect EU foreign policy and EU development policy?
- What are the impacts on third countries with which the EU has preferential trade arrangements?
- Does it affect developing countries at different stages of development (least developed and other low-income and middle income countries) in a different manner?
- Does the option impose adjustment costs on developing countries?
- Does the option affect goods or services that are produced or consumed by developing countries?

Key questions on social impacts in third countries are:

- Does the option have a social impact on third countries that would be relevant for overarching EU policies, such as development policy?
- Does it affect international obligations and commitments of the EU arising from e.g. the ACP-EU Partnership Agreement or the Millennium Development Goals?
- Does it increase poverty in developing countries or have an impact on income of the poorest populations?

Key questions on environmental impacts in relation to third countries are:

- Does the option affect the emission of greenhouse gases (e.g. carbon dioxide, methane etc) into the atmosphere?
- Does the option affect the emission of ozone-depleting substances (CFCs, HCFCs etc)?
- Does the option affect our ability to adapt to climate change?
- Does the option have an impact on the environment in third countries that would be relevant for overarching EU policies, such as development policy?

If third countries are likely to be affected, the impact assessment should analyse in greater detail what the specific impacts may be, how undesired effects can be avoided or minimised, or mitigated, how the policy options compare in this respect and what trade-offs have to be addressed in the final policy choice.

Consulting interested parties is an obligation for every impact assessment and all affected stakeholders should be engaged, using the most appropriate timing, format and tools to reach them. Appropriate consultation tools can be consultative committees, expert groups, open hearings, ad hoc meetings, consultation via Internet, questionnaires, focus groups or seminars/workshops. Existing international policy dialogues are also be used to keep third countries fully informed of forthcoming initiatives, and as a means of exchanging information, data and results of preparatory studies with partner countries and other external stakeholders.

The EU's 6th national communication provides a detailed overview of the European policies and measures to mitigate GHG emissions in all sectors.. All key strategies and climate policies have been subject to impact assessments as described above. All impact assessments and all opinions of the Impact Assessment Board are published online (see **http://ec.europa.eu/smart-regulation/impact/ia_carried_out/cia_2014_en.htm**). In addition to the general approach described above to address adverse social, environmental and economic impacts, more specific ways to minimize impacts depend on the respective policies and measures implemented. As the reporting obligation related to Article 3, paragraph 14 does not include an obligation to report on each specific mitigation policy, the EU chooses the approach to provide some specific examples for a more complete overview on the ways how the EU is striving to minimize adverse impacts.

Major EU policies such as the Directive on the promotion of the use of renewable energy (Directive 2009/28/EC, in particular its relation to biomass and biofuels, are presented in more detail as examples in this chapter, because the related impact assessments identified potential impacts on third countries. Furthermore, updates of EU policies which should lead to a low carbon strategy and energy efficient economy are also addressed in more detail in the following subchapters.

Directive on the promotion of the use of renewable energy - Promotion of biomass and biofuels

The Directive on renewable energy (Directive 2009/28/EC), a part of the EU's climate and energy package, sets ambitious targets for all Member States, such that the EU will reach a 20% share of energy from renewable sources in the overall energy consumption by 2020 (with individual targets for each Member State) and a 10% share of renewable energy specifically in the transport sector, which includes liquid biofuels, biogas, hydrogen and electricity from renewables. The impact assessments related to enhanced biofuel and biomass use in the EU showed that the cultivation of energy crops have both potential positive and negative impacts. To address the risk of potentially negative impacts, Article 17 of the EU's Directive on renewable energy sources creates pioneering "sustainability criteria", applicable to all biofuels (biomass used in the transport sector) and bioliquids. The sustainability criteria adopted include:

- establish a threshold for GHG emission reductions that have to be achieved from the use of biofuels;
- exclude the use of biofuels from land with high biodiversity value (primary forest and wooded land, protected areas or highly biodiverse grasslands),
- exclude the use of biofuels from land with high C stocks, such as wetlands, peatlands or continuously forested areas.

Developing country representatives as well as other stakeholder were extensively consulted during the development of the sustainability criteria and preparation of the directive and the extensive consultation process has been documented.

In October 2012 a new Commission proposal was published to limit global land conversion for biofuel production, and raise the climate benefits of biofuels used in the EU (European Comission 2012a). The Commission is therefore proposing to amend the current legislation on biofuels through the Renewable Energy and the Fuel Quality Directives and in particular:

- To increase the minimum greenhouse gas saving threshold for new installations to 60% in order to improve the efficiency of biofuel production processes as well as discouraging further investments in installations with low greenhouse gas performance.
- To include indirect land use change (ILUC) factors in the reporting by fuel suppliers and Member States of greenhouse gas savings of biofuels and bioliquids;
- To limit the amount of food crop-based biofuels and bioliquids that can be counted towards the EU's 10% target for renewable energy in the transport sector by 2020, to the current consumption level, 5% up to 2020, while keeping the overall renewable energy and carbon intensity reduction targets;

- To provide additional market incentives to the eixsing ones for biofuels with no or low indirect land use change emissions, and in particular the 2nd and 3rd generation biofuels produced from feedstock that do not create an additional demand for land, including algae, straw, and various types of waste, as they will contribute more towards the 10% renewable energy in transport target of the Renewable Energy Directive.

With these new measures, the Commission wants to promote stronger biofuels that help achieving substantial emission cuts, do not directly compete with food and are more sustainable at the same time. While the current proposal does not affect the possibility for Member States to provide financial incentives for biofuels, the Commission considers that in the period after 2020 biofuels should only receive financial support if they lead to substantial greenhouse gas savings and are not produced from crops used for food and feed. The Impact Assessment of the proposal for a Directive is analysing social, economic and environmental impacts on third countries in detail. The legislative proposal is now with the colegislators in the European Parliament and the Council.

The Directive also ensures that the Commission reports every two years, in respect to both third countries and Member States which constitute a significant source of biofuels or of raw material for biofuels consumed within the Union, on national measures taken to respect the sustainability criteria for soil, water and air protection. On 27 March 2013, the European Commission published its first Renewable Energy Progress Report (European Commission 2013a) under the framework of the 2009 Renewable Energy Directive, which also includes information on biofuels and bioliquids sustainability criteria. The report and its accompanying staff working document analyses *inter alia* the origin of biofuel foodstock consumed in the EU, whereby 83% of EU consumed biodiesel in 2010 was produced within the EU and 80% of the EU consumed bioethanol was produced in the EU. In 2010, imports of biodiesel came primarily from Argentina (10%), Indonesia (3%), Malaysia (1%) and China (1%), while Brazil (8%), USA (4%), Peru (1%), Kazakhstan (1%) and Bolivia (1%) were the top five importers of bioethanol. The report states that key export countries (Argentina, Brazil, Indonesia, and Malaysia) have adopted new regulatory measures to improve their environmental practices in biofuels related areas.

Whilst imported mineral oil still constitutes the vast bulk of fuel used in the transport sector, the 4.7% share of biofuels is estimated to have generated 25.5 Mt CO_2eq savings, based on national reporting (22.6 Mt CO_2eq based on the application of global default values), not taking into account indirect land use change effects.

The same report finds that the transposition and implementation of the biofuel sustainability criteria in many Member States is still not complete or correct. The Commission continues to assess Member State progress in implementation of the renewable energy Directive and legal measures are being taken in those cases where the transposition is incomplete.

In addition, the Commission reported on the effects on food prices, on land use rights and on the need for specific measures for air, soil and water protection, all of which concluded that notwithstanding current lack of major issues, future monitoring on these parameters should continue.

In addition to the official progress report, the Commission contracted a consortium led by Ecofys to perform support activities concerning the assessment of progress in renewable energy and sustainability of biofuels (Ecofys and consortium 2012). The Ecofys study revealed *inter alia* that:

- In 2010, the use of renewable energy in transport was 4.70%, consisting of:
  - 13.0 Mtoe of sustainable biofuels or 4.27%;
  - 1.3 Mtoe of renewable electricity, or 0.43%;
- Between 2008 and 2010, the volume of biofuels consumed in the EU increased by 39%, whereas the volume of petroleum fuels consumed in road transport decreased with 3.5%;
- The role of the EU in the global biofuel market has remained constant in the last years. The EU remained in 2010 by far the largest producer of biodiesel in the world with 8.5 Mtoe (55% of global market share) compared to global production of 15.5 Mtoe. Brazil and Argentina have significantly increased the production of biodiesel in recent years, whereas the production of biodiesel in the USA decreased by almost more than half compared to 2008. In the rest of the world, bioethanol

plays a much larger role. World bioethanol production reached 43.8 Mtoe in 2010, of which only 2.0 Mtoe or 5% were produced in the EU. The USA is the world's largest ethanol producer since 2006 (24,929 Mtoe produced in 2010), followed by Brazil. Net EU trade in the global biofuels market is therefore fairly insignificant;

- The most important feedstock for biodiesel is rapeseed originating from the EU, followed by Argentinean soy, Indonesian and Malaysian palm oil, and rapeseed from Canada and Ukraine. EU-produced biodiesel is partially produced from imported feedstock (palm oil, soy and part of the rapeseed);
- EU-produced bioethanol is mainly produced from EU feedstock, with only small shares of wheat and maize originating from Switzerland, Ukraine and a few other countries. Sugar cane and maize play a role via the bioethanol supplying countries – Brazil and the USA mainly;
- Statistical analysis reveals that the total land use worldwide, to produce the feedstock for EU-consumed biofuels in 2010, is about 5.7 Mha. Of this, 3.2 Mha (57%) is within the EU and 2.4 Mha (43%) resides outside the EU. True valuation of co-products would yield a lower figure;
- In most of the non-EU countries, the land dedicated to the production of feedstock for EU biofuels is less than 1% of the cropland. Notable exceptions are Argentina and Paraguay, where 3% and 4% of the total cropland produces soybean for EU biodiesel in 2010;
- Back-casting scenario analysis of the global agricultural market development clearly shows that EU-27 expanding biofuel use has contributed only little to the historical cereal price increases from 2007 to 2010, resulting in a wheat and coarse grain price increase of about 1-2%. The impact was more substantial for price increases of non-cereal food commodities by about 4%, notably through its demand for vegetable oil in the production of biodiesel;
- Estimates of the effects of EU biofuels consumption on global employment vary widely and are not often easy to determine. Still, based on on estimates and projections of the Global Renewable Fuels Association global ethanol and biodiesel production supports nearly 1.4 million jobs in all sectors of the global economy in 2010.

The EU's biofuel sustainability criteria form the first global initiative to address the climate change and sustainability issues surrounding crop production.

The recent Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (2010/C 160/01)[72] sets up a system for certifying sustainable biofuels, including those imported into the EU. It lays down rules that such schemes must adhere to if they are to be recognized by the Commission. This will ensure that the EU's requirements that biofuels deliver substantial reductions in greenhouse gas emissions and that biofuels do not result from forests, wetlands and nature protection areas.

The European Commission has so far (April 2014) recognised **15** voluntary schemes: International Sustainability and Carbon Certification (ISCC), Bonsucro EU, Round Table on Responsible Soy (RTRS EU RED), Roundtable of Sustainable Biofuels (RSB EU RED), Biomass Biofuels voluntary scheme (2BSvs), Abengoa RED Bioenergy Sustainability Assurance (RSBA), Greenergy Brazilian Bioethanol verification programme, Ensus voluntary scheme under RED for Ensus bioethanol production, Red Tractor Farm Assurance Combinable Crops & Sugar Beet Scheme, SQC (Scottish Quality Farm Assured Combinable Crops (SQC) scheme), Red Cert, NTA 8080 and RSPO RED (Roundtable on Sustainable Palm Oil RED), Biograce GHG calculation tool and HVO Renewable Diesel Scheme for Verification of Compliance with the RED sustainability criteria for biofuels[73].

In line with Article 19(4) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources[74] the Commission published in 2010 a report on the feasibility of drawing up lists of areas in

[72] OJ C160, 19.6.2010, p.1

[73] http://ec.europa.eu/energy/renewables/biofuels/sustainability_schemes_en.htm

[74] OJ L 140, 5.6.2009, p. 16

third countries with low greenhouse gas emissions from cultivation (COM(2010) 427 final) concluding that, “while desirable, it is not yet feasible to set up legally binding lists of areas for third countries where a major component of the underlying calculation is uncertain and can easily be questioned, and where third countries have had no possibility to contribute on the methodology and data used. It is therefore not appropriate, at least at this stage, to produce legislative lists for third countries based on the current modelling of N_2O emissions from agriculture. However, it is important to enhance the understanding of the topic and survey the data used in view of a new assessment in 2012. The Commission has thus published the preliminary results of the JRC work together with all necessary data and description of methodology to support such a process on the webpage of the JRC. It will use this as the basis for a discussion with third countries in the framework of its dialogue and exchange with them under Article 23(2) of the Renewable Energy Directive.”

Another way the EU will strive to minimize potential adverse impacts of biomass use is to promote second generation biomass technologies. Within the renewable energy Directive, second generation biofuels are promoted through Article 21, paragraph 2 which establishes that the contribution made by biofuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material shall be considered to be twice that made by other biofuels for the purposes of demonstrating compliance with national renewable energy targets; and EU research also has a major focus on bioenergy technologies. The goal of second generation biofuel processes is to extend the amount of biofuel that can be produced sustainably by using biomass consisting of the residual non-food parts of current crops, such as stems, leaves and husks that are left behind once the food crop has been extracted, as well as other crops that are not used for food purposes (non food crops) and also industry waste such as woodchips, skins and pulp from fruit pressing. Second generation biofuels are expected to expand the biomass feedstock available for biofuel production. Further research and impact assessments in this area are necessary to assess e.g. the long-term effects of the energy use of non-food parts of crops compared to their existing use. The Commission continues the efforts to promote second and third generation biofuels, shifting away from food-crop based fuels. In this light, it recently put forth a proposal to limit to 5% the use of food-based fuels in meeting the EU renewable energy target in transport (see discussion above on Proposal from October 2012).

As part of the Communication on a policy framework for climate and energy in the period from 2020 to 2030 (European Commission 2014a) it is proposed not to establish new targets for renewable energy specifically for the transport sector, or the greenhouse gas intensity of fuels used in the transport sector or any other sub-sector after 2020. The priority expressed in the communication is a focus of policy development on improving the efficiency of the transport system, further development and deployment of electric vehicles, second and third generation biofuels and other alternative, sustainable fuels as part of a more holistic and integrated approach. A greenhouse gas reduction target of 40% to be shared between the ETS and non-ETS sector is accompanied by a coherent headline target at EU level for renewable energy of at least of at least 27% with flexibility for Member States to set national objectives.

Inclusion of aviation in the EU emission trading scheme

In 2005 the Commission adopted a Communication entitled "Reducing the Climate Change Impact of Aviation", which evaluated the policy options available to this end and was accompanied by an impact assessment. The impact assessment concluded that, in view of the likely strong future growth in air traffic emissions, further measures are urgently needed. Therefore, the Commission decided to pursue a new market-based approach at EU level and included aviation activities in the EU’s scheme for greenhouse gas emission allowance trading.

In April 2013 the EU temporarily suspended enforcement of the EU ETS requirements for flights operated from or to non-European countries, while continuing to apply the legislation to flights within and between countries in Europe. The EU took this initiative to allow time for the International Civil Aviation Organization (ICAO) Assembly in autumn 2013 to reach a global agreement to tackle aviation emissions – something Europe has been seeking for more than 15 years. In October 2013 the EU's hard work paid off when the ICAO Assembly agreed to develop by 2016 a global market-based mechanism (MBM) addressing international aviation emissions and apply it by 2020. Until then countries or groups of countries, such as the EU, can implement interim measures.

In response to the ICAO outcome and to give further momentum to the global discussions, the European Commission has proposed amending the EU ETS[75] so that only the part of a flight that takes place in European regional airspace is covered by the EU ETS. The change would have applied from the beginning of 2014 until the planned global MBM enters into force. In March 2014 the Council of the EU and European Parliament reached an informal agreement on the changes to aviation in the EU ETS.

The regulation in preparation will limit the aviation coverage of EU ETS to emissions from flights within the European Economic Area (EEA) for the period from 2013 to 2016. This applies to all (also third country) aircraft operators. All options are left open for the EU to react to the developments of the ICAO Assembly in 2016 and to re-adjust the scope of the EU ETS from 2017 onwards. The regulation also includes exemptions for small emitters. The legislative process is expected to be concluded in the spring of 2014.

A roadmap for moving to a competitive low carbon economy in 2050

In 2011 the Commission released the Communication “A Roadmap for moving to a competitive low carbon economy in 2050” (COM(2011) 112 final) outlining a strategy to meet the long-term target of reducing domestic emissions by 80 to 95% by 2050 as agreed by European Heads of State and governments. The Roadmap shows how the sectors responsible for Europe's emissions - power generation, industry, transport, buildings and construction, as well as agriculture - can make the transition to a low-carbon economy over the coming decades. The transition towards a competitive low-carbon economy means that the EU should prepare for reductions in its domestic emissions by 80% by 2050 compared to 1990, with cost effective reduction milestones of 40% by 2030 and 60% in 2040..

The shift to a resource-efficient and low-carbon economy should be supported by using all resources, decoupling economic growth from resource and energy use, reducing CO_2 emissions, enhancing competitiveness and promoting greater energy security. A low-carbon economy will mean a much greater use of renewable sources of energy, energy-efficient building materials, hybrid and electric cars, 'smart grid' equipment, low-carbon power generation and carbon capture and storage technologies.

Because more locally produced energy would be used in a low-carbon economy, mostly from renewable sources, the EU would be less dependent on imports of oil and gas from outside the EU. On average, the EU could save € 175 - 320 billion annually on fuel costs over the next forty years.

With the shift from fuel expenses (operating costs) to investment expenditure (capital expenditure) in clean technology and clean energy, investments costs will occur in the domestic economy, requiring increased added value and output from a wide range of manufacturing industries (automotive, power generation, industrial and grid equipment, energy–efficient building materials, construction sector etc.), while fuel expenses for fossil fuel imports which are to a large extent flowing to third countries would be reduced.

Communication on a policy framework for climate and energy in the period from 2020 to 2030

In January 2014, the European Commission published a Communication on a policy framework for climate and energy in the period from 2020 to 2030 (COM(2014)15 final) (European Commission 2014a). This Communication develops a framework for the future EU climate and energy policy and proposes to set a greenhouse gas emission reduction target for domestic EU emissions of 40% in 2030 relative to emissions in 1990. The EU level target will be shared between the EU Emissions

[75] See Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in view of the implementation by 2020 of an international agreement applying a single global market-based measure to international aviation emissions, **http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013PC0722**

Trading System (EU ETS) and what the Member States must achieve collectively in the sectors outside of the ETS. The ETS sector would have to deliver a reduction of 43% in GHG in 2030 and the non-ETS sector a reduction of 30% both compared to 2005.

In addition the Commission proposes an EU-level target for the share of renewable energy in the EU of at least 27% in 2030. While binding at the EU level, there would not be binding renewable targets for Member States individually but the objective would be fulfilled through clear commitments decided by the Member States themselves which should be guided by the need to deliver collectively the EU-level target and build upon what each Member State should deliver in relation to their current targets for 2020. While not foreseeing national-level targets, the 2030 framework proposes a new governance framework based on national plans for competitive, secure and sustainable energy. The plans will be prepared by Member States under a common approach to ensure coherence at the EU level.

The EU Emissions Trading System (ETS) will remain an important instrument to bring about the transition to a low carbon economy. A market stability reserve is proposed for the period after 2020 which provides an automatic adjustment of the supply of auctioned allowances based on a pre-defined set of rules with the aim to avoid a large supply/demand imbalances in the ETS.[76]

A stakeholder consultation was carried out in preparation for the 2030 framework. The Communication on the 2030 policy framework follows the Commission's March 2013 “Green Paper on a 2030 framework for climate and energy policies” which was explained in this section of the NIR in the previous inventory submission. The Green paper launched a broadpublic stakeholder consultation on the most appropriate range and structure of climate and energy targets for 2030. The public consultation was conducted between March and July 2013 and also addressed relevant stakeholders from outside the EU.

An impact assessment (IA) was conducted for this communication (European Commission 2014b), which gives significant detail on costs and savings achieved on the basis of the proposed policy under different scenarios. All scenarios demonstrate reduced GHG emissions compared to the Reference scenario. All scenarios show reduced energy consumption (both primary and final) compared to the Reference scenario, with more pronounced energy savings and improved energy intensity in scenarios with strong energy efficiency policies, with highest improvements in those scenarios that next to ambitious energy efficiency policies also include a renewables target. Future fuel consumption in the EU will have economic impacts on fuel prices as well as trade effects for fuel exporting countries, therefore the impacts on future fuel use are summarized: With regard to fuel use, the IA analysed that solid fuel consumption declines substantially under all scenarios until 2030. Also oil consumption decreases in all scenarios, but much faster in those with policies that promote transport electrification. Natural gas absolute consumption also declines in all scenarios (in general less harply than oil) but slightly more under the scenarios that include renewable targets. By 2050 in all scenarios natural gas becomes the main fossil fuel. Net energy imports decrease significantly for all scenarios already in 2030 between 4% to 22% below 2010 levels in 2030 and by about 50% in most scenarios in 2050.[77]

The Communication was discussed by the European Council (EU Member States’ heads of state and goverments) on 21-24 March 2014, which requested the Council and the Commission to rapidly develop further policy elements, including mechanisms for fair effort sharing. EU leaders agreed to take a final decision on the framework as soon as possible and in October 2014 at the latest.

[76] See COM/2014/20 Proposal for a Decision oft he European Parliament and of the Council concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, **http://ec.europa.eu/clima/policies/ets/reform/docs/com_2014_20_en.pdf**

[77] For a more detailed analysis and explanation on the scenarios, see the Impact Assessment Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A policy framework for climate and energy in the period from 2020 up to 2030, available: **http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014SC0015**

15.2 Information on how the EU gives priority, in implementing the commitments under Article 3, paragraph 14, to specific actions

The EU reports activities that are related to the actions specified in the subparagraphs (a) to (f) of paragraph 24 of the reporting requirements in the Annex to decision 15/CMP.1. However, no decision was agreed yet that these actions form part of the commitment under Article 3, paragraph 14. For some of the actions specified in the reporting requirements, it seems rather unclear how they relate to the minimization of adverse social, environmental and economic impacts resulting from policies and measures to mitigate GHG emissions, e.g. information related to the cooperation activities requested are activities that help both Annex I and Non-Annex I Parties in reducing emissions from fossil fuel technologies, but they do not directly address the minimization of potential adverse impacts in Annex I Parties.

For the purposes of completeness in reporting, the EU addresses all subparagraphs specified in the reporting requirements, however the main ways how the EU is striving to minimize adverse impacts are described in the previous section.

a) The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities

The actions addressed in subparagraph a) also form part of the commitment to implement policies and measures requested under Article 2, paragraph 1(a) (v), however Article 2 specifies that Annex I Parties shall "implement and/or further elaborate policies and measures in accordance with national circumstances, such as progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse gas emitting sectors that run counter to the objective of the Convention and application of market instruments." Subparagraph a) in the reporting requirements lacks such objective and therefore seems somewhat inconsistent with the commitment under Article 2. The promotion of research, demonstration projects, fiscal incentives or carbon taxes is important instrument to advance the objectives of the Convention, e.g. the use of renewable energies. A progressive reduction of all fiscal incentives or subsidies in all GHG emitting sectors would run counter the objective of the Convention and counter the ability of the EU to meet its commitment under Article 3, paragraph 1 of the Kyoto Protocol. Therefore the EU interprets this reporting requirement in a way consistent with Article 2 paragraph 1(a)(v) that the EU should focus on the progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies that run counter the objectives of the Convention and application of market instruments.

The 2009 Review of the EU Sustainable Development Strategy assesses that *"the Commission has been mainstreaming the progressive reform of environmentally harmful subsidies into its sectoral policies"*. For instance, environmental concerns have been gradually incorporated into the EU Common Agricultural Policy, including "decoupled" direct payments which have replaced price support; environmental cross compliance; a substantial increase in budget for rural development. As part of 2008 Common Agriculture Policy Health Check, additional part of direct aid has been shifted to climate change, renewable energy, water management, biodiversity, innovation; - transparency of agricultural subsidies has improved. It is important to note that in the other areas most subsidies are within the competence of the Member States and not of the EU, within the limits established by EU state aid rules.

EU policies aim to address market imperfections and to reflect externalities. For example the EU has made significant efforts to liberalise the internal energy market and to create a genuine internal market for energy as one of its priority objectives. The existence of a competitive internal energy market is a strategic instrument both in terms of giving European consumers a choice between different companies supplying gas and electricity at reasonable prices, but also in terms of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy.

With the implementation of the EU Emissions Trading Scheme, the EU uses a market instrument to implement the objective of the Convention and its commitment under Article 3, paragraph 1 of the Kyoto Protocol which aims at creating the right incentives for forward looking low carbon investment decisions by reinforcing a clear, undistorted and long-term carbon price signal.

With respect to financial support provided by the Member States to undertakings, the EU Treaty pronounces a general prohibition of "State aid". This concept encompasses a broad range of financial support measures adopted at national or sub-national level (i.e. not at EU level), and which can take various forms (subsidies, tax relieves, soft loans…). The Treaty provides for exceptions to this general prohibition. When State aid measures can contribute in an appropriate manner to the furtherance of objectives of common interest for the EU, and provided that they comply with certain strict conditions, they may be authorised by the Commission. By complementing the fundamental rules through a series of legislative acts and guidelines, the EU has established a worldwide unique system of rules under which State aid is monitored and assessed in the European Union. This legal framework is regularly reviewed to improve its efficiency. EU State aid control is an essential component of competition policy and a necessary safeguard for effective competition and free trade.

State aid reform in the EU aims to redirect aid to objectives of common interest which are related to the EU Lisbon Treaty, such as R&D&I, risk capital measures, training, and environmental protection. Environmental protection, and in particular, the promotion of renewable energy and the fight against climate change, is considered one of the objectives of common interest for the EU which may, under certain circumstances, justify the granting of State aid.

Specific “Community Guidelines on State aid for Environmental Protection”[78] have been established. The Guidelines foresee in particular the possibility to authorise State aid for particular environmental purposes, such as for renewable energy sources or energy saving. The European Commission published on 9 April 2014 the “Guidelines on on State aid for environmental protection and energy 2014-2020” that intend to replace the 2008 Guidelines from 1 July 2014. A public consultation process on these draft guidelines has been conducted between December 2013 and February 2014 (European Commission 2014c). The Guidelines set out the conditions under which state aid measures for environmental protection or energy objectives may be declared compatible with the internal market. This proposal includes a list of environmental and energy measures for which state aid under certain conditions may be compatible with the EU Treaty, covering the following areas:

- Aid to energy from renewable sources
- Energy efficiency measures, including cogeneration and district heating and district cooling
- Aid for resource efficiency and in particular aid to waste management
- Aid to Carbon Capture and Storage (CCS)
- Aid in the form of reductions in or exemptions from environmental taxes and in the form of reductions in funding support for electricity from renewable sources
- Aid to energy infrastructure
- Aid for generation adequacy
- Aid in the form of tradable permit schemes
- Aid for the relocation of undertakings

[78] Official Journal No C 82, 1.4.2008, p.1

In June 2012, the Commission adopted Guidelines on certain State aid measures in the context of the EU Emissions Trading System (EU ETS). The Guidelines provide a framework under which Member states may compensate some electro-intensive industries, such as steel and aluminium producers, for part of the higher electricity costs expected to result from the application of the harmonised allocation rules to be applied in the EU ETS as from 2013. The rules, subject to state aid scrutiny, ensure that national support measures are designed in a way that preserves the EU objective of decarbonising the European economy and maintains a level playing field among competitors in the internal market. The sectors deemed eligible for compensation include producers of aluminium, copper, fertilisers, steel, paper, cotton, chemicals and some plastics. The Guidelines give a right, not an obligation to provide subsidies to energy intensive industries.

Carbon leakage means that global greenhouse gas emissions increase when companies in the EU shift production outside the EU because they cannot pass on the cost increases induced by the ETS to their customers without a significant loss of market share to third country competitors. Based on the ETS Directive (2003/87/EC as amended by 2009/29/EC), the Commission shall compile a list of sectors and sub-sectors deemed exposed to significant risk of carbon leakage. Sectors on the list will receive a higher share of free allowances. The criteria and thresholds to determine whether a sector is deemed exposed to carbon leakage or not are defined in Article 10a(13-18) of the ETS Directive and focus on additional costs incurred by the ETS Directive and trade intensity. The calculations are based on official Eurostat data and data collected from Member States. It is foreseen that the final carbon leakage list for 2015-19 will be adopted by the Commission before the end of 2014 and applied to free allocation for the first time in 2015.

b) Removing subsidies associated with the use of environmentally unsound and unsafe technologies

There is no clear definition of environmentally unsound and unsafe technologies; therefore the EU interprets this provision in the context of the Kyoto Protocol that unsound and unsafe technologies would be those increasing GHG emissions.

The phase-out of subsidies to fossil fuel production and consumption by 2010 was one of the objectives in the Communication from the Commission "A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development (Commission's proposal to the Gothenburg European Council, 2001)".[79]

Council Decision 2010/787/EU of 10 December 2010 on State aid to facilitate the closure of uncompetitive coal mines adopted a new coal regulation enabling Member States to grant State aid to facilitate the closure of uncompetitive mines until 2018, following the expiry of the current Coal Regulation (Council Regulation (EC) N° 1407/2002 of 23 July 2002) on 31 December 2010. The decision includes the following main elements:

- the possibility of continuing to grant, under certain conditions, public aid to the coal industry with a view to facilitating the closure of uncompetitive hard coal mines until December 2018;
- the modalities for the phasing-out of the aid, under which the overall amount of aid granted by a member state must follow a downward trend, in order to prevent undesirable effects of distortion of competition in the internal market. Subsidies will have to be lowered by at least 25% until 2013, by 40% until 2015, by 60% by 2016 and by 75% by 2017;
- the obligation for member states granting aid to provide a plan on intended measures to mitigate the environmental impact of the production of coal; and
- the possibility of allowing subsidies, until December 2027, in order to cover exceptional expenditure in connection with the closure of mines that are not related to production, such as social welfare benefits and rehabilitation of sites.

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79 See http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0264en01.pdf

c) Cooperating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end;

The technological development of non-energy uses of fossil fuels is not a current research priority in the EU, nor a priority of cooperation with developing countries because the EU is not a major producer of oil and gas. Given the long-term depletion of fossil fuel resources and the decline in coal production, the EU's priority in general is the replacement of the use of fossil fuels by renewable resources and the more efficient use of resources.

d) Cooperating in the development, diffusion, and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort;

In March 2005, the EU and China signed an Action Plan on Clean Coal, which included cooperation on carbon capture and storage. The subsequent 2005 EU-China Summit established the EU-China Climate Change Partnership, which includes a political commitment to develop and demonstrate in China and the EU advanced, near-zero emissions coal (NZEC) technology through carbon capture and storage (CCS) by 2020. Phase I of this cooperation will be completed in 2009. Phase II of NZEC will run from 2010-2012. It will examine the site-specific requirements for and define in detail a demonstration plant and accompanying measures. It will include the technical and cost analysis of different options. Based on this analysis, the site of the power plant as well as the combustion technology (pulverised coal or IGCC), the capture technology and the transport and storage concepts will be determined. Phase II shall also include a detailed roadmap for the construction and operation of the demonstration plant as well as an Environmental Impact Assessment of the demonstration power plant and the carbon storage site. Phase III should commence thereafter and will see the construction and operation of a commercial-scale demonstration plant in China.

In 2009 the European Commission published a Communication on CCS in emerging developing countries (European Commission 2009). The Communication sets out the Commission's plans for establishing an investment scheme to co-finance the design and construction of a power plant to demonstrate carbon capture and storage (CCS) technology in China. The Commission has programmed funding of up to €50 million for the construction and operation phase of the project, out of a total of €60 million that has been earmarked for cooperation with emerging economies on cleaner coal technologies and carbon capture and storage. nt progress in identifying options and constraints for CCS in China. At the 2009 Summit, China and EU jointly agreed to finalise the feasibility (phase II) of a demonstration plant, and a Memorandum of Understanding was signed between the European Commission and the Ministry of Science and Technology (MOST). Implementation is on-going. In 2010 Norway joined the initiative. A call for proposals has been launched in 2013 to select the project and conduct pre-feasibility studies to be finalised in 2014.

The EU is cooperating with other Annex I and Non-Annex I Parties (Australia, Brazil, Canada, China, Denmark, France, Germany, Greece, India, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Russian Federation, Saudi Arabia, South Africa, United Arab Emirates, United Kingdom and USA) in the "Carbon Sequestration Leadership Forum (CSLF)". The CSLF is a Ministerial-level international climate change initiative that is focused on the development of improved cost-effective technologies for the separation and capture of carbon dioxide (CO_2) for its transport and long-term safe storage. The mission of the CSLF is to facilitate the development and deployment of such technologies via collaborative efforts that address key technical, economic, and environmental obstacles. The CSLF will also promote awareness and champion legal, regulatory, financial, and institutional environments conducive to such technologies. In 2010 a Technology Roadmap was released by the Carbon Sequestration Leadership Forum. This road map indicates that significant international progress has been made in the past year on advancing carbon capture and storage, but that a number of important challenges remain that must be addressed to achieve widespread commercial deployment of CCS. The 2012 Strategic Plan Implementation Report recognized five new CCS projects bringing the total number of CSLF recognized technology demonstrations to 34, including 24 active projects. A number of meetings and workshops were held in 2013 and 2014, such as the 2013 and 2014 CSLF Technical Group Meeting and the 5th CSLF Ministerial Meeting. The CSLF Task Force on Reviewing Best Practices and Standards for Geological Storage and Monitoring of CO_2 published an annual report in 2013 that compiles best practice manuals developed acorss the world, guidelines published related to CCS, and summaries of regulations in place as well as monitoring tools and techniques used in ongoing projects (CSLF 2013). The Task force on Technical Challenges in the Conversion of CO_2-EOR Projects to CO_2 Storage Projects also provided a report in 2013 that concluded that the main impediment in the adoption and deployment of this technology is the unavailability of CO_2 at economic prices at the CO_2-EOR operation sites and the absence of infrastructure to both capture the CO_2 and transport it from CO_2 sources to oil fields suitable for CO_2 – EOR.

e) Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities

In the oil and gas industry the upstream sector is a term commonly used to refer to the exploration, drilling, recovery and production of crude oil and natural gas. The downstream sector includes the activities of refining, distillation, cracking, reforming, blending storage, mixing and shipping and distribution.

The EU contributes to strengthening of the capacities of fossil fuel exporting countries in the areas of energy efficiency via the work of the Energy Expert Group of the Gulf Cooperation Council (GCC)[80], in particular in the working sub-group on energy efficiency. As part of the EU's research programme, a project called "EUROGULF" was launched with the objective of analysing EU-GCC relations with respect to oil and gas issues and proposing new policy initiatives and approaches to enhance cooperation between the two regional groupings.

The Commission has recently started a project with the specific objective to create and facilitate the operation of an EU-GCC Clean Energy Network. The network is to be set up to act as a catalyst and element of coordination for development of cooperation on clean energy. A website was created at **http://www.eugcc-cleanergy.net** where further information on the EU-GCC Clean Energy Network and its recent activities can be found. The Masdar Institute of Science and Technology in Abu Dhabi has been selected as the lead research institution to represent the Gulf Cooperation Council (GCC) in the European Union-GCC Clean Energy Network. A number of discussion groups and training seminars took place, e.g. on solar resource assessment. In January 2013, the EU-GCC Energy Cooperation Conference was held in Abu Dhabi, UAE, as a side event of the "World Future Energy Summit- WFES 2013. The presentation by the high-level team of attendees from the GCC and Europe highlighted the achievements in areas of mutual interest for the two regions including renewables, energy efficiency and demand-side management, electricity interconnections, carbon capture and storage, as well as natural gas. Some of the concrete outcomes that were summarized during the sessions include publications, research work/papers, established partnerships between the GCC and EU, co-operation project ideas, targeted working meetings and training workshops. In 2013 also a Workshop and training seminar on integration of renewables in the grid and on energy efficiency and demand side management was held in Oman and an event related to CCS took place in London. In

[80] The Gulf Cooperation Council covers Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

December 2013, the EU-GCC Energy Experts Group meeting was reconvened and is planned to continue in a fruitful dialogue beyond, with the next meeting planned in 2014. The dialogue focused on energy efficiency and natural gas, and in incuded EU market regulators and the private sector, as well as representatives of the EU-GCC clean energy network.

Energy efficiency activities in the upstream or downstream sector are also candidates for CDM projects. Thus, the development of the CDM under the Kyoto Protocol and the demand of CERs by Annex I Parties under the Kyoto Protocol as well as by operators under the EU ETS have fostered such activities performed by the private sector. Related CDM projects are for example:

- Rang Dong Oil Field Associated Gas Recovery and Utilization Project in Vietnam: The purpose of this project activity is the recovery and utilization of gases produced as a by-product of oil production activities at the Rang Dong oil field in Vietnam with the involvement of ConocoPhillips (UK).
- Recovery of associated gas that would otherwise be flared at Kwale oil-gas processing plant in Nigeria involves the capture and utilisation of the majority of associated gas previously sent to flaring at Kwale OGPP plant. The Kwale OGPP plant receives oil with associated gas from oil fields operated by Eni Nigeria Agip Oil Company.
- Recovery and utilization of associated gas produced as by-product of oil recovery activities at the Al-Shaheen oil field in Qatar
- Flare gas recovery and utilisation project at Uran oil and gas processing plant in India which is handling the oil and gas produced in the Mumbai High offshore oil field.
- Flare gas recovery and utilisation project at Hazira gas and condensate processing plant in India.
- Flare gas recovery and utilisation project from Kumchai oil field in India
- Flare gas recovery and utilisation project at the Ovade-Ogharefe oil field operated by Pan Ocean Oil Corporation in Nigeria
- Flare gas recovery and utilisation project at Soroosh and Nowrooz offshore oil fields in Iran.
- Leak reduction in aboveground gas distribution equipment in the KazTransgaz-Tbilisi gas distribution system in Georgia where leakages at gate stations, pressure regulator stations, valves, fittings as well at connection points with consumers are reduced.
- There are currently 21 Coal Mine Methane Utilization Project in China which use coalmine methane previously released to the atmosphere.

Improved energy efficiency in the energy and the transport sector in a more general way is one of the priorities in the EU's development assistance as well as for the EIB (European Investment Bank) and the EBRD (European Bank for Reconstruction and Development). The EIB has also developed other means of financing, such as equity and carbon funds, to further support renewable energy and energy-efficiency projects (see here GEEREF and the Mediterranean Solar Plan, MSP). Related projects and specific activities can be found for example at http://www.eib.org/projects/topics/environment/renewable-energy/index.htm or http://www.ebrd.com/saf/search.html?type=eia

f) Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.

The EU actively undertakes a large number of activities aiming at reducing dependence on the consumption of fossil fuels, in particular the EU support activities for the promotion of renewable energies and energy efficiency in developing countries contribute to reduction of dependence on fossil fuels, meeting rural electricity needs, and the improvement of air quality. As explained in more detail in the EU's 6th national communication and 1st Biennial Report several support programmes exist in this respect. These include:

- ***Cooperation with the EU neighboring countries on renewable electricity production***

In order to support the implementation of the Renewable Energy Directive, the Commission will in September 2013 issue guidance to Member States and potential third country partners on the implementation of cooperation and trade in the renewable energy sector. Cooperation, for example, in deploying solar energy installations in North Africa for domestic consumption as well as export is supported as part of an overall agenda for sustainable growth in a viable regional renewable energy sector. The EU has already supported this development through the "Paving the Way towards a Mediterranean Solar Plan" project as well as member States substantial input into tech Mediterranean solar Plans Technical Working Groups looking at the details of the implementation of closer cooperation. The Mediterranean Solar Plan Project Preparation Initiative (MSP-PPI), an initiative of the European Investment Bank (EIB), together with the European Commission, AFD, KfW, AECID, EBRD and the Union for the Mediterranean, is financed by the EU-funded Neighbourhood Investment Facility, with the aim to accelerate the implementation of renewable energy and energy efficiency projects in 7 Mediterranean partner countries: Algeria, Egypt, Gaza/West Bank, Jordan, Lebanon, Morocco and Tunisia.[81]

Currently an additional study "Bringing Europe and Third countries closer together through renewable Energies" (BETTER) financed by the Commission is further preparing the ground for pilot projects to be put into place.

The European Union, alongside 22 of its Member States, is a member of the International Renewable Energy Agency and as such actively supporting its work, inter alia giving substantial input to the implementation of the UN Secretary's General "Sustainable Energy For All" initiative or conducting renewable energy readiness assessment in Africa, Latin America and the Pacific region. Additionally development cooperation in many areas contributes to technology transfer. The Global Energy Efficiency and Renewable Energy Fund (GEEREF), which is managed by the European Investment Fund (EIF), for example facilitates participation in small-scale private ventures that introduce new technology in the area of renewable energy.

- *Africa, Caribbean and the Pacific (ACP-E) Energy Facility*

The ACP-EU Energy Facility is a contribution under the EU Energy Initiative to increase access to energy services for the poor. The Facility was approved by the joint ACPEU Council of Ministers in June 2005, with an amount of € 220 million. The main activity of the Facility is to co-finance projects that deliver energy services to poor rural areas.

The Energy Facility was mainly implemented through a €198 million Call for Proposals which was launched in June 2006. Out of 307 proposals received, 74 projects have been contracted by the end of 2008 for a total amount of €196 million from the Energy Facility, with a total project cost of €430 million. Since 2008, the Facility has financed around 140 national and cross-border projects in ACP countries for about EUR 300 Million. Almost 13 Million people should benefit of an improved access to energy mostly utilising Renewable Energy technologies. A second Energy Facility (EFII), with a total budget of €200 million, has been established for the period 2009-2013. A €100 million call for proposals, launched in November 2009, resulted in the selection of 65 projects for funding.

The main activities performed through Energy Facility projects can be classified into three different groups: (1) energy production, transformation and distribution, (2) extension of existing electricity grids and (3) "soft" activities such as governance, capacity building or feasibility studies. The sources of energy used for electricity generation were mainly renewable energies (77 % of the projects). Only one project using exclusively fossil fuels was funded. In total, € 81 million of commitments have been marked as climate change related under the Energy Facility, covering support to enhance use of renewable energies or increase energy efficiency. A replenishment of the ACP-EU Energy Facility has

[81] http://www.eib.org/infocentre/publications/all/mediterranean-solar-plan-project-preparation-initiative.htm

been decided under the 10th European Development Fund for the period of 2009-2013. Endowed with € 200 Million, it will focus on improving access to safe and sustainable energy services in rural and peri-urban areas. The new Energy Facility will also contribute to the fight against climate change by emphasizing the use of renewable energy sources and energy efficiency measures and by taking into account impacts of climate change on energy systems. The new Facility started being implemented by the end of 2009 and funding guidelines were approved in October 2010. The Second Call for Proposals of the Energy Facility with a budget of EUR 55 million has been launched. The deadline for submission of Concept Notes and Full Applications was 03/06/2013. The second ACP-EU Energy Facility is one of the instruments implementing the Africa-EU Energy Partnership, which is part of the 2011-2013 Joint Africa-EU Strategy. A specific website for the monitoring of the ACP-EU Energy Facility was created under http://www.energyfacilitymonitoring.eu/.

- *Latin America Investment Facility (LAIF)*

The European Commission also established the Latin America Investment Facility (LAIF). The European Commission has foreseen an amount of € 125 million for the period 2009-2013.

The primary objective of LAIF is to finance key infrastructure projects in transport, energy, social and environmental sectors as well as to support private sector development in the Latin American region, in particular small- and medium-sized enterprises (SMEs). The main purpose of the LAIF is to mobilise additional financing to support investment in Latin America, encouraging beneficiary governments and public institutions to carry out essential investment in projects and programmes that could not be otherwise financed either by the market or by development Finance Institutions alone.

As part of its efforts to achieve this objective, LAIF pursues three strategic objectives:

- Improving interconnectivity between and within Latin American countries, in particular establishing better energy and transport infrastructure, including energy efficiency, renewable energy systems and the sustainability of transport and communication networks.
- Increasing the protection of the environment and supporting climate change adaptation and mitigation actions.
- Promoting equitable and sustainable socio-economic development through the improvement of social services infrastructure and support for small- and medium-sized enterprises (SMEs).

The 2012 operational annual report of LAIF reported that the grant contributions approved by the LAIF Board amounted to over € 160 million, leveraging total new investments of about € 4.2 billion. Since 2012, the amount allocated to LAIF increased to € 192.15 million.

- *Global Energy Efficiency and Renewable Energy Fund (GEEREF)*

The European Commission has launched an innovative pilot instrument to involve the private sector. The Global Energy Efficiency and Renewable Energy Fund (GEEREF), launched in 2007, aims to accelerate the transfer, development, use and enforcement of environmentally sound technologies for the world's poorer regions, helping to bring secure, clean and affordable energy to local people. GEEREF invests in regionally-oriented investment schemes and prioritises small investments below €10 million. It particularly focuses on serving the needs of the ACP, which is a group of 79 African, Caribbean and Pacific developing countries. It also invests in Latin America, Asia and neighbouring states of the EU (except for Candidate Countries). Priority is given to investment in countries with policies and regulatory frameworks on energy efficiency and renewable energy:

- €12.5 million investment in Berkeley Energy's Renewable Energy Asia Fund (REAF) for operationally and economically mature wind, hydro, solar, biomass, geothermal and methane recovery projects in India, Philippines, Bangladesh and Nepal.

- €10 million investment in the Evolution One Fund, dedicated to clean energy investment in Southern Africa (SADC countries).
- Furthermore, GEEREF invested €12.5 million in the Clean Tech Latin American Fund (CTLAF II), where the main objective is focused on the areas of renewable energy and clean technologies The CTLAF II is a capital fund investing in private companies and was established as the continued success of Cleantech Fund (I) which is now fully made available. The main geographic focus is Mexico, Brazil, Chile, Peru and Colombia and more information is available http://www.emergingenergy.com/).
- A new Fund called DI Frontier Market Energy and Carbon Fund ("DI") under the GEEREF package committed € 10 million. The main distinguishing feature is an integrated approach to project development, investment, and carbon trade. The Fund has a focus on Eastern and Southern Africa. Core focus countries include: Kenya, Mozambique, Tanzania, Uganda and Zambia. (more information is available under **http://www.frontier.dk/**).
- Armstrong Asset Management receives commitment of Euro 10 million from GEEREF for their South East Asia Clean Energy Fund.
- Emerging Energy Latin America Fund II receives € 12.5 million from GEEREF which is managed by Emerging Energy & Environment Group which is a regional fund dedicated to small and medium size renewable energy infrastructure in Latin America (more information available under http://www.emergingenergy.com).

In the regions where the two funds operate, there is a lack of equity investment available through the market for these types of projects. It is envisaged that GEEREF will invest in regional sub-funds for the African, Caribbean and Pacific (ACP) region, Neighbourhood, Latin America and Asia. Together the European Commission, Germany and Norway have committed about €112 million to the GEEREF over the period 2009-2013, the majority of which is provided by from the EU budget. It is envisaged that further financing from other public and private sources will be forthcoming. GEEREF will fundraise in 2013 to bring the total funds under management above €200 million. The target funding size for GEEREF is €200-250 million and as of March 2013, GEEREF has secured a total of €112 million.

The EU through Directorate General Development and Cooperation - EuropeAid also supports African, Carribean and Pacific countries in diversifying their economies; however, these activities are not limited to fossil fuel exporting countries, but are open to ACP countries based on Economic partnership agreements (EPAs). EPAs help ACP countries integrate into the global economy and improve the business environment, build up regional markets and promote good economic governance through reinforced regional cooperation in trade related issues. In 2008 the EU signed a comprehensive EPA with 13 CARIFORUM countries. In January 2009, Côte d'Ivoire and Cameroon have signed interim EPAs. Some ACP partners have signed interim economic partnership agreements with the EU as a first step towards comprehensive regional EPAs. The interim agreements secure and improve ACP access to the EU market and provide for more favourable rules of origin. Negotiations are ongoing with the African and Pacific regions to move from interim agreements to comprehensive regional agreements. The negotiations cover regional trade integration, trade in services, investment and trade-related rules. The strategy for private sector development in the ACP recommends the use of horizontal instruments (applicable to all ACP countries) in five priority areas where the Commission has a good experience and comparative advantages:

(1) Improvement of the macroeconomic framework and regulatory environment for enterprise development (Private Sector Enabling Environment Facility of the Business Environment (PSEEF) or BizClim with €20 million for 5 years);

(2) Investment and inter-enterprise co-operation promotion activities (PROINVEST - €110 million for 7 years);

(3) Facilitation of investment financing and development of financial markets (Investment Facility managed by the European Investment Bank (EIB) as revolving fund with €3,137 billion, completed by

the EIB own resources with €2 billion for 2008-2013 and financial envelope of €400 million for the interest subsidies and technical assistance);

(4) Support for Small and Medium- sized Enterprises in the form of non-financial services (Centre for the Development of Enterprise (CDE) with €18 million per year, PROINVEST);

(5) Support for micro-enterprises and micro-finance (ACP-EU Microfinance Framework Programme with €15 million for 6 years, in collaboration with Consultative Group to Assist the Poor program (CGAP) and investment in debt and equity for banks and microfinance institutions provided by the EIB Investment Facility).

More specific information related to these activities can be obtained at: http://ec.europa.eu/europeaid/what/development-policies/intervention-areas/epas/epas_en.htm

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PART 3: ANNUAL INVENTORY SUBMISSION (EU-28)

16 INTRODUCTION (EU-28)

This part of the EU GHG inventory report includes data for the EU-28 Member States. The EU-28 Member States are (new MS are marked with n): Austria, Belgium, Bulgaria (n), Croatia (n), Cyprus (n), the Czech Republic (n), Denmark, Estonia (n), Finland, France, Germany, Greece, Hungary (n), Ireland, Italy, Latvia (n), Lithuania (n), Luxembourg, Malta (n), the Netherlands, Poland (n), Portugal, Romania (n), Slovakia (n), Slovenia (n), Spain, Sweden and the United Kingdom. As the relevant information for the EU-15 Member States was given in part 1 of this report, this part provides information for the 13 new Member States. The relevant tables for the new Member States are included in this part as well as more detailed information on the 20 largest key categories. The general description of institutional arrangements at EU level are also included in part 1.

16.1 Institutional arrangements and inventory preparation

Table 16.1 shows the main institutions and persons involved in the compilation and submission of the new Member States' inventories.

Table 16.1 List of institutions and experts responsible for the compilation of new Member States' inventories and for the preparation of the EU inventory

Member State/EU institution	Contact address
Bulgaria	Detelina Petrova Executive Environment Agency 136, Tzar Boris III Blvd. 1618 Sofia
Cyprus	Theodoulos Mesimeris Head of Climate Action Unit Department of Environment Ministry of Agriculture, Natural Resources and Environment 1498, Nicosia, Cyprus
Czech Republic	Ondrej Minovsky Czech Hydrometeorological Institute (CHMI) Na Sabatce 17, CZ 14306 Prague 4
Estonia	Karin Radiko Ministry of the Environment Narva mnt 7a, 15172 Tallinn, Estonia Anne Mändmets Ministry of the Environment Narva mnt 7a 15172 Tallinn, Estonia
Hungary	László Gáspár Ministry of Environment and Water, department of Climate Policy Fõ u. 44-50, Budapest, 1011 Hungary
Latvia	Agita Gancone Ministry of Environmental Protection and Regional Development LV – 1494
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT 01105 Vilnius
Malta	Krista Rizzo

Member State/EU institution	Contact address
	Malta Resources Authority – Climate Change Unit Millennia, 2nd Floor, Aldo Moro Road, Marsa MRS 9065, Malta.
Poland	Anna Olecka National Centre for Emissions Management Institute of Environmental Protection - National Research Institute Chmielna 132/134, 00-805 Warszawa, PL
Romania	Sorin Deaconu Ministry of Environment and Climate Change Libertăţii Boulevard no. 12, Sector 5, Bucharest,
Slovakia	Janka Szemesova Department of Emissions, Slovak Hydrometeorological Institute Jeseniova 17, 833 15 Bratislava, Slovak Republic
Slovenia	Tajda Mekinda Majaron Environmental Agency of the Republic of Slovenia Vojkova 1/b, SI-1000 Ljubljana

Table 16.2 summarises the information on national systems/institutional arrangements in the new EU Member States.

Table 16.2 Summaries of institutional arrangements/national systems of new Member States

MS	Institutional arrangements/national systems	Source
Bulgaria	The Bulgarian National Inventory System (BGNIS) is developed following the requirements of the provisions of Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol. The legal, institutional and procedural arrangements within the BGNIS have been updated in 2010. Since 2008 the Executive Environment Agency (ExEA) is responsible for the whole process of inventory planning, preparation and management. Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The Bulgarian Government by MoEW (Climate Change Policy Directorate) has the political responsibility for compliance with commitments under the UNFCCC and the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol. In order to meet all challenges in this sphere, the Climate Change Policy has been transformed in a separate directorate and its staff has been increased with 6 experts. Now, it consists of 10 persons in total. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The Bulgarian Government by MoEW has the political responsibility for compliance with commitments under the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol: National Focal Point; QA exeperts from Climate Change Policy Directorate and Air Protection Directorate; Approval of inventory; Submission of CRF / NIR / Kyoto Tables / SEF. The ExEA has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity. ExEA has the technical responsibility for the national inventory: acts as National Inventory Compiler (supervises inventory preparation process); manages BGNIS; compiles CRF tables and NIR; coordinates the work of engaged consultants for supporting inventory; coordinates and implements the activity of National QA/QC Plan; National Inventory Focal Point. In order to strengthen the institutional arrangements and to fulfil the required general and specific functions of BGNIS the official agreements between MoEW and the main data providers were signed in 2010: • National Statistical Institute (RD21-35/12.02.2010); • Ministry of Agriculture and Food and its body Executive Forest Agency (04-00-517/26.02.2010 and RD 50-47/15.03.2010); • Ministry of Economy and Energy (14/06/2010); • Ministry of Interior (MI) (08/06/2010). The ExEA coordinates all activities, related to collecting inventory data of GHG emissions by the following authorities: 1. National Statistics Institute (NSI); 2. Ministry of Agriculture and Food (MAF) and their relevant services (Agrostatistic Directorate and Executive Forestry Agency); 3. Ministry of Economy, Energy and Tourism (MEET); 4. Ministry of Interior (MI); 5. Ministry of Environment and Water (MoEW); 6. Ministry of Transport, Information Technologies and Communications (MTITC). Other arrangement of the Bulgarian National Inventory System 7. Large industrial plants; 8. Branch Business Associations	Short NIR of GHG emissions in Republic Bulgaria 1988-2012 Jan 2014 pp 2 ff.

MS	Institutional arrangements/national systems	Source
Croatia	Institutional arrangement for inventory preparation in Croatia is regulated in Part II of the Regulation on the Monitoring of Greenhouse Gas Emissions, Policies and Mitigation Measures in the Republic of Croatia entitled National system for the estimation and reporting of anthropogenic greenhouse gas emissions by sources and removals by sinks. Institutional arrangements for inventory management and preparation in Croatia could be characterized as decentralized and out-sourced with clear tasks breakdown between participating institutions including Ministry of Environmental and Nature Protection (MENP), Croatian Environment Agency (CEA) and competent governmental bodies responsible for providing of activity data. The preparation of inventory itself is entrusted to Authorised Institution which is elected for three year period by public tendering. MENP is a national focal point for the UNFCCC, with overall responsibility for functioning of the National system in a sustainable manner, including: - mediation and exchange of data on greenhouse gas emissions and removals with international organisations and Parties to the Convention; - mediation and exchange of data with competent bodies and organisations of the European Union in a manner and within the time limits laid down by legal acts of the European Union; - control of methodology for emission calculation and greenhouse gas removal in line with good practices and national circumstances; - consideration and approval of the Greenhouse Gas Inventory Report prior to its formal submission to the Convention Secretariat. CEA is responsible for the following tasks: - organisation of greenhouse gas inventory preparation with the aim of meeting the due deadlines referred to in Article 12 of this Regulation; - collection of activity data referred to in Article 11 the Regulation; - development of quality assurance and quality control plan (QA/QC plan) related to the greenhouse gas inventory in line with the guidelines on good practices of the Intergovernmental Panel on Climate Change; - implementation of the quality assurance procedure with regard to the greenhouse gas inventory in line with the quality assurance and quality control plan; - archiving of activity data on calculation of emissions, emission factors, and of documents used for inventory planning, preparation, quality control and quality assurance; - maintaining of records and reporting on authorised legal persons participating in the Kyoto Protocol flexible mechanisms; - selection of Authorised Institution (in Croatian: Ovlaštenik) for preparation of the greenhouse gas inventory. - provide insight into data and documents for the purpose of technical reviews. Authorised Institution is the responsible for preparation of inventory. EKONERG – Energy and Environmental Protection Institute was selected as Authorised Institution for preparation of 2014 inventory submission.	National Inventory Report 2013, Croatian GHG inventory for the period 1990-2012, Mar 2014 pp.XXI-XXII
Cyprus	The Ministry of Agriculture, Natural Resources and Environment (MANRE) is the governmental body responsible for the development and implementation of the majority of the environmental policy in Cyprus. Moreover, the MANRE is responsible for the coordination of all involved ministries, as well as any relevant public or private organisation, in relation to the implementation of the provisions of the European legislation associated with climate change. In this context, the MANRE has the responsibility for the planning, preparation, management, compilation of the national GHG inventory report (The preparation of the Cypriot GHG emissions inventory is based on the application of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, as elaborated by the IPCC good practice guidance. The compilation of the inventory is completed in three main stages. The first stage consists of data collection and checks for all source / sink categories. The main data sources used are the National Statistical Service, the national energy balance, the government ministries / agencies involved, along with the verified reports from installations under the EU ETS. Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. National Statistical Service, EU ETS reports and energy balance) as well as time-series assessment in order to identify changes that cannot be explained. In cases where problems and / or inconsistencies are identified, the agency's representative, responsible for data providing, is called to explain the inconsistency and / or help solving the problem.	National GHG Inventory Report 1990-2012 Submission Mar 2014, p 11

MS	Institutional arrangements/national systems	Source
Czech Republic	The arrangement of institutions co-operating in the national GHG inventory is given by National Inventory System - NIS, which was established in accord with Decision 280/2004/EC, Article 4.4. This system accepted the rules from Resolution 20/CP.7 (FCCC/CP/13/Add.3) that was approved by COP/MOP-1 in Montreal, December 2005. The relevant information is given in the Czech Republic's Initial Report under the Kyoto Protocol, which was sent to European Commission (June 2006) and to UNFCCC (October 2006) In the Czech Republic, the Ministry of the Environment (MoE) is the national entity with overall responsibility for the NIS. The Czech Hydrometeorological Institute (CHMI), founded by the MoE, is designated as the coordinating and managing organisation responsible for the compilation of the national greenhouse gas inventory and reporting its results. In addition, the MoE provides additional specific financial resources for the NIS performance to the CHMI. The representative of CHMI for the NIS is Mr. Ondrej Minovsky (ondrej.minovsky@chmi.cz). The main roles and responsibilities of the CHMI are: inventory management, general and cross-cutting issues, QA/QC, reporting data (CRF), preparation of NIR, communication with the relevant UN FCCC and EU bodies, etc. Sectoral inventories are prepared by specialized institutions (sectoral compilers), which are coordinated and controlled by the CHMI. The responsibilities for the GHG inventory compilation from individual sectors are allocated as follows: KONEKO marketing, Ltd. (KONEKO), with responsibility for the inventory compilation in the Energy sector, in particular for stationary sources and fugitive emissions; The Transport Research Centre (CDV), with responsibility for the inventory compilation in the Energy sector, in particular for mobile sources; The Czech Hydrometeorological Institute (CHMI), with responsibility for the inventory compilation in the Industrial Processes and Product Use sectors; The Institute of Forest Ecosystem Research (IFER), with responsibility for the inventory compilation in the Agriculture and Land Use, Land Use Change and Forestry sectors; Charles University Environment Centre (CUEC), with responsibility for the inventory compilation in the Waste sector. The official submission of the National GHG Inventory is prepared by the CHMI and approved by the MoE. Moreover, the MoE secures contacts with other relevant governmental bodies, such as the Czech Statistical Office (CSO), the Ministry of Industry and Trade (MoIT) and the Ministry of Agriculture (MoA).	National GHG Inventory Report 2014 of the Czech Republik Jan 2014 p 19-20
Estonia	Single national entity with overall responsibility for the Estonian greenhouse gas inventory is MoE. The inventory is produced in collaboration between the MoE, EERC, EEIC and TUT. The MoE is responsible for: Coordinating the overall inventory preparation process; Approving the inventory before official submission to the UNFCCC; Reporting the greenhouse gas inventory to the UNFCCC, including the National Inventory Report and CRF tables; Concluding the formal agreements with inventory compiler (EERC); Coordinating the cooperative work between the inventory compilers and UNFCCC Secretariat; Informing the inventory compilers about the requirements of the national system and ensuring that existing information in national institutions is considered and used in the inventory where appropriate; Informing the inventory compilers about new or revised guidelines; Preparation of the UNFCCC inventory reviews and coordinating the communication with the expert review team, including responses to the review findings; Coordinating the UNFCCC inventory reviews. Climate Department in EERC is responsible for: Compiling the National Inventory Report according to the parts submitted by the inventory compilers; Coordinating of the implementation of the QA/QC plan; Coordinating the inventory process; Overall archiving system. The EERC is responsible for preparing the estimates for the energy, industrial processes, solvents and other product use, agriculture and waste sectors. The Forest Monitoring Department of the Estonian Environment Agency is responsible for LULUCF and KP LULUCF estimates. All experts collect activity data, estimate emissions and/or removals, implement QC procedures, fill in sectoral data to the CRF Reporter and prepare the sectoral parts of the NIR. Experts are also responsible for archiving activity data, estimates and all other relevant information according to the archiving system.	Greenhouse Gas Emissions in Estonia 1990-2012 Jan 2014 p 18

MS	Institutional arrangements/national systems	Source
Hungary	The minister responsible for the environment has overall responsibility for the Hungarian Greenhouse Gas Inventory and the Hungarian National System for Climate Reporting. He is responsible for the institutional, legal and procedural arrangements for the national system and the strategic development of the national inventory. Since the Ministry of Environment and Water had been abolished after the elections in spring 2010, and its tasks have been taken over by the Ministry of Rural Development, the designated single national entity is now the Ministry of Rural Development. As a new feature, the national system has to be operated by the minister responsible for the environment like earlier but, as prescribed by legislation, in consent and cooperation with the ministers responsible for energy policy and forest management. Within the Ministry of National Development, i.e. the ministry responsible for energy policy, a Climate Policy Department has been established that plays some coordinating and supervisory role in the national system. The head of this department is Hungary's current UNFCCC Focal Point. At the end of 2006, a Greenhouse Gas Inventory Division (GHG division) was established inthe Hungarian Meteorological Service (OMSZ) for the preparation and development of theinventory. This division is responsible for all inventory related tasks, compiles thegreenhouse gas inventories and other reports with the involvement of external institutionsand experts on a contractual basis and supervises the maintenance of the system. At the very end of 2009, a new government decree 345/2009 (XII.30.) on data provision relating to GHG emissions was put into force. This decree confirmed the designation of the Hungarian Meteorological Service as the compiler institute. As a new element, the participation of the Forestry Directorate of the National Food Chain Safety Office (NFCS, Forestry Directorate, formerly known as Central Agricultural Office) together with the National Agricultural Research and Innovation Centre (hereafter referred to as NARIC) Forest Research Institute is formalized by this decree. These two institutes are responsible for the forestry part of the LULUCF sector and for the supplementary reporting on LULUCF activities under Articles 3.3 and 3.4 of the Kyoto Protocol by making recommendations to HMS of the content of the inventory. The govt. decree had to be revised according to the changing EU regulations and reporting needs. Therefore Govt. Decree 345/2009 (XII.30) is now replaced by Govt. Decree 528/2013 (XII.30.). The Hungarian Meteorological Service is a central office under the control of the Ministry of Rural Development. The duties of the Service are specified in a Government Decree from 2005. The financial background of operation is determined in the Finances Act. OMSZ has introduced the quality management system ISO 9001:2000 for the whole range of its activities in 2002 to fulfill its tasks more reliably and for the better satisfaction of its partners. The GHG Inventory Division functions as part of the Climate and Atmospheric Environment Department. The GHG division of the Hungarian Meteorological Service coordinates the work with other involved ministries, government agencies, consultants, universities and companies in order to be able to draw up the yearly inventory report and other reports to the UNFCCC and the European Commission. The GHG division can be regarded as a core expert team of four people. The division of labor and the sectoral responsibilities within the team are laid down in the QA/QC plan and other official documents of OMSZ. The Head of Division coordinates the teamwork and organizes the cooperation with other institutions involved in inventory preparations. He is responsible for the compilation of CRF tables and NIR. Within the team the experts are responsible for different sectors. Besides, a QA/QC coordinator and an archive manager have been nominated. Some parts of the inventory (mainly energy, industrial processes and waste are prepared by the experts of the GHG division themselves. The calculations of agriculture and LULUCF (except forestry) sector are compiled by the HMS with contribution of external experts / institutions on contractual basis as follows. The forestry related parts are compiled by the Forestry Directorate of the National Food Chain Safety Office and the NARIC Forest Research Institute as laid down by the above mentioned government decree. For the calculation of emissions from agricultural soils the Karcag Research Institute of University of Debrecen (Department of Soil Utilization and Rural Development) was contracted like in the last three years. Szent István University, Gödöllı had been heavily involved in the calculations for the agriculture sector of the inventory for several years.	National Inventory Report for 1985-2012, Hungary (Draft Excerpts) Jan 2014 pp 11-12

MS	Institutional arrangements/national systems	Source
Latvia	Ministry of the Environmental Protection and Regional Development of the Republic of Latvia (MEPRD) Climate Policy and Technology Department coordinate policy related to climate change and renewable energy in Latvia as well as are designated single national entity with overall responsibility for the Latvian GHG inventory. The MEPRD is responsible for: •Preparation of legal basis for maintaining the National System; •Informing the inventory compilers about requirements of the national system; •Overall coordination of GHG inventory process (including compilation of the final NIR and CRF, approval of QA/QC plan and procedures); •Final checking and approving of the GHG inventory before official submission to the EC and UNFCCC; •Timely submission of GHG inventory to the UNFCCC and Europen Commission; •Formal agreements with inventory experts and for experts that evaluate quality assurance process; •Coordinating the work between the involved institutions, experts, Europen Commission and UNFCCC (including coordination of the UNFCCC inventory reviews); •Keeping of archive of official submissions to UNFCCC and Europen Commission (starting from 2012 submission). The Latvian Environment, Geology and Meteorology Centre (LEGMC) is a governmental limited liability company and is responsible for collecting of activity data (activity data are mainly collected from other institutions and LEGMC (Air and Climate division, Chemicals and Hazardous Waste division, Inland Waters division) uses them to calculate emissions), preparation of the emission estimates for the Energy, Industrial Processes, Solvent and Other Product use and Waste sectors, preparation of QC procedures for relevant categories and documentation and archiving of used materials for emission calculation. LEGMC Air and Climate division compile the final NIR using information from all involved institutions as well as summarized emission data in CRF Reporter. Calculations of removals and emissions for the LULUCF sector were done by Latvian State Forest Research Institute "Silava" in collaboration with MoA. "Silava" is responsible for collecting of activity data, preparation of the removals/emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. Institute of Physical Energetic (IPE) calculates emissions for Transport sector according to agreement with MEPRD. IPE is responsible for collecting of activity data, preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. Emissions from Agriculture sector were done by Latvia University of Agriculture in collaboration with MoA. Latvia University of Agriculture is responsible for collecting of necessary activity data (cooperating with CSB), preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. The main data supplier for the Latvian GHG inventory is the Central Statistical Bureau of Latvia (CSB). Mainly MEPRD, LEGMC, IPE, Latvia University of Agriculture contacted with five CSB experts.	Latvia's National Inventory Report 1990-2012 Jan 2014 p 37ff.
Lithuania	The main entities participating in GHG inventory process are: - Ministry of Environment - Environmental Protection Agency - State Forestry Service - National Climate Change Committee - Permanent GHG inventory working group - Data providers - External consultants The Ministry of Environment is responsible for: Overall coordination of GHG inventory process; Preparation of legal basis necessary for National System functioning; An official consideration and approval of GHG inventory; Approval of QA/QC plan and procedures; Timely submission of GHG inventory to UNFCCC Secretariat and European Commission; Coordination of the UNFCCC inventory reviews in Lithuania; Keeping of archive of official submissions to UNFCCC and European Commission; Informing the inventory compilers about relevant requirements for the national system. Before final submission to the UNFCCC Secretariat and the European Commission, National Inventory Report is forwarded to the National Climate Change Committee for the comments and final approval. The National Committee on Climate Change was set up in 2001 in the first instance and renewed in January 2013. It consists of experts from government, academia and non-governmental organizations (NGOs) and has an advisory role.	Draft National GHG Emission Inventory Report 2014 of the Republic of Lithuania (Reported Inventory 1990 – 2012) Jan 2014 P 22ff.

MS	Institutional arrangements/national systems	Source
Malta	The inventory reporting requirements under EU legislation, and then also under Annex I status, made it necessary to establish a process whereby annual inventory reporting could be fulfilled. The Malta Environment and Planning Authority was initially entrusted to take on this obligation, subsequently followed up by a migration of this and other climate action responsibilities to the Malta Resources Authority (MRA) as of 2010, following a change in Ministerial portfolios at the time. Thus, the Climate Change Unit at MRA is currently responsible for the preparation of the national GHG inventory, including this submission. Political ownership of the national GHG inventory is invested on the Ministry responsible for climate change action and policy, previously the Ministry of Resources and Rural Affairs (MRRA), and as of March of this year, the Ministry for Sustainable Development, Environment and Climate Change (MSDEC). The approval of the report prior to submission is a shared responsibility between the Ministry responsible for climate change affairs and the EU Secretariat (previously within the Office of the Prime Minster and as of March 2013, within the Ministry for European Affairs and the Implementation of the Electoral Manifesto).	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2012 Jan 2014 pp 4-7
Poland	The Act on the system to manage the emissions of greenhouse gases and other substances (Journal of Laws No 130 item 1070) established a legal base to manage national emission cap for greenhouse gases or other substances in a way that should ensure that Poland complies with EU and international commitments and will allow for cost-effective reductions of pollutant emission. The area of work specified in the act, carried out by the National Centre for Emissions Management (Krajowy Ośrodek Bilansowania i Zarządzania Emisjami – KOBiZE), include: - carry out tasks associated with functioning of the national system to balance and forecast emissions, including managing a national database on greenhouse gas emissions and other substances, - elaborate methodologies to estimate emissions for individual types of installations or activities and methodologies to estimate emission factors per unit of produced good, fuel used or raw material applied, - elaborate emission reports and forecasts (projections) for air pollutants, - manage the national registry for Kyoto Protocol units, - manage the list of JI projects in Poland for which the letters of endorsement or approval have been issued, - administration of Emission Trading Scheme. The Minister responsible for issues related to the environment supervises the carrying out of tasks by KOBiZE. The emission calculation, choices of activity data, emission factors and methodology are performed by Emission Balancing and Reporting Unit (ZBIRE) in the National Centre for Emissions Management. The national Centre is collaborating with a number of individual experts as well as institutions when compiling inventories. Among the latter are: Central Statistical Office (GUS), Agency of Energy Market (ARE), Institute of Ecology of Industrial Areas in Katowice (IETU), Motor Transport Institute (ITS) as well as Office for Forest Planning and Management (BULGiL). These institutions are mainly involved in providing activity data for inventory estimates. The experts of the National Centre have access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This verified data is included in GHG inventory for some IPCC subcategories (e.g. in some subsectors in industrial processes). Prior to submission the elaborated inventories undergo internal process for the official consideration and approval. The responsibility for approval GHG inventories lies on the Minister of Environment.	Information based on Poland,s National Inventory Report 2012 March 2014 p. 18

MS	Institutional arrangements/national systems	Source
Romania	The Governmental Decision (GD) no. 668/2012 for modifying and completing the GD no. 1570 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels from sources and removals by sinks (NS), adopted in 2007, and the subsequent relevant procedures, and, respectively, the GD no. 48/2013 on the organization and functioning of the Ministry of Environment and Climate Change and for modifying some environment protection and climate change domain related legal acts are regulating all the institutional, legal and procedural aspects for supporting the Romanian authorities to estimate the greenhouse gas emissions/removals levels, to report and to archive the National Greenhouse Gas Inventory (NGHGI) information, including supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol. In this respect, the GD no. 48/2013 also modified the GD no. 1570/2007. The main objective of the Governmental Decision no. 1570/2007, as ulteriorly modified and completed, is to ensure the fulfillment of the relevant provisions and the obligations of Romania under the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol (KP) and the European Union legislation. The elements characterizing the institutional arrangements comprise: - according to the Governmental Decision no. 1570/2007 as ulteriorly modified and completed, the single national entity with overall responsibility for the national inventory, including with the responsibilities of administrating the NS and of preparation and management of the NGHGI, is the Ministry of Environment and Climate Change (MECC). Before 1 April 2013, the competent authority was the National Environmental Protection Agency (NEPA), under the subordination of the MECC. Based on the GD no. 48/2013, all NEPA climate change related structure, personnel, attributions and responsibilities were took over by MECC, in order to improve the institutional arrangements and capacity within the climate change domain, thus increasing the efficiency in activities implementation also in respect to the NS/NGHGI administration. - central and territorial public authorities, research and development institutes and other public organizations under the authority, in the subordination or in the coordination of central public - authorities, owners and professional associations, economic operators and other relevant organizations have the obligation of providing to MECC the necessary activity data, emission factors and associated uncertainty data; - the main activity data supplier is the National Institute for Statistics through the yearly-published documents as the National Statistical Yearbook and the Energy Balance and other documents; the characteristics of the institutional arrangements include: - centralized approach – MECC maintain a large degree of control and decision making authority over the inventory preparation process; - in-sourced approach, in majority – the major part of the inventory is prepared by MECC (governmental agency); - single agency – the single national entity is housed within a single governmental organization; - separate approach – the NGHGI related work is not integrated with other air pollutant inventories work; however, cross checking activities are periodically implemented.	Information pursuant Article 4.1 (a) of Decision 166/2005/EC Institutional arrangements Jan 2014 p 1ff

MS	Institutional arrangements/national systems	Source
Slovakia	The National Inventory System of the Slovak Republic (http://ghg-inventory.shmu.sk/) has been established and officially announced by Decision of the Ministry of the Environment of the Slovak Republic on 1st January 2007 in the official bulletin: Vestnik, Ministry of Environment, XV, 3, 2007. In agreement with paragraph 30(f) of Annex to Decision 19/CMP.1 which gives the definitions of all qualitative parameters for the national inventory systems, the description of quality assurance and quality control plan according to Article 5, paragraph 1 is also required. The revised report of the National Inventory System dated on November 2008 was focused on the changes in the institutional arrangement, quality assurance/quality control plan and planned improvements. The regular update of the National Inventory System with all qualitative and quantitative indicators is providing in the National Inventory Reports and was also provided in the Sixth National Communication of the SR on Climate Change, published in December 2013. The Ministry of the Environment of the Slovak Republic (MZP) (http://www.minzp.sk/) is responsible for implementation of national environmental policy including climate change and air protection. It serves also as the National Focal Point to the UNFCCC. It has the responsibility to develop strategies and further instruments of implementation, such as acts, regulatory measures, economic and market based instruments for cost efficient fulfilment of adopted goals. Both, the conceptual documents as well as legislative proposals are always annotated by all ministries and other relevant bodies. Following the commenting process, the proposed acts are negotiated in the Legislative Council of the Government, approved by the Government, and finally by the Slovak Parliament. The Ministry of the Environment of the Slovak Republic is the main body to ensure conditions and to monitor progress of Slovakia in fulfilment of all commitments and obligations in climate change and adaptation policy. According to the Governmental Resolution No 821/2011 from 19th December 2011, the inter-ministerial High Level Committee on Coordination of Climate Change Policy was established. This Committee is created at the state secretary level and will replace previous coordinating body, i.e. the High Level Committee on Climate-Energy Package established in August 2008. Committee is chaired by the State Secretary of the Ministry of Environment, other members are the state secretaries of the Ministry of Economy, Ministry of Agriculture and Rural Development, the Ministry of Transport, Construction and Regional Development, the Ministry of Education, Science, Research and Sport, the Ministry of Health, the Ministry of Finance, the Ministry of Foreign Affairs and the Head of the Regulatory Office for the Network Industries. allowance trading are given to the MZP and the regional and district environmental offices. The Slovak Hydrometeorological Institute (the SHMU) www.shmu.sk is authorised by the Ministry of the Environment of the Slovak Republic to provide environmental services, including annual GHG inventories according to the approved statute (http://www.shmu.sk/File/statut.pdf). The range of services, competencies, time schedule and financial budget are updated and agreed annually. All details of the SHMU activities are described in the Plan of Main Tasks. The plan, commented by all stakeholders is after approval published at the website of the SHMU http://www.shmu.sk/File/2014_SHMU_Kontrakt.pdf. Deadline for the approval of this plan by the ministry is 31st December each year.	Slovak Republic Annual Report 2014 Mar 2014 p 21 f

MS	Institutional arrangements/national systems	Source
Slovenia	In Slovenia, the institution responsible for GHG inventories is the Slovenian Environment Agency (ARSO). In accordance with its tasks and obligations to international institutions, the Slovenian Environmental Agency is charged with making inventories of GHG emissions, as well as emissions that are defined in the Convention on Long Range Transboundary Air Pollution within the specified time limit. In making the inventories, the Environmental Agency cooperates with numerous other institutions and administrative bodies which relay the necessary activity data and other necessary data for the inventories. The chief sources of data are the Statistical Office of the Republic of Slovenia (SORS) and the Ministry of Environment and Spatial Planning; however, the Environmental Agency obtains much of its data through other activities which it performs under the Environmental Protection Act. Emissions from Agriculture are calculated in cooperation with the Slovenian Agriculture Institute (KIS), and sinks in the LULUCF sector are calculated by the Slovenian Forestry Institute (GIS). A Memorandum of Understanding has been concluded with institutions that participate in inventory preparation, binding these institutions to submit quality and verified data to the Environmental Agency in due time, because the time limits for inventories and the NIR have shortened with the entry of Slovenia into the EU, since inventories and part of the NIR for the year before last must be made by 15 January, and with corrections and final submission of the NIR by 15 March. In view of this, an agreement has been reached with the participating institutions to shorten the time limits for submitting data. For reasons of complexity, attention was mostly focused on the Joint Questionnaires of the Statistical Office of the Republic of Slovenia, on the basis of which the Statistical Office produces the Energy Balance of the Republic of Slovenia, wherein the most important data on the energy sector are to be found. Experts from the Slovenian Forestry Institute and the Agricultural Institute of Slovenia work on GHG inventories according to the standing rules of institutes (ordinance). Financing is assured by governmental institutions according to the yearly work plan. All data from external institutions are submitted to the Slovenian Environmental Agency, where they are archived. The detailed process from gathering data to emissions calculation and reporting is described in the Manual of Procedures, which was prepared in 2005 and has been further updated in 2009. The QA/QC plan as part of the Manual was developed and mostly implemented in 2009. In 2014 a new QA/QC Plan and a new Manual of procedures which will include also a new methodologies described in the 2006 IPCC Guidelines is under preparation.	Slovenia's National Inventory Report 2014 Jan 2014 p 7-9

16.2 General description of methodologies and data sources used

16.2.1 The compilation of the EU GHG inventory

The EU inventory is compiled in accordance with the recommendations for inventories set out in the *'UNFCCC guidelines for the preparation of national communications by parties included in Annex 1 to the Convention, Part 1: UNFCCC reporting guidelines on annual inventories'* (FCCC/SBSTA/2004/8), to the extent possible. In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. Finally, for the compilation of the EU GHG inventory, the Monitoring Mechanism Regulation and its implementing legislation is applicable.

The EU-28 GHG gas inventory is compiled on the basis of the inventories of the 28 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 28 Member States. This is also valid for the base year estimate of the EU-15 as fixed in the initial review report (which is included in part 1). Table 16.3 shows the base year emissions for the new EU Member States.

All EU Member States are Annex I parties to the UNFCCC. Malta acceded to Annex I status under the UNFCCC in October 2010 and Cyprus in January 2013; however, no quantified emissions limitation or reduction target is inscribed for Malta and Cyprus in Annex B to the Kyoto Protocol. Therefore, all Member States have committed themselves to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April. In addition, all Member States are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the Commission by 15 January every year under the MMR.

Table 16.3 Base year emissions for the new Member States

New MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (Tonnes CO_2 equivalents)
Bulgaria	1988	1995	132 618 658
Croatia	1990	1990	31 321 790
Cyprus	Not relevant	Not relevant	
Czech Republic	1990	1995	194 248 218
Estonia	1990	1995	42 622 310
Hungary	1985-87	1995	115 397 149
Latvia	1990	1995	25 909 160
Lithuania	1990	1995	49 414 386
Malta	Not relevant	Not relevant	
Poland	1988	1995	563 442 774
Romania	1989	1989	278 225 022
Slovakia	1990	1990	72 050 764
Slovenia	1986	1995	20 354 042

1) Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.
Source: Initial review reports of the new Member States (www.unfccc.int)

16.2.2 Use of data from EU ETS for the purposes of the national GHG inventories in EU Member States

16.2.2.1 Bulgaria

General

A total of 161 operators have provided their verified CO_2 emissions required under the EU ETS for the years 2007-2012. These emissions have been incorporated in the inventory as far as posssible. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Energy

- Data from the verified ETS reports was analysed in order to use a Tier 2 methodology for emission calculations. From all the operators, in 2012 only the largest 22 plants use plant specific methodologies, so it was possible to derive country specific EFs for the major solid fuels only. These country-specific emission factors are derived from the verified ETS reports as a weighted average from all operators, which have declared that they have used plant-specific emission factors (Tiers 2b or 3 according to the Methodology for monitoring GHG emissions of operators participating in the ETS). The EFs are calculated as the total sum of the verified CO_2 emissions divided by the total amount of the respective fuel as reported by the operators. For the years 2007 to 2012 are applied the respective annual emission factors and for the years 1988 to 2006 is applied an average EF, calculated as a weighted average.
- Up to the 2011 submission, the country specific factors were recalculated as a weighted average from the available ETS reports of the full time series. From the 2012 submission on, the country specific emission factors for the years 2007, 2008, 2009 and 2010 and applied for the years 1988-2006, while for the years after 2007 is used the respective EF.
- Since it was found that the use of alternative fuels (industrial waste) is not reported in the energy balances for the full time series, the reports provided by the plant operators according to the Bulgarian waste legislation and the ETS reports were used, in order to calculate the GHG from waste incineration in the cement plants.

- For the country-specific EFs for solid fuels were used the ETS verified reports, which have much lower uncertainty. Nevertheless, the conditions in which solid fuels are burnt are very different, especially considering the oxidation factors for solid fuels in households could cause higher uncertainty.
    - 1A2 Manufacturing industries and production: There is a specific case for other fuels used in the cement industry, for which a separate calculation model was developed. Due to the fact that all cement plant participate in the ETS, their verified reports were used in order to calculate the country-specific EFs for the following fuels: SRF/RDF, Waste oils, Tyres, Filters, Biomass.

Industrial Processes

In some categories emission and production data were reported directly by industry or ETS, IPPC and/or E-PRTR reports thus represent plant and country specific data. Verified CO_2 emissions reported under the EU ETS were available for the years 2007-2012. These emissions have been incorporated in the inventory as far as possible. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Emission estimations as well as activity data and emission factors are compared with EU ETS verified emission reports, IPPC reports as well as E-PRTR reports where available.

- 2A1 Cement Production: All 5 plants are covered by the EU ETS and the IPPC Directive and have been modernized accordingly during the last 10 years. One from the 5th existing/operational installation was the decrease substantially its production during 2010. In 2011 this factory completely ceases operation and all equipment is decommissioned. At present there are only 4 operating plants. The 2012 CO_2 emissions are taken from the operators EU ETS reports. In their reports CaCO3, MgCO3 and other carbonates content in the raw materials used is taken into account. As a part from the QA activities the aggregated national clinker production data provided by the NSI were compared with the production data reported by the cement plants in the annual reports for compliance with their IPPC permits (EPRTR data), as well as in their verified emission reports within the EU ETS.
- 2A2 Lime Production: Currently there are 5 lime producing plants in Bulgaria which fall under IPPC and EU ETS. They produce quicklime.
- 2A4 Soda Ash Production and Use: Source specific QA/QC and verification: Emissions from soda ash used in glass production (calculated by plants in the EU ETS reports) and using the mass balance approach are compared.
- 2A7 Glass Production: Currently there are six glass plants in Bulgaria mainly producing flat, container and domestic glass. All of them fall under EU ETS (except one plant) and IPPC. For the period 2007 - 2010 plant specific (for five plants) emission factors were calculated on the basis of data from IPPC and ETS reports. These emission factors were used to calculate an implied emission factor which was further used to recalculate the emissions for the rest of the time series. Plant specific activity data from IPPC and ETS reports are available for the years 2007 - 2012. Source specific QA/QC and verification: Revision of the activity data by using IPPC and EU ETS reports as well as statistical data. Development of country specific emission factor for glass production based on IPPC and ETS data.
- 2A7 Others (Ceramics Production): The CO_2 emissions from the verified ETS reports are used. These emissions are estimated taking into account the CaO and MgO content in the products. Country specific emission factor was calculated on the basis of data from ETS and IPPC reports of the operators. The ETS data used to estimate the EF take into account the CaCO3, MgCO3 in the used in the raw materials (clay). Source specific QA/QC and verification: ETS CO_2 emissions used for the emission factor estimation and recalculations.
- 2A7 Others Non-Specified (Desulphurisation): Currently there are five large combustion plants (LCP) in Bulgaria applying desulphurization for the flue gas cleaning with lime stone. Tier 2 method for the CO_2 emissions estimation is used. The CO_2 emissions estimated are taken from the LCP

operators EU ETS reports. The quantities of calcium carbonate (CaCO3) and magnesium carbonate (MgCO3) used for the estimations are also taken form the EU ETS reports thus allowing to take into account the pure carbonates used in the process. Plant specific activity data on the amount of carbonates use are obtained from EU ETS reports. EU ETS reports are used for source specific QA/QC and verification.

- 2B1 Ammonia Production: Currently ammonia is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and EU ETS.
- 2B2 Nitric acid Production: Currently nitric acid is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and ETS.
- 2B42 Carbide Production and Use: There is one carbide producing plant in Bulgaria. It reports under EU ETS and has an IPPC permit. EU ETS reports are used for source specific QA/QC and verification.
- 2C1 Iron and Steel Production: Electric steel making: The CO_2 emissions from the sector are calculated using country specific data from EU ETS reports. Country specific emission factor was developed for the EAF steel based on data from EU ETS reports for the period 2007 - 2011. In the calculation of ETS emissions the operators performed a mass balance of the Carbon content in the raw materials used and the produced end product. Country specific activity data from EU ETS reports as well as from BAMI and WSA on total crude steel production were received. Taking into account that plant specific activity data from EU ETS reports were used to estimate emissions an uncertainty of 5% is considered. Applying Tier 2 material-specific carbon contents would be expected to have an uncertainty of 10 percent for EF. This uncertainty is considered due to using EU ETS data. CO_2 emissions were taken from ETS reports for source specific QA/QC and verification

16.2.2.2 Croatia

Energy

- 1A2 Manufacturing Industries and Construction: Planned improvements: Since industries such as iron and steel industries, industries of non-ferrous metals, chemicals, pulp and paper, food processing, beverages and tobacco, construction and building material industries, petrochemical industries, are in ETS, verified annual emission report of each industrial plant are available. In verified annual emission reports there are available data about yearly fuel consumption and detailed fuel characteristics data (net calorific value) and plant-specific emission factors.

16.2.2.3 Cyprus

The main data sources used are the National Statistical Service, the national energy balance, the government ministries / agencies involved, along with the verified reports from installations under the EU ETS. Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. National Statistical Service, EU ETS reports and energy balance) as well as time-series assessment in order to identify changes that cannot be explained.

16.2.2.4 **Energy**

- 1A1 Energy Industries: There is only one electricity producing company in Cyprus (EAC), therefore the fuel consumption for public electricity and heat production was obtained from this one company. Detailed data on fuel consumption and other parameters are submitted annually by the installation since 2005 in compliance to the Emissions Trading System law (110(I)/2011). For the years 2005-2012, the CO_2 emissions as reported by the company in compliance with the ETS law have been used.
- 1A2 Manufacturing Industries and Construction: The main industrial activities that take place in Cyprus are food and beverage processing, cement and gypsum production, light chemicals (predominately pharmaceuticals), metal and wood products. Non-metallic minerals: The CO_2 emissions from pet-coke for the period 2005-2012 were used as reported for the ETS. Fuel

consumption of other bituminous coal for the period 2005-2011 was obtained in TJ from the annual ETS reports. The CO_2 emissions from other bituminous coal for the period 2005-2012 were used as reported for the ETS. The CO_2 emissions from solid biomass for the period 2005-2012 were used as reported for the ETS. Non-renewable waste data was available in TJ. Non-renewable waste is consumed by only one cement-producing installation, which has been submitting annual emissions' report according to the requirements of the ETS law 110(I)/2011, since 2005. The CO_2 emissions from non-renewable waste for the period 2005-2012 were used as reported for the ETS.Industrial Processes

- 2A1 Cement Production: For this submission it was decided to use the IPCC 1996 guidelines and GPG to estimate the emissions from cement production, regardless that installation specific data is available from the annual verified reports submitted by the installations included in the ETS, to maintain consistency in the method used for the whole period. the emissions estimated were compared to the verified emissions reported for ETS. The emissions from all the years were estimated using the implied emission factor from the process emissions reported for the ETS in 2005. The emissions for the period 2005-2011 remain the same: the emissions reported for the ETS are used.
- 2A7.2 Ceramics Production: The CO_2 process emissions from ceramics production were estimated following the methodology below:
  - (a) The activity data and CO_2 process emissions from the 8 ETS installations were tabulated. The years for which activity data and CO_2 emissions are available are 2001-2011. For 2001-2004 was data obtained during the preparation of the first national allocation plan of Cyprus and for 2005-2011 the data was obtained from the verified emissions reports submitted annually according to the ETS legislation.
  - (b) Dividing the total CO_2 process emissions of the ETS installations by the total production, the annual implied emission factor was estimated for the years 2005-2011.
  - (c) The activity data for the non-ETS installation for the years 2001-2011 was estimated by subtracting from the total annual production of ceramics obtained from the Department of Labour Inspection, the total annual production of the ETS installations collected from (a).
  - (d) The CO_2 process emissions of the non-ETS installation for 2001-2011 were estimated by multiplying the implied emission factor estimated in (b) by the annual production.
  - (e) For the years 1990-2000 the total annual ceramics production data was obtained from the Department of Labour Inspection. For the estimation of total CO_2 process emissions, the highest emissions factor of the estimated ETS annual implied emission factor was used (0.15988 tCO_2/t product in 2003).
- The reports for the ETS are prepared annually by the installations according to the EU regulations that are based on the IPCC methodologies.

16.2.2.5 Czech Republic

General

So far, data from the emission trading system has been used to only a limited degree in the Czech national greenhouse gas inventory (e.g. in the sector of Industrial processes - mineral products). It was recommended to the Czech inventory team during the recent "in-country review" that the data from EU ETS be used to a greater degree. For this purpose, the team began to prepare an "improvement plan" to provide for gradual inclusion of the relevant EU ETS data in the national inventory. At the present time, CHMI, in cooperation with MoE, is preparing a database of activities and emission data from the EU ETS system, which could be used in preparation of the national inventory. Consequently, it can be expected that these data will be employed more extensively only in future inventories. The main part of this "improvement plan" consists in gradual introduction of higher tiers into the national inventory. The sectoral QA/QC guarantor, in cooperation with the NIS coordinator, will assess the conditions for Tier 2 in the given sector (e.g. comparison with EU ETS data or with other independent sources).

Energy

- 1A Fuel combustion: The fuel consumption is taken from the energy balance of the Czech Republic and is transformed to the IPCC structure. Consumption of other kinds of fuels (Other Fuels) was taken from the national ETS system.
- 1A2f Other: In this year's submission, this subcategory also includes the combustion of other kinds of fuel (Other Fuels). Activity data and data on CO_2 production were taken from the national ETS system, while CH_4 and N_2O emissions were calculated using the default emission factors for solid and liquid fuels.
- QA/QC: QC procedures at the Tier 2 are included upon the suggestion of the QA/QC sectoral guarantor after the consultation with the NIS coordinator. They are aimed mainly at the comparison with independent data sources that are not based on data processing from the CzSO energy balance. The relevant independent sources in the Czech Republic are represented by data published and verified within the EU Emission Trading Scheme (ETS), from the national system REZZO, used for the registration of ambient air pollutants, and based mainly on data collection from individual plants.
- Source-specific planned improvements: Attention is constantly devoted to obtaining data from the ETS national database for use in performing QA/QC procedures. At the present time, the creation of this database is included in the plan of the Ministry of the Environment.

Industrial Processes

- 2A1 Cement Production: Since 2006 submission methodology equal to the Tier 3 has been employed. CO_2 emissions are based on data submitted by the cement kiln operators to the EU ETS system. EU ETS system covers all cement kiln operators in the Czech Republic. Information submitted directly by cement kiln operators is available for years 1990, 1996, 1998 - 2002 and 2005 - 2011. For these years, the emission factor value was derived from individual installation data collected for EU ETS (emissions) and from CCA data (activity data about production of clinker). For other years the EFs were interpolated. All operating cement plants in the Czech Republic are equipped with dust control technology and the dust is then recycled to the kiln. Only in one cement plant is a small part of the CKD discarded, for technical reasons. Use of dolomite or amount of magnesium carbonate in the raw material, as well as fissile carbon (C) content is known, all above mentioned variables are used for emissions estimates in the EU ETS system.
- 2A2 Lime Production: ETS data closely corresponds to the IPCC methodology and national circumstances. Two lime producers are not included in the EU ETS data. The calculations in the lime production category are based on data taken from the Czech Lime Association and EU ETS data are used for verification of the CO_2 emissions. The EU ETS reports are proved by independent verifiers. The country-specific emission factor was compared with the emission factors used by individual operators for the calculation.
- 2A3 Limestone and Dolomite Use: In 2005, these data was verified by comparison with data from the individual operators, which were collected for EU ETS preparation and which cover the years 1999 – 2005. The EU ETS data form has been used since 2006. Emissions from limestone and dolomite use in sintering plants were new source, in 2006 submission, which was identified in the process of preparation of the EU Emission Trading Scheme. Only 2 sintering plants have existed in the CR in recent times. CO_2 emissions from this category are calculated on the basis of data from statistics (The Steel Federation, Inc - production of agglomerate / sinter) and the EF value, which was derived from EU ETS CO_2 emission data based on the limestone and dolomite compositions and consumptions (0.08 t CO_2 / t sinter). The calculations in the limestone and dolomite use category are based on data taken from CzSO and EU ETS. The EU ETS data are verified by independent verifiers. CzSO has its own verification procedures employed before data is published.

- 2A7 Other: Emissions from 2A7.2 Brick and Ceramics Production are derived particularly from the decomposition of alkaline carbonates fossil and biogenic carbon based substances included in the raw materials. The EF value was derived from individual installation data collected for EU ETS (emissions) and from CzSO (production). The calculation is based on the total production of ceramic products (fine ceramics, tiles, roofing tiles, and bricks) and the EF value. It is planed to verify emission estimates with data form the EU ETS and other available sources.
- 2B5 Other: Production of Caprolactam: More exact data should be available in the coming years, when the N_2O emissions from the production of caprolactam will be continuously measured from 2012 as a consequence of inclusion of the production in the emission trading scheme (EU ETS) and thus recording in the relevant register.

Improvement plan

Improvement Plan also includes using of EU ETS data for the purposes of national inventory. Substantial effort is put into implementation of this issue. In this submission EU ETS data were used for emission estimates in some subcategories in 2A Mineral Product (e.g. 2A1 Cement Production). EU ETS data would be useful tool for QA/QC procedures also in Energy sector.

16.2.2.6 Estonia

The EU ETS reports' data can be used, in aggregated form, to draw source category specific conculsions regarding the completeness and consistency of the certain parts of the GHG inventories. Comparison of EU ETS emissions with emissions reported in national GHG inventory was carried out for year 2012. The results indicated that share of verified ETS emissions in stationary combustion (includes emissions of was about 79.8% in 2012. Share of verified ETS emissions in CRF category 2.A Mineral Products was about 100.0% in 2012.

Energy

In 2012 inventory submission Energy Sector CO_2 emissions and emission factors were compared against EFs used by European Union Emission Trading System (EU ETS) enterprises (for the year 2012) and with the total EU ETS emissions.

Industrial Processes

- 2A1 Cement Production: The emissions of last seven years (including 2011 emissions) have been compared with EU ETS data (as recommended by the UNFCCC review team). Differences between those two figures have been less than 0.1%.
- 2A2 Lime Production: The emissions from bigger plant (responsible more than 99% of the lime production emissions in Estonia) have been compared with EU ETS data. Differences have been less than 0.1% (2005–2012).

16.2.2.7 Hungary

Since the use of ETS data has several advantages, the inventory team was granted access to the verified emissions database held by the National Inspectorate for Environment, Nature and Water.

Energy

It is important to note first that no emission data are taken directly from the ETS database and put into the CRF as they are without analysis. Instead, facility level activity data (fuel use) and carbon emission factors are used from the ETS database to calculate weighted averages of the emission factors for different fuel types. These derived country specific EFs are then applied with the fuel use from the national energy statistics. Fuel uses in energy statistics and ETS are compared also to see whether the fuel use in a given category is fully covered by ETS plants or not.

- 1A1 Energy Industries: Energy consumption data were taken from the IEA annual questionnaires compiled by the Hungarian Energy and Public Utility Regulatory Authority. Besides, waste statistics and ETS data were taken into account. Traditionally, refinery gas and heavy fuel oil were reported together in the Hungarian Energy Statistical Yearbooks. Expressed in mass units, three-four times more refinery gas is used in the refinery as fuel oil. However, as the ETS data show, refinery gases have significantly different characteristics. Country specific OF and EF values – taken mostly from the ETS database – were used for most solid fuels and some liquids. It should be noted that only those measured factors were applied where the EU ETS covers all or most of the installation of the sector. For Hungary's calculations three main activity data sources were used: data from the Waste Incineration Works (FKF) of Budapest (1985-2012), the Hungarian Waste Management Information System (2004-2012) and the ETS data (2006-2012). The biggest co-incinerator plant is Mátra Power Plant. Since this plant reports its verified emissions in the framework of the European emission trading, direct ETS data relating its fuel use and CO_2 emissions were taken over. Verified energy use from EU ETS was compared to statistical data. It was noticed that data in metric tonnes are similar in the ETS to those in the statistics, but there are some differences in energy values due to different NCVs. Since the energy consumption in sectoral approach should be compared with those of reference approach, we kept the NCVs of energy statistics, however emission factors of coals were corrected for some years to achieve consistency in energy balance and verified emissions. In the inventory, emissions from natural gas were estimated using default calorific values and emission factors. For a justification of this approach, about 40 emission reports from the ETS had been analyzed. Using the same activity data as reported by these facilities, we have calculated CO_2 emissions with default parameters and compared our results with the reported CO_2 emissions from the ETS database. To be more consistent with the emissions reported under the ETS regime, Hungary has switched to country specific emission factors for 2010-2012. A comparison between ETS and inventory data was also made for the coking plant. The difference was higher here. As the main fuel consumption is related to public electricity and heat production, a comparison was also performed with independent dataset collected by the Hungarian Energy Office. For the main power plants the total fuel consumption's difference between the ETS and this dataset was around 1% in 2009. Recalculations: For emissions from blast furnace gas used for energy purposes emission factors, plant specific data were derived from the ETS database for 2006-2012, and their average value, i.e. 255.7 t CO_2/TJ, was used for the preceding years. Use of country-specific emission factor for natural gas for the years 2010-12 based on ETS data of larger power plants. Plant specific CO_2 emission factors based on ETS data has been introduced for natural gas for the years 2008-2012 also in petroleum refining. plant specific CO_2 emission factors based on ETS data has been introduced for natural gas in Manufacture of Solid Fuels and Other Energy Industries but only for the years 2010-2012.

- 1A2 Manufacturing Industries and Construction: Part of the emissions from waste incineration for energy purposes was allocated to this source category. Special attention was given to the four big cement factories, as they incinerate large amount of waste of fossil origin (plastics, rubber etc.). Their verified ETS data (emissions and fuel use) were analyzed, from which a specific emission factor was derived: 2.2 tonne CO_2/tonne fossil waste. This EF was used for the years 2004 and 2005 in case of fossil wastes. From 2006 on, ETS data (fuel consumption and emission) of the cement factories were used directly. CO_2 emission in the process of manufacturing bricks and ceramics is calculated using the verified emission reports (EU ETS) in the *Industrial Processes Sector.* For coke oven coke combusted by the iron and steel industry, where measured (by accredited laboratory) carbon content of fuels were available from the EU ETS ETS, the resulting carbon dioxide emission factor was 112.0 t CO_2/TJ in 2012 and the factory used an oxidation factor of 0.99. Country specific emission factors are used also in the non-metallic minerals category (based on ETS information). For this submission, new country specific CO_2 emission factors have been introduced for petroleum coke/coal mix varying between 92.4 t/TJ and 95.0 t/TJ for the period 2008-2012Verified energy use from EU ETS was compared to the statistical data. It was noticed that data in metric tonnes are similar in the ETS to those in the statistics, but there are some differences in energy values due to different NCVs.
- 1A3 Transport: Hungary has checked that five compressor stations reported under the EU-ETS in 2010.
- 1B2 Fugitive Emissions from Oil and Natural Gas: In 2013 submission, completeness was further improved by including estimation of emissions from oil refinery flaring for the years before 2005 as

well. In category 1B2c-Venting and flaring of oil and natural gas, Hungary has reported CO_2 emissions from oil refinery flaring since the 2009 submission in addition to gas and oil production/processing venting and flaring emissions. The latter emissions are reported using default emission factors from GPG2000 and oil refinery flaring CO_2 emissions were taken from EU ETS annual emission reports since 2005 due to lack of emission factors in the Guidebooks. In this year oil refinery flaring EU ETS data of an additional oil refinery in Hungary was included and oil refinery flaring data was extrapolated for the years before 2005 using the amount of “Refinery intake” as surrogate data. In this way full coverage and consistency within the time-series has been reached.

Industrial Processes

Several sub-sectors within Industrial Processes sector consist of emission originating from industrial facilities that are also falling under the scope of EU Emission Trading System (Directive 2003/87/EC). Although EU ETS data reported by the individual operators (summed together by industrial sector) would be probably more accurate than the use of default factors, its use in inventory preparation is very limited due to time series consistency problems. Last year the time series consistency of the sectors using EU ETS data after 2005 was analysed and reviewed if needed. In the Industrial Processes sector EU ETS data is directly used in sector 2.A.1 Cement production, 2.A.2 (since 2014 submission), 2.A.7 Other mineral (Glass and Bricks and ceramics) and partly in 2.A.3 Limestone and dolomite use.

- 2A1 Cement Production: In 2012 five factories were operating in Hungary. Production data for the whole time series were obtained directly from the factories and from the EU Emission Trading System (ETS) According to the ETS introduced by the European Union from 2005 on, the factories report their CO_2 emission. The reported quantities of CO_2 emitted between 2005 and 2012 are based on reports of the factories. It is assumed that the data after 2005 is more accurate since in EU ETS accredited laboratories are to be used. As the country specific method is mainly the same as the emission reporting methodology of the EU ETS, the time series is more consistent this way, than it would be in the case of the use of Tier1 or Tier2 method of the IPCC Guidelines. As the use of ETS data means the use of verified data, where the carbon contents should be measured in accredited laboratory (or at least a laboratory yearly validated and inter-compared with accredited laboratory as it is prescribed in section 13.5 of Annex I of 589/2007/EC), Hungary believe that the use of ETS data improves the accuracy of the data reported in the inventory.
- 2A2 Lime Production: During the 2012 EU Technical review a question was raised, whether the autoproduction of lime of sugar producers is included. The investigation resulted that sugar producing companies have never reported technological (originating from dissociation of limestone) emissions in EU ETS annual emission report (as they do not have this emission source in their GHG emission permit). However the practice is right because no technological CO_2 emissions arise from Hungarian sugar producers since all of them use Ca(OH)2 + CO_2 precipitation technology to remove impurities. The activity data were received directly from the operators which increased the reliability of the information.
- 2A3 Limestone and Dolomite Use: Activity data on the use of carbonates for SO_2 scrubbing is either reported by the operators directly to the HMS or to EU ETS competent authority (In EU ETS the operators are required to report CO_2 emission from the use of carbonate for scrubbing separately in their annual emission report).
- 2A7 Glass Production: Considering the fact that all the glass factories are covered by EU Emission Trading System the quantity of CO_2 reported by them was accepted as emissions between 2005 and 2012. In order to achieve time-series consistency, Hungary supplemented the inventory with data of earlier years as well. A specific emission factor was created from the emission trading data of 2005, and emissions were calculated retrosprectively using this EF with the known production data.
- 2A7 Other: Bricks and Ceramics: Coal and petroleum coke serve as additives increasing the porosity of bricks, therefore emissions of these fuels are calculated in the Industrial Processes Sector using the EU ETS database of manufacturing bricks and ceramics.The estimation of

uncertainties is based on the uncertainty of EU ETS data. The years before 2005 in the time series are calculated by the application of an emission factor calculated based on the 2005 EU ETS data.

- 2C1 Iron and Steel Production: Carbon content of steel has been verified using EU ETS annual emission report of Iron and steel production facility. The verification resulted the update of carbon content data used in calculation 2.C.1.1 from 0.5% to 1%, which is in accordance with IPCC2006.
- 2G Other: verification was performed with EU ETS annual emission reports of Petrochemical companies as they are the users of several oil products for non-energy use. Based on EU ETS CO_2 emission data for naphta, LPG, Gas/Diesel Oil and Other Oil products, it was possible to express country specific C stored factors.

QA/QC

Further QA and verification activities to be continuously performed and/or planned:

- Checking the differences in activity data to increase the consistency between different emission databases, especially the GHG inventory, LRTAP inventory, ETS data, NAMEA data, and the E-PRTR data.
- Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions

16.2.2.8 Latvia

General

As all Latvia's industrial processes sector's companies are participating in ETS then data from these companies can be obtained from their annual GHG report within compliance obligations within ETS. These activity data used emission factors and used emission estimation methodologies can be reported in NIR and in CRF Tables as the data of ETS can't be confidential and all companies' annual GHG reports are published in LEGMC webpage.

Energy

- 1A: Carbon emission factor for industrial wastes (used tires) was estimated based on CO_2 emission factor reported by cement production plant within ETS.
- 1A2f Others: EF for CO_2 emission estimation for other fuels – used tires, combusted in CRF 1.A.2.f Other Manufacturing Industries – cement production, category for years 1999–2012 is taken from GHG emission reports that plant submitted under ETS. This CO_2 emission factor is estimated at the plant by using plant specific data about combustion installation, as well as net calorific value and carbon content measured and obtained in the plant laboratory.
- 1A2: CO_2 emission factor of municipal wastes combusted in cement production plants is taken from plant's annual GHG report within EU ETS for 2008-2012. This CO_2 emission factor is estimated at the plant by using plant specific data about combustion installation, as well as net calorific value and carbon content measured and obtained in the plant laboratory. Uncertainty of other fuels consumption – municipal and industrial wastes, used in mineral production is assumed also low – 2%, as the activity data is obtained from only one producer within EU ETS therefore the data is verified by accredited verifier and Regional Environmental Board.

Industrial Processes

All industrial production data used in emission estimation from 2.A Mineral Products sector is taken from the annual GHG reports that industrial producers submit within EU ETS. Activity data, CO_2 emission factors and estimated emissions from glass production plants are taken from the annual GHG reports that plants submit within EU ETS.

- 2A1 Cement Production: According to IPCC GPG 2000 alternative of activity data if clinker production data is not available is to use cement clinker data and the estimate this amount back to clinker production data. In the cement production plant it is done for the EU ETS annual reporting by taking into account clinker and cement ratio for the particular types of cement produced. Cement, cement kiln dust production data and estimated clinker production data is taken from plant's annual GHG reports within EU ETS.

- 2A2 Lime Production: In iron & steel production facility lime necessary for steel smelting in open heart furnaces is produced only from limestone in vertical shaft kiln. The plant is reporting their non-marketed quicklime production data for 2005-2012 within ETS so the estimated emissions as well as used activity data and emission factor are taken from plant's annual GHG report within GHG. Activity data of produced lime in steel production company is taken from plant's GHG reports within ETS. Source-specific QA/QC and verification: Activity data, CO_2 emission factor and estimated emissions are taken from the annual GHG reports that steel production plant submit within EU ETS.
- 2A3, 2A4 Limestone, Dolomite and Soda Ash Use: Limestone, dolomite and soda ash are used in glass production plants, steel production plant and lime production plants. All these plants are participants of EU ETS so the detailed information of used technologies, raw materials as well as emission factors are available as plants report their annual GHG reports to LEGMC. Activity data were taken from industrial production plants. Industrial producers are participants of the ETS the GHG reports of these enterprises have to be freely available according to EU ETS regulations. The activity data reported in production plants' annual GHG reports within ETS is verified by accredited verifiers and Latvia's Regional Environment Boards so the activity data is adequately verified.
- 2A7 Glass Production: For time period 1990-1996 only butylacetate data is available from glass fibre production company's application for GHG permit within EU ETS. For year 2005 also glass production company had reported its NMVOC emissions (these emissions are reported together under Glass fibre production sector in CRF Reporter) but since then glass production is not operating therefore NMVOC emissions from glass production are reported only for 2005. CO_2 emission factors used to estimate emissions from raw materials use in glass production are plant specific and taken from plants' annual GHG reports within ETS. CO_2 emission factors for emission from additional raw materials use in glass production processes were taken from plants annual GHG reports within EU ETS.
- 2A7 Bricks Production: CO_2 emission factors used in emission calculation from bricks and tile production are the default from Monitoring and Reporting Guidelines within ETS so the uncertainty of emission factors is assumed as 50%. Activity data is taken from plants reported annual GHG reports within EU ETS.
- 2A7 Tiles Production: There is only one tiles production plant in Latvia and CO_2 emissions from use of clay in tile production process in 1995-2015 are reported in this sector. The tiles production plant is participant of ETS so the data from plant's annual GHG reports is available for inventory. Activity data, CO_2 emission factor and estimated emissions are taken from the annual GHG reports that steel production plant submit within EU ETS.
- 2C Metal Production: There is only one Iron & Steel production plant in Latvia that produces crude steel by melting crude iron not only by melting scrap metals. The plant is participant of ETS and submits their annual GHG reports to LEGMC. It is possible to obtain more accurate and complete activity data and emission factors from enterprise that is involved in the emission trading system. Till Submission 2008 CO_2 emissions from plant's GHG reports were taken to report emissions from crude steel production.

16.2.2.9 Lithuania

General

Annual ETS data reports by operators are indicated as one of the most important data sources for the Lithuanian GHG inventory preparation.

Energy

- 1A1a Public Electricity and Heat Production: Plant specific CO_2 emission factors based on EU ETS data are used for emulsified vacuum residue, not liquefied petroleum gas and orimulsionFollowing recalculations in this category has been done taking into account ERT recommendations: correction of CO_2 plant specific emission factor for not liquefied petroleum gas based on EU ETS data. The following improvement is foreseen: Further investigate the possibility of using data provided in the EU ETS, reported by the operators for the energy sector emission estimates.
- 1A1b Petroleum Refinery: Following recalculations in this category has been done: correction of CO_2 plant specific emission factors for residual fuel oil and not liquefied petroleum gas based on EU ETS data.

Industrial Processes:

- 2A1 Cement production: For the period 2005-2012 CO_2 emission data have been accessed via the verified EU ETS reports of the production plant. CO_2 emissions were calculated using plant specific data on production of clinker and CKD, and plant specific emission factors (t CO_2/ t clinker, t CO_2/ t CKD). For the period 1990-2004 CO_2 emission was calculated using Tier 2 method using specific production data provided by the production company. As the producer reports CO_2 emissions for EU ETS, it was decided to perform a quality control quality by comparing the two estimates (IPCC Tier 2 versus EU ETS). The difference between the Tier 2 estimations based on plant-specific data (annual clinker and CKD data, CaO and MgO content in clinker) and EU ETS data was less than 1%. Therefore it is concluded that the estimates for the period 1990-2004 and 2005-2012 are consistent.
- 2A2 Lime Production: Source category-specific quality control procedures have been carried out in this submission. Emission data for years 2009-2012 have been verified with EU ETS data. The calculated emissions are significantly higher than reported in EU ETS for all four years. This difference in estimated CO_2 emission is due to difference in activity data and methodology.
- 2A7.1 Glass Production: According to EU ETS report of Kauno stiklas, small quantity of carbon is oxidised directly in glass furnace. CO_2 emissions were calculated for each production plant based on plant specific data on use of particular carbonates. Source category-specific quality control procedures have been carried out in this submission. Emission data for years 2007-2012 have been verified with EU ETS data. The difference between the GHG inventory and the EU ETS data is less than 0.5%
- 2A7.Other: Mineral Wool Production: Source category-specific quality control procedures have been carried out in this submission. The recalculated emission data based on updated activity data and plant-specific emission factors provided by the producer for years 2008-2012 have been verified with ETS data and the correspondence between these data is 100%.
- 2B2 Nictric Acid Production: For the years 2009-2012 production unit specific N_2O emission factors were obtained from the producer.

16.2.2.10 Malta

Energy

- 1A1a: two installations that are situated in territory of Malta fall within the scope of the EU ETS Directive, and have done so since the inception of the scheme in 2005. These are the two local electricity generation plants which also account for all emissions under CRF source category 1A1a. The total allocation for Phase II amounts to 10.715 million allowances allowances, completely allocated to the two installations. All emissions reported were accounted for by allowances surrendered. These two power plants currently run on liquid fossil fuels: residual fuel oil (RFO) and gas oil (GO). It is important to note that for the years 2005 to 2012, fuel consumption data is used that reported annually by Enemalta pursuant ro European Union Directive 2003/87/EC. For the years 2009 onwards, the calorific values and oxidation factor identified in the verified emission reports submitted pursuant eot EU Directive 2003/87/EC have been used for estimating greenhouse gas inventory emissions.

16.2.2.11 Poland

General

The experts of the National Centre have access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This verified data is included in GHG inventory for some IPCC subcategories (e.g. in some subsectors in industrial processes).

Energy

Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE).

- 1B2c Fugitive Emissions from Fuels – Venting and Flaring: CO_2 process emission from refineries and flaring was included into sub-category 1.B.2.C.2. This emission was estimated based on the verified reports for refineries, which participate in EU ETS.

Industrial Processes

For estimation of the 2012 emission in sector 2. *Industrial Processes,* CO_2 process emission data were used from installations which take part in the EU ETS. Emissions based on such data were estimated in the following subcategories:

- subcategory 2.A. Mineral Products: 2.A.1. Clinker Production, 2.A.7. Other: Glass Production, Ceramics materials production
- subcategory 2.C. *Metal Production*: processes included into *Iron and Steel Production* (2.C.1) such as: sinter production, pig iron production, steel production in basic oxygen process, steel production in electric arc furnace process
- subcategory 2.D. Other Production: 2.D.1. Pulp and Paper
- 2A1 Cement Production: CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2012 for installations which participate in EU ETS.
- 2A7 Other (Glass production): CO_2 emission from glass production was taken from the verified reports for 2012 for installation of glass and glass wool production, which participate in the emission trading scheme.
- 2A7 Other (Ceramics material production): CO_2 emission from production of ceramics materials was calculated based on the verified reports for 2012 for installation of ceramics production, which participate in EU ETS.
- 2C1 Iron and Steel Production: Estimation of carbon dioxide process emissions from ironore sinter production for 2012 was based on data from the verified reports on annual emissions of CO_2 from iron ore sinter installations in EU ETS. Sinter production amounts (not published from 2000 in statistical materials), data relating to main components of input and output in the sintering process were accepted according to mentioned EU ETS reports in order to estimate of country specific CO_2 emission factor for inventory purpose. Values of CO_2 emission and sinter production for 2005-2011 were also estimated in accordance with EU ETS reports. Emissions of CO_2 for the years 1988-2004 were calculated (using carbon balance method) based on data (amount of feedstock material and output from production process) from questionnaires regarding to installations included into the EU ETS collected by the National Centre for Emissions Management. The HIPH data was supplemented for the years 1988-2004 with the information from questionnaires collected by the National Centre for Emissions Management (KOBiZE) for installations covered by EU ETS and starting from 2005 with the data from verified reports concerning CO_2 emission, prepared as part of EU ETS. For the last years information from verified reports, prepared as part of EU ETS, was applied for emission calculation of electric furnace steel production.

- 2D Other Production: CO_2 process emissions from pulp and paper production for 2011 and for 2005-2010 were taken from the verified reports for installations of paper and cardboard production, which participate in EU ETS.
- 2F Consumption of Halocarbons and SF_6: Country specific emission factor are based on installations reporting under EU ETS.
- QA/QC: Activity data used in the GHG inventory concerning industry sector come from yearbooks published by the Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. Data on selected production is compared to data collected from installations/entities covered by the EU ETS. Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE). Additionally data on industrial production is compared with public statistics in case where entire sector is covered by EU ETS.
- Source-specific planned improvements: Further development of methodology of EU ETS data implication in GHG inventory in sub-sector 2.A.

16.2.2.12 Romania

General

A sum of operators has provided their verified CO_2 emission reports required under the EU ETS for the years 2007-2012. Data from the verified ETS reports were analysed in order to use a Tier 2 methodology for emission calculations. The number of plants, using a plant specific methodologies, made possible to achieve country specific EFs for a sum of solid and liquid fuels and natural gas. Also, the country specific emission factor for the industrial wastes ETS reporting, was derived. These emission factors (without oxidation fraction included) are derived from the verified ETS reports as a weighted average from all operators which have declared that they have used plant-specific emission factors (Tiers 3 according to the Methodology for monitoring GHG emissions of operators participating in the ETS).

Energy

- 1A Stationary combustion: To achieve the estimations of the CO_2 emissions on the national circumstances, a study has determined the national emission factors based on EU-ETS operators reporting on the period of 2007–2010. For the years 2011 and 2012, the estimations for the CO_2 emissions were determined using the national emission factors, based on the methodology of the same study. It was accomplished a study by the Romanian Institute for Studies and Power Engineering (ISPE), analysing the data from the operators reporting on EU ETS, conducting to the development of the Country Specific Emission Factors.
- A further analysis on the EU-ETS 2012 reporting (object of a further Study) will be conducted in order to take into consideration these emissions, as Tier 3 approach, on the activity category where these operators have to report. Furthermore the background data for the emission factors calculations under the ETS, were used for further QA/QC checks. The co-operation with Romanian authorities administrating the EU-ETS and National Institute for Statistics will be maintained in order to have a fully correspondence concerning the definitions (fuel's calorific power) and quantities of the fuels, between the declarations of the operators under EU-ETS and, respectively, to NIS. A further analysis, in co-operation with the National Institute for Statistics, on the EU-ETS reporting will be conducted in order to take into consideration these emissions data, in the context of Tier 3 approach, on the activity category where these operators have to report. Annualy analysis on the EU-ETS reporting in comparison with Large Combustion Plants reporting, in order to check the concistency of the reported data, will be performed. Following the same procedure used until now, based on EU-ETS operators reporting, the country-specific CO_2 emission factors will be calculated and included in the next inventory submission.

- 1A1 Energy Industries: It is planned to take into consideration the emissions from the operators reporting on EU-ETS (having their reports verified by accredited verifiers) in order to achieve a higher tier approach in the estimation of the CO_2 emissions.
- 1A2 Manufacturing Industries and Construction: It is planned to take into consideration the emissions from the operators reporting on EU-ETS (having their reports verified by accredited verifiers) in order to achieve a hire tier approach in the estimation of the CO_2 emissions.
- 1A3b Road Transport: To achieve the estimations of the CO_2 emissions on the national circumstances, a study, has determined the national emission factors based on EU-ETS operators reporting on the period of 1989 – 2010; for 2011 the estimations for the CO_2 emissions were determined using the national emission factors, based on the methodology of the same study. Furthermore the background data for the emission factors calculations under the ETS, were used for further QA/QC checks.
- 1A4 Other Sectors: Since the resources for solid fuels in the Romanian economy are mainly from the internal exploitations, the weighted arithmetic averages for the emission factors calculated based on all the EU-ETS activities reporting, are used in the 1.A.4 – Other Sectors. For the fuels reported in this activity category having determined Country Specific Emission Factors on EU-ETS reporting, Tier 2 methodology is used. Based on the recommendation of the ISPE Study, have been used the weighted arithmetic averages for the Emission Factors calculated based on the all the EU-ETS activities reporting. For the fuels reported in this activity category having determined Country Specific Emission Factors on EU-ETS reporting, Tier 2 methodology is used.

Industrial Processes

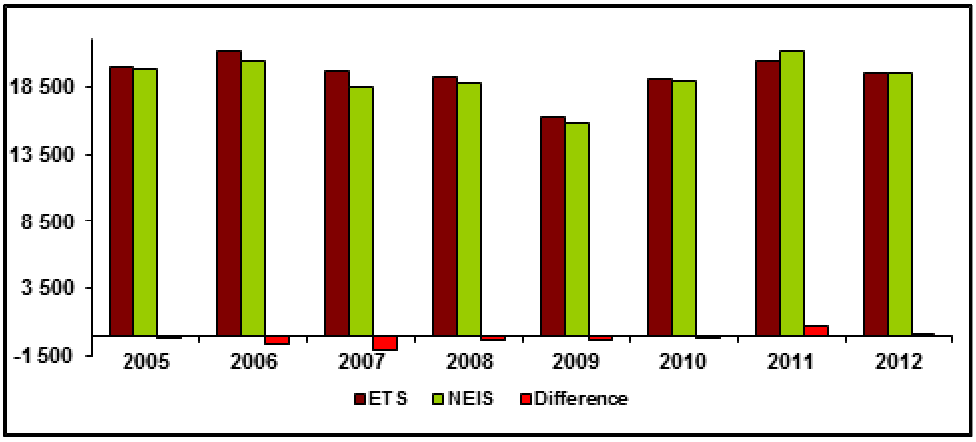
The CO_2 emissions from Lime Production, Limestone and Dolomite Use, Soda Ash Use and Glass Production, were compared with the emissions reported in monitoring plans of GHG emissions for the EU-ETS installations.

- 2A1 Cement Production: Starting with 2008 the figures related with clinker production, plant specific CO_2 EF for clinker production and CO_2 emissions from clinker production were compared with the data reported in monitoring plan of GHG emissions for the EU-ETS cement production installations. The data are similar.
- 2C1 Iron and Steel Production: The CO_2 emissions from Iron and Steel Production were compared with the emissions reported in monitoring plans of GHG emissions for the EU-ETS installations.

16.2.2.13 Slovakia

QA/QC: In order to comply with the quality management criteria and data harmonization between ETS and the national emission balance at sectoral level, emission factors of the most important fuels have been re-evaluated and new methods have been implemented at the level of source operators. By comparison and correct allocation of CO_2 emissions in sector energy, it can be concluded that the balance is in a good compliance with the emissions verified within ETS. The comparison was provided for most important sources (energy and technology), but also only for energy sources (Figure 16.1). For the comparison study, 26 biggest emitters were taken, which represent more than 90% of all allocated emissions in the Slovak Republic.

Figure 16.1: Comparison of CO_2 emissions from energy sources (in Gg) allocated in ETS and estimated by sectoral approach from the dbase NEIS for 2005 – 2012



Source: NIR of Slovakia, submission 2014, p. 86, Figure 3.24

Industrial Processes

- 2A1 Cement Production: The cement plants in the Slovak Republic (4 plants), where cement clink is produced, are included into the ETS and the verification reports from the ETS were used the verification of data reported in questionnaires by producers. On the basis of the information provided in questionnaires and the verified ETS reports, tier 2 methodology according to the IPCC 2000 Good Practice Guidelines has been applied since 2002 based on plant specific information. The calculations provided by the cement clinker producers in the ETS reports balanced CO_2 emissions on the basis of cement clink production and CaO and MgO contents. Activity data are verified with ETS reports data and information provided by the Slovak Association of Cement Producers.
- 2A2 Lime Production: The calculations are based on the data provided by the lime producers in questionnaires and in the ETS reports (produced lime and CaO and MgO contents). Activity data are verified with the ETS reports and compared with the information from the Statistical Office of the Slovak Republic on lime production.
- 2A3 Limestone and dolomite use: Activity data are verified with the ETS reports and compared with the information from the Statistical Office of the Slovak Republic on industrial production.
- 2A7 Other: Activity data for glass production and magnesite production are verified with the ETS reports and compared with the information from the Statistical Office of the Slovak Republic on glass production.
- 2B1 Ammonia Production The activity data were compared with information provided by the Statistical Office of the Slovak Republic, NEIS database and the ETS report.
- 2B2 Nitric acid production: Activity data are verified with the ETS reports and compared with the measurements protocols on N_2O concentration in output gases.
- 2C1 Iron and Steel Production: Blast furnaces: The EU ETS reports are available since 2005, but no detail data on fuel consumption or CO_2 emissions are presented in the reports. The methodology used by plant operator in the EU ETS report is based on mass balance and was used during QA/QC process for comparison. EAF steel production: The emission calculation was based on the available data and assumptions: Železiarne Podbrezová and Metalurg Steel: EU ETS reports are available since 2005. UNEX Prakovce: The plant is not included in the EU ETS. The EU ETS reports contain information on CO_2 emissions, these results were compared with the results obtained by carbon balance methodology.
- 2C2 Ferroalloys Production: Information about activity data were taken from the ETS reports and directly from the producers of ferroalloys in the Slovak Republic.

16.2.2.14 Slovenia

General

In 2006, an additional quality control check point was introduced by forwarding the assessment of verified emission reports from installations included in the National Allocation Plan to the Statistical Office of the Republic of Slovenia (SORS). The role of SORS is to compare data from installations included in the EU-ETS with data from their reporting system and to propose corrective measures, if necessary. The outcome of data consistency checks is used as preliminary information for the Ministry of the Environment and Spatial Planning to perform on-site inspections.

Energy

- 1A1a Public Electricity and Heat Production: From 2005 the activity data from the verified reports from ETS have been used for four power plants. For four thermal power plants the aggregated fuel from SORS data are compared with the sum of fuel used from verified ETS reports. The NCV values are also checked. If case these numbers are not the same the ETS data are taken in account for GHG inventory and notification to SORS is made to correct their data. In other cases where connection between both set of data is uniform, the data from Statistical office are substitute with data from verified reports from installations included in ETS, if necessary. ETS data are also used for different types of waste used as a fuel. The list of waste types is not always complete in the SORS data. The uncertainty was lowered because of use of EU-ETS data.
- QA/QC: The main source specific QA/QC activity is comparison of the ETS data with statistical data.

Industrial Processes

- 2A1 Cement Production: To calculate emissions from cement production after 2005 Slovenia has been using data obtained by EU ETS. Data on clinker production and plant specific emission factors for both cement factories have been annually verified by independent verifiers. ETR recommended showing that the estimated CO_2 process emissions from cement production are comparable and consistent with the emissions reported under the EU ETS. EU ETS reports can not be publicly revealed due to sensitivity of information.
- 2A2 Lime Production: The EFs for the period 2005-2012 are based on data provided from three lime plants in the scope of Greenhouse Gas Emission Trading System (verified ETS reports). EFs from both before 2005 and for EU ETS data (after 2005) based on plant specific production conditions. There are three producers of lime in Slovenia and the data for both periods were obtained from these three lime works. The same sources of raw material and methodology were used for calculation both, before and after 2005 EFs. Before the year 2005 the producers have reported data directly to Agency of the Republic of Slovenia, after 2005, when Slovenia entered into EU ETS scheme, they have reported data via EU ETS. To calculate emissions from lime production after 2005 Slovenia has been using data obtained by ETS. These data have been annually verified by independent verifiers. The EFs for lime production is calculated annually on data (amount of CaO and MgO or amount of CaCO3 and amount of lime produced) obtained from these three producers.
- 2A3 Limestone and dolomite use: SO_2 scrubbing & Ceramics production: Data on CaCO3 and MgCO3 for the period 2005–2010 have been obtained from verified ETS reports.
- 2A3 Limestone and dolomite use: Ceramics production: Activity data on CaCO3 and MgCO3 due to limestone and dolomite use in ceramics production for the period 2005–2012 have been obtained from verified ETS reports.
- 2C1 Iron and Steel production: For the period 2005-2012 Slovenia has used precise and verified data obtained from verified ETS reports in the scope of Greenhouse Gas Emission Trading System.
- QA/QC: QC procedures for the plant data included in the inventory that are collected under the European Union Emissions Trading Scheme (EU ETS) have been performed. ETS emissions data from verified printed reports have been compared with data obtained in electronic form. ETS emissions data are collected by EU ETS experts from Environmental Agency of Republic of

Slovenia. As national inventory team and EU ETS experts work together in the same institution, even in the same unit, it is very easy to access these hard copy reports for each company. Besides the data, reports include also the description of monitoring of this data, eventual stops and changes of production. As Slovenia is small country only 15 installations from EU ETS report process emissions (2 cement, 3 lime, 3 steel and 4 glass producers, 3 ceramics), this QC can be performed manually. After entering this data to the calculation spreadsheet the QC is performed.

16.3 Key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000) for the EU-28. The tables are included in Annex 2.1.

16.4 Information on the quality assurance and quality control plan

Table 16.4 gives an overview of QA/QC procedures in place for the new EU Member States.

Table 16.4 Overview of quality assurance and quality control procedures for the new MS (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Bulgaria	The ExEA is also responsible for coordination and implementation of QA/QC activities for the national inventory. A quality manger is in place. The Bulgarian Quality Management System was established in the frame of project with Bulgarian Academy of Science, Geophysical Institute. The project was carried out and finished in 2008. The QA/QC plan is an internal document to organize, plan and implement QA/QC activities. Once developed for the next submission, it is referenced and used in subsequent inventory preparation, or modified as appropriate. The QA/QC plan has been updated in August 2010 in order to implement the new established legal, institutional and procedural arrangements within the BGNIS. The updated National QA/QC Plan was approved by the Ministry of Environment and Water in September 2010. National QA/QC Plan includes following elements: Responsible institutions; Data collection; Preparation of inventory; QC Procedures; QA Procedures; Uncertainty evaluation; Organisation of the activities in quality management system; Documentation and archiving. The legal and institutional arrangements within the BGNIS regulate the responsibilities of all engaged institutions for implementation of the requirements of the National QA/QC Plan. The QC procedures are performed by the sectors, who are directly involved in the process of preparation of inventory with their specific responsibilities. The QC procedures are implemented by all activity data provider and ExEA's sector experts (Order N 202/29.09.2010 by the Executive Director of ExEA) and/or external consultants. For 2013 submission the QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers.	Short NIR of GHG emissions in Republic Bulgaria 1988-2012 Mar 2014 p 49 ff

MS	Description of the national QA/QC activities	Source
Croatia	Quality control activities are focused on following elements of inventory preparation and submission process: Activity data collection and archiving; Preparation of inventory report; Submission of inventory report; Review activities; Reporting on GHG registry. For the purposes of transparency of the emission calculation and archiving of data, inventory team has continued with the good practice in preparation of Inventory Data Record Sheets which were introduced in 2001 submission and which contain details of the person and/or organization responsible for an emission estimate, the primary or secondary sources of activity data and emission factors used, the methodology applied, data gaps, ways to cross-check, suggestion for future improvement in the estimates and relevant bibliographic references. The information provided in Inventory Data Record Sheets is available for each source category and for the entire time-series. An example of Inventory Data Record Sheet for 2012 in Waste sector is presented in Annex 6, Table A6-1. All data in the form of Inventory Data Record Sheets are also archived at CEA. During the preparation of the NIR a number of checks were carried out by sector experts related to completeness, consistency, comparability, recalculation and uncertainty of activity data, emission factors and emission estimates. The details on these issues are elaborated in the NIR by each sector, subsector and corresponding CRF tables. Finally, before the Authorized Institution submits the NIR to CEA, QA/QC manager carried out an audit which covers selected IPCC source categories, as outlined in the QA/QC plan, with purpose to check which quality control elements, both general (Tier 1) and specific (Tier 2), as defined in the IPCC Good Practice Guidance, are already implemented by sector experts and which improvements and corrective actions should be carried out in the future submissions. CRF tables for each sector are reviewed in accordance with the Quality Management Standard (ISO 9001) and Environmental Management Standard (ISO 14001) implemented within the Agency and the authorized institution. Audit results are registered in control lists as well as performed correction activities. Quality assurance activities are accomplished in a way that CEA submits complete Inventory and CRF tables to the MENP, which, upon receipt, approves the latter. National System Committee is included in the approval process; its members provide their opinion on certain parts of the Inventory within the frame of their speciality. Members of the National System Committee are nominated by the authorized Ministries upon the request of the MENP. QA/QC coordinator documents all Committee results/findings.	National Inventory Report 2014, Croatian Greenhouse Gas Inventory for the Period 1990-2012, Mar 2014 p. 13-15

MS	Description of the national QA/QC activities	Source
Cyprus	In this framework, a QA/QC system is being implemented since the May 2007. The Ministry of Agriculture, Natural Resources and Environment is responsible for the implementation of the QA/QC system. The system has the following objectives: 1. Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals. 2. Continuous improvement of GHG emissions/removals estimates. 3. Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements The accomplishment of the above-mentioned objectives can only be ensured by the implementation, from all the members of the Inventory Team (see Figure 1.4 for the flow chart of activities concerning emissions inventory), of the QA/QC procedures included in the plan for the following: Data collection and processing. Applying methods consistent with IPCC Good Practice Guidance and LULUCF Good Practice Guidance for calculating / recalculating emissions or removals. Making quantitative estimates of inventory uncertainty. Archiving information and record keeping. Compiling national inventory reports. The QA/QC system developed covers the following processes (see Table 1.7 for the list of procedures within each process and Figure 1.3 for the relationship between the processes and the activities of the inventory team): QA/QC system management: comprises of all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the abovementioned quality objectives. Quality control: directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. Archiving inventory information: comprises of activities related to central archiving of inventory information and the compilation of the national inventory report. Quality assurance: comprises of activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public Estimation of uncertainties: defines procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory. Inventory improvement: related to the preparation and the justification of any recalculations made.	National GHG Inventory Report 1990-2012 2014 Submission Mar 2014 pp 18-22
Czech Republic	In the “in-country review” in October of 2009, the original QA/QC plan was considered inadequate and thus it was necessary to immediately establish a new conception of the QA/QC plan, an outline of which is presented in this chapter. The QA/QC system is an integral part of the national system. It ensures that the greenhouse gas inventories and reporting are of high quality and meet the criteria of transparency, consistency, comparability, completeness, accuracy and timeliness set for the annual inventories of greenhouse gases. The objective of the National Inventory System (NIS) is to produce high-quality GHG inventories. In the context of GHG inventories, high quality provides that both the structures of the national system (i.e. all institutional, legal and procedural arrangements) for estimating GHG emissions and removals and the inventory submissions (i.e. outputs, products) comply with the requirements, principles and elements arising from UNFCCC, the Kyoto Protocol, IPCC guidelines and the EU GHG monitoring mechanism (Regulation No 525/2013/ of the European Parliament and of the Council). Annex 8 provides general form for QC procedures which is used in CR by each sectoral expert. Possible findings are examined and if possible corrected or included in Improvement plan for future submissions. Quality assurance comprises a planned system of review procedures. The QA reviews are performed after application of the QC procedures to the finalised inventory. The inventory QA system comprises reviews and audits to assess the quality of the inventory and the inventory preparation and reporting process, to determine the conformity of the procedures employed and to identify areas where improvements could be made. While QC procedures are carried out annually and for all the sectors, it is anticipated that QA activities will be performed by the individual sectors at longer intervals. Each sector should be reviewed by a QA audit approx. once in three years, as far as possible. In addition, QA activities should be focused mainly on key categories. Peer reviews (QA procedures) are sector- or category-specific projects that are performed by external experts or groups of experts. The reviewers should preferably be external experts who are independent of the inventory preparation. The objective of the peer review is to ensure that the inventory results, assumptions and methods are reasonable, as judged by those knowledgeable in the specific field.	National GHG Inventory Report 2014 of the Czech Republic, Mar 2014 Pp 28-32

MS	Description of the national QA/QC activities	Source
Estonia	This section presents the general QA/QC program including the quality objectives and the QA/QC plan for the Estonian greenhouse gas inventory at the national inventory level. Source specific QA/QC details are discussed in the relevant sections of this NIR. All institutions involved in the inventory process (MoE, EERC, EEIC and TUT) are responsible for implementing the QC procedures to meet the data quality objectives. MoE as a national entity is responsible for overall QC and is in charge of checking on an annual basis that the appropriate QC procedures are implemented internally in EERC, EEIC and TUT. EERC as the quality coordinator has an overall responsibility for coordinating and implementing the QA/QC plan. EERC checks the QC reports of EERC, EEIC and TUT performed by sectoral experts, and the QA report performed by independent experts. Also a public review is carried out annually. The draft NIR is uploaded to the MoE website www.envir.ee where all interested parties have an opportunity to comment on it. During the Twinning Light project "Improving the quality of Estonia's National Greenhouse Gas Inventory" with Finland in 2009 Estonia updated its QA/QC plan. The Estonia's QA/QC plan consist of seven parts: (1) production plan (see Table 1.1); (2) annual meetings; (3) QA/QC checks; (4) QA results documentation form; (5) archiving structure; (6) response tables to the review process and (7) a list of planned activities and improvements.	Greenhouse Gas Emissions in Estonia 1990-2012 Mar 2014 p 40
Hungary	The Hungarian Meteorological Service introduced the quality management system ISO 9001:2000 in 2002 for the whole range of its activities which was quite unique among meteorological services. However, GHG inventory preparation was not among its activities in that time. Therefore, the scope of our ISO accreditation had to be modified and lots of efforts have been made to bring also the national system under the umbrella of the ISO QM system. Several regulatory ISO documents were created, among others: ISO procedure on the activities of the GHG Division; QA/QC plan; registers and records for quality checks and documentation. Of course from that time general, HMS level QA/QC activities apply for the GHG Division as well, such as general quality objectives, application of QA/QC Manual of the HMS, QA/QC regarding contractors, etc. In 2012 the ISO procedure of the GHG division was reviewed, and the former QA/QC Plan with the archiving manual was integrated into it. So, from now on this new ISO document No.: ELFO_UHG_401.01 entered into force on 4th January 2013 can be regarded as the QA/QC Plan required for inventory preparation. In addition the records used for documentation of QA/QC and other standardized activities have also been renewed. The renewed QA/QC Plan contains detailed description of the data collection, inventory preparation and reporting processes, regulates the documentation and archiving activities in order to ensure transparency and reproducibility of the inventory the same as before. Besides ISO requirements, other QA/QC activities are carried out, as well. For every sector of the inventory, there is a responsible person within the core team in the Meteorological Service. These sectoral responsibilities are laid down in the QC record No.UHG04. Especially in case of external experts, this responsible member of our team conducts several quality checks on the provided calculations. Moreover, this exercise can be regarded as an interactive process throughout the whole inventory cycle, since the used methodologies, early results are discussed during the process of the emission/removal calculations. This QC procedure also led to a few recalculations. The used parameters and factors, the consistency of data are checked regularly. Completeness checks are undertaken, new and previous estimates are compared every time. Data entry into the database is checked many times by a second person. If possible, activity data from different data sources are compared and thus verified. In response to our request, several data suppliers made declarations as regards quality assurance systems in place during the collection of the data and QC record UHG02 has been introduced for the documentation of evaluation of data quality by data providers. Experts involved in emission forecast consulted in many areas with inventory experts of the Hungarian Meteorological Service to reach better consistency, which in turn represented some sort of QA procedure for the inventory itself. Nevertheless, the work continues to refine the used QA/QC procedures and implement further elements.	NIR for 1985-2012 , Hungary Mar 2014, pp 20-23

MS	Description of the national QA/QC activities	Source
Latvia	The implementation of Quality Assurance and Quality Control (QA/QC) procedures in the development of national GHG inventory is required by IPCC GPG 2000. According to CoM Regulation No. 217 (27.03.2012.) all institutions involved in inventory process are responsible for implementing QC procedures. Mainly Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000 are used. The legislation act determines: -) the quality objectives for GHG inventory; -) tasks and responsibilities of involved institutions; -) QA/QC time schedule; -) QA/QC plan that has been prepared to improve transparency, comparability, and completeness of GHG inventory. In the QA/QC plan quality control procedures to be used before and during the compilation of GHG inventory are described. -) check-lists and procedure descriptions for independent experts for quality assurance of GHG inventory. -) background for inventory improvement plan preparation activities. MEPRD as national entity is responsible for overall QC procedures and quality assurance of national system, including UNFCCC reviews. For submission 2014, QC activities were carried out at the various stages of the inventory compilation process - processing, handling, documenting, cross checking, and recalculations. These activities are implemented by sectoral experts and inventory compiler (NIC – LEGMC in collaboration with MEPRD	Latvia's National Inventory Report 1990-2012 March 2014 p 53 ff
Lithuania	QA/QC plan was updated in 2012. The Ministry of Environment and the Environment Protection Agency was responsible for the development of the updated QA/QC Plan. The EPA is responsible for the coordination and implementation of the Plan with a supervision performed by the MoE. The QA/QC Plan describes the quality objectives of the GHG inventory, the national system for inventory preparation, tasks and responsibilities. A description is provided of various formal procedures already implemented in the development of the GHG inventory and of planned improvements. EPA, as the coordinator of the GHG inventory and QA/QC Manager, has the following functions and responsibilities: - Checking and archiving supplied input data; - Checking assumptions and data selection criteria; - Checking data inputs and references; - Checking data processing procedures and emission calculations; - Checking units, conversion and adjustment factors, etc.; - Ensuring adequate documentation; - Checking consistency of data between source categories; - Checking data aggregation and transcription; - Coordinating QA/QC activities, preparing QC and QA procedures; - Providing the final inventory (CRF tables and NIR) for the MoE. As the coordinating institution, EPA is also responsible for establishing a quality assurance system comprising review procedures which are conducted by personnel not directly involved in the inventory compilation/development. Its responsibilities include: - Identification and prioritization of sets of data for review based on key category and uncertainty analysis, - Identification of review personnel, - Conclusions and corrective actions based on the review results.	Draft National GHG Emission Inventory Report 2014 of the Republic of Lithuania, Reported inventory 1990-2012 Mar 2014 pp 37 ff
Malta	a formally documented greenhouse gas inventory QA/QC system has yet to be developed in respect of the Maltese inventory process. However, this does not mean that the inventory process is not already subject to quality checks. Indeed, the inventory is subject to at least two peer review processes every year: a peer review in-line with requirements set out in the EU's Monitoring Mechanism and a peer review under UNFCCC rules. An important deliverable from these reviews is the publication of reports highlighting, in particular, those areas where the respective review teams feel that inventory compilation practices need to be further developed in order to ensure better-quality reporting. These review reports form a basis for the internal evaluations of inventory submissions performed by the inventory team itself and thus help guide the inventory team in its preparation of future submissions. Though the formal documentation of inventory processes, in terms of standard operating procedures, is yet to commence, there is already a process for documenting the work performed by the Climate Change Unit in preparing an inventory submission. Besides the spreadsheets that are used to estimate emissions, and thus serving to document the estimation process itself, a number of additional ancillary forms are already in use	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2012 Mar 2014 p. 12

MS	Description of the national QA/QC activities	Source
Poland	Based on recommendations of the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories the following elements of the Quality Assurance and Quality Control system has been addressed: · Inventory agency responsible for coordinating QA/QC activities, · QA/QC plan, · General QC procedures (Tier 1 method), · Source category-specific QC procedures (Tier 2), · QA review procedures, · Reporting, documentation and archiving procedures. The unit directly responsible for GHG inventory preparation, as well as for co-ordination and implementation of QA/QC procedures within inventory, is the National Centre for Emissions Management (KOBIZE) in the Institute of Environmental Protection National Research Institute (IOŚ PIB) established based on Act of 17 July 2009 on the System to Manage the Emissions of Greenhouse Gases and Other Substances (Journal of laws Nr 130 item 1070on 18 August 2009). The Minister responsible for the environment shall supervise the performance of responsibilities by KOBiZE.	Poland's National Inventory Report 2014, GHG Inventory for 1988-2012 Mar 2014 p. 21
Romania	This QA/QC Programme was established according to the UNFCCC and Kyoto Protocol's provisions related to GHG inventory preparation and national system establishment and also to 1996 Revised IPCC Methodology and Good Practice Guidance. Therefore, the document comprises information on: The national authority responsible for the coordination of QA/QC activities; The objectives of the QA/QC framework; The QA/QC Plan; The QC procedures; The QA procedures; The reporting, documenting and archiving procedures. According to the provisions of the Governmental Decision no.1570/2007 establishing the national system and to those in the NEPA's President Decision no. 119/2012, NEPA represents the competent authority responsible with the implementation of the QA/QC activities under the NGHGI. For this purpose, NEPA is performing the following activities: Ensures that specific QA/QC objectives are established; Develops and regularly updates a QA/QC plan; Implements the QA/QC procedures Considering the provisions of relevant regulations, NEPA designated a QA/QC coordinator. The overall objective of the QA/QC programme is to develop the NGHGI in line with the requirements of the IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003 and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission. Romania's QA/QC plan closely follows the definitions, guidelines and processes presented in Chapter 8 – Quality Assurance and Quality Control of the IPCC GPG 2000. The QA/QC plan constitutes the heart of the QA/QC procedures. It outlines the current and planned QA/QC activities. The specific QA/QC activities are performed during all stages of the inventory preparation. The QA/QC plan will be reviewed periodically if needed and can be modified as appropriate when changes in processes occur or based on the advice from independent reviewers. The QA/QC plan is intended to ensure the fulfillment of the NGHGI principles in Romania. The objectives of the plan include: Applying greater QC effort for key source categories and for those source categories where data and methodological changes have occurred recently; Periodically checking the validity of all information as changes in reporting, methods of collection or frequency of data collection occur; Conducting the general procedures outlined in QC procedures (Tier 1) on all parts of the inventory over a complete exercise; Balancing efforts between development and implementation of QA/QC procedures and continuous improvement of inventory estimates; Customizing the QC procedures to the resources available and the particular characteristics of Romania's greenhouse gas inventory; Confirming the national statistical institute and other agencies supplying activity data to NEPA have implemented QC procedures	Romania's Greenhous e Gas Inventory 1989 – 2012 Mar 2014 P108

MS	Description of the national QA/QC activities	Source
Slovakia	In 2009, Slovenia developed and mostly implemented a Quality Assurance and Quality Control plan as recommended by the IPCC Good Practice Guidelines (IPCC 2000). The QA/QC plan is part of the Manual of Procedures, elaborated in 2005 and updated in 2009. During the in-country review in 2013, the ERT found that due to the very limited resources and support available, a coordinated and systematic QA/QC was not in place. Although no important errors have been found in emission calculations the insufficient application of QA/QC procedures in the preparation of NIR does affect the transparency of the submission significantly. In the Potential Problems and Further Questions from the ERT formulated in the course of the 2013 review of the greenhouse gas inventories of Slovenia submitted in 2013 the ERT recommends that Slovenia provide the ERT with evidence that the National System will: a) As a matter of priority, allocate additional resources to support the work of the GHG inventory team; b) Develop a QA/QC plan in accordance with the IPCC good practice guidance, which will allow to solve the above mentioned issues before the next annual submission (2014); In response the Minister have secured the additional administrative resources to carry out the necessary QA/QC activities. He has nominated QA/QC manager as well as a control team of experts with the following main tasks: - Develop a QA/QC plan in accordance with the IPCC good practice guidance; - Develop an inventory improvement plan; - Implement general inventory QC procedures (tier 1) in accordance with the QA/QC plan following the IPCC good practice guidance; - Collaboration of other members of the team with the inventory experts and QA/QC manager when necessary; - Regular partial review of QA/QC by sector, scheduled by the team; - Preparation of expert framework for the elaboration of emission inventories for land use.	Annual report 2014 Submission under the EU GHG Monitoring Mechanism Mar 2014, p 23
Slovenia	The Ministry of the Environment of the Slovak Republic made a contract with consulting company ISO Management for the project “Implementation Process for QA/QC Model and QMS ISO 9001”. The Project started in March 2009 and was separated into two parts: Part I Implementation Process for QA/QC Model and Part II Implementing QMS according to ISO 9001:2008. The QMS was certified in March 2010. Preparatory phase of Part I of the Project was aimed at the QA/QC plan for internal and external procedurals steps concerning GHG emission inventory. The QA/QC plan for sectors will be updated and evaluated annually by the quality manager of NIS. The project was finalized at the meeting and workshop for the experts involved in the National Inventory System on 13th January 2010. Sectoral experts apply the QA/QC methodology according to the Quality Manual, collect data from providers and process emission inventory for a given sector – they provide partial reports with information on quality and reliability of data on activities and emissions. These partial conclusions serve as a basis to estimate total uncertainties in emission inventories by a coordinator for uncertainties for all sectors. In some cases Tier 2 – Monte Carlo methodology (wastes, energy and industry) which requires detailed review of quality of each input parameter, works out uncertainty analysis. During the first half of 2013, the European Commission launched a project to assist Member States (MS) in the effective implementation of the reporting requirements under the Kyoto Protocol to the UNFCCC. The project aims at providing technical assistance and capacity building support to selected MS (included Slovakia) that have consistently exhibited difficulties in the preparation of their national inventories. Support is provided via a web-based tool wiki forum. This forum has been designed for the exchange of views and provision of advice and solutions for common GHG estimation and reporting problems under the UNFCCC Kyoto Protocol. Slovakia has obtained support in energy, F-gases, LULUCF and agriculture sectors including improvement in QA/QC activities. Some experts visit wiki forum to share information between MS, and between MS and the project support team experts.	Slovenia’s National Inventory Report 2014 (selected chapters) Mar 2014 pp.29ff

16.5 Uncertainty estimates

Table 16.5 gives an overview of information provided by the new Member States on uncertainty estimates in their national inventory reports 2014 and presents summarised results of these estimates.

Table 16.5 Overview of uncertainty estimates available from new Member States

Member State	Bulgaria	Cyprus	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Romania	Slovakia	Slovenia
Citation	NIR, Apr 2014, p. 68	NIR, Mar 2014, pp. 23-24	NIR, Apr 2014, pp. 28-30	NIR, May 2014, p. 45	NIR, May 2014, p. 23	NIR, Apr 2014, p. 62	NIR, Apr 2014, p. 41	NIR, May 2014, p. 13	NIR, Mar 2014, p. 22	NIR, May 2014, p. 121 ff	NIR, Apr 2014, p. 48	NIR Apr 2014, p. 30
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes (Annex 7)	Yes	Yes	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex 2)	Yes (Annex 7)	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex 5)	Yes (Annex 7)
Years and sectors included	emissions: 2012; BY-2012; including LULUCF	emissions: 2012; trend: 1990-2012; excluding LULUCF	emissions: 2012; trend: 1990- 2012; including LULUCF	emissions: 2012; trend: 1990-2012; including LULUCF	emissions: 2012; trend: BY-2012; including LULUCF	emissions: 2012; trend: 1990-2012; including LULUCF	emissions: 2012; trend: 1990-2012; including LULUCF	emissions: 2012; trend: 1990-2012; including LULUCF	emissions: 2012; including LULUCF	emissions: 2012; trend: BY - 2012; including LULUCF	emissions 2012; trend: 1990-2012; including LULUCF	emissions: 2011; trend: 1986-2011; including LULUCF
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2		0.1%			6.2%				3.7%			
CH_4		0.0%			16.5%				24.1%			
N_2O		0.0%			196.9%				44.1%			
F-gases		0.3%			22.2%				HFC 48.5% PFC 100% SF6 90.3%			
Total	e.L. 15.84% i.L. 36.65%	6.6%	i. L.: 3.21%	i. L.: 9.45% e. L.: 5.65%	i. L.: 23.8%; e. L.: 21.9%	i. L.: 29.64%; e. L.: 20.67%	i. L.: 43.0% e. L.:11.5%	4.4%	i. L.: 5.5% e.L.: 4.5	e. L.: 17.3% i. L.: 28.9%	14.2%	i. L.: 15.44%
Uncertainty in trend (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1		Tier 1	Tier 1	Tier 1
CO_2		0.2%										
CH_4		0.0%										
N_2O		0.0%										
F-gases		0.8%										
Total	e.L. ±2.84% points i.L. ±8.57%	±10.32% points	i. L.: ±2.2% points	i. L.: ±4.57% points e. L.: ±1.89% points	i. L.: ±2.8% points e. L.: ±2% points	i. L.: ±137.09% points e. L.: ±9.84% points	i. L.: ±8.5% points e. L.: ±2.5% points	±7.62% points		e. L.: ±2.1% points i. L.: ±12.1% points	±5.1% points	e.L.:±.2.7% points i.L.:±2.81% points

16.6 Completeness and data basis

Table 16.6 summarises timeliness and completeness of the new Member States' submissions in 2014. It shows that GHG inventories for 2012 were submitted by all new Member States by 8 May 2014 (cut off date). The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 2.3.

Table 16.6 Date, mode and content of submissions of new Member States in 2014 (status 09.05.2014)

Country	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
BG	14.01.2014	CDR	BGR-2014-v1.1	14.01.2014	1988-2012	2008-2012	Short NIR
BG	14.03.2014	CDR	BGR-2014-v1.2	-	1988-2012	2008-2012	x
BG	15.04.2014	CDR	BGR-2014-v1.3	-	1988-2012	2008-2012	x
CY	19.01.2014	CDR	CYP-2014-v1.1	-	-	n/a	-
CY	29.01.2014	CDR	-	-	1990-2012	n/a	-
CY	04.02.2014	CDR	CYP-2014-v1.2	-	1990-2012	n/a	-

Country	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
CY	14.02.2014	CDR	CYP-2014-v1.5	-	1990-2012	n/a	x
CY	05.05.2014	CDR	CYP-2014-v1.6	-	1990-2012	n/a	-
CZ	15.01.2014	CDR	CZE-2014-v1.1	13.01.2014	1990-2012	2008-2012	Short NIR
CZ	14.03.2014	CDR	CZE-2014-v1.3	30.01.2014	1990-2012	2008-2012	x
CZ	15.04.2014	CDR	CZE-2014-v1.4	-	1990-2012	2008-2012	x
EE	15.01.2014	CDR	EST-2014-v1.1	13.01.2014	1990-2012	2008-2012	x
EE	14.03.2014	CDR	EST-2014-v1.2	-	1990-2012	2008-2012	x
EE	17.04.2014	CDR	EST-2014-v1.3	-	1990-2012	2008-2012	x
EE	17.04.2014	CDR	-	-	-	-	-
HR	15.01.2014	CDR	HRV-2014-v1.1	15.01.2014	1990-2012	2008-2012	-
HR	14.03.2014	CDR	HRV-2014-v1.3	-	1990-2012	2008-2012	x
HR	07.04.2014	CDR	-	-	-	-	-
HR	08.05.2014	CDR	HRV-2014-v2.1	-	1990-2012	2008-2012	x
HU	24.01.2014	CDR	HUN-2014-v1.1	13.01.2014	1985-2012	2008-2012	-
HU	04.02.2014	CDR	-	-	-	-	Short NIR
HU	17.03.2014	CDR	HUN-2014-v1.2	-	1985-2012	2008-2012	x
HU	05.05.2014	CDR	HUN-2014-v1.3	-	1985-2012	2008-2012	x
HU	08.05.2014	CDR	HUN-2014-v2.1	-	1985-2012	2008-2012	x
LT	14.01.2014	CDR	LTU-2014-v1.1	10.01.2014	1990-2012	2008-2012	x
LT	14.03.2014	CDR	LTU-2014-v1.2	12.03.2014	1990-2012	2008-2012	x
LT	15.04.2014	CDR	LTU-2014-v1.3	-	1990-2012	2008-2012	x

Country	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
LV	15.01.2014	CDR	LVA-2014-v1.1	13.01.2014	1990-2012	2008-2012	x
LV	14.03.2014	CDR	LVA-2014-v1.2	-	1990-2012	2008-2012	x
LV	15.04.2014	CDR	LVA-2014-v1.3	-	1990-2012	2008-2012	x
MT	15.01.2014	CDR	MLT-2014-v1.2	-	1990-2012	n/a	x
MT	14.03.2014	CDR	MLT-2014-v1.3	-	1990-2012	n/a	x
MT	05.05.2014	CDR	MLT-2014-v1.4	-	1990-2012	n/a	x
PL	15.01.2014	CDR	POL-2014-v1.1	09.01.2014	1988-2012	2008-2012	Short NIR
PL	14.03.2014	CDR	POL-2014-v1.2	07.03.2014	1988-2012	2008-2012	x
PL	08.05.2014	CDR	POL-2014-v1.3	-	1988-2012	2008-2012	-
RO	15.01.2014	CDR	-	13.01.2014	-	-	Short NIR
RO	15.01.2014	CDR	ROU-2014-v1.1	-	1989-2012	1989, 2008-2012	-
RO	14.03.2014	CDR	ROU-2014-v1.2	-	1989-2012	1989, 2008-2012	x
RO	15.04.2014	CDR	ROU-2014-v1.3	-	1989-2012	1989, 2008-2012	x
RO	08.05.2014	CDR	ROU-2014-v1.4	-	1989-2012	1989, 2008-2012	x
SI	13.01.2014	CDR	SVN-2014-v1.1	10.01.2014	1986-2012	2008-2012	-
SI	15.01.2014	CDR	-	-	-	-	Short NIR
SI	14.03.2014	CDR	SVN-2014-v1.2	-	1986-2012	2008-2012	x
SI	15.04.2014	CDR	SVN-2014-v1.3	-	1986-2012	2008-2012	x
SK	15.01.2014	CDR	SVK-2014-v1.1	10.01.2014	1990-2012	2008-2012	x

Country	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
SK	14.03.2014	CDR	SVK-2014-v1.2	14.03.2014	1990-2012	2008-2012	x
SK	15.04.2014	CDR	SVK-2014-v1.3	-	1990-2012	2008-2012	x

In response to the Saturday paper 2010 the EU mobilized the mechanisms of its national system to further enhance its QA/QC programme and develop an appropriate action plan, in consultation with the MS, geared in particular towards complementing the existing procedures and improving the completeness regarding NEs of the EU greenhouse gas inventory in 2011 and beyond (see description in Chapter 1).

GHG inventory estimates for 2012 are available for all new Member States. Therefore, no gap-filling was needed.

Table 16.7 to Table 16.10 show the data basis of the 2012 EU GHG inventory.

Table 16.7 Data basis of CO_2 emissions excluding LULUCF (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	3 369	3 307	3 375	3 477	3 470	3 412	3 333	3 064	3 156	3 011	2 988
Bulgaria	80	58	46	50	52	55	54	45	48	53	48
Croatia	23	17	20	24	24	25	24	22	21	21	19
Cyprus	5	6	7	8	8	8	8	8	8	8	7
Czech Republic	165	129	126	126	127	127	122	114	117	115	111
Estonia	37	18	15	16	16	19	17	14	18	18	17
Hungary	72	61	58	60	59	58	57	51	52	50	46
Latvia	19	9	7	8	8	9	8	7	9	8	7
Lithuania	36	15	12	14	14	16	15	13	14	14	14
Malta	2	2	2	3	3	3	3	3	3	3	3
Poland	375	361	319	318	331	332	324	310	330	328	321
Romania	178	126	93	99	104	103	99	83	80	86	84
Slovakia	62	45	41	42	42	40	40	37	37	37	35
Slovenia	15	15	15	17	17	17	18	16	16	16	16
EU-28	**4 437**	**4 169**	**4 136**	**4 262**	**4 274**	**4 224**	**4 123**	**3 788**	**3 908**	**3 767**	**3 717**

Table 16.8 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	443	423	383	333	326	321	316	310	304	298	296
Bulgaria	17	11	9	8	8	8	8	7	7	8	7
Croatia	4	3	3	3	4	4	4	4	4	4	3
Cyprus	1	1	1	1	1	1	1	1	1	1	1
Czech Republic	18	13	11	11	11	11	11	10	10	10	10
Estonia	2	1	1	1	1	1	1	1	1	1	1
Hungary	12	9	9	9	9	9	8	8	8	8	8
Latvia	3	2	2	2	2	2	2	2	2	2	2
Lithuania	6	4	3	3	3	3	3	3	3	3	3
Malta	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1
Poland	52	48	46	45	46	45	44	43	44	43	43
Romania	43	31	26	26	26	25	25	24	23	22	22
Slovakia	5	4	4	4	4	4	4	4	4	4	4
Slovenia	2	2	2	2	2	2	2	2	2	2	2
EU-28	**607**	**552**	**501**	**449**	**443**	**436**	**430**	**420**	**413**	**405**	**403**

Table 16.9 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	402	383	344	313	301	299	292	281	272	269	264
Bulgaria	12	7	6	6	5	5	5	5	5	5	5
Croatia	4	3	3	4	4	4	4	3	3	4	3
Cyprus	1	1	1	1	1	1	1	1	1	1	1
Czech Republic	14	9	9	9	8	8	9	8	8	8	8
Estonia	2	1	1	1	1	1	1	1	1	1	1
Hungary	13	8	9	9	9	8	7	7	7	7	7
Latvia	4	2	2	2	2	2	2	2	2	2	2
Lithuania	7	3	5	6	6	7	6	4	4	4	4
Malta	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Poland	42	34	33	33	34	35	34	31	30	31	30
Romania	24	17	13	15	14	14	14	12	12	13	12
Slovakia	6	4	4	4	4	4	4	4	3	3	3
Slovenia	1	1	1	1	1	1	1	1	1	1	1
EU-27	**533**	**474**	**430**	**402**	**389**	**389**	**380**	**359**	**350**	**348**	**341**

Table 16.10 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
	HFC	27 832	40 197	44 419	54 526	56 090	59 268	62 722	65 762	68 963	70 304	71 540
EU-15	PFC	17 275	11 730	8 061	5 385	4 946	4 601	3 959	2 531	2 987	3 228	2 781
	SF_6	10 980	15 486	10 514	7 749	7 112	6 894	6 433	6 079	6 185	5 994	6 042
	HFC	NA,NO	2	18	114	168	209	321	350	372	410	456
Bulgaria	PFC	NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.02	0.04	0.1	0.0
	SF_6	4	5	7	9	9	9	10	10	13	15	12
	HFC	NO	49	171	333	365	406	424	436	472	485	486
Croatia	PFC	937	NO	NO	NA,NO	NA,NO	NA,NO	NA,NO	0.2	0.03	0.01	0.02
	SF_6	11	12	12	14	14	14	13	8	9	10	10
	HFC	NA,NE,NO	2	29	121	152	181	206	230	250	259	260
Cyprus	PFC	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
	SF_6	NA,NE,NO	NA,NE,NO	0.01	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	HFC	NA,NE,NO	0	178	617	821	1 116	1 314	1 424	1 689	1 925	2 083
Czech Republic	PFC	NA,NE,NO	0	3	10	22	21	28	33	37	9	7
	SF_6	79	83	111	113	102	89	95	105	71	84	92
	HFC	NA,NE,NO	25	70	118	135	149	131	138	153	160	167
Estonia	PFC	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.1	0.1	0.04	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
	SF_6	NA,NE,NO	3	3	1	1	1	1	1	2	2	2
	HFC	NA,NO	38	237	682	804	873	986	944	1 039	1 145	1 006
Hungary	PFC	271	167	212	210	3	4	4	3	1	2	1
	SF_6	88	170	195	238	186	253	276	221	235	220	153
	HFC	IE,NA,NE,NO	1	5	28	63	99	73	74	72	75	84
Latvia	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NE,NO	0	1	8	7	9	10	14	12	12	14
	HFC	NA,NO	3	14	68	93	123	153	168	192	220	241
Lithuania	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NO	0	0	1	1	1	3	3	6	8	4
	HFC	NA,NE,NO	NA,NE,NO	8	64	87	106	117	120	121	132	171
Malta	PFC	NA,NE,NO	NA,NE,NO	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
	SF_6	0	2	2	2	2	2	2	2	2	5	0
	HFC	NA,NO	197	1 352	5 100	5 741	6 522	6 020	6 468	6 756	7 394	7 700
Poland	PFC	123	149	152	161	166	158	140	59	56	50	42
	SF_6	NA,NO	31	24	28	35	33	34	39	37	41	42
	HFC	0	2	64	323	423	579	826	804	855	946	1 033
Romania	PFC	2 116	1 774	1 292	82	55	24	15	7	8	11	6
	SF_6	0	1	7	13	19	23	27	37	48	38	41
	HFC	NA,NO	12	77	206	248	284	335	380	420	440	452
Slovakia	PFC	271	114	12	20	36	25	36	18	21	17	22
	SF_6	0	10	13	16	17	17	19	19	20	21	21
	HFC	NA,NO	32	41	133	154	177	188	196	215	217	219
Slovenia	PFC	257	106	106	133	125	91	21	7	14	29	26
	SF_6	10	13	16	19	18	18	17	16	17	17	17
	HFC	27 832	40 511	46 511	62 102	64 980	69 687	73 392	77 058	81 098	83 625	85 413
EU-28	PFC	20 313	14 040	9 837	6 001	5 352	4 924	4 204	2 659	3 124	3 345	2 885
	SF_6	11 161	15 802	10 893	8 196	7 509	7 347	6 926	6 546	6 647	6 456	6 441

Table 16.11 shows the geographical coverage of the new Member States' national inventories. As the EU inventory is the sum of the Member States' inventories, the EU inventory covers the same geographical area as the inventories of the Member States.

Table 16.11 Geographical coverage of the new Member States

Member State	Geographical coverage
Bulgaria	Bulgaria
Croatia	Croatia
Cyprus	Area under the effective control of the Republic of Cyprus
Czech Republic	Czech Republic
Estonia	Estonia
Hungary	Hungary
Latvia	Latvia
Lithuania	Lithuania
Malta	Malta
Poland	Poland
Romania	Romania
Slovakia	Slovakia
Slovenia	Slovenia

17 EU-28 GREENHOUSE GAS EMISSION TRENDS

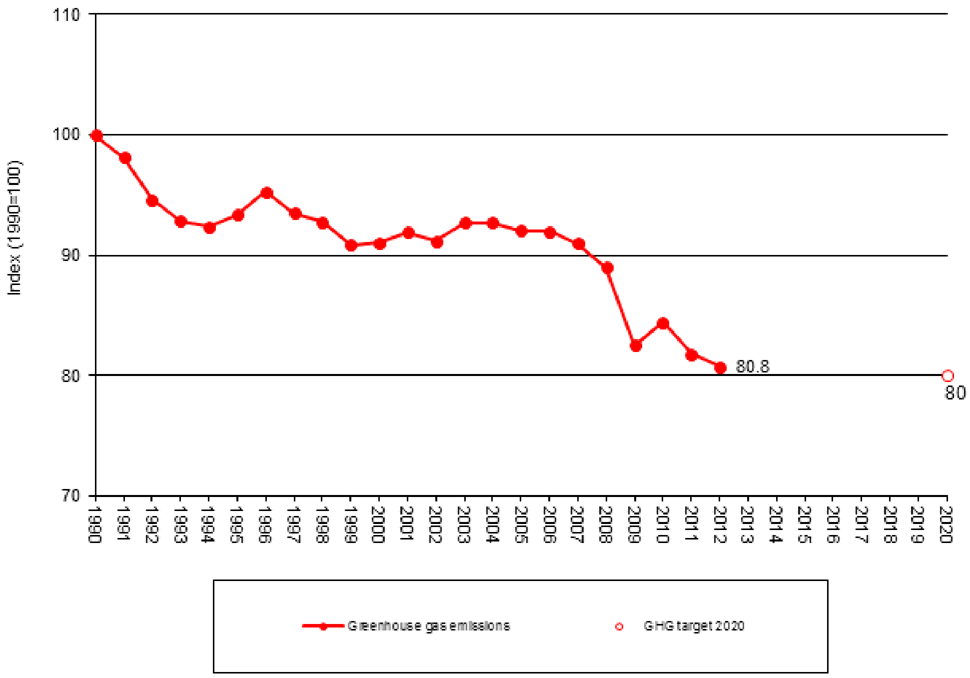
This chapter presents the main GHG emission trends in the EU-28. Firstly, aggregated results are described for EU-28. Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EU GHG trends is given. Finally, also the trends of indirect GHGs and SO_2 emissions are also presented.

17.1 Aggregated greenhouse gas emissions

On 23 January 2008 the European Commission adopted the 'Climate Action and Renewable Energy' package. The proposal was part of draft legislation implementing the 'Integrated Energy and Climate Change' package of 10 January 2007, which was endorsed by the European Council in March 2007. In December 2008 the European Parliament and the Council reached agreement on the package. It was adopted by the Council on 6 April 2009. The package underlines the objective of limiting the rise in global average temperature to no more than two degrees Celsius above pre-industrial levels. To achieve this goal the EU committed to a unilateral emission reduction target of 20%[82] by 2020, compared with 1990 levels, and agreed to a reduction by 30% provided that other major emitters agree to take on their fair share of a global reduction effort.

Total GHG emissions, without LULUCF, in the EU-28 decreased by 19 % between 1990 and 2012 (-1082 million tonnes CO_2 equivalents). Emissions decreased by 1.3 % (59 million tonnes CO_2 equivalents) between 2011 and 2012 (Figure 17.1).

Figure 17.1 EU-28 GHG emissions 1990–2012 (excl. LULUCF)



Notes: GHG emission data for the EU-28 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

[82] All emission information for EU-27 in this report uses 1990 as the starting point when addressing emission reductions. EU-27 does not have a common target under the Kyoto Protocol in the same way as EU-15.

17.1.1 Main trends by source category, 1990-2012

Table 17.1 shows the source categories contributing the most to changes in greenhouse gas emissions between 1990 and 2012.

Table 17.1 EU-28: Overview of Top decreasing/increasing source categories 1990-2012 (+/- 20 Million tonnes CO_2 equivalents)

Source category	EU-28 Million tonnes (CO_2 eq.)
Road Transportation (CO_2 from 1A3b)	123
Consumptions of halocarbons (HFC from 2F)	85
Production of halocarbons (HFC from 2E)	-27
Cement Production (CO_2 from 2A1)	-28
Nitric Acid Production (N_2O from 2B2)	-42
Enteric fermentation (CH_4 from 4A)	-48
Manufacture of Solid fuels (CO_2 from 1A1c)	-59
Adipic Acid Production (N_2O from 2B3)	-59
Solid waste disposal on land (CH_4 from 6A)	-61
Fugitive emissions from fuels (CH_4 from 1B)	-73
Agricultural soils (N_2O from 4D)	-74
Iron and Steel Production (CO_2 from 1A2a +2C1)	-98
Households and services (CO_2 from 1A4)	-137
Public Electricity and Heat Production (CO_2 from 1A1a)	-214
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-258
Total	**-1 082**

Notes: As the table only presents sectors whose emissions increased or decreased by 20 million tonnes CO_2-equivalents, the sum of the source categories presented does not match the total change listed at the bottom of the table.

17.1.2 Main trends by source category, 2011-2012

Between 2011 and 2012 emissions decreased by 1.3 % in the EU-28. This was mainly due to emission decreases in the sectors road transportation, manufacturing industries excl. iron and steel, manufacture of solid fuels and iron and steel production (Table 17.2).

Table 17.2 EU-28: Overview of Top decreasing/increasing source categories 2010-2012 (+/- 3 Million tonnes CO_2 equivalents)

Source category	EU-28
	Million tonnes (CO_2 eq.)
Households and services (CO_2 from 1A4)	20
Public Electricity and Heat Production (CO_2 from 1A1a)	10
Cement production (CO2 from 2A1)	-5
Agricultural Soils (N_2O from 4D)	-5
Refineries (CO2 from 1A1b)	-5
Iron and Steel Production (CO_2 from 1A2a +2C1)	-8
Manufacture of Solid fuels (CO2 from 1A1c)	-10
Manufacturing industries (excl. Iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-15
Road Transportation (CO_2 from 1A3b)	-32
Total	**-59**

Notes: As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2-equivalents, the sum of the source categories presented does not match the total change listed at the bottom of the table

17.1.3 Main reasons for emission changes 2011-2012

Between 2011 and 2012, emission decreases in the EU-28 were mainly due to:

- CO_2 from road transport (-32 million tonnes or -4 %)

  This decrease was mainly due to emission reductions in the EU-15. Most of the new Member States also contributed to this decreasing trend, while Bulgaria, Estonia, Lithuania, Romania, Slovakia and Slovenia reported emission increases.

- CO_2 from manufacturing industries excl. iron and steel (-15 million tonnes or -3 %).

  This decrease was mainly due to EU-15 Member States. Large industrialized new Member States such as the Czech Republic and Poland also reported decreasing emissions, while emissions increased mainly in the smaller new Member States.

- CO_2 from manufacture of solid fuels (-10 million tonnes or -14 %)

  This decrease was mainly caused by the EU-15; all new Member States except Bulgaria and Estonia had also falling emissions.

- Other major emission decreases occurred in agricultural soils, iron and steel production, refineries and cement production.

Emission increases of more than 3 million tonnes between 2011 and 2012 in the EU-28 were only reported for:

- CO_2 from households and services (+20 million tonnes or +3 %)
- CO_2 from public electricity and heat production (+10 million tonnes or +1 %)

17.1.4 Overview of GHG emissions in new Member States

Table 17.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2012 (million tonnes)	2011–2012 (million tonnes)	Change 2011–2012 (%)	Change 1990-2012 (%)	Change base year–2012 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
EU-15	**4262.1**	**4265.5**	**3619.5**	**-30.5**	**-0.8%**	**-15.1%**	**-15.1%**	**-8.0%**
Bulgaria	109.1	132.6	61.0	-5.0	-7.5%	-44.1%	-54.0%	-8.0%
Croatia	31.9	31.3	26.4	-2.1	-7.4%	-17.3%	-15.7%	-5.0%
Cyprus	6.1	Not applicable	9.3	-0.4	-4.4%	52.1%	Not applicable	Not applicable
Czech Republic	196.1	194.2	131.5	-3.8	-2.8%	-33.0%	-32.3%	-8.0%
Estonia	40.6	42.6	19.2	-1.3	-6.3%	-52.8%	-55.0%	-8.0%
Hungary	97.6	115.4	62.0	-4.1	-6.1%	-36.5%	-46.3%	-6.0%
Latvia	26.2	25.9	11.0	-0.2	-1.4%	-58.1%	-57.6%	-8.0%
Lithuania	48.7	49.4	21.6	-0.1	-0.3%	-55.6%	-56.2%	-8.0%
Malta	2.0	Not applicable	3.1	0.1	3.7%	57.7%	Not applicable	Not applicable
Poland	466.4	563.4	399.3	-6.5	-1.6%	-14.4%	-29.1%	-6.0%
Romania	247.7	278.2	118.8	-2.7	-2.3%	-52.0%	-57.3%	-8.0%
Slovakia	73.2	72.1	42.7	-2.0	-4.4%	-41.7%	-40.7%	-8.0%
Slovenia	18.4	20.4	18.9	-0.6	-2.8%	2.5%	-7.1%	-8.0%
EU-28	**5626.3**	**Not applicable**	**4544.2**	**-59.0**	**-1.3%**	**-19.2%**	**Not applicable**	**Not applicable**

([a]) The base year under the Kyoto Protocol for each new Member State is further outlined in Table 16.3. As Cyprus, Malta and EU-28 do not have targets under the Kyoto Protocol, they do not have applicable Kyoto Protocol base years.

17.2 Emission trends by gas

Table 17.4 gives an overview of the main trends in EU-28 GHG emissions and removals for 1990–2012. The most important GHG by far is CO_2, accounting for 82 % of total EU-28 emissions in 2012 excluding LULUCF. In 2012, EU-28 CO_2 emissions without LULUCF were 3717 Tg, which was16 % below 1990 levels. Compared to 2011, CO_2 emissions decreased by 1.3%. Emissions of CH_4, N_2O and PFCs decreased , while HFCs increased again in 2012.

Table 17.4 Overview of EU-28 GHG emissions and removals from 1990 to 2012 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Net CO_2 emissions/removals	4 168	3 866	3 821	3 947	3 930	3 943	3 784	3 443	3 585	3 445	3 401
CO_2 emissions (without LULUCF)	4 437	4 169	4 136	4 262	4 274	4 224	4 123	3 788	3 908	3 767	3 717
CH_4	607	552	501	449	443	436	430	420	413	405	403
N_2O	533	474	430	402	389	389	380	359	350	348	341
HFCs	28	41	47	62	65	70	74	77	82	84	86
PFCs	21	14	10	6	5	5	4	3	3	3	3
SF_6	11	16	11	8	8	7	7	7	7	6	6
Total (with net CO_2 emissions/removals)	**5 368**	**4 963**	**4 819**	**4 874**	**4 840**	**4 850**	**4 679**	**4 309**	**4 439**	**4 292**	**4 241**
Total (without CO2 from LULUCF)	**5 637**	**5 266**	**5 134**	**5 190**	**5 185**	**5 131**	**5 017**	**4 654**	**4 762**	**4 614**	**4 556**
Total (without LULUCF)	**5 626**	**5 253**	**5 122**	**5 178**	**5 173**	**5 119**	**5 006**	**4 642**	**4 751**	**4 603**	**4 544**

17.3 Emission trends by source

Table 17.5 gives an overview of EU-28 GHG emissions in the main source categories for 1990–2012. The most important sector by far is Energy (i.e. combustion and fugitive emissions) accounting for 79 % of total EU-28 emissions in 2012. The second largest sector is Agriculture (10%), followed by Industrial Processes (7 %).

Table 17.5 Overview of EU-28 GHG emissions in the main source and sink categories 1990 to 2012 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
1. Energy	4 325	4 058	4 004	4 103	4 107	4 044	3 961	3 678	3 783	3 642	3 604
2. Industrial Processes	462	441	394	403	401	412	388	324	335	332	321
3. Solvent and Other Product Use	17	14	14	12.288	12	12	11	10	11	10	10
4. Agriculture	617	533	521	493	490	490	489	478	475	475	469
5. Land-Use, Land-Use Change and Forestry	-258	-291	-302	-304	-333	-268	-328	-334	-312	-311	-304
6. Waste	206	207	190	166	164	160	156	152	147	144	141
7. Other	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5 368**	**4 963**	**4 819**	**4 874**	**4 840**	**4 850**	**4 679**	**4 309**	**4 439**	**4 292**	**4 241**
Total (without LULUCF)	**5 626**	**5 253**	**5 122**	**5 178**	**5 173**	**5 119**	**5 006**	**4 642**	**4 751**	**4 603**	**4 544**

17.4 Emission trends by Member State

Table 17.6 gives an overview of new Member States' contributions to the EU GHG emissions for 1990–2012. Member States show large variations in GHG emission trends.

Table 17.6 Overview of new Member States' contributions to EU GHG emissions excluding LULUCF from 1990 to 2012 in CO_2 equivalents (Tg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	**4 262**	**4 171**	**4 156**	**4 183**	**4 157**	**4 095**	**4 007**	**3 722**	**3 803**	**3 650**	**3 619**
Bulgaria	109	76	59	64	65	68	67	58	60	66	61
Croatia	32	24	27	31	31	33	31	29	29	29	26
Cyprus	6	8	9	10	10	10	11	10	10	10	9
Czech Republic	196	152	146	146	147	147	142	134	137	135	131
Estonia	41	20	17	18	18	21	20	16	20	20	19
Hungary	98	78	77	78	77	76	73	67	68	66	62
Latvia	26	13	10	11	12	12	11	11	12	11	11
Lithuania	49	22	20	23	24	26	25	20	21	22	22
Malta	2	2	3	3	3	3	3	3	3	3	3
Poland	466	441	396	399	414	415	406	388	407	406	399
Romania	248	175	134	141	145	143	140	120	116	122	119
Slovakia	73	53	49	50	50	48	49	45	45	45	43
Slovenia	18	19	19	20	21	21	21	19	19	19	19
EU-28	**5 626**	**5 253**	**5 122**	**5 178**	**5 173**	**5 119**	**5 006**	**4 642**	**4 751**	**4 603**	**4 544**

The overall EU GHG emission trend is dominated by the EU-15 (mainly by Germany, the United Kingdom, Italy, France and Spain) accounting for almost 80 % of total EU-28 GHG emissions. Of the new Member States Poland contributes most to the total EU-28 GHG emissions, namely 9 %, followed by the Czech Republic and Romania (share of 2.9 % and 2.6 %, respectively). Poland decreased GHG emissions by 14 % between 1990 and 2012 (-29 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception is transport (especially road transport) where emissions increased.

17.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_X, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_X and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. In the EU-28, SO_2 emissions decreased by 81 %, followed by CO (-64 %), NMVOC (-58 %) and NO_X (-51 %) (Table 17.7).

Table 17.7 Overview of EU-28 indirect GHG and SO_2 emissions for 1990–2012 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
	(Gg)										
NOx	17 473	14 842	12 807	11 620	11 340	11 006	10 166	9 305	9 171	8 827	8 516
CO	68 648	51 639	39 722	31 005	29 642	29 903	27 480	25 322	26 082	24 546	24 377
NMVOC	17 500	13 940	11 442	9 514	9 340	8 806	8 344	7 815	7 814	7 557	7 367
SO2	26 251	16 827	10 375	8 155	8 011	7 696	6 306	5 556	5 397	5 534	5 116

Table 17.8 shows the NO_X emissions of the new Member States between 1990 and 2012. The EU-15 makes up for 79 % of total NO_X emissions, followed by Poland with a share of 10 % in 2012. Most new Member States reduced their emissions, only Cyprus and Malta had emission increases between 1990 and 2012.

Table 17.8 Overview of the EU-15 and the new Member States' contributions EU-28 NO_X emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	**13 769**	**12 087**	**10 533**	**9 501**	**9 192**	**8 886**	**8 115**	**7 409**	**7 214**	**6 902**	**6 685**
Bulgaria	265	177	145	158	159	166	163	141	147	164	148
Croatia	93	65	73	73	73	76	75	69	63	60	55
Cyprus	16	18	21	21	20	22	20	19	18	21	21
Czech Republic	742	430	397	279	284	286	263	253	240	226	211
Estonia	77	41	38	34	33	36	33	28	34	33	32
Hungary	233	188	189	154	156	150	148	142	140	125	109
Latvia	84	49	41	41	42	41	37	34	36	31	35
Lithuania	163	80	60	64	66	64	65	59	61	57	60
Malta	8	9	8	10	9	10	10	9	9	9	9
Poland	1 280	1 120	862	860	891	868	830	791	863	851	817
Romania	457	341	283	275	270	257	260	222	211	217	207
Slovakia	227	179	108	102	97	96	94	83	89	86	81
Slovenia	61	59	51	48	49	49	54	47	46	46	45
EU-28	**17 473**	**14 842**	**12 807**	**11 620**	**11 340**	**11 006**	**10 166**	**9 305**	**9 171**	**8 827**	**8 516**

Table 17.9 shows the CO emissions of the new Member States between 1990 and 2012. The EU-15 has a share of 74 %, followed by Poland and Romania. These two account for 17 % of EU-28 emissions in 2012. All new Member States reduced emissions between 1990 and 2012.

Table 17.9 Overview of the EU-15 and the new Member States' contributions EU-28 CO emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	**54 467**	**42 142**	**32 461**	**24 126**	**22 634**	**23 127**	**20 628**	**18 692**	**19 327**	**18 082**	**18 133**
Bulgaria	665	367	271	265	272	246	257	244	266	278	282
Croatia	586	395	476	353	353	332	290	287	277	287	293
Cyprus	53	45	34	26	24	25	22	20	15	0	1
Czech Republic	1 070	932	680	556	540	582	496	452	454	405	366
Estonia	190	165	166	139	134	149	145	146	152	137	140
Hungary	1 237	799	691	483	503	466	418	431	427	418	388
Latvia	382	291	235	208	233	191	180	197	185	157	161
Lithuania	471	296	221	220	220	206	205	200	206	187	193
Malta	24	30	30	29	29	30	30	31	6	8	6
Poland	7 406	4 547	2 633	2 649	2 857	2 739	2 769	2 715	3 052	2 916	2 818
Romania	1 239	901	1 302	1 492	1 389	1 396	1 627	1 534	1 335	1 277	1 208
Slovakia	520	427	306	282	280	252	254	218	230	236	227
Slovenia	337	301	213	178	173	162	158	155	151	159	160
EU-28	**68 648**	**51 639**	**39 722**	**31 005**	**29 642**	**29 903**	**27 480**	**25 322**	**26 082**	**24 546**	**24 377**

Table 17.10 shows the NMVOC emissions of the EU-28 Member States between 1990 and 2012. The EU-15 makes up 80 % of total NMVOC emissions in 2012. Of the new Member States Poland and Romania have the highest shares. All new Member States reduced emissions between 1990 and 2012.

Table 17.10 Overview of the EU-15 and the new Member States' contributions EU-28 NMVOC emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	**14 654**	**12 016**	**9 744**	**7 886**	**7 680**	**7 185**	**6 713**	**6 299**	**6 264**	**6 040**	**5 881**
Bulgaria	519	112	68	60	62	59	59	53	54	55	57
Croatia	118	80	90	104	113	117	111	79	78	74	70
Cyprus	17	16	14	14	13	13	12	11	11	9	9
Czech Republic	311	215	244	182	179	174	166	151	151	140	129
Estonia	54	43	38	34	34	37	34	30	31	31	31
Hungary	249	178	154	124	123	116	109	110	108	104	104
Latvia	78	65	56	55	55	53	51	52	51	50	53
Lithuania	98	77	68	71	70	69	67	65	65	62	62
Malta	6	8	3	4	4	4	3	3	3	3	4
Poland	831	769	574	572	630	611	634	615	654	652	630
Romania	362	206	266	290	262	256	276	240	239	229	237
Slovakia	134	91	67	71	69	67	66	64	62	68	61
Slovenia	69	63	55	47	48	46	44	43	41	41	39
EU-28	**17 500**	**13 940**	**11 442**	**9 514**	**9 340**	**8 806**	**8 344**	**7 815**	**7 814**	**7 557**	**7 367**

Table 17.11 shows the SO_2 emissions of the new Member States between 1990 and 2012. The largest emitters beside the EU-15, which makes up 43 %, are Bulgaria, Poland and Romania. These three States account for 49 % of total EU-28 emissions in 2012. All new Member reduced emissions between 1990 and 2012.

Table 17.11 Overview of Member States' contributions to EU-15 and EU-28 SO_2 emissions for 1990–2012 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
EU-15	**16 444**	**10 036**	**6 118**	**4 518**	**4 307**	**4 080**	**3 023**	**2 599**	**2 380**	**2 291**	**2 217**
Bulgaria	1 582	1 228	1 106	1 162	1 157	1 288	1 244	1 166	1 241	1 526	1 335
Croatia	174	82	62	63	60	67	57	59	35	33	26
Cyprus	30	37	46	35	29	27	22	17	22	21	16
Czech Republic	1 876	1 095	264	219	211	217	174	173	170	169	158
Estonia	184	76	81	82	80	84	77	64	75	72	70
Hungary	827	619	423	43	41	36	37	31	32	35	32
Latvia	102	49	16	7	6	6	5	4	3	3	2
Lithuania	212	87	44	43	44	34	33	32	32	29	36
Malta	16	27	24	12	12	13	12	8	8	8	8
Poland	3 210	2 376	1 445	1 233	1 311	1 223	1 001	867	950	910	853
Romania	871	748	526	608	651	536	539	460	368	357	293
Slovakia	524	245	127	89	88	71	69	64	69	68	59
Slovenia	199	122	93	41	16	15	13	10	10	11	10
EU-28	**26 251**	**16 827**	**10 375**	**8 155**	**8 011**	**7 696**	**6 306**	**5 556**	**5 397**	**5 534**	**5 116**

18 ENERGY (CRF SECTOR 1)

18.1 Overview of sector (EU-28)

Figure 18.1 CRF Sector 1 Energy: EU-28 GHG emissions in CO_2 equivalents (Tg) for 1990–2012

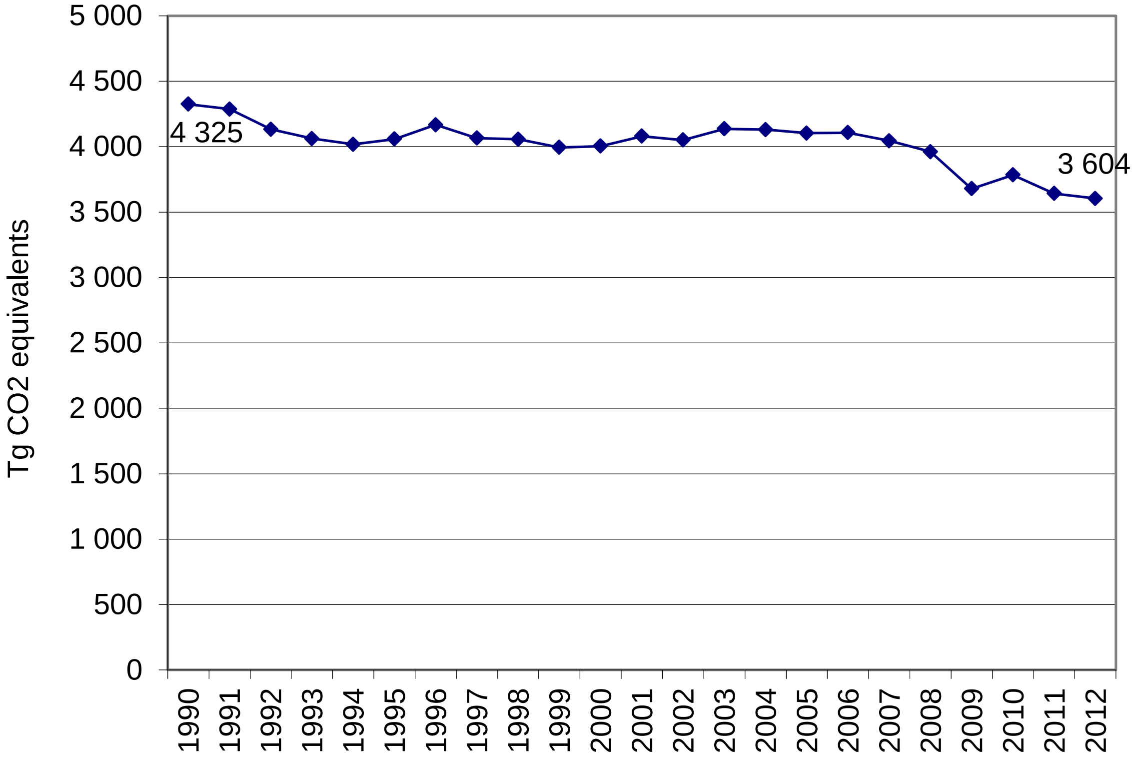
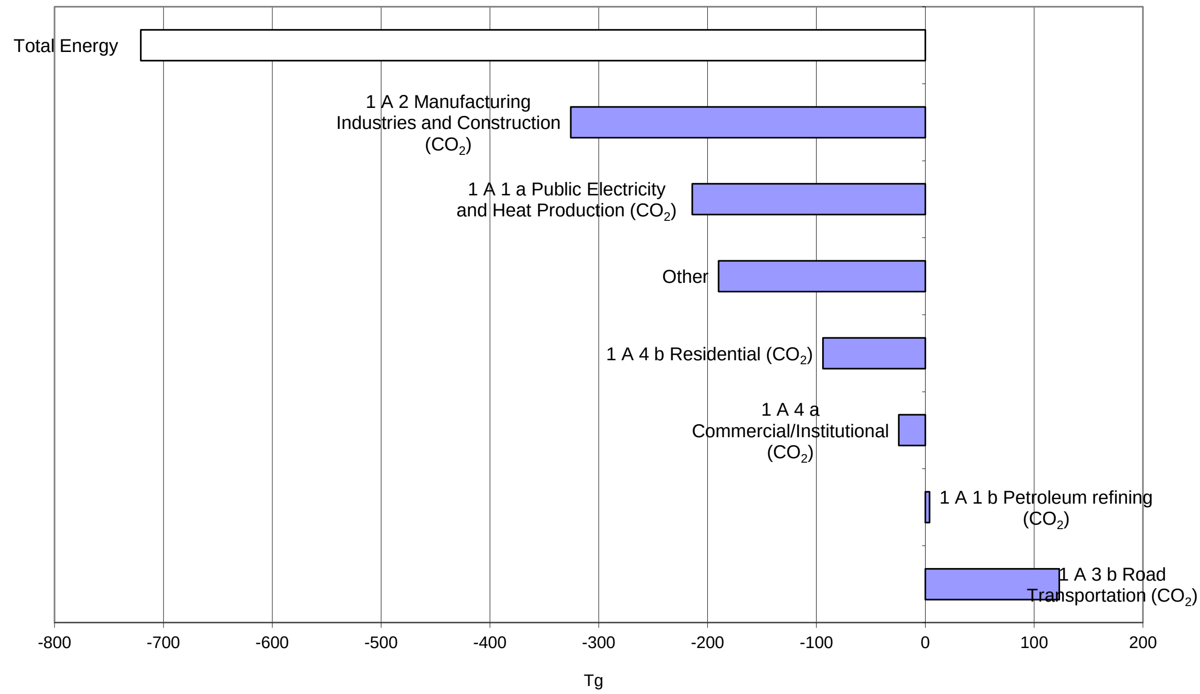
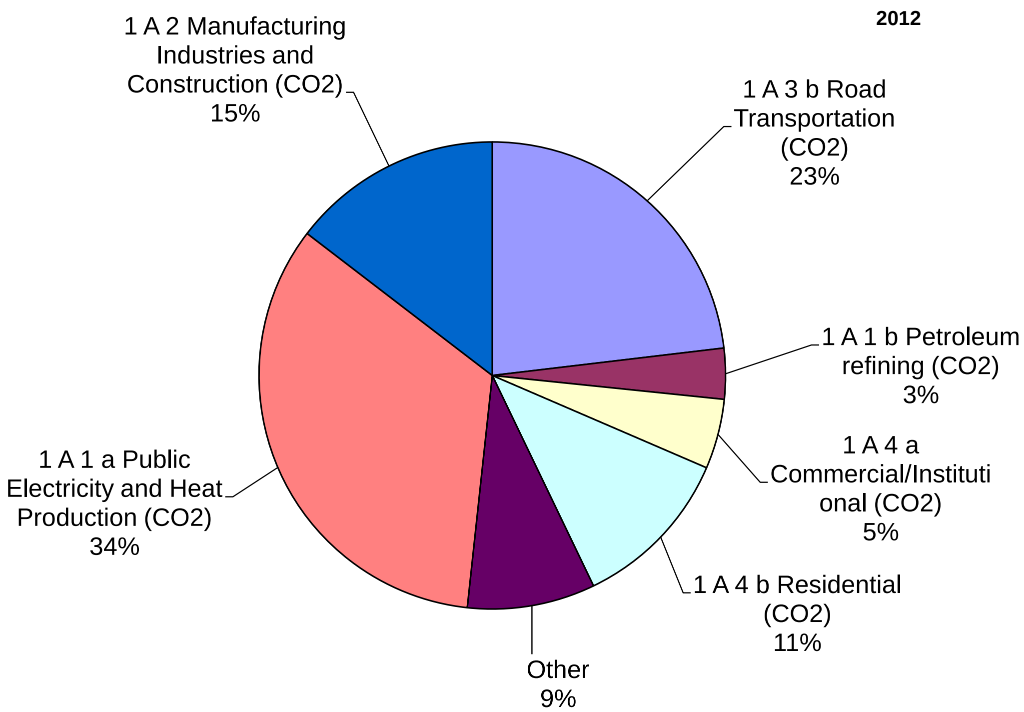


Figure 18.2 CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2012 and share of largest key source categories in 2012





18.2 Source categories (EU-28)

18.2.1 Energy industries (CRF Source Category 1A1) (EU-28)

18.2.1.1 Public Electricity and Heat Production (1A1a) (EU-28)

Figure 18.3 1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends

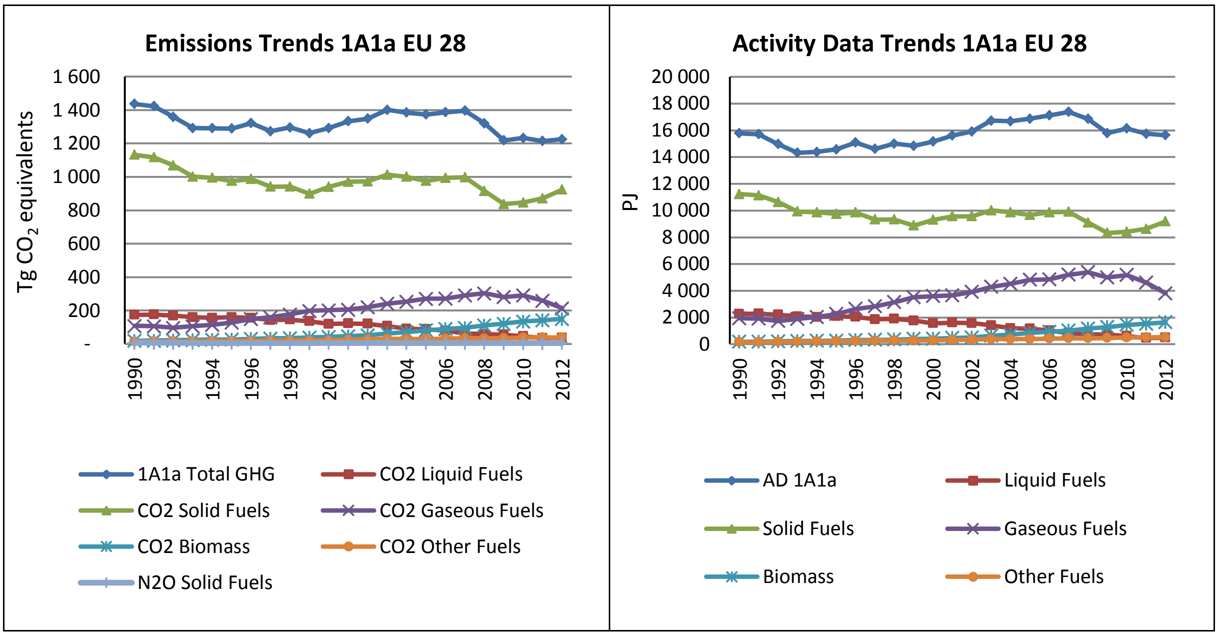


Table 18.1 1A1a Public Electricity and Heat Production, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	123 579	25 955	28 368	75%	2 413	9%	-95 211	-77%		
Bulgaria	3 211	425	631	2%	207	49%	-2 580	-80%	T1	D
Croatia	2 132	516	399	1%	-117	-23%	-1 733	-81%	T2	PS
Cyprus	1 676	3 710	3 546	9%	-164	-4%	1 870	112%	CS	CS
Czech Republic	819	136	130	0.3%	-6	-5%	-689	-84%	T1	D
Estonia	4 900	339	340	1%	1	0.2%	-4 560	-93%	T1,T2	CS,D
Hungary	1 456	174	178	0.5%	3	2%	-1 278	-88%	T2	CS
Latvia	3 051	47	37	0.1%	-10	-20%	-3 014	-99%	T2	CS
Lithuania	6 021	200	525	1%	325	163%	-5 496	-91%	T1,T2,T3	CS,D,PS
Malta	749	1 931	2 050	5%	119	6%	1 301	174%	D,T1	D
Poland	5 116	615	551	1%	-64	-10%	-4 565	-89%	T1	D
Romania	20 353	1 067	995	3%	-71	-7%	-19 358	-95%	T2	CS
Slovakia	1 033	24	32	0.1%	8	33%	-1 001	-97%	T2	CS
Slovenia	277	23	25	0.1%	1	5%	-252	-91%	T1	D
EU-28	**174 374**	**35 164**	**37 809**	**100%**	**2 645**	**8%**	**-136 566**	**-78%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.4 1A1a- Public Electricity and Heat Production, liquid fuels: Activity Data and Implied Emission Factors for CO_2

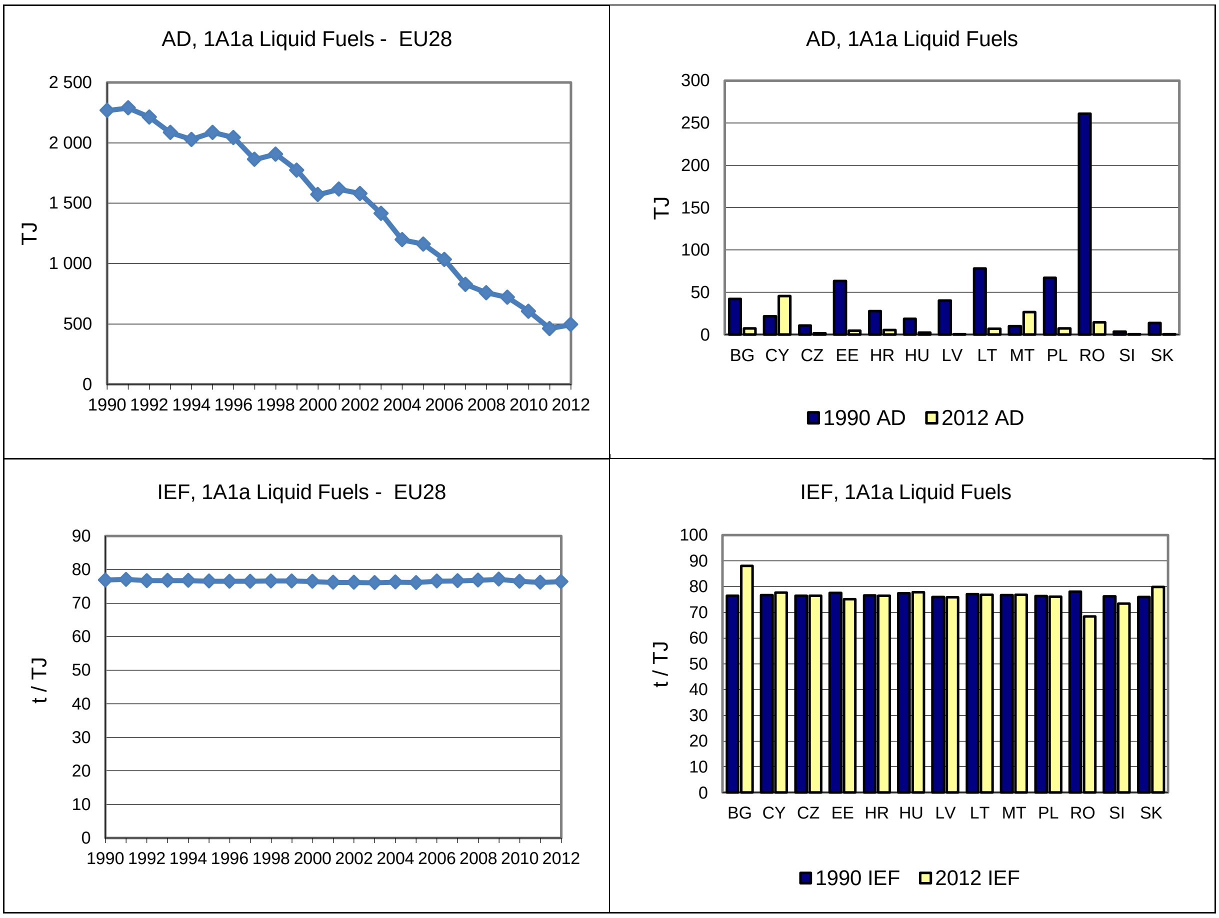


Table 18.2 1A1a Public Electriciy and Heat Production, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	752 525	568 600	636 917	69%	68 317	12%	-115 608	-15%		
Bulgaria	27 884	32 516	27 587	3%	-4 930	-15%	-298	-1%	T2	CS,D
Croatia	589	2 250	1 970	0.2%	-280	-12%	1 381	234%	T2	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	51 658	50 905	49 891	5%	-1 013	-2%	-1 767	-3%	T1	CS,D
Estonia	21 887	12 848	11 396	1%	-1 452	-11%	-10 491	-48%	T1,T2,T3	CS,D,PS
Hungary	12 266	8 838	8 732	1%	-106	-1%	-3 534	-29%	T3	PS
Latvia	339	40	48	0.01%	9	22%	-290	-86%	T2	CS
Lithuania	185	27	22	0.002%	-5	-17%	-163	-88%	T2,T3	CS,PS
Malta	618	NO	NO	-	-	-	-618	-100%	NA	NA
Poland	220 494	160 963	155 872	17%	-5 091	-3%	-64 622	-29%	T1,T2	CS,D
Romania	26 429	24 286	22 403	2%	-1 883	-8%	-4 026	-15%	T1, T2	D, CS
Slovakia	11 542	4 085	3 932	0.4%	-153	-4%	-7 610	-66%	T2	CS
Slovenia	5 600	5 862	5 590	1%	-272	-5%	-10	-0.2%	T3	PS
EU-28	**1 132 017**	**871 222**	**924 362**	**100%**	**53 140**	**6%**	**-207 655**	**-18%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.5 1A1a- Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for CO_2

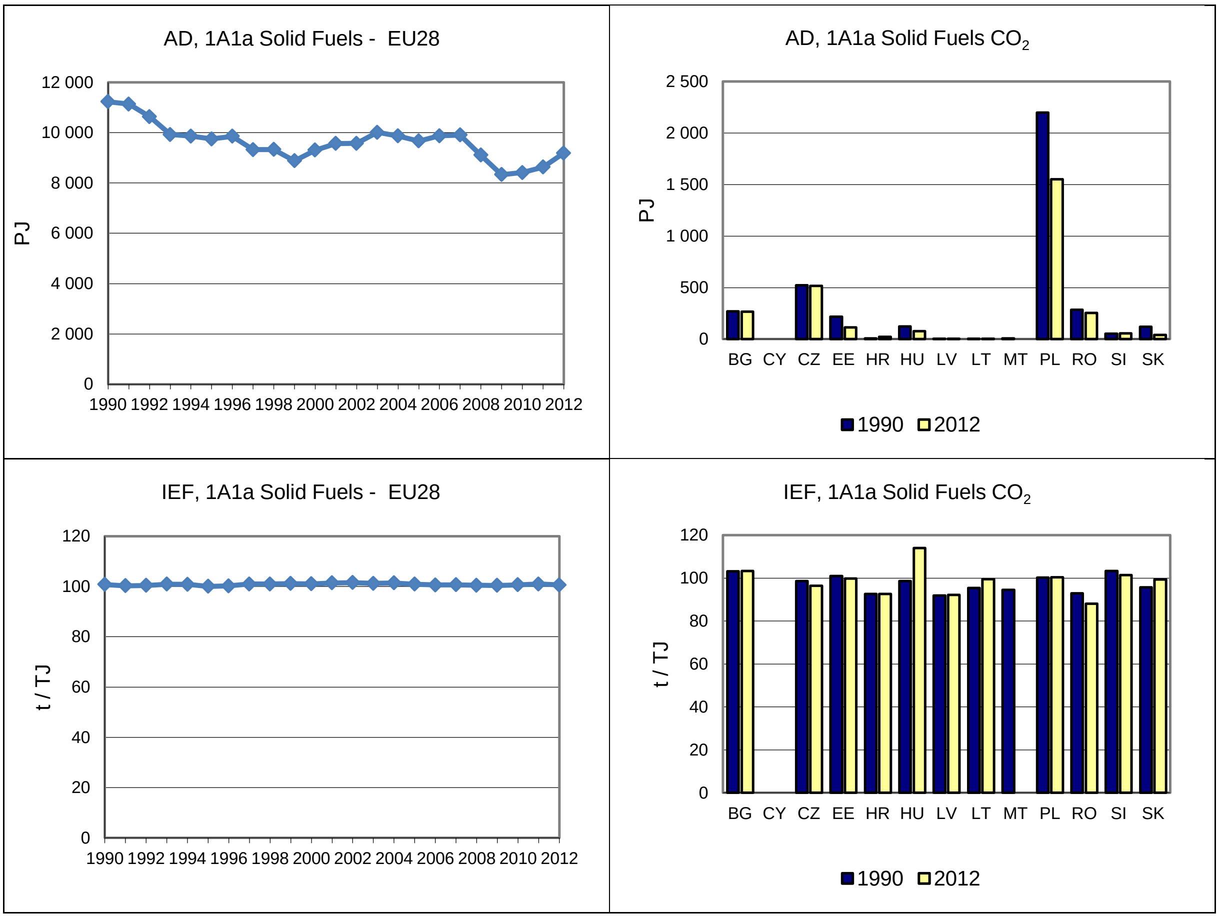


Table 18.3 1A1a Electricity and heat production, solid fuels: N_2O emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	5 313	3 922	4 401	78%	479	12%	-912	-17%
Bulgaria	117	137	116	2%	-21	-15%	-2	-1%
Croatia	3	12	11	0.2%	-1	-12%	7	234%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	229	229	224	4%	-5	-2%	-5	-2%
Estonia	4	9	8	0.1%	-1	-15%	4	93%
Hungary	54	31	31	1%	-0.5	-1%	-23	-43%
Latvia	3	0.2	0.2	0.004%	0.03	17%	-2	-92%
Lithuania	1	0.1	0.1	0.002%	-0.02	-17%	-1	-88%
Malta	3	NO	NO	-	-	-	-3	-100%
Poland	1 009	734	708	13%	-26	-4%	-301	-30%
Romania	123	121	110	2%	-11	-9%	-13	-11%
Slovakia	56	19	18	0.3%	-1	-3%	-38	-67%
Slovenia	24	25	24	0.4%	-1	-5%	0.4	2%
EU-28	**6 940**	**5 240**	**5 651**	**100%**	**411**	**8%**	**-1 289**	**-19%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.4 1A1a Electricity and heat production, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	60 397	229 731	185 905	87%	-43 826	-19%	125 507	208%		
Bulgaria	6 264	2 273	2 211	1%	-63	-3%	-4 053	-65%	T2	CS
Croatia	965	1 436	1 461	1%	24	2%	496	51%	T2	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 507	1 897	1 938	1%	41	2%	430	29%	T1	CS
Estonia	1 969	914	909	0.4%	-5	-1%	-1 060	-54%	T2	CS
Hungary	4 127	6 048	5 657	3%	-391	-6%	1 530	37%	T2	CS
Latvia	2 644	1 914	1 703	1%	-211	-11%	-941	-	T2	CS
Lithuania	5 806	2 651	2 390	1%	-261	-10%	-3 416	-59%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	1 208	3 275	3 549	2%	274	8%	2 341	194%	T1	D
Romania	20 789	6 443	5 616	3%	-827	-13%	-15 173	-73%	T2	CS
Slovakia	2 089	2 199	2 053	1%	-146	-7%	-36	-2%	T2	CS
Slovenia	112	328	333	0.2%	5	1%	221	198%	T2	CS
EU-28	**107 877**	**259 110**	**213 723**	**100%**	**-45 386**	**-18%**	**105 846**	**98%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.6 1A1a- Public Electricity and Heat Production, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

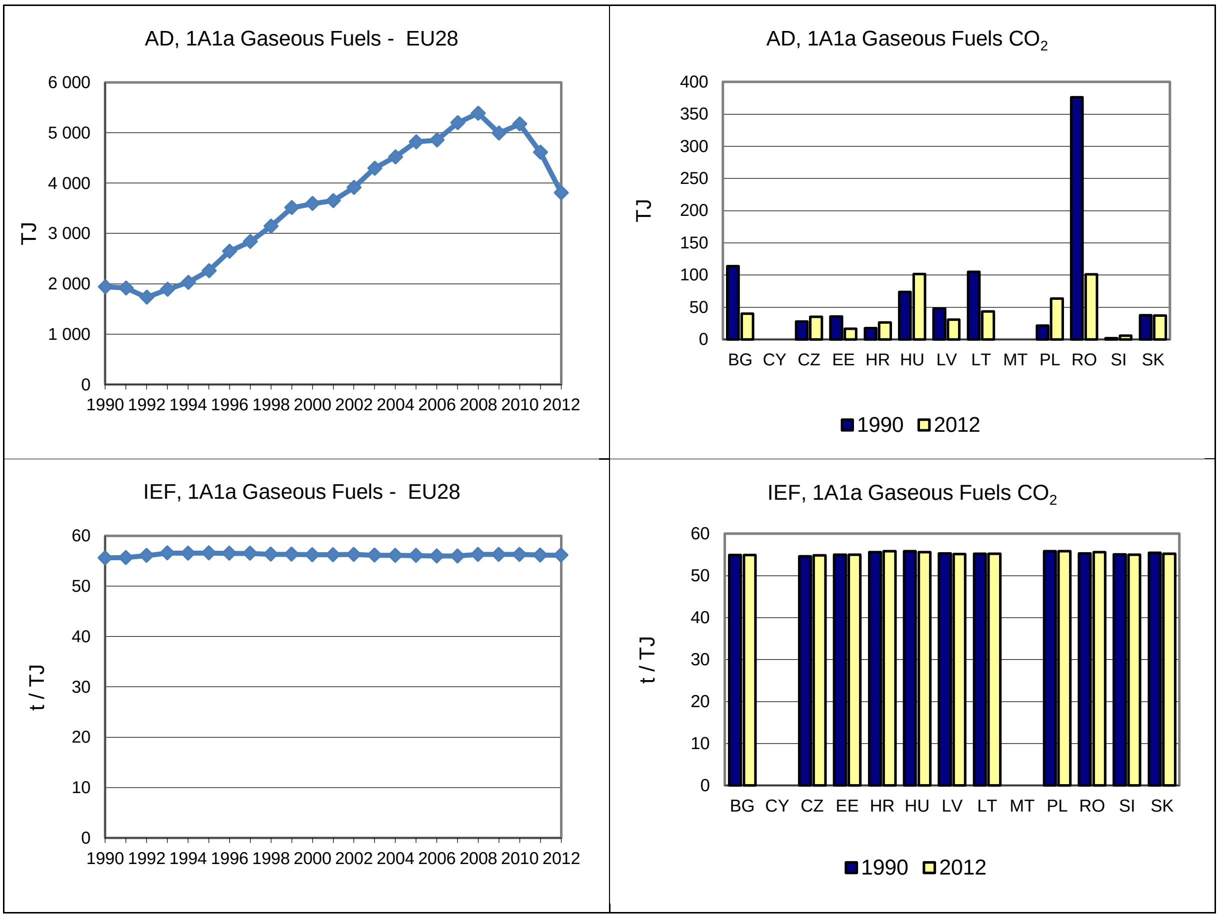


Table 18.5 1A1a Public Electriciy and Heat Production, other fuels:CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	12 899	38 145	37 373	98%	-772	-2%	24 474	190%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	37	326	340	1%	13	4%	303	830%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	28	279	272	1%	-7	-2%	245	879%	T2	CS,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	738	197	162	0%	-36	-18%	-576	-78%	T1	D
Romania	NO	4	NO	-	-4	-	-	-	NA	NA
Slovakia	170	63	57	0.2%	-6	-9%	-113	-66%	T1a,T2	CS,D
Slovenia	NO	10	8	0.02%	-2	-	8	-	T1	D
EU-28	**13 872**	**39 025**	**38 213**	**183%**	**-812**	**-2%**	**24 341**	**175%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.1.2 Petroleum Refining (1A1b) (EU-28)

Figure 18.7 1A1b Petroleum Refining: Total and CO_2 emission and activity trends

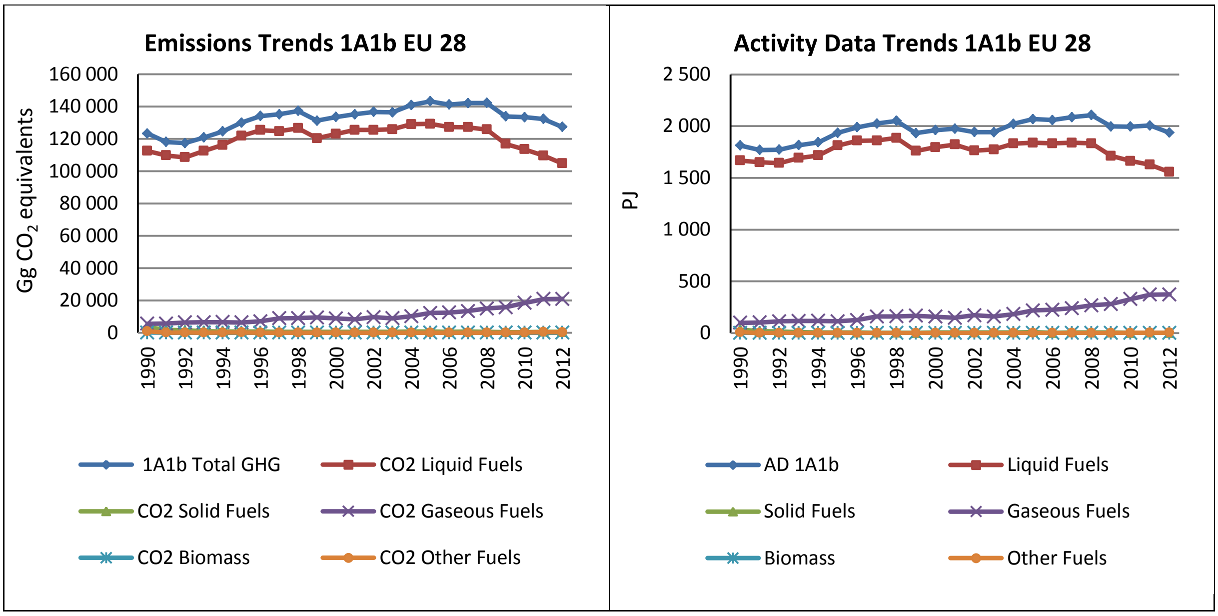


Table 18.6 1A1b Petroleum Refining, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	96 162	96 198	91 810	88%	-4 388	-5%	-4 352	-5%		
Bulgaria	856	908	930	1%	22	2%	75	9%	T1	D
Croatia	2 552	1 597	1 541	1%	-56	-3.5%	-1 011	-40%	T1	D
Cyprus	91	NO	NO	-	-	-	-91	-100%	NA	NA
Czech Republic	893	788	803	1%	15	2%	-90	-10%	T1	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	1 677	991	977	1%	-14	-1%	-700	-42%	T3	PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 494	1 517	1 413	1%	-104	-7%	-81	-5%	T2,T3	CS,PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	1 373	4 508	4 400	4%	-107	-2%	3 027	220%	T1	D
Romania	4 277	1 422	1 423	1%	2	0.1%	-2 854	-67%	T2	CS
Slovakia	3 026	1 647	1 445	1%	-202	-	-1 581	-	T3	PS
Slovenia	43	NO	NO	-	-	-	-43	-100%	NA	NA
EU-28	**112 444**	**109 577**	**104 744**	**100%**	**-4 833**	**-4%**	**-7 700**	**-7%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.8 1A1b Petroleum Refining, liquid fuels: Activity Data and Implied Emission Factors for CO_2

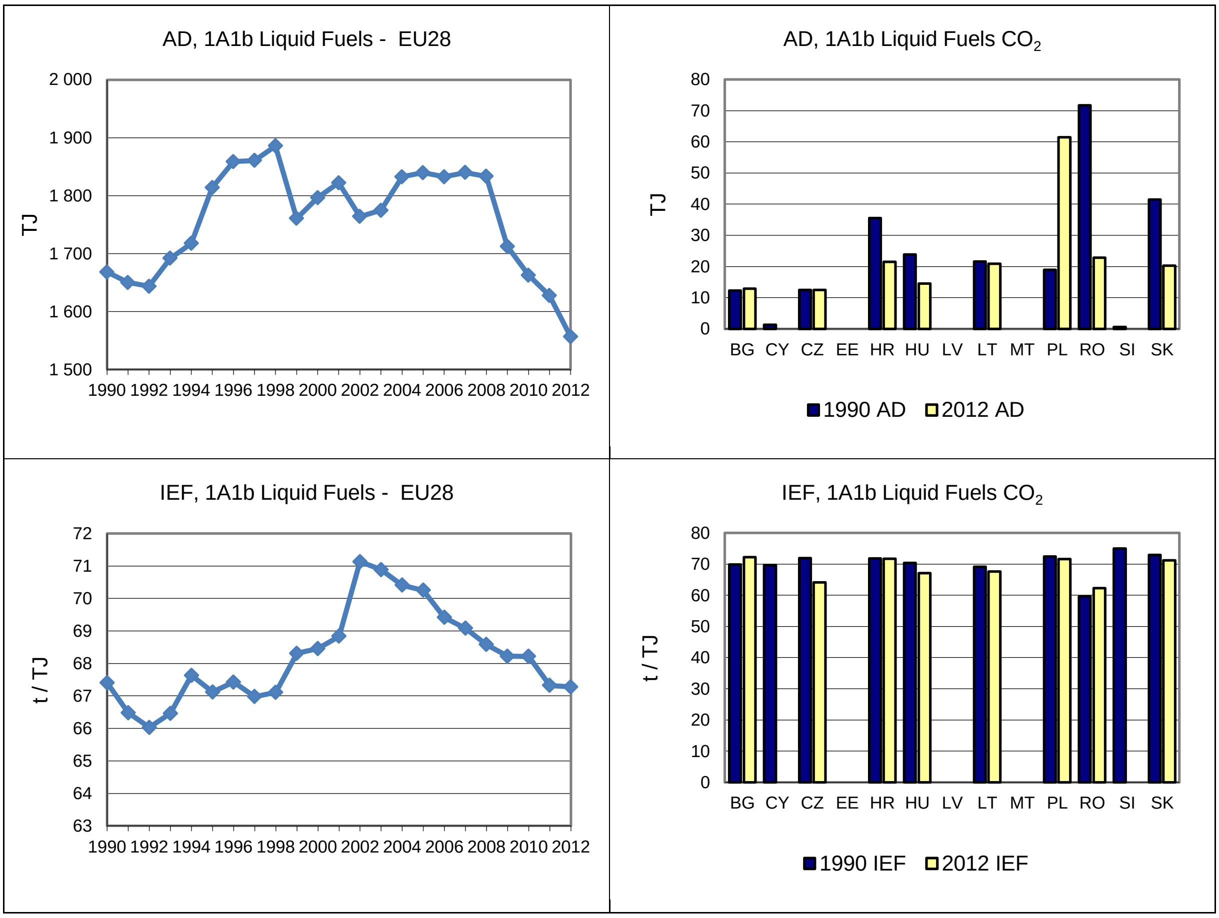


Table 18.7 1A1b Petroleum Refining, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	3 574	600	477	99%	-122	-20%	-3 097	-87%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	4	8	5	1.0%	-3	-40%	0	5%	T1,T2	CS,D
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**3 578**	**607**	**482**	**100%**	**-125**	**-21%**	**-3 096**	**-87%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.8 1A1b Petroleum Refining, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	3 868	16 953	17 390	83%	437	3%	13 522	350%		
Bulgaria	68	85	82	0.4%	-4	-4%	13	20%	T2	CS
Croatia	14	156	9	0.04%	-147	-94%	-5	-33%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	317	221	210	1%	-11	-5%	-108	-34%	T1	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	689	546	433	2%	-113	-21%	-256	-37%	T3	PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	0.1	1	0.01%	1	850%	1	-	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	93	1 501	1 620	8%	119	8%	1 527	1637%	T1	D
Romania	NO	712	561	3%	-151	-21%	561	-	T2	CS
Slovakia	380	687	632	3%	-55	-8%	252	66%	T3	CS
Slovenia	126	NO	NO	-	-	-	-126	-100%	NA	NA
EU-28	**5 557**	**20 862**	**20 938**	**100%**	76	0.4%	15 382	-		

Abbreviations explained in the Chapter 'Units and abbreviations'

18.2.1.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-28)

Figure 18.9 1A1c- Manufacture of Solid Fuels and Other Energy Industries: Total, CO_2 and N_2O emission and activity trends

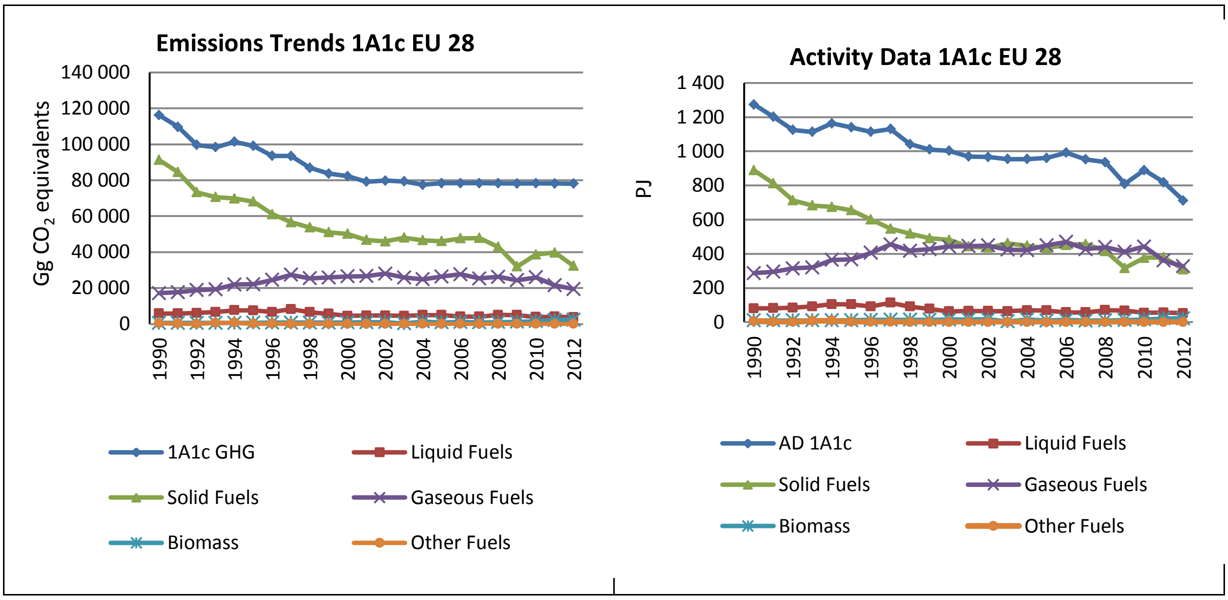


Table 18.9 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	15 525	19 822	17 807	91%	-2 014	-10%	2 283	15%		
Bulgaria	NO	1	2	0.01%	1	55%	2	-	T2	CS
Croatia	835	297	217	1%	-80	-27%	-618	-74%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	8	9	0.05%	2	20%	9	-	T1	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	30	3	2	0.01%	-0.5	-16%	-27	-92%	T3	PS
Latvia	45	52	54	0.3%	2	3%	9	21%	T2	CS
Lithuania	NO	11	6	0.03%	-4.7	-44%	6	-	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	691	555	637	3%	82	15%	-53	-8%	T1	D
Romania	NO	696	686	4%	-10	-1%	686	-	T2	CS
Slovakia	NO	44	46	0.2%	2	5%	46	-	T2	CS
Slovenia	42	4	4	0.02%	0.2	6%	-37	-90%	T2	CS
EU-28	**17 166**	**21 493**	**19 472**	**100%**	**-2 021**	**-9%**	**2 306**	**13%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.10 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	82 807	32 045	25 112	78%	-6 932	-22%	-57 695	-70%		
Bulgaria	291	2	3	0.01%	1	57%	-288	-99%	T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 393	3 752	3 743	12%	-9	0%	1 350	56%	T1	CS,D
Estonia	65	391	397	1%	6	2%	332	509%	T3	PS
Hungary	161	180	178	1%	-2	-1%	17	-	T2	CS,D
Latvia	164	NO	NO	-	-	-	-164	-	NA	NA
Lithuania	NO	1	3	0.01%	1	92%	3	-	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	4 085	2 131	1 730	5%	-401	-19%	-2 355	-58%	T1,T2	CS,D
Romania	NO	5	4	0%	-1	-25%	4	-	T2	CS
Slovakia	1 319	1 233	1 228	4%	-4	-0.3%	-91	-7%	T2	CS
Slovenia	36	NO	NO	-	-	-	-36	-100%	NA	NA
EU-28	**91 322**	**39 740**	**32 398**	**100%**	**-7 341**	**-18%**	**-58 924**	**-65%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2 Manufacturing industries and construction (CRF Source Category 1A2) (EU-28)

18.2.2.1 Iron and Steel (1A2a) (EU-28)

Figure 18.10 1A2a- Iron and Steel: Total, CO_2 and N_2O emission and activity trends

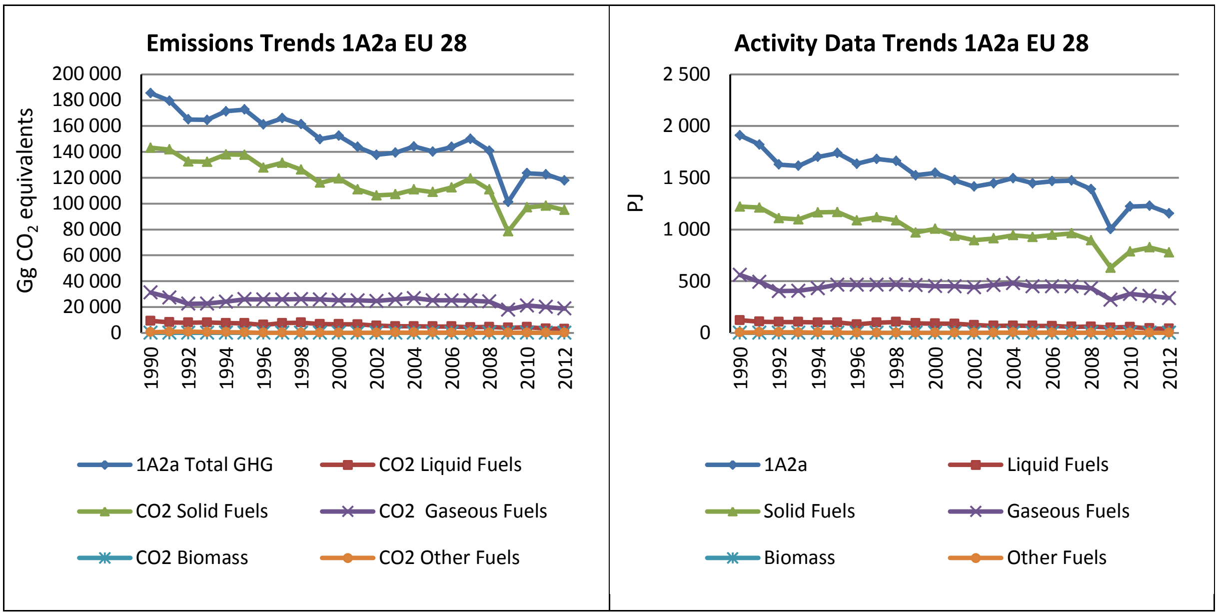


Table 18.11 1A2a Iron and Steel, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	7 125	3 196	2 983	97%	-213	-7%	-4 142	-58%		
Bulgaria	37	NO	NO	-	-	-	-37	-100%	NA	NA
Croatia	IE	13	15	0.5%	2	16%	15	-	T1	D
Cyprus	14	27	12	0.4%	-15	-55%	-2	-13%	T1	D
Czech Republic	455	62	31	1%	-31	-50%	-424	-93%	T1	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	413	NO	NO	-	-	-	-413	-100%	NA	NA
Latvia	154	NO	NO	-	-	-	-154	-100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	855	9	9	0.3%	-0.2	-2%	-846	-99%	T1	D
Romania	NO	9	9	0.3%	0.1	1%	9	-	T2	CS
Slovakia	164	1.1	1	0.04%	0.2	16%	-163	-99%	T2	CS
Slovenia	54	9	7	0.2%	-2	-22%	-47	-87%	T1	D
EU-28	**9 271**	**3 327**	**3 068**	**100%**	**-259**	**-8%**	**-6 203**	**-67%**		

Table 18.12 1A2a Iron and Steel, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	115 489	83 342	81 274	85%	-2 069	-2%	-34 216	-30%		
Bulgaria	1 622	NO	NO	-	-	-	-1 622	-100%	NA	NA
Croatia	IE	11	6	0.01%	-5	-42%	6	-	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	7 680	3 475	2 531	3%	-944	-27%	-5 149	-67%	T1	CS,D
Estonia	3	NO	0.1	0.0001%	0.1	-	-3	-97%	T2	CS
Hungary	2 538	1 032	989	1%	-43	-4%	-1 550	-61%	T2	CS,D,PS
Latvia	5	9	31	0.03%	22	237%	27	584%	T1,T2	CS,D
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	11 347	4 574	5 045	5%	472	10%	-6 302	-56%	T1,T2	CS,D
Romania	2 184	1 319	1 960	2%	641	49%	-224	-10%	T1, T2	D, CS
Slovakia	2 296	4 668	3 213	3%	-1 455	-31%	917	40%	T3	PS
Slovenia	56	29	24	0.03%	-6	-19%	-32	-57%	T1	D
EU-28	**143 221**	**98 460**	**95 073**	**100%**	**-3 387**	**-3%**	**-48 148**	**-34%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.11 1A2a Iron and Steel, solid fuels: Activity Data and Implied Emission Factors for CO_2

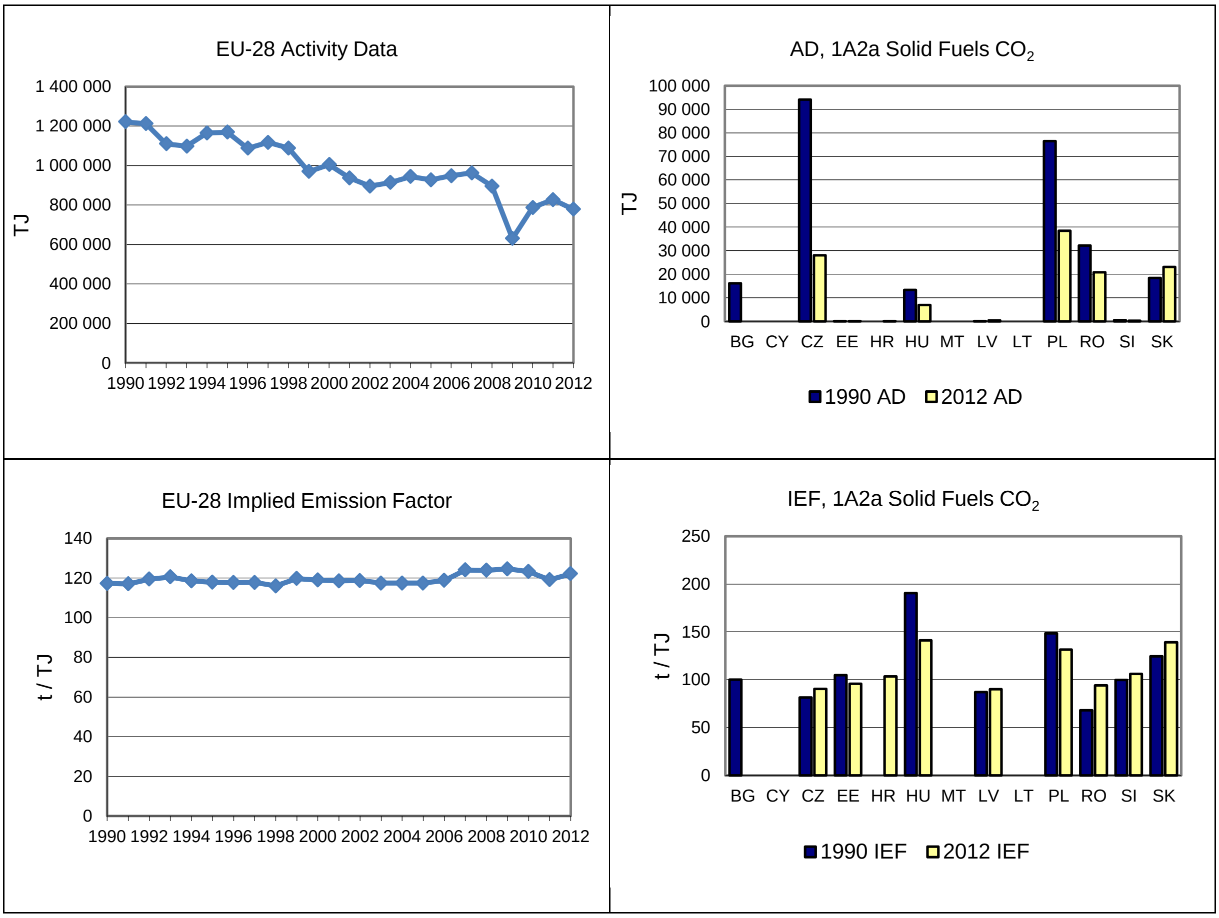


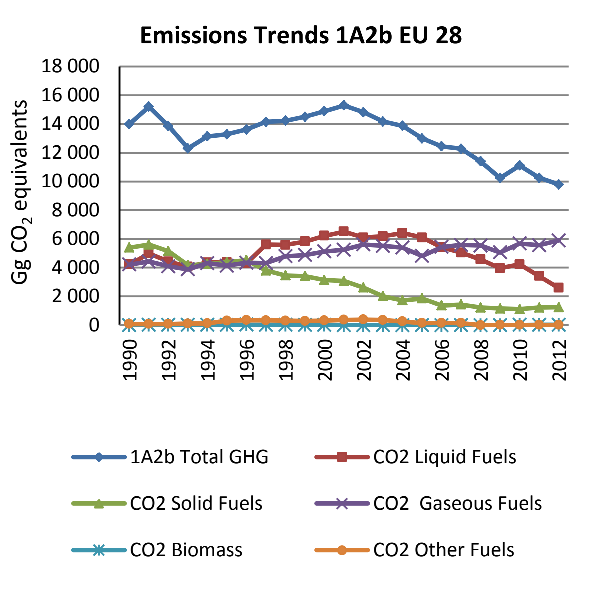
Table 18.131A2a Iron and Steel, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	17 533	16 625	15 726	83%	-899	-5%	-1 807	-10%		
Bulgaria	1 032	145	116	1%	-30	-20%	-916	-89%	T2	CS
Croatia	IE	60	29	0.2%	-30	-51%	29	-	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	725	660	518	3%	-141	-21%	-207	-29%	T1	CS
Estonia	NO	0.1	NO	-	-0.1	-100%	-	-	NA	NA
Hungary	1 505	84	112	1%	27	32%	-1 393	-93%	T1	D
Latvia	234	65	80	0.4%	15	23%	-155	-66%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	2 950	961	944	5%	-17	-2%	-2 006	-68%	T1	D
Romania	6 661	1 191	1 055	6%	-136	-11%	-5 606	-84%	T2	CS
Slovakia	221	104	97	1%	-7	-7%	-124	-56%	T2	CS
Slovenia	308	156	166	1%	10	7%	-142	-46%	T2	CS
EU-28	**31 169**	**20 051**	**18 843**	**100%**	**-1 209**	**-6%**	**-12 326**	**-40%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.2 Non Ferrous Metals (1A2b) (EU-28)

Figure 18.12 1A2b- Non ferrous Metals: Total, CO_2 emission and activity trends



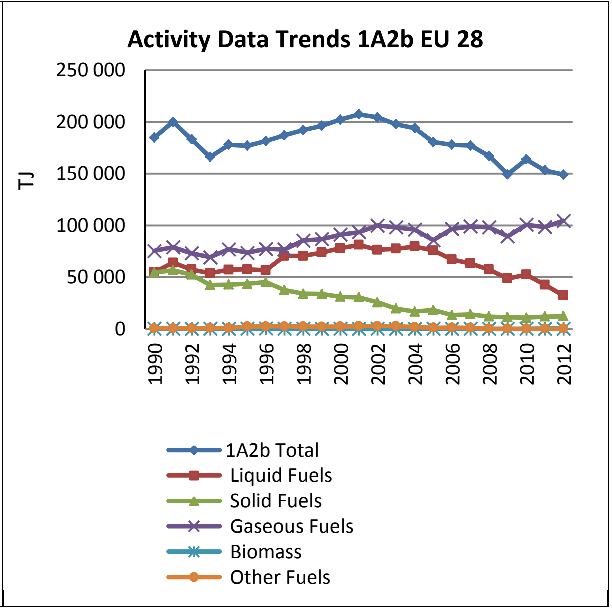


Table 18.14 1A2b Non ferrous Metals, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	3 300	361	393	32%	32	9%	-2 906	-88%		
Bulgaria	213	NO	NO	-	-	-	-213	-100%	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	141	18	15	1%	-3	-15%	-126	-89%	T1	CS,D
Estonia	NO	NO	2	0.2%	2	-	2	-	T2	CS
Hungary	9	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	0.2	0.1	0.01%	-0.1	-50%	0.1	-	T2	CS
Lithuania	NO	0.3	NO	-	-0.3	-1%	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	701	684	690	56%	5	1%	-12	-2%	T1,T2	CS,D
Romania	79	NO	NO	-	-	-	-79	-100%	NA	NA
Slovakia	798	145	132	11%	-13	-9%	-666	-83%	T2	CS
Slovenia	152	5	5	0.4%	0.1	2%	-147	-97%	T1	D
EU-28	**5 392**	**1 213**	**1 237**	**100%**	**24**	**2%**	**-4 155**	**-77%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.15 1A2b Non ferrous Metals, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	3 197	4 694	5 078	86%	384	8%	1 881	59%
Bulgaria	23	53	51	0.9%	-1	-2%	28	120%
Croatia	IE	2	2	0.04%	-0.2	-8%	2	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	53	92	68	1%	-24	-26%	15	27%
Estonia	NO	NO	0.3	0.01%	0.3	-	0.3	-
Hungary	87	190	159	3%	-30	-16%	72	-
Latvia	NO	9	9	0.2%	-0.02	-0.2%	9	-
Lithuania	NO	3	NO	-	-2.65	-	-	-
Malta	IE	IE	IE	-	-	-	-	-
Poland	257	372	385	7%	12	3%	128	50%
Romania	IE	IE	IE	-	-	-	-	-
Slovakia	435	86	80	1%	-6	-7%	-354	-82%
Slovenia	163	55	60	1%	5	10%	-103	-63%
EU-28	**4 214**	**5 555**	**5 893**	**100%**	**338**	**6%**	**1 678**	**40%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.3 Chemicals (1A2c) (EU-28)

Figure 18.13 1A2c- Chemicals: Total, CO_2 and N_2O emission and activity trends

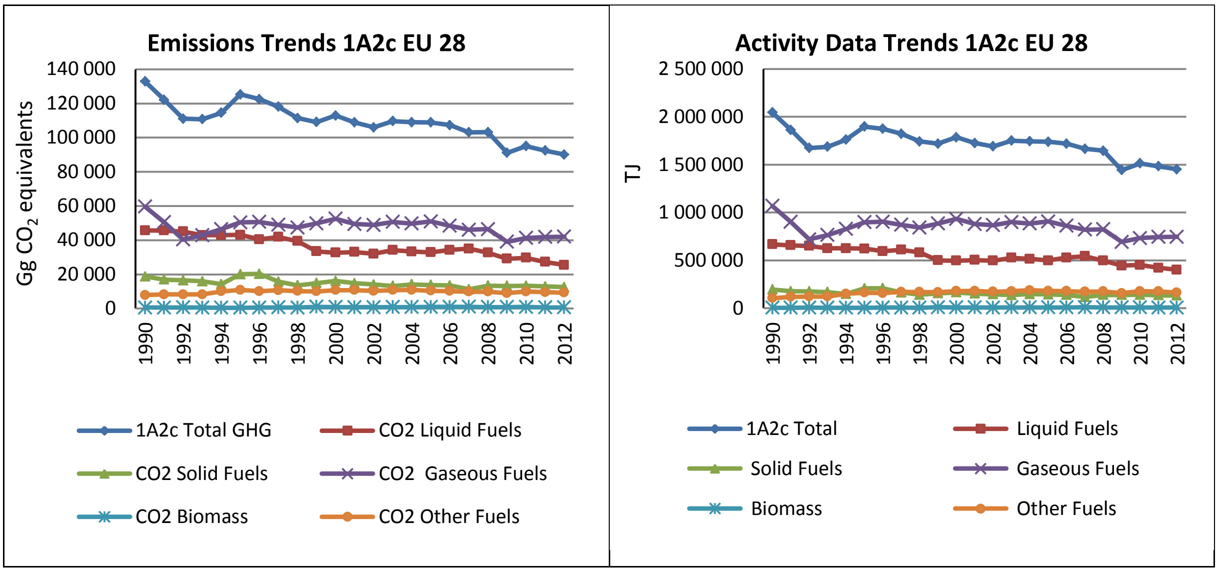


Table 18.16 1A2c Chemicals, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	41 019	22 930	21 419	84%	-1 511	-7%	-19 600	-48%		
Bulgaria	930	19	12	0.05%	-7	-36%	-918	-99%	T1	D
Croatia	IE	17	6	0.02%	-10	-63%	6	-	T1	D
Cyprus	2	3	3	0.01%	0	0%	1	42%	T1	D
Czech Republic	2 678	2 250	2 275	9%	25	1%	-403	-15%	T1	D
Estonia	13	7	8	0.0%	1	8%	-5	-39%	T1,T2	CS,D
Hungary	376	3	NO	#WERT!	#WERT!	#WERT!	#WERT!	#WERT!	NA	NA
Latvia	277	9	10	0.04%	1	7%	-267	-96%	T2	CS
Lithuania	69	0.3	2	0.01%	2	575%	-67	-97%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	307	1 381	1 116	4%	-265	-19%	809	264%	T1	D
Romania	NO	654	579	2%	-75	-11%	579	-	T1, T2	D, CS
Slovakia	51	28	15	0.1%	-13	-47%	-36	-71%	T2	CS
Slovenia	31	20	21	0.1%	1	5%	-10	-32%	T1	D
EU-28	**45 752**	**27 322**	**25 466**	**100%**	**-1 856**	**-7%**	**-20 286**	**-44%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.17 1A2c Chemicals, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	8 052	3 672	3 753	30%	81	2%	-4 299	-53%		
Bulgaria	416	371	370	3%	-0.1	-0.03%	-45	-11%	T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	6 313	3 987	3 431	27%	-556	-14%	-2 882	-	T1	CS,D
Estonia	621	NO	NO	-	-	-	-621	-100%	NA	NA
Hungary	96	3	3	0.02%	0	0%	-93	-97%	T1	D
Latvia	NO	0.1	NO	-	-0.1	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	1 025	4 338	4 506	36%	168	4%	3 481	339%	T1,T2	CS,D
Romania	625	499	453	4%	-46	-9%	-172	-28%	T1, T2	D, CS
Slovakia	1 584	85	72	1%	-12	-15%	-1 511	-95%	T2	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	NA	NA
EU-28	**18 732**	**12 954**	**12 588**	**100%**	**-366**	**-3%**	**-6 144**	**-33%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.18 1A2c Chemicals, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	35 020	34 424	35 267	84%	843	2%	247	1%		
Bulgaria	1 437	712	590	1%	-122	-17%	-847	-59%	T2	CS
Croatia	IE	399	272	0.6%	-127	-32%	272	-	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	334	615	659	2%	43	7%	324	97%	T1	CS
Estonia	166	5	25	0.1%	20	362%	-140	-85%	T2	CS
Hungary	1 447	695	540	1%	-155	-22%	-906	-63%	T1	D
Latvia	23	22	20	0.05%	-2	-8%	-3	-13%	T2	CS
Lithuania	331	152	204	0.5%	52	34%	-127	-38%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	295	768	757	2%	-10	-1%	462	157%	T1	D
Romania	18 499	2 964	2 468	6%	-496	-17%	-16 031	-87%	T2	CS
Slovakia	1 961	1 080	1 212	3%	132	12%	-749	-38%	T2	CS
Slovenia	175	64	57	0.1%	-7	-11%	-118	-68%	T2	CS
EU-28	**59 689**	**41 900**	**42 072**	**100%**	**172**	**0%**	**-17 617**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.19 1A2c Chemicals, other fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	5 547	8 489	8 126	88%	-363	-4%	2 579	46%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	2 342	1 017	1 086	12%	69	7%	-1 256	-54%	T1	D
Romania	NO	62	56	0.6%	-6	-10%	56	-	T2	CS
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	0.5	NA	NA	-	0	-	-0.5	-100%	NA	NA
EU-28	**7 890**	**9 569**	**9 268**	**100%**	**-301**	**-3%**	**1 378**	**17%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.4 Pulp, Paper and Print (1A2d) (EU-28)

Figure 18.14 1A2d Pulp, Paper and Print: Total, CO_2 and N_2O emission and activity trends

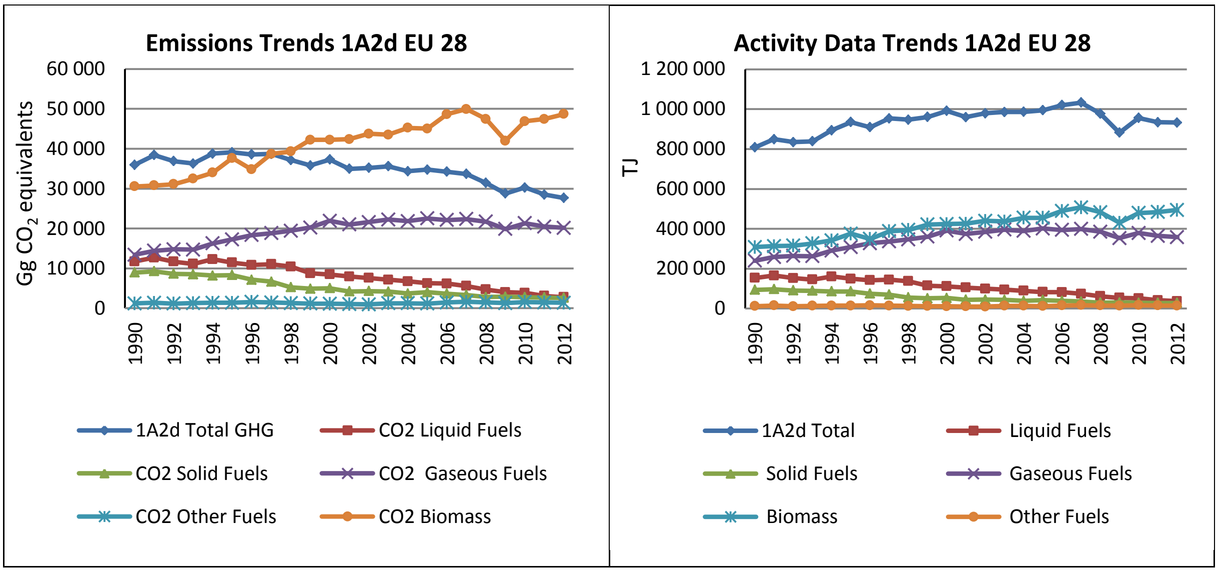


Table 18.20 1A2d Pulp, Paper and Print, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	9 852	2 847	2 536	92%	-311	-11%	-7 317	-74%		
Bulgaria	15	31	15	0.6%	-15	-50%	-0.1	-0.5%	T1	D
Croatia	IE	22	14	0.5%	-9	-38%	14	-	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	474	33	27	1%	-6	-18%	-447	-94%	T1	CS,D
Estonia	NO	0.1	1	0.03%	0.9	1389%	1	-	T1,T2	CS,D
Hungary	28	6	9	0.33%	3	50%	-18	-67%	T1	D
Latvia	16	1	0.4	0.02%	-0.6	-57%	-15	-97%	T2	CS
Lithuania	162	2.05	1.7	0.06%	-0.3	-17%	-160	-99%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	104	150	135	5%	-15	-10.07%	31	30%	T1	D
Romania	NO	NO	9	0.3%	9	-	9	-	T1, T2	D, CS
Slovakia	985	24	9	0.3%	-16	-64%	-976	-99%	T2	CS
Slovenia	97	5	6	0.2%	0.3	6%	-91	-94%	T1	D
EU-28	**11 732**	**3 122**	**2 763**	**100%**	**-359**	**-12%**	**-8 970**	**-76%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.21 1A2d Pulp, Paper and Print, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	5 104	911	977	37%	66	7%	-4 127	-81%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 376	390	368	14%	-21	-5%	-2 007	-84%	T1	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	6	NO	NO	-	-	-	-6	-100%	NA	NA
Latvia	2	NO	NO	-	-	-	-2	-100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	174	1 051	1 008	38%	-43	-4%	834	479%	T1,T2	CS,D
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	1 142	227	155	6%	-73	-32%	-987	-86%	T2	CS
Slovenia	169	140	126	5%	-14	-10%	-43	-25%	T3	PS
EU-28	**8 972**	**2 719**	**2 634**	**100%**	**-85**	**-3%**	**-6 338**	**-71%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.22 1A2d Pulp, Paper and Print, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	12 464	19 129	18 762	93%	-366	-2%	6 298	51%		
Bulgaria	NO	81	92	0.5%	11	13%	92	-	T2	CS
Croatia	IE	125	112	1%	-13	-11%	112	-	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	179	264	260	1%	-4	-1%	81	45%	T1	CS
Estonia	NO	2	4	0.02%	2	76%	4	-	T2	CS
Hungary	50	153	146	1%	-7	-4%	96	194%	T1	D
Latvia	149	6	4	0.02%	-1.848	-33%	-146	-98%	T2	CS
Lithuania	252	87	65	0.3%	-22	-25%	-187	-74%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	6	256	309	2%	53	21%	303	5380%	T1	D
Romania	NO	62	86	0.4%	25	40%	86	-	T2	CS
Slovakia	203	117	113	1%	-4	-4%	-90	-44%	T2	CS
Slovenia	109	203	205	1%	2	1%	96	88%	T2	CS
EU-28	**13 411**	**20 483**	**20 158**	**100%**	**-326**	**-2%**	**6 747**	**50%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.5 Food Processing, Beverages and Tobacco (1A2e) (EU-28)

Figure 18.15 1A2e Food Processing, Beverages and Tobacco: Total, CO_2 and N_2O emission and activity trends

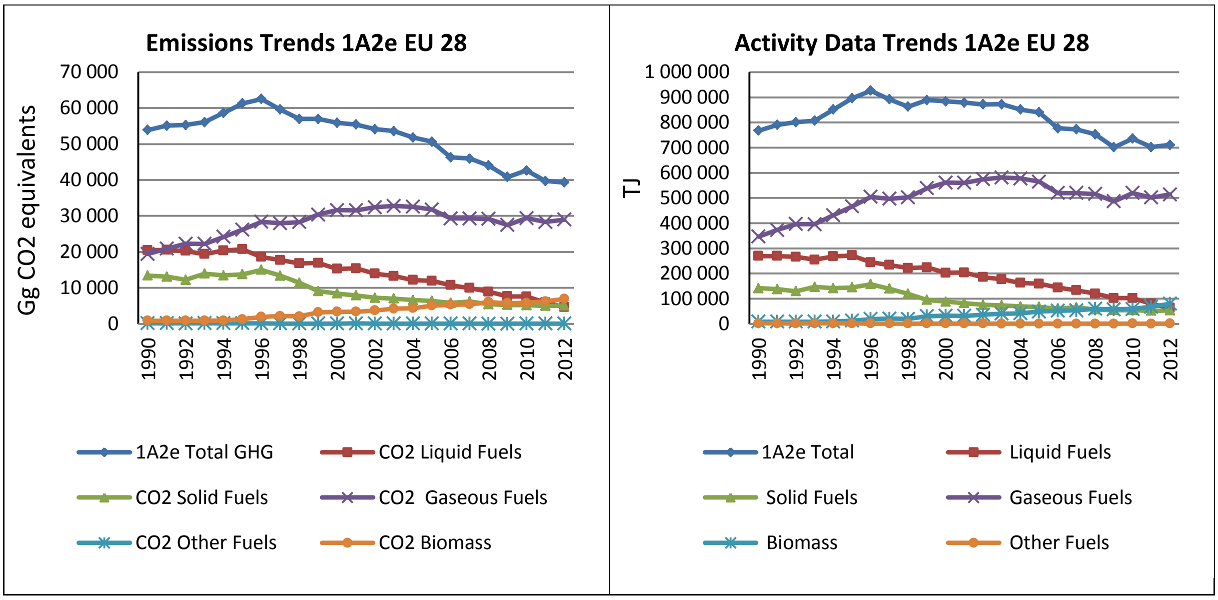


Table 18.23 1A2e Food Processing, Beverages and Tobacco, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	16 755	5 043	3 801	82%	-1 242	-25%	-12 955	-77%		
Bulgaria	405	51	46	1%	-6	-11%	-359	-89%	T1	D
Croatia	IE	108	72	2%	-36	-33%	72	-	T1	D
Cyprus	53	100	52	1%	-48	-48%	-1	-2%	T1	D
Czech Republic	566	70	23	0.5%	-47	-67%	-543	-96%	T1	CS,D
Estonia	438	2	1	0.02%	-1	-46%	-437	-100%	T1,T2	CS,D
Hungary	591	12	12	0.3%	-0.1	-1%	-579	-98%	T1	D
Latvia	798	33	40	0.8%	6.16	18%	-759	-95%	T2	CS
Lithuania	174	40	42	0.9%	2.4	6%	-132	-76%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	229	326	391	8%	65	20%	162	71%	T1	D
Romania	NO	128	151	3%	23	18%	151	-	T1, T2	D, CS
Slovakia	359	0.04	0.03	0.001%	-0.004	-12%	-359	-100%	T2	CS
Slovenia	144	38	33	0.7%	-6	-15%	-111	-77%	T1	D
EU-28	**20 513**	**5 952**	**4 663**	**100%**	**-1 290**	**-22%**	**-15 850**	**-77%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.24 1A2e Food Processing, Beverages and Tobacco, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	6 393	2 118	2 225	44%	107	5%	-4 168	-65%		
Bulgaria	33	9	4	0.1%	-4	-50%	-28	-86%	T2	CS,D
Croatia	IE	87	82	2%	-6	-7%	82	-	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 863	192	164	3%	-29	-15%	-2 699	-94%	T1	CS,D
Estonia	5	NO	0.2	-	-	-	-4	-96%	T1,T2	CS,D
Hungary	184	13	13	0.2%	-0.1	-1%	-171	-93%	T2	CS
Latvia	91	2	2	0.05%	0	0%	-89	-97%	T2	CS
Lithuania	33	12	11	0.2%	-0.4	-3%	-22	-66%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	3 389	2 483	2 510	49%	27	1.1%	-880	-26%	T2	CS,D
Romania	125	2	49	1.0%	47	-	-76	-61%	T1	D
Slovakia	312	38	33	0.6%	-5	-13%	-279	-89%	T2	CS
Slovenia	9	NO	NO	-	-	-	-9	-100%	NA	NA
EU-28	**13 436**	**4 956**	**5 092**	**100%**	**137**	**3%**	**-8 344**	**-62%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.25 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	16 168	23 787	24 582	85%	795	3%	8 413	52%		
Bulgaria	11	256	238	1%	-18	-7%	227	1995%	T2	CS
Croatia	IE	296	273	1%	-24	-8%	273	-	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	728	749	706	2%	-43	-6%	-23	-3%	T1	CS
Estonia	15	1	3	0.01%	2	144%	-11	-77%	T2	CS
Hungary	1 233	556	486	2%	-70	-13%	-747	-61%	T1	D
Latvia	174	103	100	0.3%	-4	-4%	-74	-43%	T2	CS
Lithuania	469	237	244	1%	7	3%	-225	-48%	T2	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	110	1 235	1 323	5%	88	7%	1 213	1103%	T1	D
Romania	NO	761	727	2.5%	-34	-5%	727	-	T2	CS
Slovakia	470	274	263	1%	-11	-4%	-207	-44%	T2	CS
Slovenia	65	61	55	0.2%	-6	-10%	-11	-16%	T2	CS
EU-28	**19 445**	**28 317**	**28 999**	**100%**	**682**	**2%**	**9 554**	**49%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.6 Other (1A2f) (EU-28)

Figure 18.16 1A2f Other, liquid fuels: Total, CO_2 and N_2O emission and activity trends

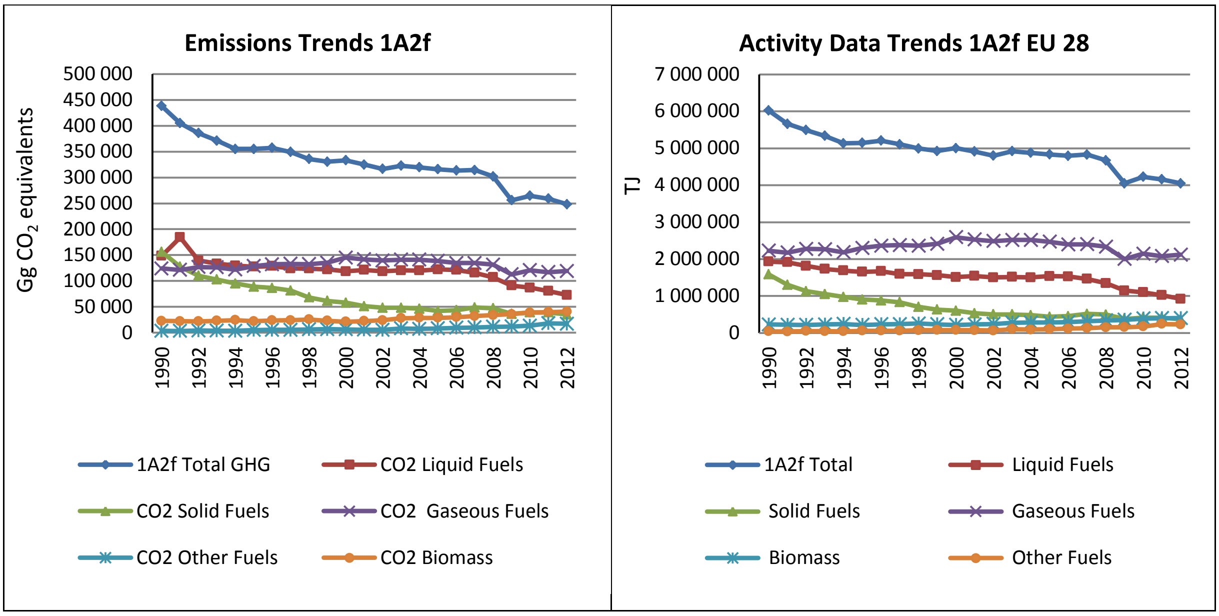


Table 18.26 1A2f Other, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	115 326	73 440	65 624	90%	-7 816	-11%	-49 702	-43%		
Bulgaria	9 224	571	591	1%	20	3%	-8 633	-94%	T1	D
Croatia	2 136	724	732	1%	8	1%	-1 404	-66%	T1	D
Cyprus	192	382	345	0.5%	-37	-10%	154	80%	T1	CS,D
Czech Republic	4 936	1 424	1 407	2%	-17	-1%	-3 529	-71%	T1	CS,D
Estonia	328	146	161	0.2%	15	10%	-167	-51%	T1,T2	CS,D
Hungary	2 120	285	305	0.4%	20	7%	-1 815	-86%	T1,T2	CS,D
Latvia	945	134	152	0.2%	18	14%	-793	-84%	T2	CS
Lithuania	3 096	25	34	0.05%	9	34%	-3 062	-99%	T2	CS
Malta	59	73	73	0.1%	0.2	0.3%	14	23%	D,T1	D
Poland	1 403	1 194	933	1%	-261	-22%	-470	-34%	T1	D
Romania	6 906	1 881	2 211	3%	330	18%	-4 695	-68%	T1,T2	CS,D
Slovakia	1 286	81	28	0.04%	-53	-65%	-1 257	-98%	T2	CS
Slovenia	696	257	247	0.3%	-10	-4%	-450	-65%	T1	D
EU-28	**148 653**	**80 617**	**72 843**	**100%**	**-7 775**	**-10%**	**-75 810**	**-51%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.17 1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2

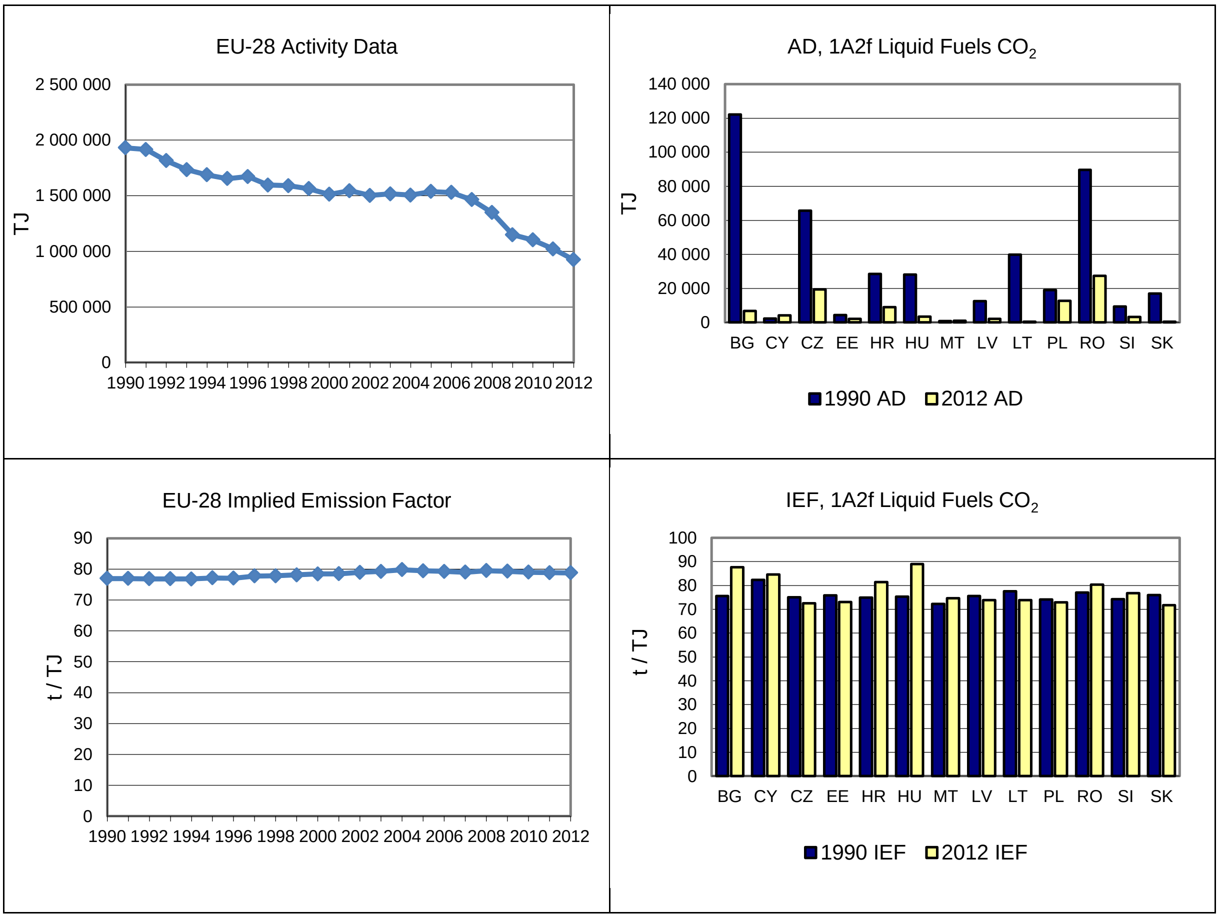


Table 18.27 1A2f Other, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	113 386	28 042	25 310	72%	-2 732	-10%	-88 076	-78%		
Bulgaria	2 178	414	318	1%	-96	-23%	-1 861	-85%	T2	CS,D
Croatia	1 677	454	396	1%	-59	-13%	-1 281	-76%	T1	D
Cyprus	268	29	NA,NO	-	-29	-	-268	-	NA	NA
Czech Republic	12 150	1 090	843	2%	-247	-23%	-11 307	-93%	T1	CS,D
Estonia	791	380	353	1%	-27	-7%	-439	-55%	T1,T2	CS,D
Hungary	1 288	190	159	0.5%	-31	-16%	-1 130	-88%	T2	CS
Latvia	39	202	180	0.5%	-21	-11%	142	366%	T2	CS
Lithuania	156	420	475	1%	55	13%	319	205%	T2,T3	CS,PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	13 788	4 707	3 720	11%	-986	-21%	-10 067	-73%		
Romania	7 513	2 218	2 356	7%	138	6%	-5 157	-69%	T1,T2	CS,D
Slovakia	2 897	1 018	866	2%	-151	-15%	-2 030	-70%	T2	CS
Slovenia	199	92	89	0.3%	-3	-3%	-110	-55%	T3	PS
EU-28	**156 330**	**39 256**	**35 066**	**100%**	**-4 190**	**-11%**	**-121 264**	**-78%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.18 1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2

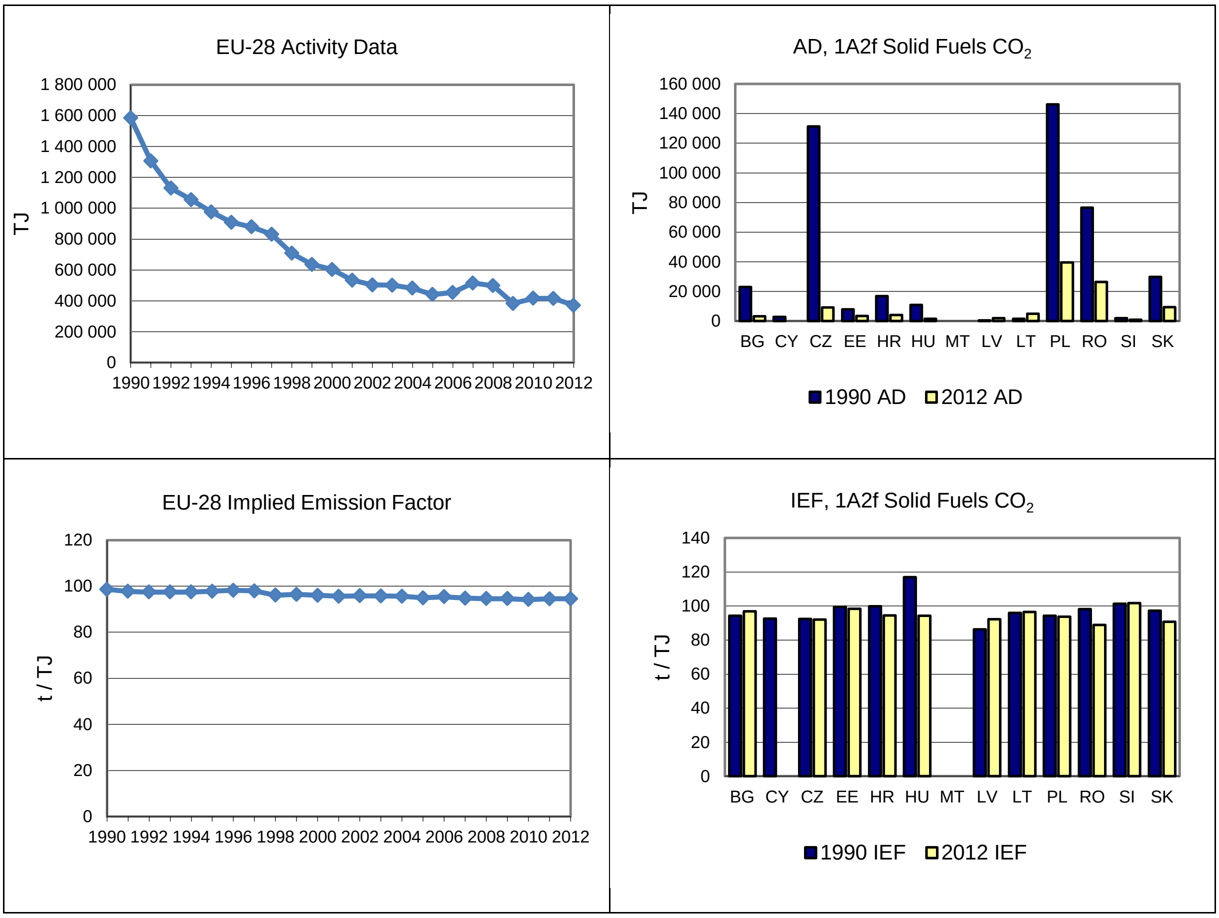
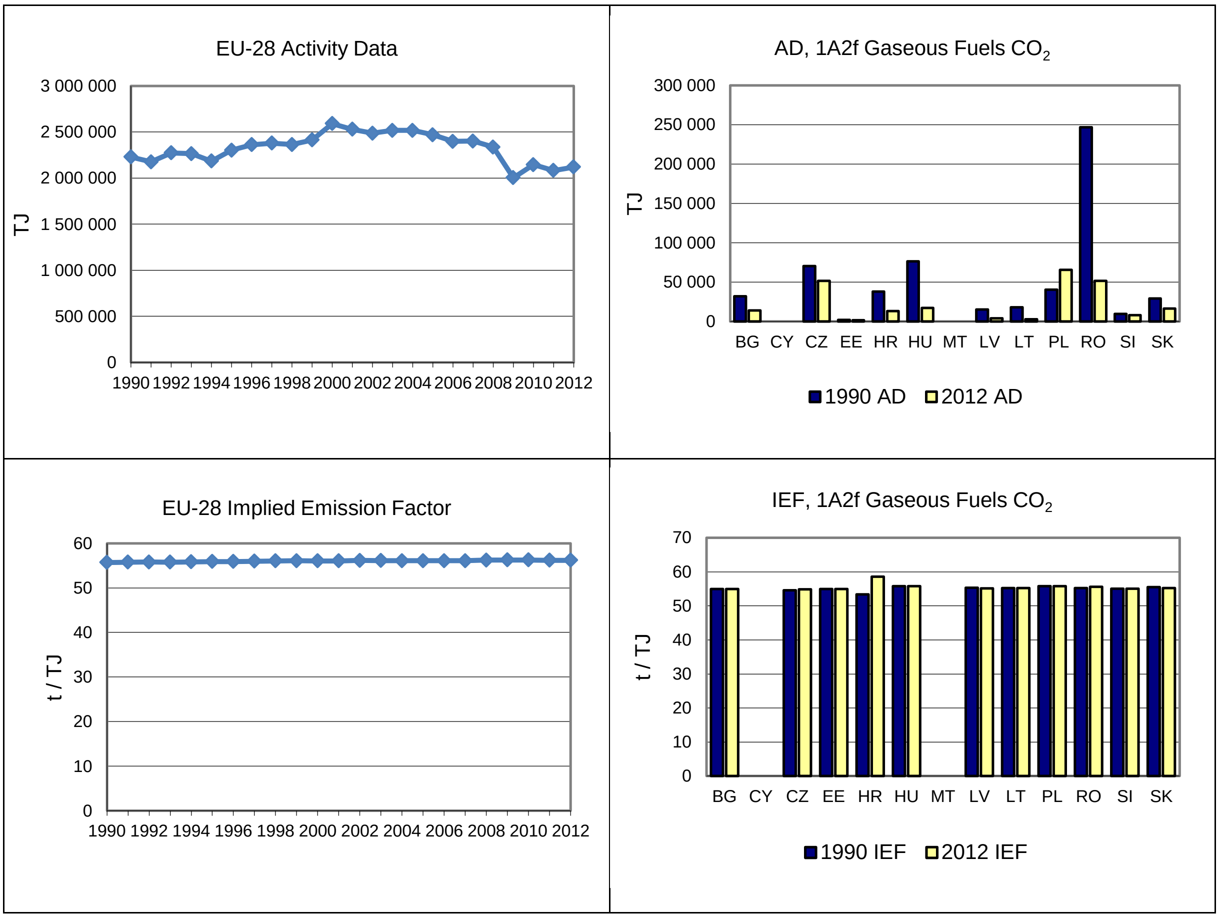


Table 18.28 1A2f Other, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	92 289	102 955	105 459	89%	2 504	2%	13 171	14%		
Bulgaria	1 764	774	767	1%	-8	-1%	-997	-57%	T2	CS
Croatia	2 031	840	760	1%	-80	-10%	-1 271	-63%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	3 832	2 944	2 821	2%	-123	-4%	-1 011	-26%	T1	CS
Estonia	100	82	87	0.1%	5	6%	-13	-13%	T2	CS
Hungary	4 254	1 223	949	1%	-274	-22%	-3 305	-78%	T1	D
Latvia	835	211	222	0.2%	11	5%	-613	-73%	T2	CS
Lithuania	996	157	157	0.1%	0.2	0.1%	-839	-84%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	2 245	3 829	3 659	3%	-169	-4%	1 414	63%	T1	D
Romania	13 635	2 485	2 870	2%	386	16%	-10 765	-79%	T2	CS
Slovakia	1 613	976	911	1%	-65	-7%	-702	-44%	T2	CS
Slovenia	530	466	444	0.4%	-22	-5%	-86	-16.2%	T2	CS
EU-28	**124 124**	**116 942**	**119 106**	**100%**	**2 164**	**2%**	**-5 018**	**-4%**		

Figure 18.19 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



18.2.3 Transport (CRF Source Category 1A3) (EU-28)

18.2.3.1 Civil Aviation (1A3a) (EU-28)

Figure 18.20 1A3a- Civil Aviation: Total, CO_2 and N_2O emission and activity trends

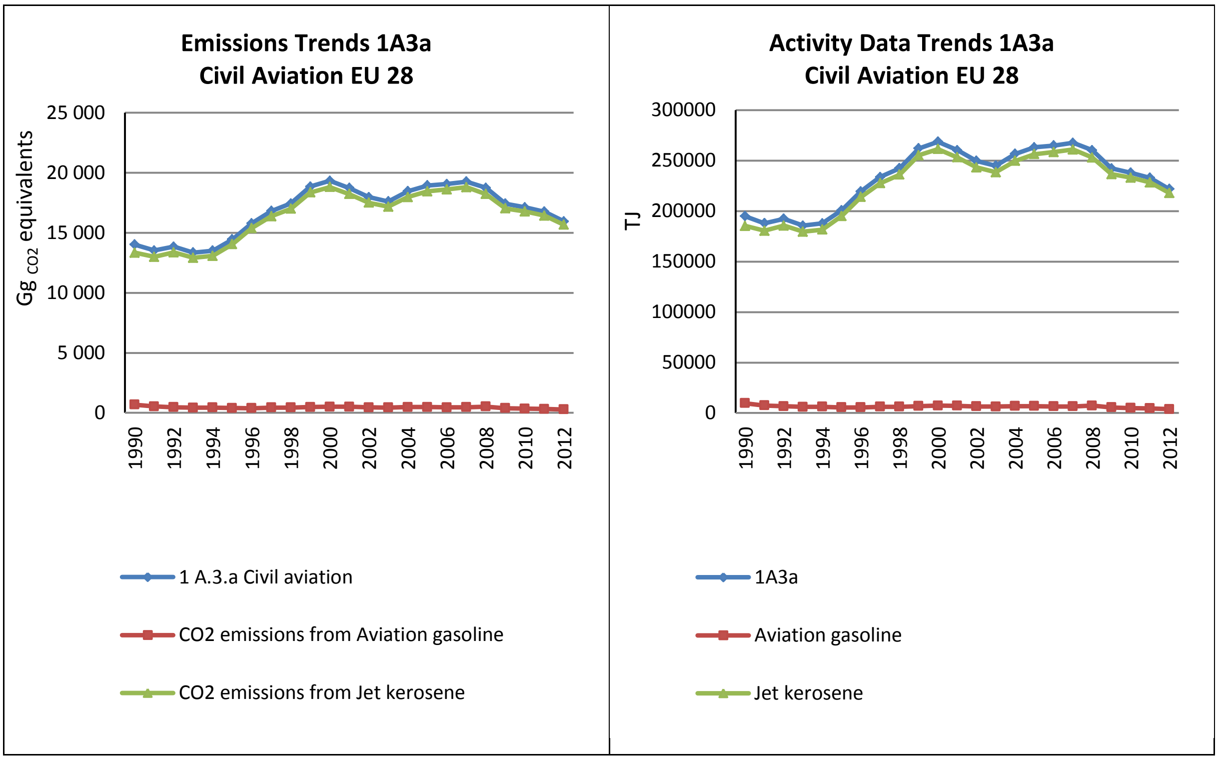


Table 18.29 1A3a Civil Aviation, jet kerosine: CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	12 975	15 935	15 356	98%	-579	-4%	2 381	18%		
Bulgaria	114	62	31	0.2%	-31	-50%	-83	-73%	T2	D
Croatia	155	88	93	1%	5	6%	-62	-40%	T1	D
Cyprus	19	34	29	0.2%	-5	-14%	10	49%	OTH	OTH
Czech Republic	1	2	1	0.01%	-0.4	-25%	-0.2	-15%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	1	2	1	0.01%	-0.5	-27.4%	0.05	4%	T1	D
Latvia	0.05	0.1	1.77	0.01%	1.62	1078%	1.7	3120%	T2	D
Lithuania	8	1	0.4	0.003%	-0.1	-25%	-8	-95%	T2	CS
Malta	0.4	0.6	1	0.008%	0.7	119%	0.9	243%	T1	D
Poland	34	76	41	0.3%	-35	-46%	7	21%	T1	D
Romania	25	230	119	1%	-112	-48%	94	381%	T2	D
Slovakia	7	6	5	0.03%	-0.8	-15%	-2	-33%	T2	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
EU-28	13 340	16 435	15 679	100%	-756	-5%	2 339	18%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.2 Road Transportation (1A3b) (EU-28)

Figure 18.21 1A3b- Road Transport, CO_2 and N_2O emission and activity trends

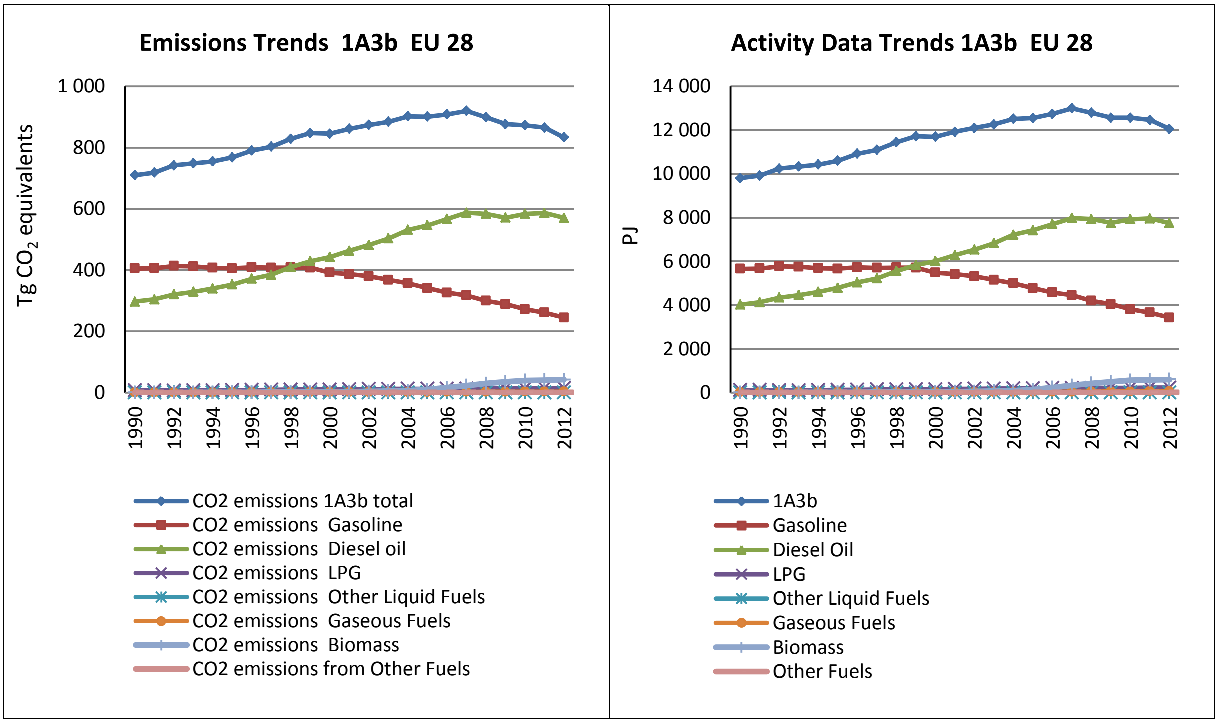


Table 18.30 1A3b Road Transport, diesel oil: CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	268 342	505 632	490 155	86%	-15 477	-3%	221 812	83%		
Bulgaria	1 547	4 664	4 976	1%	311	7%	3 428	222%	T2	CR
Croatia	1 146	3 400	3 334	1%	-66	-2%	2 188	191%	T1	D
Cyprus	667	994	880	0.2%	-114	-12%	213	32%	T1	D
Czech Republic	2 836	10 514	10 628	2%	113	1%	7 791	275%	T1	D
Estonia	697	1 305	1 379	0.2%	74	6%	682	98%	T2	CS
Hungary	2 364	7 429	6 859	1%	-570	-8%	4 494	190%	T2	CS
Latvia	616	1 698	1 662	0.3%	-36	-2%	1 046	170%	T3	CS
Lithuania	2 134	2 806	2 919	1%	114	4%	786	37%	T2	CS
Malta	150	280	263	0.05%	-17	-6%	113	76%	CR	CR
Poland	8 615	30 248	29 361	5%	-887	-3%	20 746	241%	T2	CS
Romania	3 648	9 093	9 617	2%	524	6%	5 969	164%	T3	OTH
Slovakia	3 123	4 430	4 580	1%	150	3%	1 457	47%	M,T1	D
Slovenia	904	3 819	4 018	1%	199	5%	3 114	344%	M,T3	M
EU-28	296 790	586 314	570 630	100%	-15 683	-2.7%	273 840	92%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.22 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factors for CO_2

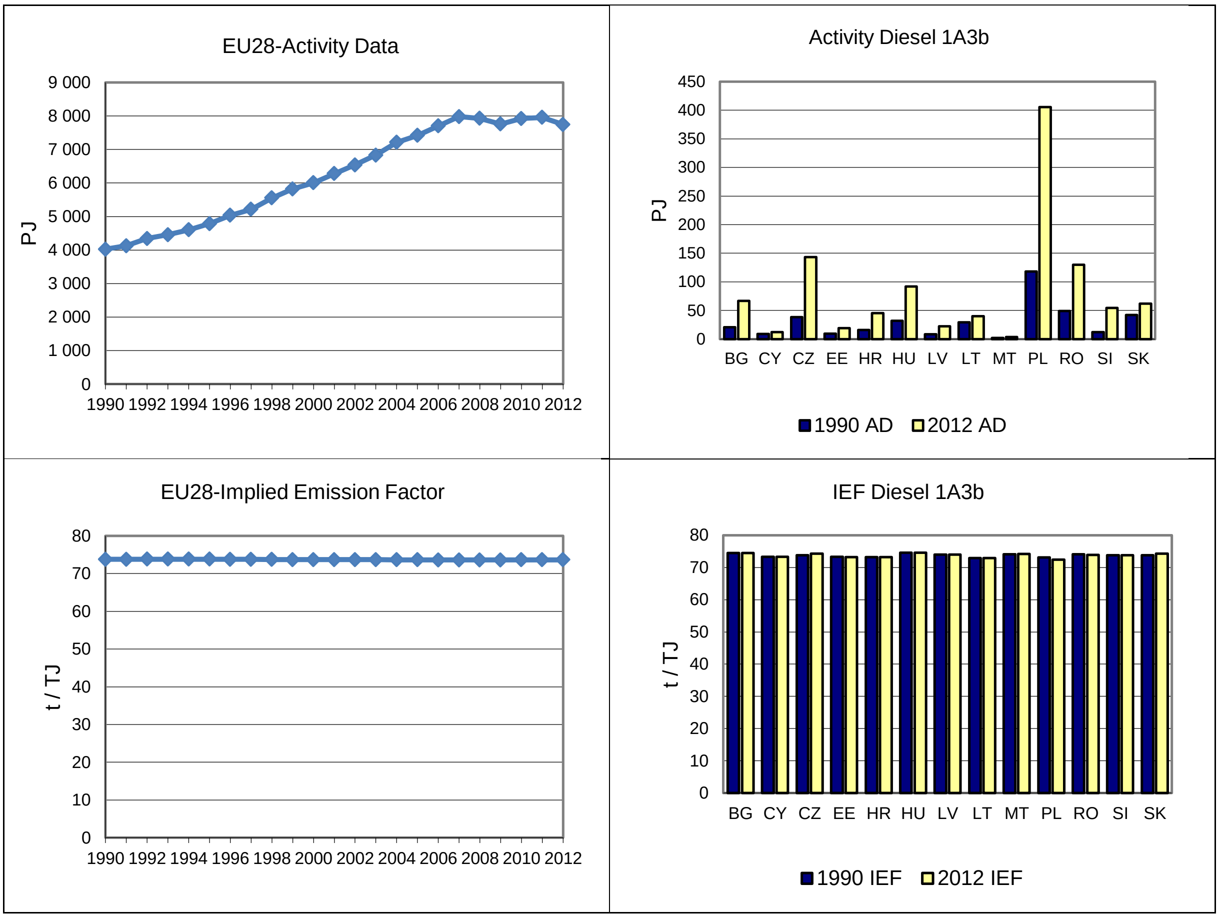


Table 18.31 1A3b Road Transport, gasoline: CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	362 939	225 169	210 274	86%	-14 894	-7%	-152 665	-42%		
Bulgaria	4 390	1 669	1 597	1%	-72	-4%	-2 793	-64%	T2	CR
Croatia	2 448	2 004	1 863	1%	-141	-7%	-584	-24%	T1	D
Cyprus	501	1 183	1 143	0.5%	-40	-3%	642	128%	T1	D
Czech Republic	3 403	5 360	4 994	2%	-366	-7%	1 592	47%	T1	D
Estonia	1 530	808	769	0%	-39	-5%	-761	-50%	T2	CS
Hungary	5 276	3 598	3 649	1%	51	1.42%	-1 626	-31%	T2	CS
Latvia	1 689	814	690	0.3%	-123	-15%	-999	-59%	T3	CS
Lithuania	3 053	788	705	0.3%	-84	-11%	-2 348	-77%	T2	CS
Malta	183	224	228	0.1%	4	2%	45	24%	CR	CR
Poland	9 814	11 679	11 147	5%	-532	-5%	1 333	14%	T2	CS
Romania	6 591	4 002	4 253	2%	251	6%	-2 337	-35%	T3	OTH
Slovakia	1 380	1 712	1 714	1%	2	0.1%	333	24%	M,T1	D
Slovenia	1 695	1 755	1 622	1%	-134	-8%	-74	-4%	M,T3	M
EU-28	404 892	260 765	244 649	100%	-16 116	-6.2%	-160 243	-40%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.23 1A3b Road Transport, gasoline: Activity Data and Implied Emission Factors for CO_2

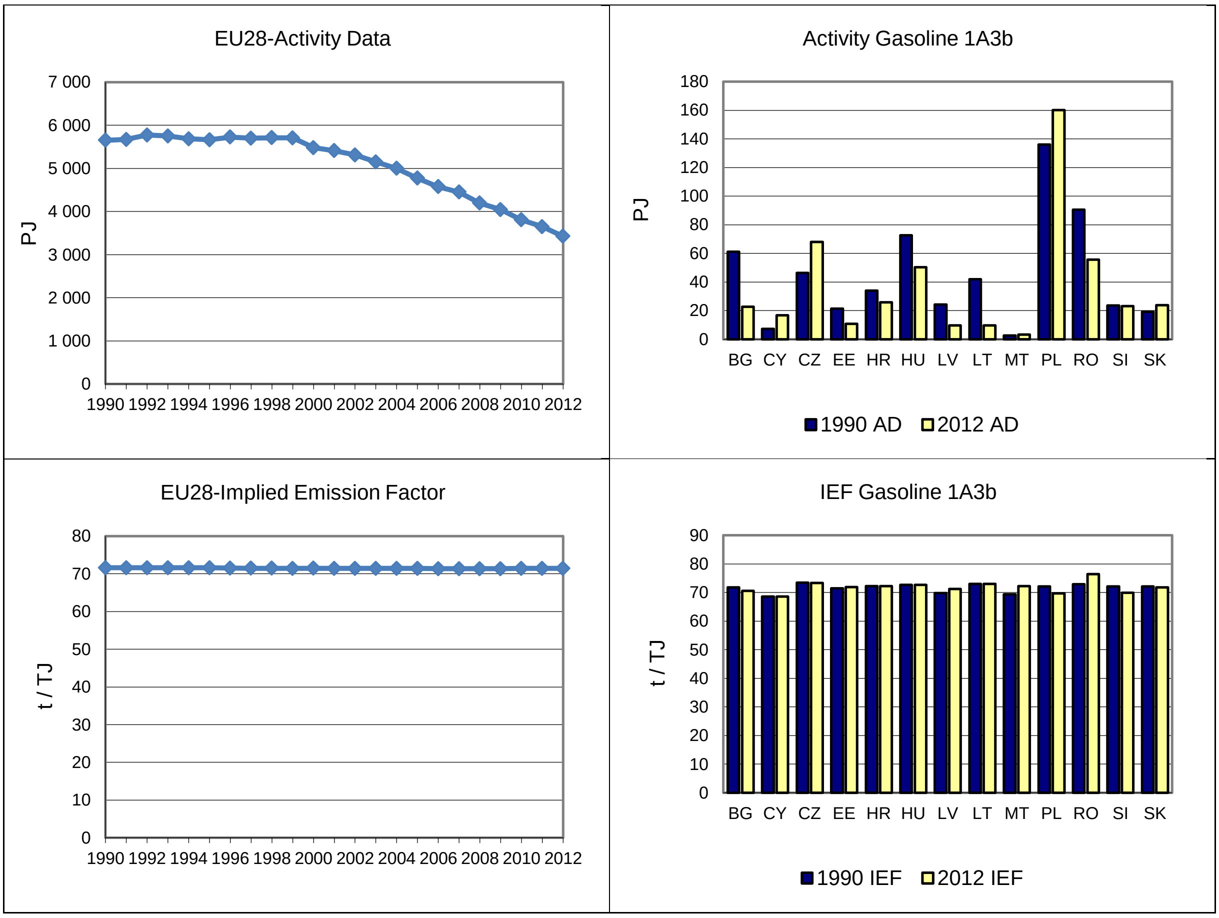


Table 18.32 1A3b Road Transport, LPG: Member CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	7 323	7 780	7 682	53%	-98	-1%	359	5%		
Bulgaria	NO	961	1 019	7%	57	6%	1 019	-	T2	CR
Croatia	NO	130	165	1%	35	27%	165	-	T1	CR
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	224	215	1%	-9	-4%	215	-	T1	CS
Estonia	9	0.4	0.3	0.002%	-0.1	-16%	-9	-96%	T2	CS
Hungary	NA	82	62	0.4%	-20.5	-25%	62	-	T1	D
Latvia	37	74	117	1%	43	58%	80	215%	T3	CS
Lithuania	60	444	419	3%	-26	-6%	359	596%	T2	CS
Malta	NO	NO	0.1	0.0004%	0.1	-	0.1	-	CR	CR
Poland	NO	4 621	4 616	32%	-6	-0.1%	4 616	-	T2	CS
Romania	NO	222	159	1%	-63	-28%	159	-	T3	OTH
Slovakia	NO	54	92	1%	38	70%	92	-	M,T1	D
Slovenia	NO	18	24	0.2%	6	-	24	-	M,T3	M
EU-28	7 429	14 611	14 569	100%	-43	-0.3%	7 140	96%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.33 1A3b Road Transport, diesel oil: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	1 572	5 330	5 504	84%	175	3%	3 933	250%		
Bulgaria	20	41	46	1%	5	12%	26	126%	T2	CR
Croatia	10	28	30	0.5%	2	6%	19	183%	T3	CR
Cyprus	2	3	2	0.03%	-0.3	-12%	1	32%	T1	D
Czech Republic	29	213	219	3%	6	3%	190	652%	T2	CS
Estonia	7	11	12	0.2%	1	13%	5	63%	T3	CS
Hungary	41	78	72	1%	-6	-7%	31	75%	T2	D
Latvia	6	13	13	0.2%	-0.5	-4%	7	117%	T3	CR
Lithuania	20	25	25	0.4%	1	2%	5	24%	T3	CR
Malta	2.4	3	3	0.04%	0.2	8%	0.4	16%	CR	CR
Poland	117	440	427	7%	-13	-3%	310	265%	T2	D
Romania	32	92	99	2%	7	8%	67	208%	T3	OTH
Slovakia	43	36	39	0.6%	3	9%	-4	-9%	M,T1	D
Slovenia	11	35	38	0.6%	3	8%	27	247%	M,T3	M
EU-28	**1 913**	**6 345**	**6 529**	**100%**	**183**	**3%**	**4 615**	**241%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.34 1A3b Road Transport, gasoline: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	4 232	1 345	1 179	63%	-167	-12%	-3 053	-72%		
Bulgaria	56	14	13	1%	-1.69	-12%	-43	-77%	T2	CR
Croatia	30	18	16	1%	-2.24	-12%	-14	-46%	T3	CR
Cyprus	1	3	3	0.2%	-0.1	-3%	2	128%	T1	D
Czech Republic	103	431	407	22%	-24	-6%	304	296%	T2	CS
Estonia	15	7	7	0.3%	-1	-11%	-8	-56%	T3	CS
Hungary	58	34	34	2%	0	1%	-24	-42%	T2	D
Latvia	14	7	6	0.3%	-1	-14%	-8	-59%	T3	CR
Lithuania	19	7	7	0.4%	-0.4	-5%	-12	-64%	T3	CR
Malta	2.62	2	2	0.1%	-0.08	-3%	-0.4	-17%	CR	CR
Poland	70	139	133	7%	-6	-5%	63	90%	T2	D
Romania	204	38	39	2%	1	3%	-165	-81%	T3	OTH
Slovakia	16	28	26	1%	-2	-6%	11	69%	M,T1	D
Slovenia	21	15	13	1%	-2	-14%	-8	-40%	M,T3	M
EU-28	**4 840**	**2 089**	**1 883**	**100%**	**-206**	**-10%**	**-2 957**	**-61%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.3 Railways (1A3c) (EU-28)

Figure 18.24 1A3c- Railways, CO_2 and N_2O emission and activity trends

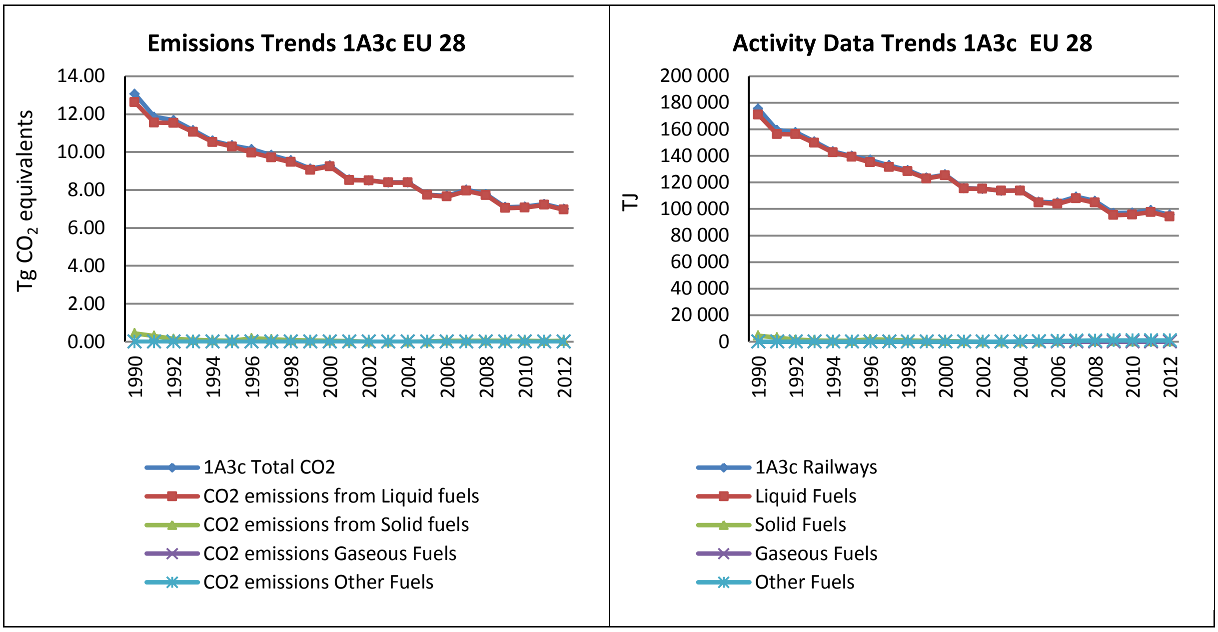


Table 18.35 1A3c Railways, liquid fuels: CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	7 816	5 037	4 866	70%	-171	-3%	-2 950	-38%		
Bulgaria	318	56	68	1%	12	22%	-250	-79%	T1	D
Croatia	118	83	78	1%	-5	-6%	-40	-34%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	651	282	273	4%	-9	-3%	-378	-58%	T1	D
Estonia	143	106	92	1%	-14	-13%	-51	-36%	T2	CS
Hungary	514	142	126	2%	-15	-11%	-388	-75%	T1	D
Latvia	531	233	248	4%	16	7%	-283	-53%	T2	CS
Lithuania	350	193	181	3%	-12	-6%	-169	-48%	T2	CS
Malta	NO	NA	NA	-	-	-	-	-	NA	NA
Poland	1 332	370	350	5%	-20	-5%	-982	-74%	T2	CS
Romania	413	588	567	8%	-21	-4%	154	37%	T1,T2	CS,D
Slovakia	377	85	72	1%	-13	-15%	-305	-81%	T1	D
Slovenia	64	37	37	1%	0	0%	-27	-42%	T1	D
EU-28	12 628	7 211	6 959	100%	-252	-3%	-5 669	-45%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.4 Navigation (1A3d) (EU-28)

Figure 18.25 1A3d Navigation, CO_2 and N_2O emission and activity trends

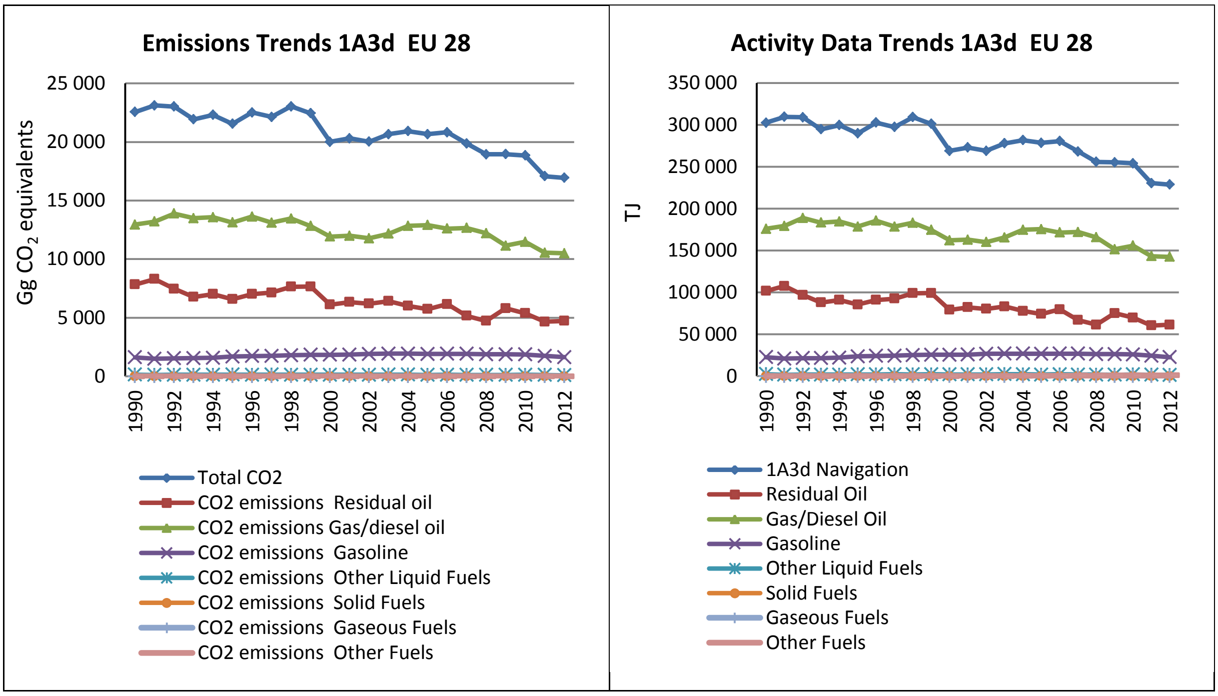


Table 18.36 1A3d Navigation, residual oil: CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	6 747	4 650	4 724	99.9%	74	2%	-2 024	-30%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	6	6	6	0.1%	0.3	6%	-1	-10%	T1	D
Cyprus	NE	NE	NE	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	3	NO	NO	-	-	-	-3	-100%	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	0	NO	-	-	-	-	-	NA	NA
Poland	70	1	1	0.02%	-0.3	-25%	-69	-99%	T1	D
Romania	1 017	NO	NO	-	-	-	-1 017	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	7 843	4 656	4 730	100%	74	2%	-3 113	-40%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.37 1A3d Navigation, gas/diesel oil: CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	12 434	10 175	10 131	97%	-45	0%	-2 303	-19%		
Bulgaria	56	9	8	0.1%	-1	-10%	-48	-85%	T1	D
Croatia	126	111	105	1%	-6	-5%	-21	-17%	T1	D
Cyprus	NE	NE	NE	-	-	-	-	-	NA	NA
Czech Republic	56	9	16	0.1%	6	67%	-41	-72%	T1	D
Estonia	22	15	13	0.1%	-2	-14%	-9	-42%	T2	CS
Hungary	28	3	18	0.2%	15	500%	-9	-33%	T1	D
Latvia	1	16	13	0.1%	-3	-19%	12	1410%	T1	D
Lithuania	15	16	15	0.1%	-1	-8%	-1	-4%	T2	CS
Malta	8	36	32	0.3%	-4	-11%	24	280%	D,T1	D
Poland	80	10	10	0.1%	0	1%	-70	-87%	T1	D
Romania	123	155	130	1%	-25	-16%	7	6%	T2	CS
Slovakia	0.02	0.85	1.12	0.01%	0.3	33%	1	4837%	T1	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
EU-28	12 951	10 557	10 493	100%	-65	-1%	-2 458	-19%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.5 Other (1A3e) (EU-28)

Table 18.38 1A3e Other: CO_2 emissions of EU-28

Member State	CO2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	7 061	7 838	7 764	84%	-73	-1%	704	10%
Bulgaria	132	469	468	5%	-1	-0.2%	336	255%
Croatia	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	484	144	70	1%	-75	-52%	-414	-86%
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Lithuania	1 764	212	247	3%	34	16%	-1 517	-86%
Malta	IE,NO	17	17	-	0	0%	-	-
Poland	IE,NA,NO	522	606	7%	84	16%	606	-
Romania	11	38	27	0%	-12	-30%	16	145%
Slovakia	0	0	0	-	-	-	-	-
Slovenia	NO	1	1	0.01%	0.3	37%	1	-
EU-28	9 451	9 242	9 200	100%	-42	-0.5%	-251	-3%

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.4 Other Sectors (CRF Source Category 1A4) (EU-28)

18.2.4.1 Commercial/Institutional (1A4a) (EU-28)

Figure 18.26 1A4a Commercial/Institutional, CO_2 and N_2O emission and activity trends

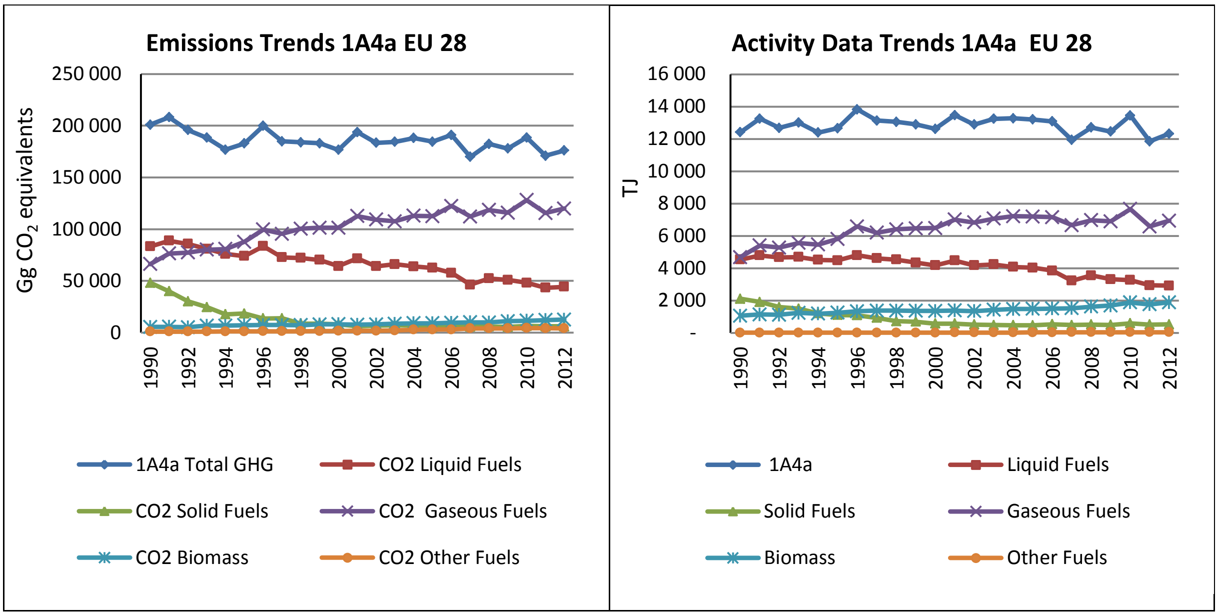


Table 18.391A4a Commercial/Institutional, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	74 049	39 872	41 371	93%	1 499	4%	-32 678	-44%		
Bulgaria	2 954	107	106	0.2%	-1	-1%	-2 849	-96%	T1	D
Croatia	525	273	221	0.5%	-52	-19%	-304	-58%	T1	D
Cyprus	0.05	0.1	0.1	0.0002%	-0.01	-10%	0.02	43%	T1	D
Czech Republic	1 786	55	52	0.1%	-3	-6%	-1 734	-97%	T1	CS,D
Estonia	19	1	2	0.003%	0.3	24%	-17	-92%	T1,T2	CS,D
Hungary	1 095	47	81	0.2%	34	72%	-1 014	-93%	T1	D
Latvia	1 131	99	133	0.3%	34	35%	-998	-88%	T2	CS
Lithuania	933	11	9	0.02%	-1	-12%	-924	-99%	T2	CS
Malta	62	50	67	0.2%	17	33%	6	9%	D,T1	D
Poland	NO	2 075	1 620	4%	-455	-22%	1 620	-	T1	D
Romania	NO	324	226	0.5%	-98	-30%	226	-	T1, T2	D, CS
Slovakia	384	6	7	0.02%	2	35%	-376	-98%	T2	CS
Slovenia	267	481	382	1%	-99	-21%	115	43%	T1	D
EU-28	**83 206**	**43 401**	**44 278**	**100%**	**877**	**2%**	**-38 928**	**-47%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.40 1A4a Commercial/Institutional, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	27 802	2 406	2 467	41%	62	3%	-25 335	-91%		
Bulgaria	60	19	15	0.2%	-5	-24%	-45	-75%	T2	CS,D
Croatia	86	8	8	0.1%	-0.3	-3%	-78	-91%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	6 274	122	119	2%	-3	-2%	-6 155	-98%	T1	CS,D
Estonia	8	1	0.3	0.005%	-1	-80%	-8	-96%	T1,T2	CS,D
Hungary	465	12	3	0.1%	-9	-72%	-461	-99%	T2	CS
Latvia	1 332	82	35	1%	-48	-58%	-1 297	-97%	T2	CS,OTH
Lithuania	1 185	239	171	3%	-69	-29%	-1 014	-86%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	8 959	3 205	3 199	53%	-6	-0.2%	-5 760	-64%	T1,T2	CS,D
Romania	NO	3	1	0.02%	-2	-54%	1	-	T2	CS
Slovakia	1 729	45	38	1%	-7	-15%	-1 691	-98%	T2	CS
Slovenia	200	NO	NO	-	-	-	-200	-100%	NA	NA
EU-28	**48 100**	**6 143**	**6 057**	**100%**	**-86**	**-1%**	**-42 044**	**-87%**		

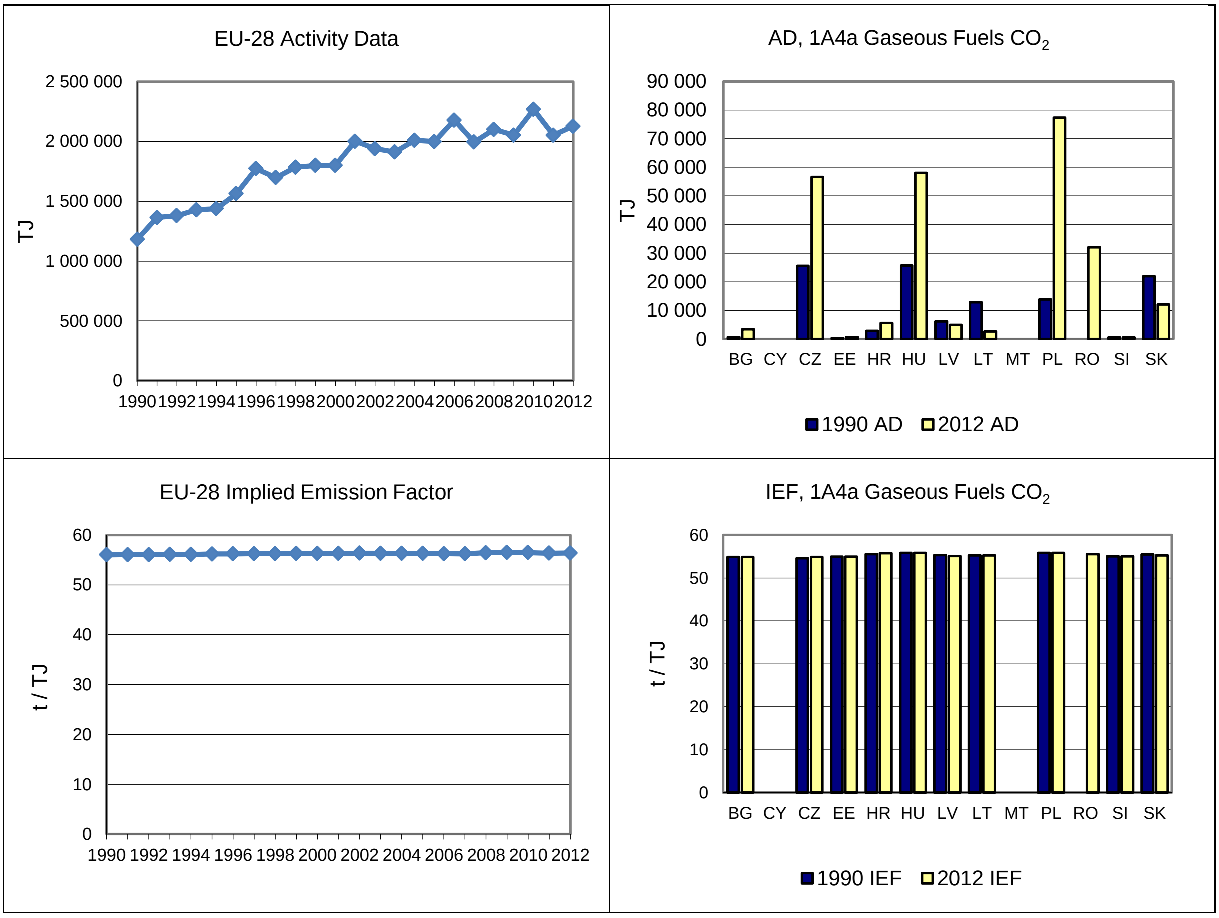
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.41 1A4a Commercial/Institutional, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	60 058	100 554	105 869	88%	5 314	5%	45 810	76%		
Bulgaria	39	189	187	0.2%	-2	-1%	148	382%	T2	CS
Croatia	159	331	309	0.3%	-22	-7%	150	94%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 396	3 123	3 105	3%	-18	-1%	1 709	122%	T1	CS
Estonia	20	41	33	0.03%	-9	-21%	12	61%	T2	CS
Hungary	1 435	4 033	3 242	3%	-792	-20%	1 807	126%	T1	D
Latvia	337	275	270	0.2%	-5	-2%	-67	-20%	T2	CS
Lithuania	709	139	146	0.1%	7	5%	-562	-79%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	770	4 361	4 318	4%	-43	-1%	3 549	461%	T1	D
Romania	NO	1 757	1 778	1%	21	1%	1 778	-	T2	CS
Slovakia	1 215	672	666	1%	-5	-1%	-549	-45%	T2	CS
Slovenia	29	89	29	0.02%	-60	-67%	0.3	1%	T2	CS
EU-28	**66 168**	**115 567**	**119 953**	**100%**	**4 386**	**4%**	**53 785**	**81%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.27 1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



18.2.4.2 Residential (1A4b) (EU-28)

Figure 18.28 1A4b Residential, CO_2 emission and activity trends

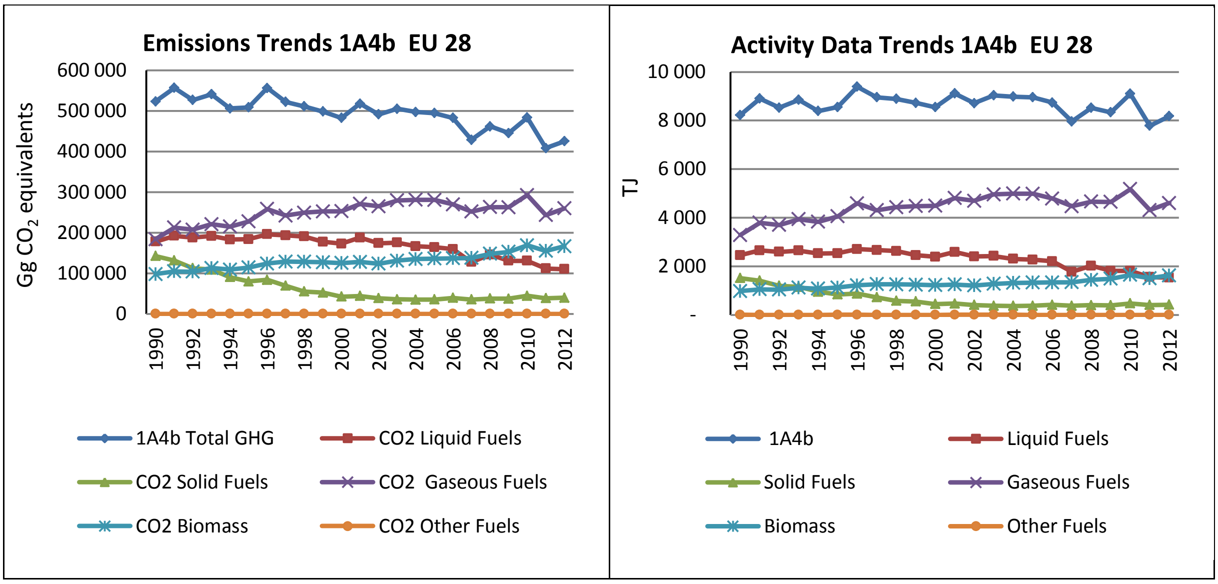


Table 18.42 1A4b Residential, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	169 703	107 001	105 964	96%	-1 037	-1%	-63 739	-38%		
Bulgaria	156	72	66	0.1%	-6	-8%	-90	-58%	T1	D
Croatia	1 113	640	503	0.5%	-136	-21%	-609	-55%	T1	D
Cyprus	307	417	411	0.4%	-6	-1%	104	34%	T1	D
Czech Republic	503	30	30	0.03%	0	0%	-473	-94%	T1	CS,D
Estonia	545	41	39	0.04%	-2	-4%	-505	-93%	T1,T2	CS,D
Hungary	3 423	308	261	0.2%	-47	-15%	-3 162	-92%	T1	D
Latvia	330	154	154	0.1%	0	0%	-176	-53%	T2	CS
Lithuania	310	149	165	0.1%	16	11%	-145	-47%	T2	CS
Malta	35	49	50	0.05%	1	2%	15	44%	D,T1	D
Poland	106	1 782	1 715	2%	-67	-4%	1 608	1513%	T1	D
Romania	912	614	524	0.5%	-90	-15%	-389	-43%	T1, T2	D, CS
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	434	757	660	1%	-97	-13%	226	52%	T1	D
EU-28	**177 876**	**112 014**	**110 543**	**100%**	**-1 472**	**-1%**	**-67 333**	**-38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.29 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2

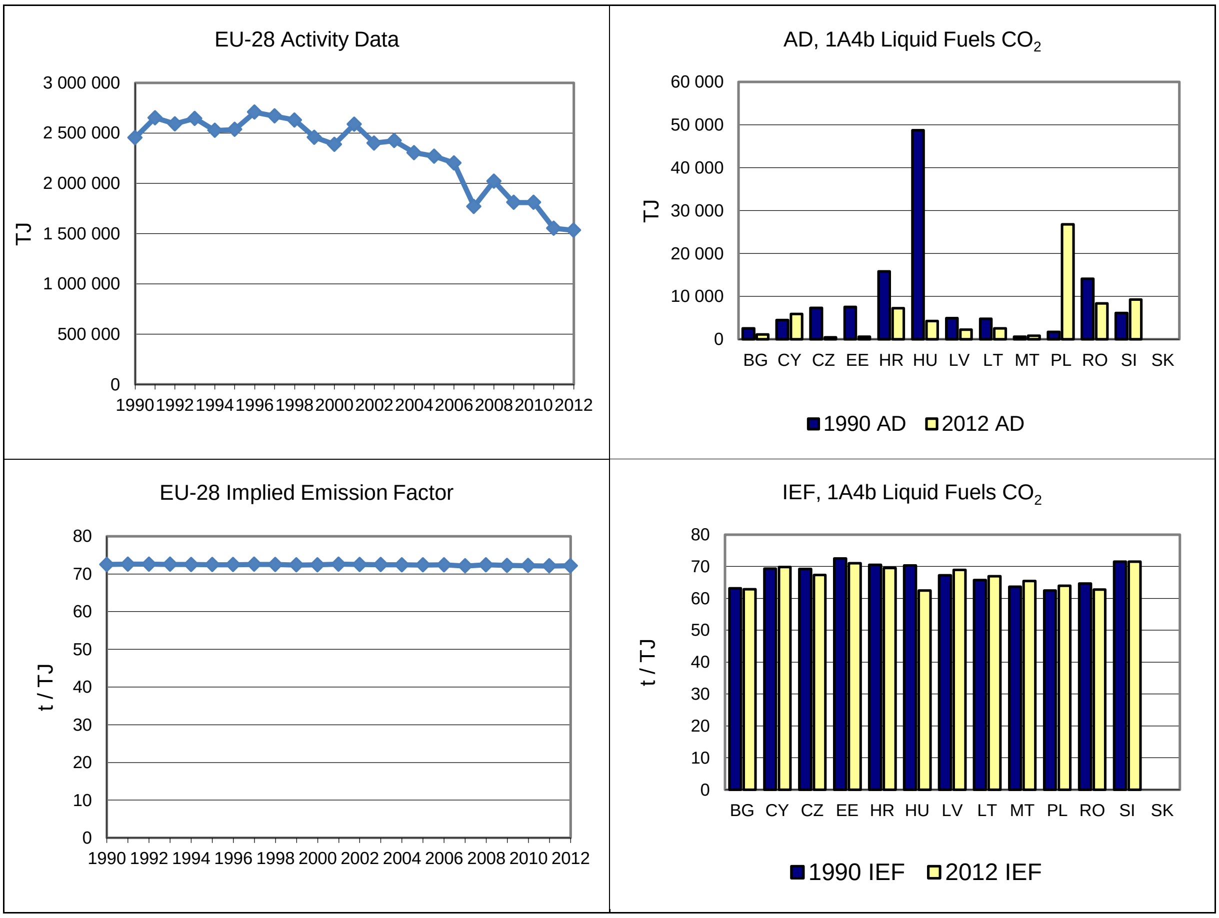


Table 18.43 1A4b Residential, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	74 463	11 891	11 277	28%	-614	-5%	-63 185	-85%		
Bulgaria	2 635	954	937	2%	-18	-2%	-1 698	-64%	T2	CS,D
Croatia	428	14	12	0.03%	-2	-12%	-415	-97%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	17 373	1 931	2 246	6%	315	16%	-15 127	-87%	T1	CS,D
Estonia	667	44	39	0.1%	-5	-12%	-629	-94%	T1,T2	CS,D
Hungary	7 867	708	641	2%	-67	-10%	-7 226	-92%	T2	CS
Latvia	585	90	53	0.1%	-37	-41%	-532	-91%	T2	CS
Lithuania	1 457	275	274	1%	-1	-1%	-1 183	-81%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	28 445	22 707	23 876	60%	1 169	5%	-4 568	-16%	T1,T2	CS,D
Romania	2 829	75	91	0.2%	17	22%	-2 737	-97%	T1,T2	D,CS
Slovakia	5 441	176	396	1%	220	125%	-5 045	-93%	T2	CS
Slovenia	338	2	2	0.004%	-1	-25%	-336	-99%	T1	D
EU-28	**142 527**	**38 868**	**39 844**	**100%**	**976**	**3%**	**-102 683**	**-72%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.44 1A4b Residential, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	161 967	213 381	230 084	89%	16 703	8%	68 117	42%		
Bulgaria	NO	129	123	0.05%	-6	-5%	123	-	T2	CS
Croatia	455	1 276	1 196	0.5%	-80	-6%	741	163%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2 686	4 607	4 649	2%	41	1%	1 963	73%	T1	CS
Estonia	116	117	126	0.05%	9	7%	10	8%	T2	CS
Hungary	4 228	7 136	6 447	2%	-689	-10%	2 219	52%	T1	D
Latvia	220	247	247	0.1%	-0.5	-0.2%	27	12%	T2	CS
Lithuania	510	335	313	0.1%	-22	-7%	-197	-39%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	6 821	7 562	7 893	3%	331	4%	1 071	16%	T1	D
Romania	5 225	5 421	5 919	2%	498	9%	694	13%	T2	CS
Slovakia	1 628	2 708	2 674	1%	-34	-1%	1 045	64%	T2	CS
Slovenia	25	261	270	0.1%	9	4%	245	981%	T2	CS
EU-28	**183 881**	**243 180**	**259 940**	**100%**	**16 759**	**7%**	**76 059**	**41%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.30 1A4b Residential, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

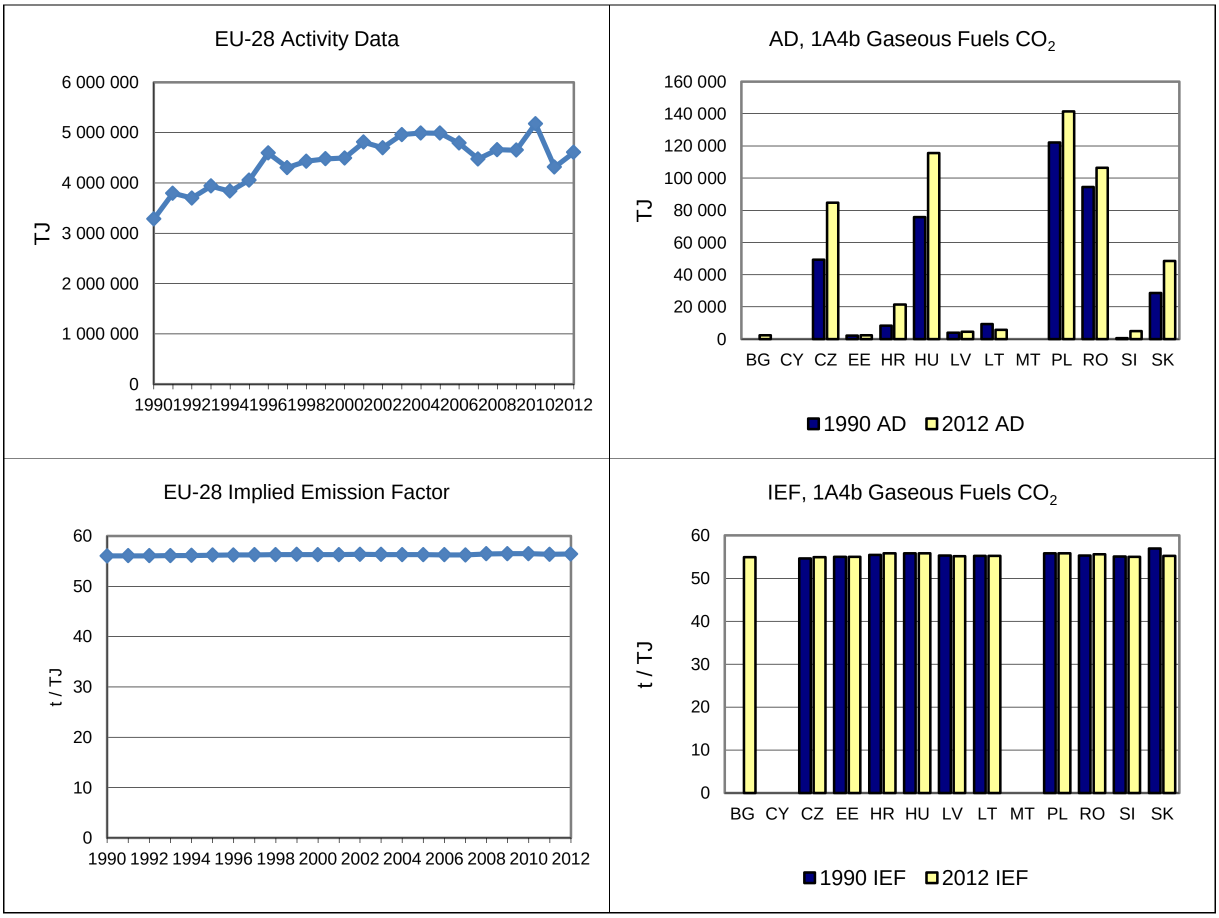


Table 18.45 1A4b Residential, biomass: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	6 046	4 368	4 694	61%	326	7%	-1 351	-22%
Bulgaria	45	197	200	3%	3	2%	155	340%
Croatia	120	102	108	1%	6	6%	-12	-10%
Cyprus	1	2	2	0.02%	0.04	2%	1	81%
Czech Republic	37	294	303	4%	9	3%	265	710%
Estonia	34	96	102	1%	5.98	6%	68	203%
Hungary	157	191	191	2%	0	0%	34	22%
Latvia	126	165	175	2%	11	6%	49	39%
Lithuania	57	147	148	2%	0.62	0.4%	91	161%
Malta	NE	0.16	NO	-	-0.2	-	-	-
Poland	216	725	736	10%	12	2%	520	240%
Romania	152	830	866	11%	36	4%	714	471%
Slovakia	3	13	13	0.2%	0.5	4%	10	342%
Slovenia	86	122	124	2%	2.36	2%	38.81	45%
EU-28	**7 079**	**7 251**	**7 663**	**100%**	**412**	**6%**	**584**	**8%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.4.3 Agriculture/Forestry/Fisheries (1A4c) (EU-28)

Figure 18.31 1A4c Agriculture/Forestry/Fisheries, CO_2 emission and activity trends

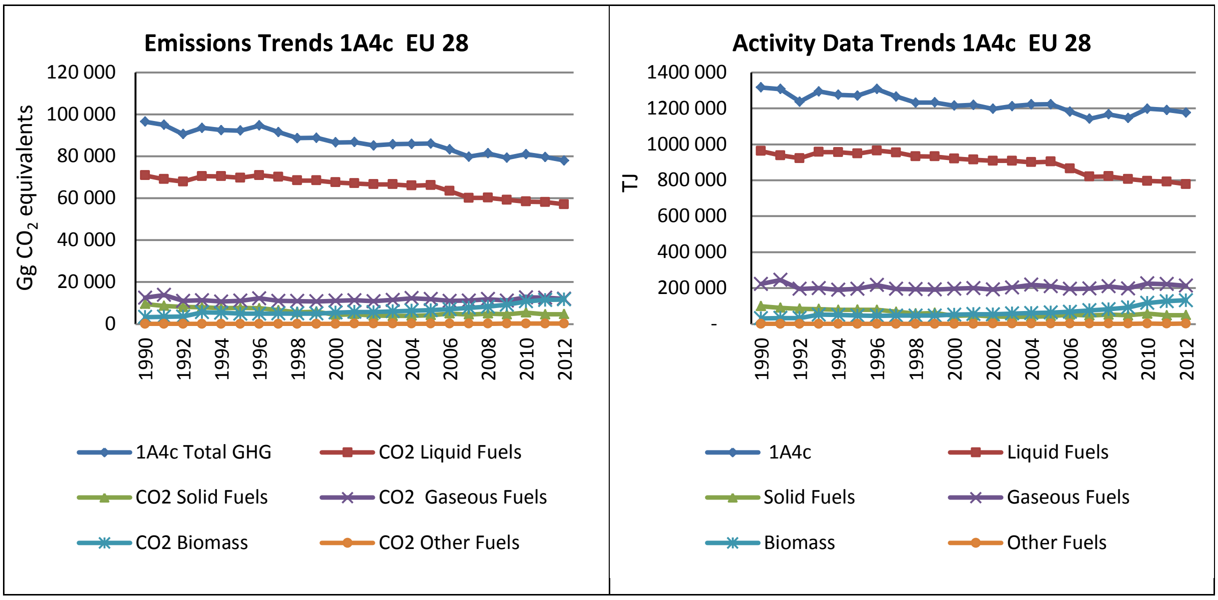


Table 18.46 1A4c Agriculture/Forestry/Fisheries, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	56 467	48 666	47 554	83%	-1 112	-2%	-8 913	-16%		
Bulgaria	1 482	412	415	1%	3	1%	-1 067	-72%	T1	D
Croatia	792	674	627	1%	-47	-7%	-165	-21%	T1	D
Cyprus	56	82	79	0.1%	-3	-4%	23	-	T1	D
Czech Republic	342	33	31	0.1%	-3	-8%	-311	-91%	T1	CS,D
Estonia	476	246	249	0.4%	3	1%	-227	-48%	T1,T2	CS,D
Hungary	2 025	808	644	1%	-165	-20%	-1 382	-68%	T1	D
Latvia	694	349	314	0.5%	-35	-10%	-380	-55%	T2	CS
Lithuania	99	31	32	0.1%	1	4%	-67	-68%	T2	CS
Malta	NE	5	23	0.04%	17	323%	23	-	D,T1	D
Poland	4 656	5 818	5 962	10%	143	2%	1 305	28%	T1	D
Romania	3 477	821	975	2%	154	19%	-2 502	-72%	T1, T2	D, CS
Slovakia	3	3	3	0.01%	0.4	18%	-0.1	-2%	T2	CS
Slovenia	332	201	209	0.4%	8	4%	-123	-37%	T1	D
EU-28	**70 902**	**58 149**	**57 116**	**100%**	**-1 033**	**-2%**	**-13 786**	**-19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.47 1A4c Agriculture/Forestry/Fisheries, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	3 712	355	362	8%	7	2%	-3 350	-90%		
Bulgaria	147	19	18	0.4%	-1	-8%	-129	-88%	T2	CS,D
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 493	40	43	1%	3	6%	-1 450	-97%	T1	CS,D
Estonia	16	0.1	NO	-	-0.1	-	-16	-	NA	NA
Hungary	132	2	2	0.0%	-1	-25%	-131	-99%	T2	CS
Latvia	95	2	5	0.1%	2	100%	-90	-95%	T2	CS
Lithuania	148	4	4	0.1%	-1	-12%	-144	-97%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3 768	4 160	4 292	91%	132	3%	523	14%	T1,T2	CS,D
Romania	73	35	2	0.04%	-33	-95%	-71	-97%	T1	D
Slovakia	1	1	1	0.02%	-0.2	-20%	-0.4	-28%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**9 585**	**4 620**	**4 728**	**100%**	**108**	**2%**	**-4 858**	**-51%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.48 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	8 716	11 589	11 118	92%	-472	-4%	2 401	28%		
Bulgaria	3	64	53	0.4%	-12	-18%	49	1512%	T2	CS
Croatia	47	41	39	0.3%	-2	-4%	-8	-17%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	406	123	116	1%	-7	-6%	-290	-71%	T1	CS
Estonia	4	4	2	0.02%	-2	-47%	-2	-48%	T2	CS
Hungary	435	290	221	2%	-69	-24%	-214	-49%	T1	D
Latvia	779	43	56	0.5%	13	29%	-723	-93%	T2	CS
Lithuania	163	70	64	1%	-6	-9%	-99	-61%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	25	85	100	1%	15	17%	75	301%	T1	D
Romania	1 919	131	174	1%	43	33%	-1 745	-91%	T2	CS
Slovakia	41	88	83	1%	-5	-6%	42	104%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**12 537**	**12 529**	**12 026**	**100%**	**-504**	**-4%**	**-511**	**-4%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.5 Other (CRF Source Category 1A5) (EU-28)

18.2.5.1 Stationary (1A5a) (EU-28)

Table 18.49 1A5a Stationary, solid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	4 667	8	8	65%	0.1	1%	-4 659	-100%
Bulgaria	29	NO	NO	-	-	-	-29	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NO	1	1	10%	0	0%	1	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Malta	NA	NA	NA	-	-	-	-	-
Poland	IE	IE	IE	-	-	-	-	-
Romania	1 207	NO	NO	-	-	-	-1 207	-100%
Slovakia	216	3	3	24%	-0.2	-7%	-213	-99%
Slovenia	NA	NA	NA	-	-	-	-	-
EU-28	6 120	12	12	**100%**	**0**	**-1%**	**-6 108**	**-100%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.5.2 Mobile (1A5b) (EU-28)

Table 18.50 1A5b Mobile, liquid fuels: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	13 721	5 012	4 273	79%	-740	-15%	-9 448	-69%		
Bulgaria	IE	IE	IE	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NA	NA	NA	-	-	-	-	-	NA	NA
Czech Republic	1 601	1 091	1 095	20%	3	0.3%	-506	-32%	T1	D
Estonia	43	20	23	0.4%	3	14%	-21	-48%	T2	CS
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	7	7	0.1%	0.1	2%	7	-	T1,T2	CS,D
Lithuania	NE,NO	13	9	0.2%	-4	-30%	9	-	T1	CS
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	NA	NA	NA	-	-	-	-	-	NA	NA
Slovakia	7	2	1	0.03%	-0.2	-10%	-6	-80%	T2	D
Slovenia	32	3	3	0.1%	0.01	0.2%	-28	-89%	T1	D
EU-28	**15 404**	**6 149**	**5 411**	**100%**	**-737**	**-12%**	**-9 993**	**-65%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.6 Fugitive emissions from fuels (CRF Source Category 1.B) (EU-28)

18.2.6.1 Fugitive emissions from Solid Fuels (1B1) (EU-28)

Table 18.51 1B1a Coal Mining: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	42 976	6 088	6 784	34%	696	11%	-36 192	-84%		
Bulgaria	1 736	1 069	937	5%	-132	-12%	-799	-46%	T1	D
Croatia	49	NO	NO	-	-	-	-49	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	7 600	3 279	3 262	17%	-16	-1%	-4 338	-57%	T1,T2	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	659	10	11	0.1%	1	15%	-648	-98%	D,T2	CS,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	13 092	6 991	7 369	37%	378	5%	-5 722	-44%	CS	CS
Romania	3 240	860	810	4%	-50	-6%	-2 430	-75%	T1	D
Slovakia	571	340	335	2%	-5	-1%	-236	-41%	T2	CS
Slovenia	303	253	241	1%	-12.55	-5%	-62	-20%	T3	PS
EU-28	**70 226**	**18 890**	**19 750**	**100%**	**860**	**5%**	**-50 476**	**-72%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.6.2 Fugitive emissions from oil and natural gas (1B2) (EU-28)

Table 18.52 1B2a Fugitive CO_2 emissions from oil: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	8 199	9 898	9 590	94%	-308	-3%	1 391	17%		
Bulgaria	1	0.24	0.26	0.003%	0.02	9%	-0.39	-60%	T1	D
Croatia	1	0.21	0.19	0.002%	-0.02	-9%	-0.66	-78%	T1	D
Cyprus	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-	NA	NA
Czech Republic	0.02	0.06	0.05	0.001%	-0.003	-5%	0.03	169%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	1	0.2	0.2	0.002%	-0.003	-2%	-0.41	-67%	D	D
Latvia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Lithuania	0.05	0.06	0.06	0.001%	-0.004	-6%	0.01	15%	T1	D
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Poland	42	161	179	2%	17	11%	137	329%	T2	CS,D
Romania	769	412	387	4%	-25	-6%	-383	-50%	T1	D
Slovakia	0.0012	0.0007	0.0007	0.00001%	-0.00002	-3%	-0.0004	-39%	T1	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**9 012**	**10 471**	**10 156**	**100%**	**-316**	**-3%**	**1 144**	**13%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.53 1B2b Fugitive CH_4 emissions from natural gas: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	25 547	16 949	17 175	57%	226	1%	-8 371	-33%		
Bulgaria	787	662	613	2%	-48	-7%	-174	-22%	T1	D
Croatia	1 162	1 388	1 200	4%	-188	-14%	39	3%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	878	655	528	2%	-128	-20%	-350	-40%	T1,T2	CS
Estonia	178	74	77	0.3%	3	4%	-101	-57%	T1	D
Hungary	908	1 526	1 485	5%	-41	-3%	577	64%	D	OTH
Latvia	193	38	56	0.2%	18	48%	-138	-71%	T2	PS
Lithuania	139	244	246	1%	1	1%	106	76%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3 076	4 444	4 691	16%	247	6%	1 615	52%	T2	CS
Romania	7 088	3 409	3 141	11%	-268	-8%	-3 947	-56%	T1	D
Slovakia	448	660	662	2%	2	0.3%	214	48%	T1	CS
Slovenia	43	21	22	0.1%	0.65	3%	-21	-49%	T1,T3	CS,D
EU-28	**40 446**	**30 070**	**29 895**	**100%**	**-175**	**-0.6%**	**-10 551**	**-26%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.54 1B2c Fugitive CO_2 emissions from venting and flaring: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	7 015	5 702	5 522	93%	-181	-3%	-1 494	-21%		
Bulgaria	3	20	18	0.3%	-2	-11%	15	468%	T1	D
Croatia	223	67.59	73.59	0.7%	6.00	9%	-149.19	-67%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	4	13	12	0.2%	-0.69	-5%	8	212%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	197	89	80	1%	-8	-10%	-116	-59%	D,T1	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1	9	8	0.1%	-1	-11%	7	753%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	0.002	0.01	0.01	0.0001%	0.001	10%	0.005	324%	T1	D
Romania	438	232	219	4%	-12.713	-5%	-218.405	-50%	T1	D
Slovakia	0.02	0.02	0.02	0.0004%	0.003	18%	0.007	43%	T1	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**7 880**	**6 132**	**5 933**	**100%**	**-200**	**-3%**	**-1 948**	**-25%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.3 Reference approach (new Member States)

Table 18.55 Comparison between Eurostat and national reference approach for fuel combustion for the new MS for 2012 (CRF 1.A) (83);

MS	Gaseous fuels			Liquid fuels			Solid fuels		
	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %
BG	102,625	102,637	0.01%	152,345	160,524	5.4%	290,206	290,173	0.0%
CY	- -	- -	- -	88,303	89,113	0.9%	5	12	138.0%
CZ	287,051	287,051	0.0%	357,040	350,596	-1.8%	700,843	719,660	2.7%
EE	22,835	22,109	-3.2%	19,883	21,227	6.8%	158,984	159,794	0.5%
HR	101,038	101,780	0.7%	133,475	132,341	-0.8%	26,407	26,341	-0.2%
HU	347,753	347,753	0.0%	240,474	243,980	1.5%	112,591	112,252	-0.3%
LT	111,119	111,132	0.01%	100,485	102,565	2.1%	8,859	10,144	14.5%
LV	50,709	50,812	0.2%	52,867	52,902	0.1%	3,848	3,839	-0.2%
MT	- -	- -	- -	33,293	35,781	7.5%	- -	- -	- -
PL	569,447	569,447	0.0%	997,843	997,467	0.0%	2,103,471	2,138,137	1.6%
RO	452,715	452,715	0.0%	358,289	345,739	-3.5%	318,343	316,632	-0.5%
SI	29,730	29,735	0.02%	103,025	105,257	2.2%	58,226	57,743	-0.8%
SK	182,767	182,796	0.0%	125,910	134,462	6.8%	145,517	146,657	0.8%

([83]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

19 INDUSTRIAL PROCESSES (CRF SECTOR 2)

19.1 Overview of sector (EU-28)

CRF Sector 2 Industrial Processes is the third largest sector contributing 7 % to total EU-28 GHG emissions in 2012. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs (2 %) and N_2O (0.3 %). The emissions from this sector decreased by 31 % from 462 Tg in 1990 to 321 Tg in 2012 (Figure 19.1). In 2012, the emissions decreased by 3 % compared to 2011. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from Eastern European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in HCFC production. The large decrease in 2009 mainly occurred in cement production and iron and steel production.

Figure 19.1 CRF Sector 2 Industrial Processes: EU-28 GHG emissions for 1990–2012 in CO_2 equivalents (Tg)

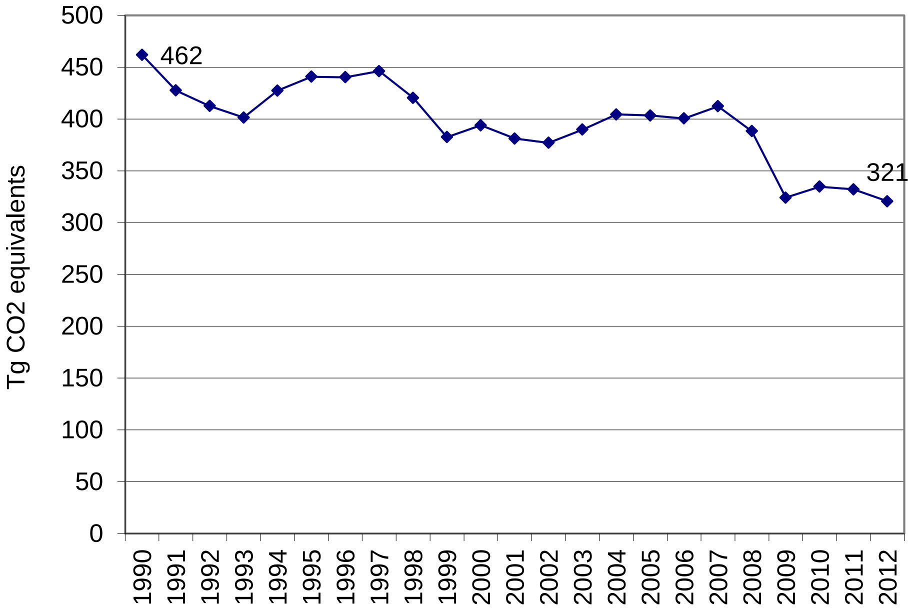
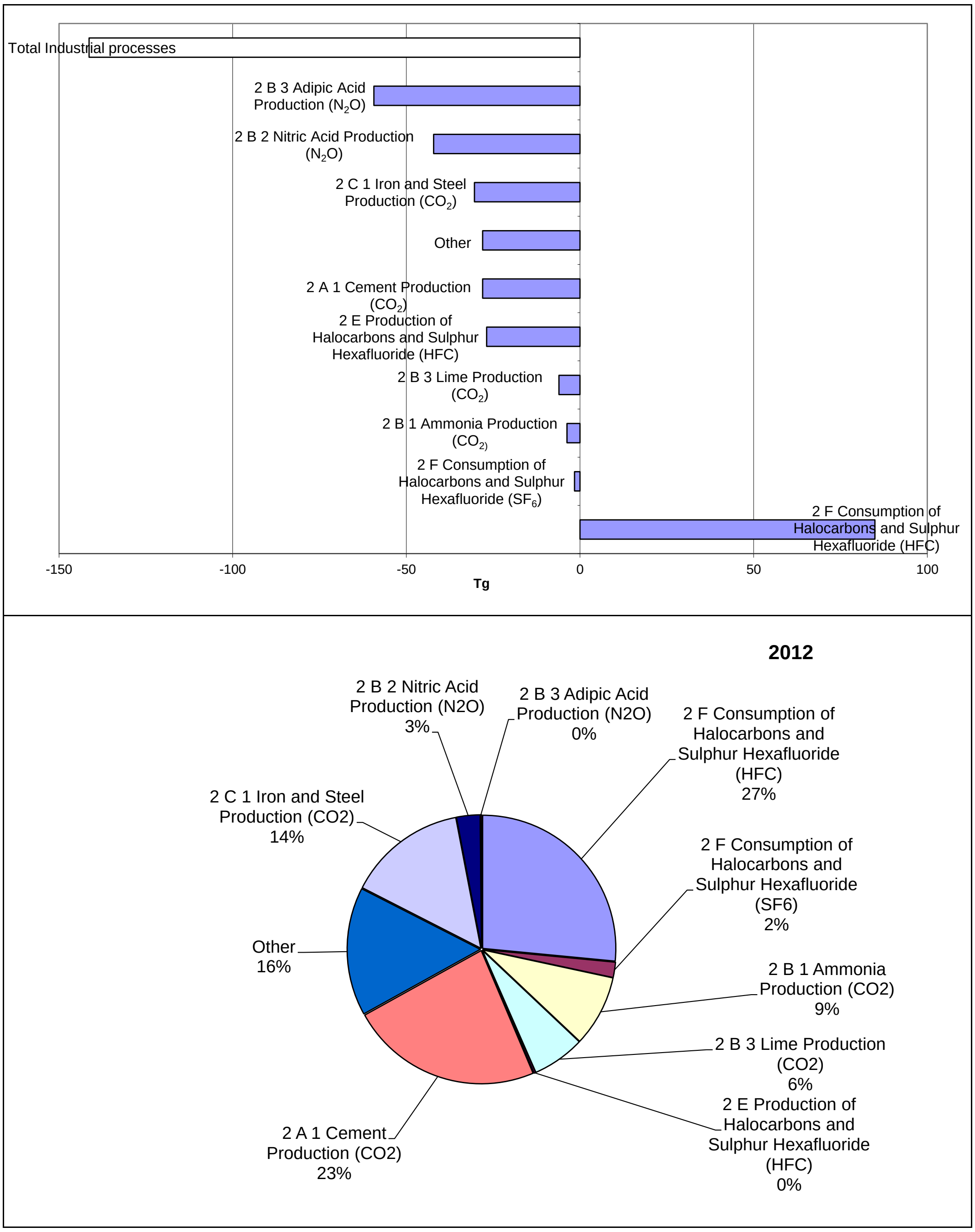


Figure 19.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in nitric acid production (N_2O) and iron and steel production (CO_2). Additional emission reductions were achieved in cement production (CO_2), production of halocarbons and SF_6 (HFCs), lime production (CO_2) and ammonia production (CO_2). Large HFC emission increases can be observed from consumption of halocarbons and SF_6. The contribution of the new Member States to a possible change of the share in total process-related GHG emissions is small; again the three largest key sources account for about two thirds of total process-related GHG emissions in the EU-28 (Figure 19.2).

Figure 19.2 CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2012 in CO_2 equivalents (Tg) and share of largest key source categories in 2012



19.2 Source categories (EU-28)

19.2.1 Mineral products (CRF Source Category 2A) (EU-28)

The source category 2A Mineral Products includes three key sources: CO_2 from 2A1 Cement Production, CO_2 from 2A2 Lime Production and CO_2 from 2A3 Limestone and Dolomite Use. In source category 2A1 Cement Production by-product CO_2 emissions in cement production are reported that occur during the production of clinker, an intermediate component in the cement manufacturing process. Source category 2A2 Lime Production accounts for CO_2 emitted through the calcination of the calcium carbonate in limestone or dolomite for lime production. Source category 2A3 Limestone and Dolomite Use covers a number of industrial applications generating CO_2 through the heating of limestone or dolomite, such as in metallurgy (iron and steel), glass manufacture, agriculture, construction or environmental pollution control.

19.2.1.1 2A1 Cement Production

In 2012, CO_2 emissions from 2A1 Cement production were 27 % below 1990 levels in the EU-28; for the EU-15 the decrease of CO_2 emissions from Cement production was 28 % in the period 1990 to 2012. CO_2 emissions decreased by 6 % from 2011 to 2012 in both the EU15 and the EU-28. In the period 2011-2012, Bulgaria, Hungary, Latvia, Lithuania, Romania and Slovenia increased emissions from cement production, while the in other new Member States emissions from this category decreased.

Table 19.1 provides information on emission trends of the key source CO_2 from 2A1 Cement Production for EU-13. In 2012 Poland and Romania were the largest contributors to this category among new Member States, respectively contributing an 9% and 4% share of EU-28 emissions.

Table 19.1 2A1 Cement production: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	80 294	61 581	57 743	77%	-3 838	-6%	-22 552	-28%		
Bulgaria	2 100	791	998	1%	207	26%	-1 103	-52%	T2	PS
Croatia	1 086	1 050	999	1%	-51	-5%	-87	-8%	T2	CS
Cyprus	697	546	505	1%	-42	-8%	-192	-28%	T1	D
Czech Republic	2 489	1 665	1 517	2%	-148	-9%	-972	-39%	T3	PS
Estonia	483	416	407	1%	-9	-2%	-76	-16%	T2	PS
Hungary	1 797	564	678	1%	115	20%	-1 119	-62%	T2	PS
Latvia	366	559	577	1%	18	3%	211	57%	T2	PS
Lithuania	1 668	320	395	1%	75	24%	-1 273	-76%	T2	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	5 453	7 379	6 384	9%	-995	-13%	931	17%	T2,T3	CS
Romania	4 445	3 089	3 150	4%	61	2%	-1 295	-29%	CS,T2	PS
Slovakia	1 438	1 239	1 079	1%	-160	-13%	-359	-25%	T2	PS
Slovenia	482	316	326	0.4%	10	3%	-156	-32%	T2	CS
EU-28	**102 800**	**79 514**	**74 758**	**100%**	**-4 756**	**-6%**	**-28 042**	**-27%**		

Bulgaria, Hungary, Lithuania and Romania had large reductions in absolute terms between 1990 and 2012. Of these, the largest drop occurred in Romanian where the production of clinker decreased by 39 %. In the early nineties a significant decrease in Lithuanian emissions (-95 % during 1990 and 1993) was caused by a decrease of the production rate of clinker due to economic changes.

The large drop in emissions in Bulgaria between 1990 and 2012 was caused by a significant reduction of clinker production of about -75 % in one of the plants, more than -50 % in other two plants and around -20% in the last two plants. Conversely, Bulgaria has seen an increase of the total emission in the sector in 2012 compared to 2011 with increased production in three out of four plants.

Table 19.2 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement production in the new Member States for 1990 and 2012. The table shows that all

EU-13 MS use clinker production as activity data for calculating CO_2 emissions and it also suggests that 97 % of EU-13 emissions are estimated with higher Tier methods.

The EU-28 IEF (excluding UK, as the British activity data is confidential and thus no IEF is provided) in 2012 is 0.53 t CO_2/t of clinker produced. The implied emission factors per tonne of clinker produced range between 0.51 t CO_2/t for Latvia and Hungary to 0.54 t CO_2/t for Bulgaria, Estonia, Poland, Romania and Slovenia. All new MS use country-specific and plant-specific emission factors. No significant changes of IEFs during 1990 and 2012 could be observed for any MS. In Hungary the IEF decreased from 0.56 t/t in 1990 to 0.51 t/t in 2012. Explanations for changes of the implied emission factors are given in the following overview:

Implied Emission Factor, Hungary

The decrease of the IEF from 2004 reflects changes in reported carbon content of the raw flour. Both the composition of raw flour and the clinker/raw flour proportion might be influenced by special additives, therefore this issue needs further investigation.

Table 19.2 2A1 Cement Production: Information on methods applied and emission factors for CO_2 emissions

			1990				2012			
Member State	Method applied	Emission factor	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
			Description	(kt)			Description	(kt)		
EU15			EU15 w/o UK (91%)	136839	0.53	72999	EU15	109496	0.53	57743
Bulgaria	T2	PS	Clinker production	3987	0.53	2100	Clinker production	1839	0.54	998
Croatia	T2	CS	Clinker production	2062	0.53	1086	Clinker production	1996	0.50	999
Cyprus	T1	D	Clinker production	1249	0.56	697	Clinker production	953	0.53	505
Czech Republic	T3	PS	Clinker production	4726	0.53	2489	Clinker production	2838	0.53	1517
Estonia	T2	PS	Clinker production	910	0.53	483	Clinker production	754	0.54	407
Hungary	T2	PS	Clinker production	3210	0.56	1797	Clinker production	1333	0.51	678
Lithuania	T2	PS	Clinker production	3058	0.55	1668	Clinker production	730	0.54	395
Latvia	T2	PS	Clinker production	669	0.55	366	Clinker production	1129	0.51	577
Malta	NA	NA		NO	NO	NO		NO	NO	NO
Poland	T2,T3	CS	Clinker production	10309	0.53	5453	Clinker production	11807	0.54	6384
Romania	CS,T2	PS	Clinker production	8379	0.53	4445	Clinker production	5874	0.54	3150
Slovenia	T2	CS	Clinker production	891	0.54	482	Clinker production	605	0.54	326
Slovakia	T2	PS	Clinker production	2836	0.51	1438	Clinker production	2126	0.51	1079
EU28			**EU28 w/o UK (93%)**	**179 125**	**0.53**	**95 505**	**EU28 w/o UK (95%)**	**141 481**	**0.53**	**74 758**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.3 summarizes the methodological information for cement production provided by EU-13 Member States in their national inventory reports. Ten of the new Member States use data collected from plants under the EU emission trading scheme.

Table 19.3 2A1 Cement Production: Summary of methodological information provided by Member States

Cement Production	
Member State	**Methodology overview**
Bulgaria	The GHG emissions from the sector are calculated by using clinker production data and a country specific method, similar to a Tier 2 Method according to item 3.1.1 from the IPCC GPG. The aggregated national clinker production data in t/y are provided by the National Statistical Institute (NSI). The assumption for the CKD Correction Factor is based on the modern status of all 5 operational cement plants and the total (100%) recycling of their CKD as a raw material. The calculations are based on the conservative assumption that all of the lime comes from a carbonate sources

Cement Production	
Member State	**Methodology overview**
	(limestone - $CaCO_3$ and $MgCO_3$) and assumes 100% calcinations of the carbonate sources present in the raw materials mixture. The 2012 CO_2 emissions are taken from the operators EU ETS reports. In their reports $CaCO_3$, $MgCO_3$ and other carbonates content in the raw materials used are taken into account. The aggregated national clinker production data provided by the NSI and plants cover the period from 1988 to 2012. [NIR 2014]
Croatia	Estimation of CO_2 emissions is accomplished by applying an emission factor, in tonnes of CO_2 released per tonne of clinker produced, to the annual clinker output corrected with the fraction of clinker that is lost from the kiln in the form of Cement Kiln Dust (CKD), (Tier 2 method, Good Practice Guidance). Country-specific emission factor for Portland and Aluminate cement was estimated by using data on CaO and MgO content of clinker produced from individual plants. CO_2 from Cement Kiln Dust (CKD) leaving the kiln system was calculated using the default CFckd (2 percent of the CO_2 calculated for the clinker) due to the absence of plant-specific data for the whole time series. The activity data for clinker production, data on the CaO and MgO content of the clinker, information on the CKD collection and recycling practices and likewise on the calcination fraction of the CKD were collected by a direct survey of cement manufacturers. The data were cross-checked with cement production data from Annual PRODCOM results published by Central Bureau of Statistics, Department of Manufacturing and Mining. [NIR 2014]
Cyprus	Data for clinker production was obtained from the installations that operate in Cyprus (2 installations 1990-2011, one installation 2011-2012). Data was compared to the data reported by the statistical service and the data used by the department of Labour Inspection for the preparation of air pollutants inventories under Directive 2001/81/EC. The emission factor of 0.558 tCO_2/t clinker was used, which is the implied emission factor estimated from the CO_2 process emissions reported by the two cement producing installations for the 2005 according to the ETS national law. The CO_2 emissions for the years 2005-2012 were use as reported by the installations for ETS purposes. [NIR 2014]
Czech Republic	Since 2006 submission methodology equal to the Tier 3 has been employed. CO_2 emissions are based on data submitted by the cement kiln operators for preparation and standard operation of the EU ETS system, which includes all the cement kilns in Czech Republic. Information from individual kilns is reported to the competent authority. This data covers years 1990, 1996, 1998 - 2002 and 2005 - until most recent submission. For these years, the emission factor value was derived from individual installation data collected for EU ETS (emissions) and from CCA data (activity data about production of clinker). For other years the EFs were interpolated. The content of calcium/magnesium oxide (CaO/MgO) and composition of the limestone and dolomite are measured and independently verified. These parameters are used for calculation of the CO_2 emissions and, therefore, substantial attention is devoted to their determination. For other years the EFs were interpolated. All operating cement plants in the Czech Republic are equipped with dust control technology and the dust is then recycled to the kiln. Only in one cement plant is a small part of the CKD discarded, for technical reasons. Use of dolomite or amount of magnesium carbonate in the raw material, as well as fissile carbon (C) content is known, all above mentioned variables are used for emissions estimates in the EU ETS system. Data on cement clinker production is published by the Czech Cement Association (CCA) (CCA, 2012), which associates all Czech cement producers. Clinker production data together with interpolated EF was used for years without direct data from cement kiln operators. IEF, which is calculated based on CO_2 emissions and clinker production, varies from 0.527

Cement Production	
Member State	Methodology overview
	to 0.553 t CO_2 / t clinker. [NIR 2014]
Estonia	Emissions from cement production were calculated using Tier 2 methodology. Emission factors used in calculating the emissions from cement production are plant-specific provided by the industry. In calculating the emissions from cement production the amount of clinker produced annually is used as activity data. The clinker production data was received directly from the plant - AS Kunda Nordic Cement – throughout the time series. Emission factors from cement production are based on the actual CaO and MgO contents of clinker. Cement kiln dust and by pass dust as well as the amounts of CaO and MgO that are already calcinated before the process (and therefore do not cause emissions) are taken into account at plant. CKD correction factors were calculated by dividing the total CO_2 process emissions (emissions from clinker production and cement kiln dust, but not emissions from the biological substance) with CO_2 emissions from the clinker production. The total CO_2 emissions from process and emissions from clinker production and cement kiln dust were provided by the plant for all of the years. Each year has a different CKD correction factor due to different amounts of cement kiln dust (calcination rate of CKD and CaO content of the clinker). [NIR 2014]
Hungary	According to the ETS introduced by the European Union from 2005 on, the factories report their CO_2 emission. This value is calculated on the basis of the derivatographic analysis of carbonate, which contains also CO_2 generated from the MgCO3 content of limestone. All these increase the accuracy of emission-determination. The reported quantities of CO_2 emitted between 2005 and 2012 are based on reports of the factories. This is in fact the same emission estimation methodology at plant level as before at country level, because for the preceding years, also raw material consumption was used for emission calculation (kiln input based method and the permanent stoichiometric ratios detailed above) instead of cement or clinker production. This is more accurate because cement factories have always measured the amount and composition of the raw flour. In 2000, production at one site was abandoned therefore previous production data of this factory were obtained directly from the Cement Industry Association that supplied only clinker data and the ratio of calcium-oxide to clinker. [NIR 2014]
Latvia	Tier1 method from IPCC GPG 2000 was used to estimate clinker production data from final cement production amount when clinker / cement ratio for different types of cement is known. For CO_2 emission factor as well as emission estimations IPCC GPG 2000 Tier2 method is used. The CO_2 emission factor is calculated for all years of the time series 1990–2012 according to CaO content in used limestone that is measured in laboratory of cement production facility. LEGMC is able to use all laboratory measurements data from cement production plant even if it is not accredited and certified as requested in EU ETS MRG so CaO content in limestone is available to estimate CO_2 emission factor for clinker. These emission factors will correspond to Tier2 emission factor estimations from IPCC GPG 2000 as CO_2 emissions from Cement Production sector. For year 1996–2005 average CaO content data of years 1995 and 2006 was used in emissions calculation since data for average CaO content in produced clinker for years 1996–2003 was not available in cement production plant. Also information from plant that average CaO content of years where data is available could be used was received. For Submission 2014 the CaO content data for 2012 was requested to cement production plant. CO_2 emission factor for 2012 was used according to information on CaO content in produced clinker provided by plant. [NIR 2014]

Cement Production	
Member State	**Methodology overview**
Lithuania	Cement is produced in a single company UAB “Akmenes Cementas”. For the period 1990-2004 CO_2 emissions were calculated by a Tier 2 method using specific production data provided by the production company. CO_2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO_2. Actual CO_2 emissions were calculated from the clinker production data and composition. In addition it was assumed that CO_2 was released from calcinated fraction of kiln dust. The data on generation of cement kiln dust (CKD) (fraction not recycled to the kiln) were provided only for 2005-2010. An average value was used for the period when specific data were not available. According to the UAB “Akmenes Cementas”, only about 5% of the CKD is calcinated. For the period 2005-2012 CO_2 emission data have been accessed via the verified EU ETS reports of the production plant using plant specific data on production of clinker and CKD, and plant specific emission factors (t CO_2/ t clinker, t CO_2/ t CKD). [NIR 2014]
Malta	This sector does not occur in Malta. [NIR 2014]
Poland	CO_2 emission from clinker production is the sum of the process emissions given in the verified reports for 2005- 2012 for installation of clinker production, which participate in the EU ETS. For other years emissions were estimated based on clinker production and country specific emission factors. [NIR 2014]
Romania	The method for calculating emissions of CO_2 from cement is in line with the IPCC GPG 2000 (Tier 2). The AD necessary to estimate emissions from this source category are provided by economic agents (clinker production data) and National Institute for Statistics (cement production). Activity data related to the calcinations process were collected directly from the companies: - clinker production data was provided by each company 1989-2012 period; - plant specific content of CaO (%) in clinker was provided by each company (according with laboratory analyses) starting with 2008 year; - plant specific content of MgO (%) in clinker was provided by each company (according with laboratory analyses) starting with 2008 year; - cement kiln dust (CKD) is completely recycled in the kiln. Two plants reported a correction factor for discarded amounts of dust: one of them for the period 1989-2003 and other plant for 2006 year. Starting with 2008 emissions resulted from discarded cement kiln dust were calculated separately taking into account its degree of calcinations and added to the CO_2 emissions resulted from calcinations (the production of clinker). The value of correction factor for discarded amounts of dust is 1. Emissions were calculated distinctly, for every plant; the activity and, respectively, emissions data were added and reported for the entire subsector. Starting with 2008 the figures related with clinker production, plant specific CO_2 EF for clinker production and CO_2 emissions from clinker production were compared with the data reported in monitoring plans associated with GHG emissions for the EU-ETS cement production installations. [NIR 2014]
Slovak Republic	On the basis of the information provided into the verified ETS reports, Tier 2 methodology according to the IPCC 2000 Good Practice Guidance has been applied since 2002 based on plant specific information. The calculations provided by the cement clinker producers in the ETS reports balanced CO_2 emissions on the basis of cement clinker production and CaO and MgO contents. Plant specific emission factors are used from 2002. The annual estimation of overall EF is expressed as weighted average and is based on the specific content of CaO in cement clinker in each producer and varies over the years. The content varies from 64.58% to 67.40% according to the plant specifications with the value of weighted average 65.25% in 2012. The content of MgO in cement clinker varies from zero to 4.32% with the weighted average of 1.86% in 2012. The implied CO_2 emission factor is 0.5073 t CO_2/t of cement clinker in 2012.

Cement Production	
Member State	**Methodology overview**
	Correction factors are related to the amount of non-carbonate origin of CaO and MgO (ground granulated blast-furnace slag). The correction factor includes also the CKD factor. All producers have modern technology with complete capturing of dust. [NIR 2014]
Slovenia	The Tier 2 method has been applied. Activity data are data on the annual production of clinker. Clinker production data were obtained from the Statistical Office of the Republic of Slovenia for the period 1986–1998, and directly from the two plants that produce cement for the years 1999–2012. For national allocation plan purposes linked to emissions trading system more detailed data were obtained from 1999 onwards. Data on fraction of CaO and MgO in clinker from both cement works for the period 1999–2004 enabled us to determine our own emission factor. The average EF for the period 1999–2004 is 541 kg CO_2/t of clinker. As the location of quarries is the same as in the base year, we have applied this emission factor for calculating emissions from the base year 1986 to 1998. For calculating emissions for the years 1999–2004 we have used year-specific EFs. For the period 2005–2012 we have obtained plants data on CaO and MgO composition of clinker and EFs from verified ETS reports. Country specific EFs from these reports have been used to calculate CO_2 emissions using IPCC methodology. EFs from both before and after 2005 based on plant specific production conditions. There are two producers of cement in Slovenia and the data for both periods were obtained from these two cement works. The same sources of raw material and methodology were used for calculation both before and after 2005 EFs. Detailed data on EFs is presented in Table 4.1.1. Inter-annual variations of EFs are due to different annual ratio of CaO and MgO in clinker. Cement kiln dust (CKD) is not accounted in emission calculation as in both cement factories CKD is returned into the process. [NIR 2014]

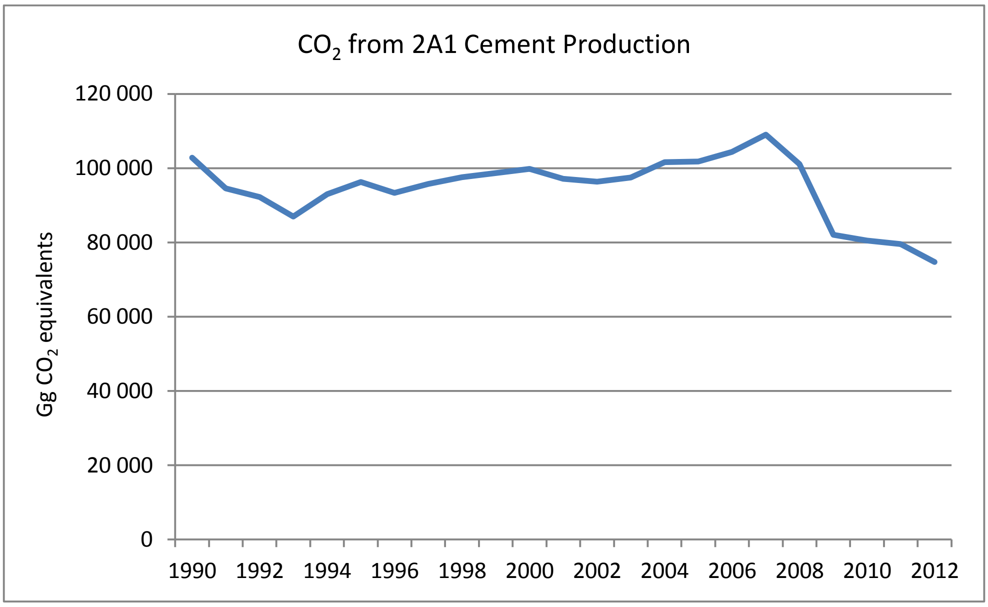
Source: NIR 2014.

19.2.1.2 2A2 Lime Production

CO_2 emissions from 2A2 Lime Production account for 0.4 % of EU-28 total GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from this source decreased by 23 % in the EU-28 (Table 19.4).

In 2012, Poland and Romania were the largest emitters accounting for 7 % and 6 % of EU-28 emissions respectively. It is also the case that the decrease of CO_2 emissions between 1990 and 2012 was mainly due to decreased production of lime and dolomite in these two countries. Emissions fell in Romania by 46 % and in Poland by 44 %.

Figure 19.3 2A2 Lime Production: EU-28 CO_2 emissions



While CO_2 emissions from lime production between 1990 and 2012 decreased in all new Member States (Table 19.4). Croatia, Estonia and Romania saw small increases between 2011 and 2012. The extreme percentage change for Latvia between 2011 and 2012 reflects small changes on a very small base. The table shows that about 36 % of EU-13 CO_2 emissions from 2A2 Lime Production are estimated with higher Tier methods.

Table 19.4 2A2 Lime Production: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	17 207	15 806	15 075	74%	-731	-5%	-2 133	-12%		
Bulgaria	1 035	1 037	1 000	5%	-37	-4%	-36	-3%	T2	D
Croatia	153	102	114	1%	12	12%	-39	-26%	T2	CS
Cyprus	6	8	4	0.02%	-4	-53%	-2	-36%	D	D
Czech Republic	1 337	691	609	3%	-83	-12%	-728	-54%	T1	CS
Estonia	131	23	49	0%	26	111%	-83	-63%	T1	PS
Hungary	614	170	140	1%	-30	-18%	-474	-77%	T2	PS
Latvia	8	0.001	0.4	0.002%	0.4	31239%	-8	-95%	T1	D
Lithuania	218	39	36	0.2%	-2	-6%	-182	-83%	T2	D
Malta	1	NO	NO	-	-	-	-1	-	NA	NA
Poland	2 453	1 561	1 379	7%	-182	-12%	-1 074	-44%	T1	D
Romania	2 389	1 260	1 281	6%	21	2%	-1 108	-46%	D	D
Slovakia	770	738	713	3%	-25	-3%	-58	-7%	T2	PS
Slovenia	206	91	74	0.4%	-17	-18%	-132	-64%	D	CS
EU-28	**26 530**	**21 526**	**20 473**	**100%**	**-1 053**	**-5%**	**-6 057**	**-23%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.5 summarises the methodological information for lime production provided by EU-13 Member States in their national inventory reports. Bulgaria, Latvia, Lithuania, the Slovak Republic and Slovenia have each included an explicit reference to the use of plant-specific data under the EU ETS.

Table 19.5 2A2 Lime Production: Summary of methodological information provided by Member States

Lime Production new MS	
Member State	**Methodology overview**
Bulgaria	There are 5 lime producing plants in Bulgaria which fall under IPPC and EU ETS. The emissions from the sector are calculated using country specific data on the total amount of lime produced provided by NSI. Default emission factor is applied. An approach in line with Tier 2 method (2006 IPCC Guidelines, p.2.19) is used to estimate CO_2 emissions from lime production. The emissions are estimated following the general approach recommended in 1996 IPCC Guidelines and using the following equation from 2000 GPG (p.3.19). Country specific data on the total lime production (quicklime) are provided by NSI. Emission factors take into account the CaO and MgO content of the lime produced. [NIR 2014]
Croatia	the annual lime output. The emission factors were derived on the basis of calcination reaction depending on the type of raw material used in the process. Country-specific emission factor for quicklime was estimated by using data on CaO content of the lime and stoichiometric ratio between CO_2 and CaO from individual plants. Country-specific emission factor for dolomitic lime was estimated by using data on CaO*MgO content of the lime and stoichiometric ratio between CO_2 and CaO*MgO from one plant. Vertical shaft kilns, which are mostly used, generate relatively small amounts of Lime Kiln Dust (LKD). It is judged that a correction factor for LKD from vertical shaft kilns would be negligible and do not need to be estimated. The data for quicklime and dolomitic lime production, data on the CaO and CaO*MgO content of the lime and stoichiometric ratio between CO_2 and CaO and CaO*MgO were collected by survey of lime and sugar manufacturers. The data were cross-checked with Annual PRODCOM results published by Central Bureau of Statistics, Department of Manufacturing and Mining. [NIR 2014]
Cyprus	The activity data for lime production was obtained from the one installation in Cyprus that produces slaked lime. The emission factor chosen was the one for high calcium quicklime according to the GPG (pg. 3.20), 0.785 t CO_2/t quicklime [NIR 2014]
Czech Republic	Emissions from lime production were calculated in accordance with 2000 GPG. Only CO_2 emissions generated in the process of the calcination step of lime treatment are considered under category 2A2. CO_2 emissions from combustion processes (heating of kilns and furnaces) are reported under category 1A2f. National EF reflects the production of lime and quick lime (0.7884 t CO_2 / t lime) (Vácha, 2004). Furthermore, it is taken into account the average purity (93%) (Vácha, 2004) of lime produced in Czech Republic. Activity data are based on statistics from the Czech Lime Association, which publishes data on pure lime production, so that these data were considered to be more accurate in comparison with data from the Czech Statistical Office, which do not differentiate between lime and hydrated lime. [NIR 2014]

Lime Production new MS	
Member State	**Methodology overview**
Estonia	Activity data are collected mainly directly from the industry but in the earlier years (1990–1996) industrial statistics have also been used. Emission factors are calculated by the industry or are based on IPCC's default factors. The methods for calculating emissions from lime production are consistent with the IPCC Tier 1 level method. There are three different emission factors used to calculate emissions from lime production. Two emission factors are received directly from the plants, based on the actual CaO and MgO contents. From Limex AS emission factor has been available since 1994 (production in Limex AS started in 1994). From Nordkalk AS emission factor based on actual CaO and MgO content has been available since 2005. As this emission factor differs strongly from default emission factor, emission factors for 1990–2004 are established as a mean value from emission factors in 2005–2008. Third emission factor used is IPCC default value for quicklime. This value is applied to those companies that were closed before 1996, as no better data is available. Activity data for lime production is collected mainly directly from the industry and taken partly from industrial statistics (1990–1996). Since 1997 there have been two lime producing plants in Estonia and therefore activity data is collected directly from the industry (1997–2012). From 1990–1996 there were more producing plants and therefore industrial statistics have also been used. From 1990–1996 activity data is collected on one hand directly from plants producing lime nowadays, on the other hand industrial statistics have been used to calculate emissions from plants closed during 1990–1996. [NIR 2014]
Hungary	The amount of CO_2 generated by this sub-sector was calculated according to the method recommended by the Revised IPCC Guidelines. The emissions were calculated using the production data received from the manufacturers and the proper stoichiometric ratio (0.785). The IEF of years between 2005 and 2012 do not show a clear trend therefore the average seems to be applicable for extrapolation for the years before 2005 in order to reach consistent time series. The corresponding stoichiometric ratio was used for slacked lime (Ca(OH)2) production data as well. [NIR 2014]
Latvia	CO_2 emissions from lime production in steel production plant are estimated with Tier1 method based on total produced quicklime data and default emission factor. Default CO_2 emission factor from IPCC GPG was used by steel production plant as per tonne of high calcium quicklime – 0.785 tCO_2/t lime. Activity data of produced lime in steel production company is taken from plant's GHG reports within ETS. [NIR 2014]

Lime Production new MS	
Member State	**Methodology overview**
Lithuania	The data on lime production were provided by the Statistics Lithuania. The data on hydrated lime production are provided by the Statistics Lithuania from 2002. Actual hydrated lime production data were used for emission calculation in 2002-2012 and it was assumed that hydrated lime production was zero in 1990 to 2001. CO_2 emission was calculated by Tier 2 method using production data provided by the Statistics Lithuania and limestone composition data provided by the AB "Naujasis Kalcitas". CO_2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO_2. For determining activity data and emissions of CO_2 within the sugar industry, the amounts of limestone for the production of quicklime are used. The quantities were obtained directly from the sugar producing companies for the years 1990-2012. According to the producers the used limestone consists to 97% of $CaCO_3$. In the production of sugar, lime is used for purification of the juice. Lime is added to the raw juice and some impurities are precipitated. In the carbonisation step CO_2 is bubbled through the juice and most of the remaining lime is precipitated as $CaCO_3$. The precipitated "limestone" is sold and used within agricultural activities. It is assumed that around 90% of the lime used were precipitated as $CaCO_3$ in the carbonation process. Only the part of CaO which is not recovered as $CaCO_3$ is reported as activity data. Emission data for years 2009-2012 have been verified with EU ETS data. [NIR 2014]
Malta	Lime production was commonplace in Malta in the past. Nowadays the industry has stopped operating and any lime used in Malta is imported. The activity data utilised (quantity of lime produced) was compiled by Gauci from data provided by the National Office of Statistics. The CO_2 emissions from this activity during the period 1995-1998 have been reported. For the years 1990 till 1994 no emissions have been reported, since at the time only two lime production plants were operational and hence the quantities of lime produced were confidential data and were not available at the National Statistics Office. The 2006 IPCC Guidelines [3] provide two default emission factors. The Lime produced in Malta can be classified as high Calcium lime, thus an emission factor of 0.75 [ton CO_2 per ton lime] is used. Production for the period 1990-1994 was obtained by back extrapolation of the production figures reported between 1995 and 1997, thus producing an estimate emission from this sector in that period. [NIR 2014]
Poland	Emission of CO_2 from lime production was calculated based on data on lime production from statistical yearbooks. The applied emission factor is estimated according to IPCC recommendations [IPCC 2000]. Emission for entire period 1988-2012 was estimated based on emission factors. The same value of emission factor equal 767 kg CO_2/Mg of lime was used for all years. [NIR 2014]

Lime Production new MS	
Member State	**Methodology overview**
Romania	Total CO_2 emissions from lime production were estimated using production data and the emission factors, in line with the Good Practice Guidance - IPCC GPG 2000 Tier 1. The ADs necessary to estimate emissions from this source category (quicklime and dolomite lime) are provided by the National Statistics. Romania corrected estimates of CO_2 emissions from Lime Production through the use of revised activity data (AD) in that calculation: dolomitic lime production (calcined/sintered dolomite and agglomerated dolomite). Anteriorly emission estimation was based on AD mentioned above and on crude dolomite production. For 1989 year and for the 1998 to 2000 period there is no data information on the production of calcined/sintered dolomite and agglomerated dolomite. For these years an average percentage of dolomitic lime production excluding crude dolomite amount in total dolomitic lime production amount for years for which data on dolomitic lime production excluding crude dolomite amount is available was obtained and applied for 1989 and 1998–2000 years to total dolomitic lime production. The CO_2 EF‘s are estimated considering the Equations 3.4, 3.5A, 3.5B, from IPCC GPG 2000, page 3.20. taking into account the default values from —Table 3.4 - Basic Parameters for the Calculation of Emission Factors for Lime Production— – page 3.22 (IPCC GPG 2000). [NIR 2014]
Slovak Republic	In Table 4.7 the “hypothetic” CaO content is presented. It includes data on the CaO and MgO contents on the basis of stoichiometry. This approach is used because no distinguished data are available for the period 1900 – 2000. In that period the same content of CaO in the lime is assumed (91.2%). This value is based on the 2001 and 2002 data and applied on all the data available in the period 1990 – 2000. The average content of CaO in the lime is (91.2 ± 0.2)% in the period 1990 – 2002. Tier 2 according to the IPCC 2000 GPG has been applied since 2001 with the combination of plant specific activity data and emission factors estimated for each plant. The calculations are based on the data provided by the lime producers in questionnaires and in the ETS reports (produced lime and CaO and MgO contents). The implied emission factor of CO_2 using the data on the purity of lime is 0.765 t CO_2/t of lime. [NIR 2014]
Slovenia	CO_2 emission was calculated according to IPCC methodology. Similar to cement production, for allocation plan purposes more detailed data directly from producers for 1999 -2004 were obtained. Data on fraction of CaO and MgO in lime for the period 1999-2004 enabled us to determine our own emission factor. We have estimated country specific EF to be 749 kg CO_2/ton of lime and applied this emission factor to calculate the CO_2 emissions for 1986–1998. Emissions for the years 1999-2004 have been calculated using the year-specific EFs. The EFs for the period 2005-2012 are based on data provided from three lime plants in the scope of Greenhouse Gas Emission Trading System (verified ETS reports). [NIR 2014]

Source: NIR 2014.

19.2.1.3 2A3 Limestone and Dolomite Use

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.2 % of total EU-28 GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions in the EU-28 decreased by 15 %. The increase of emissions in five new Member States (Poland, the Czech Republic, Slovenia, Slovakia and Hungary) offset emission reductions achieved in EU-15 MS by 25 % (Table 19.6). The Czech Republic and Poland were responsible for 12 % and 10 % of the emissions from this source respectively, followed by Romania with 4 %.

Emission reductions of more than 90 % between 1990 and 2012 occurred in Romania and Latvia but due to their low share in EU-28 emissions, no significant effect on EU-28 could be observed. Due to Romanian share of 4 % in EU-28 emissions in 2012, decreases in Romania of -59 % significantly contributed to the overall reduction (highest reduction in absolute terms); the decline was due to a significant decrease of limestone and dolomite consumption. The emission decrease was due to economic crisis. In this source category, the MS include limestone and dolomite used in flue gas desulphurization in power plants which participated in EU ETS between 2005 and 2012. The remaining emissions from limestone and dolomite used arose in other subcategories where these minerals are used. Table 19.6 suggests that about 83 % of EU-13 CO_2 emissions from 2A3 Limestone and Dolomite Use are estimated with higher Tier methods for 2012 (Tier 2 and Tier 3).

Table 19.6 2A3 Limestone and Dolomite Use: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	8 059	6 075	5 581	57%	-494	-8%	-2 478	-31%		
Bulgaria	IE	IE	IE	-	-	-	-	-	NA	NA
Croatia	52	44	38	0.4%	-7	-15%	-14	-27%	T1	D
Cyprus	NA	0.1	0.1	0.001%	0.01	12%	0.1	-	D	D
Czech Republic	678	1 151	1 106	11%	-45	-4%	428	63%	CS	CS
Estonia	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	202	346	324	3%	-21	-6%	122	60%	D,T2	D
Latvia	141	5	5	0.1%	0.1	3%	-136	-96%	T2,T3	D,PS
Lithuania	4	0.1	0.1	0.001%	0.01	11%	-4	-97%	T2	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	904	1 930	1 765	18%	-165	-9%	861	-	T3	PS
Romania	1 061	399	431	4%	32	8%	-630	-59%	OTH	D
Slovakia	318	329	353	4%	24	7%	35	11%	T2	PS
Slovenia	27	165	160	2%	-5	-3%	134	503%	D	D
EU-28	**11 446**	**10 444**	**9 763**	**100%**	**-681**	**-7%**	**-1 683**	**-15%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Emissions of Bulgaria are included in 2A1, 2A2, 2A7 (glass and FGD) and 2C1

Emissions of Estonia are included in 2A1, 2A2 and 2A7

Table 19.7 summarises the methodological information for limestone and dolomite use provided by EU-13 Member States in their national inventory reports. The Czech Republic, Latvia and Poland use plant-specific data reported and verified under the EU ETS.

Table 19.7 2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States

Limestone and dolomite use new MS	
Member State	**Methodology overview**
Bulgaria	The emissions from the limestone and dolomite usage are reported under the specific production industries: 2A1 Cement Production, 2A2 Lime Production, 2A7.1 Glass Production, 2C1 Iron and Steel Production and 2A7 Other non-specified for desulphurisation. [NIR 2014]

Limestone and dolomite use new MS	
Member State	**Methodology overview**
Croatia	Emissions are calculated from annual consumption of raw material and emission factors, which are based on a ratio between CO_2 and limestone/dolomite used in a particular process. Emissions of CO_2 from the use of limestone have been estimated by using emission factor which equals 440 kg CO_2/tonne limestone. Emissions of CO_2 from the use of dolomite have been estimated by using emission factor which equals 477 kg CO_2/tonne dolomite. Emissions from the use of lithium carbonate were calculated by using emission factor which equals 596 kg CO_2/tonne carbonate7. A 100 percent purity of raw material was assumed for the purpose of calculations (Revised 1996 IPCC Guidelines). The activity data for limestone use in the production of pig iron (for the 1990 and 1991), cast iron, glass, brick and ceramics, and for the use in desulphurization were collected by a survey of manufacturers. The activity data for dolomite use in glass, brick, ceramic and refractory materials manufacture for the period 1990-1996 were extracted from Annual PRODCOM results published by Central Bureau of Statistics, Department of Manufacturing and Mining. After this period, national classification of activities did not distinguish dolomite use in abovementioned activities and because of that, AD was collected by survey of manufacturers. Some of these activities (from the period 1990-1996) were halted in the meantime. [NIR 2014]
Cyprus	Limestone in Cyprus is used only in cement and lime production - already accounted for in 2A1 and 2A2. Dolomite is used in environmental pollution control. Due to lack of other source for data, it is assumed that the consumption is equal to the annual imports. The emission factor used was the default proposed by the revised IPCC 1996 guidelines (workbook, pg. 2.7), 0.477 t CO_2/t dolomite consumed. [NIR 2014]
Czech Republic	CO_2 emissions from sulphur removal were calculated from coal consumption for electricity production, the sulphur content and the effectiveness of sulphur removal units between 1996, when the first sulphur removal units came into operation, and 2005. In 2005, these data were verified by comparison with data from the individual power plants, which were collected for EU ETS preparation and which cover the years 1999 – 2005. The EU ETS data form has been used since 2006. Emissions from limestone and dolomite use in sintering plants were new source, in 2006 submission, which was identified in the process of preparation of the EU Emission Trading Scheme. Only 2 sintering plants have existed in the CR in recent times. CO_2 emissions from this category are calculated on the basis of data from statistics (The Steel Federation, Inc. - production of agglomerate / sinter) and the EF value, which was derived from EU ETS CO_2 emission data based on the limestone and dolomite compositions and consumptions (0.08 t CO_2 / t sinter). [NIR 2014]
Estonia	CO emissions from the use of limestone are reported under CRF categories 2.A.1, 2.A.2, 2.A.7.1, 2.A.7.2a and 2.A.7.2b. CO_2 emissions from the use of dolomite are reported under CRF categories 2.A.7.2a and 2.A.7.2b. [NIR 2014]

Limestone and dolomite use new MS	
Member State	**Methodology overview**
Hungary	The emissions were calculated according to the IPCC Revised Guidelines using the correct stoichiometric ratios as emission factors (440 kg CO_2 / ton limestone and 477 kg CO_2/ ton dolomite, along with the default factor for fraction of purity of 1). Only limestone and dolomite used during various phases of iron production and limestone quantities used during flue gas desulphurization are calculated here. Activity data of the limestone and dolomite used in iron and steel industry were obtained on the basis of the data received from the manufacturers. For those years when such data were not available, the default value (250 kg dolomite/t iron mentioned in chapter 2.13.3.1 of IPCC1996 Revised Guidelines) was used. Flue gas desulphurization has been carried out in one power plant since 2002 and in another one since 2004. Activity data on the use of carbonates for SO_2 scrubbing is either reported by the operators directly to the HMS or to EU ETS competent authority (In EU ETS the operators are required to report CO_2 emission from the use of carbonate for scrubbing separately in their annual emission report). [NIR 2014]
Latvia	Limestone, dolomite and soda ash are used in glass production plants, steel production plant and lime production plants. All these plants are participants of EU ETS so the detailed information of used technologies, raw materials as well as emission factors are available as plants report their annual GHG reports to LEGMC. Under CRF 2.A.3 and CRF 2.A.4 sectors following CO_2 emission sources are reported: - limestone and dolomite use in two glass production plants and one glass fibre production plant; - limestone and dolomite use in one iron & steel production plant; - limestone use in one lime production plant; - dolomite use in one lime production plant; - limestone use in sugar production processes; - soda ash use in one glass production plant. CO_2 emissions from Limestone and Dolomite Use in Glass and Metal industry, limestone use in sugar production and Soda Ash Use in Glass Production are estimated with Tier2 method basing on plant specific activity data and default IPCC 1996 emission factors. CO_2 emissions from Lime production in two direct lime production plants are calculated basing on data of carbonates – dolomite and limestone use. Purity factor from IPCC GPG 2000 is taken into account in estimation of CO_2 emissions from dolomite use in lime production calculation. CO_2 emissions from limestone use in lime production processes are estimated with Tier2 method based on plant specific activity data and default IPCC 1996 emission factors. Tier3 method is used in CO_2 emission from dolomite use in lime production processes estimation as plant specific activity data as well as plant specific CO_2 emission factors are used in estimation. [NIR 2014]
Lithuania	CO_2 emission was calculated by Tier 2 method. Iron production data provided by Statistics Lithuania. Consumption of limestone flux in iron foundries was calculated as one tenth of iron production in accordance with the information provided by the foundries. CO_2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) used as flux was released to the atmosphere as CO_2. [NIR 2014]
Malta	Limestone is a raw material commonly found on the Maltese islands and is extensively used as a construction material. In the past, this material was also a raw material for the production of lime with relevant emissions from this sector being included under source category 2A2. No other use of limestone is reported. [NIR 2014]

Limestone and dolomite use new MS	
Member State	**Methodology overview**
Poland	Limestone and dolomite use in following processes was included in 2.A.3 subcategory: dolomite use in dead burned dolomite and calcined dolomite production, limestone and dolomite use in glass production, and limestone use as a sorbent in lime wet flue-gas desulfurization, FGD in FBB (fluid bad boiler) and other method of flue gas desulfurization. Emission from use of dolomites and limestone as fluxes in metallurgy was included in 2.1.C Iron and steel production subcategory. In case of cement and lime production, the CO_2 emission was categorized into 2.A.1 Cement production and 2.A.2 Lime production subsectors respectively, according to IPCC guidelines. [NIR 2014]
Romania	The IPCC methodology has been followed for estimating the CO_2 emissions from limestone and dolomite used. The method estimates the amount of limestone and dolomite used in the iron and steel production, pulp and paper production, sugar mills production, ceramics plants, for all time-series. The activity data were provided directly by the plants (iron and steel producers, pulp and paper producers, sugar mills producers, ceramics producers). Each agency manages all economic agents which are in its responsibility (iron and steel producers, pulp and paper producers, sugar mills producers, ceramics producers) in order to complete the needed data. The completed questionnaire has been sent to NEPA where the data are aggregated. Considering the Iron and Steel Production data there was estimated the amount of lime used for each technological process and then it was aggregated all the amount of lime used. For avoiding the double counting with Lime Production category, the total amount of lime used in the two integrated iron and steel plants, was subtracted from the total consumption of limestone provided by economic agents. The default emission factors 477 kg CO_2/tonne dolomite and 440 kg CO_2/tonne limestone are used. [NIR 2014]
Slovak Republic	In this sub-category the mass of consumed limestone in different industrial processes (iron and steel production, desulphurization of coal and ceramics) is included. The limestone used in the Slovak Republic often contains a small amount of MgCO3. Emissions are calculated on the basis of carbonates using Tier 2 method according to the IPCC 2000 GPG and the plant specific emission factors from 2004. Emission factor is based on the stoichiometry of limestone and dolomite in mixtures and it was 0.441 t per ton of used carbonates in 2012. [NIR 2014]

Limestone and dolomite use new MS	
Member State	**Methodology overview**
Slovenia	This sector comprises use of limestone and dolomite in production of iron and steel, in technology for the reduction of SO_2 emissions in the process of consumption of coal, in ceramics production, mineral wool production and production of TiO2. Consumption of limestone and dolomite in production of iron and steel produces CO_2 emissions. Primary production from ore existed only in the 1986 and 1987, after 1990 steel production is based on utilization of scrap iron and steel. Activity data on CaCO3 consumption were obtained directly from iron and steel producers. CO_2 emissions have been calculated according to IPCC methodology. Default emission factor, 440 kg CO_2/ton limestone, has been applied for the whole period. CO_2 emissions from scrubbing have been calculated from consumption of additive CaCO3 and appropriate emission factor. Activity data on CaCO3 consumption for the period 1995-2004 have been taken from the documents of Milan Vidmar Electroinstitute. Prior to 1995, there were no wet flue gas desulphurisation units installed for reducing emission of SO_2 in Slovenia. Data on CaCO3 and MgCO3 for the period 2005 onwards have been obtained from verified ETS reports. Default emission factor, 440 kg CO_2/ton limestone and 522 kg CO_2/ton magnesium carbonate, were applied for the whole period. Following the ERT recommendation limestone and dolomite use in bricks and ceramics production was additionally taken into account. Activity data on CaCO3 and MgCO3 due to limestone and dolomite use in ceramics production for the period 2005 onwards have been obtained from verified ETS reports. Default emission factor, 440 kg CO_2/ton limestone and 522 kg CO_2/ton magnesium carbonate, were applied for the whole period. Mineral wool production: Dolomite is used as raw material in mineral wool production. Activity data have been obtained from the producer of mineral wool used for insulation purposes. Default emission factor 477 kg CO_2/ton dolomite was applied for the whole period 1986-2012. Manufacture of dyes and pigments: Limestone has been used in manufacturing of TiO2 pigment for neutralization processes. Activity data on CaCO3 use for the whole period have been obtained from the producer. Default emission factor 440 kg CO_2/ton calcium carbonate has applied for the whole period. [NIR 2014]

Source: NIR 2014.

19.2.2 Chemical industry (CRF Source Category 2B) (EU-28)

CO_2 emissions from 2B1 Ammonia Production account for 0.4 % of total EU-28 GHG emissions in 2012. Between 1990 and 2012, CO_2 emissions from this source decreased by 12 %, (Table 19.8). In 2012 Poland was responsible for 15.5 % and Romania for 10 % of emissions from ammonia production in the EU-13, followed by Lithuania (8 %). Bulgaria, Hungary and Romania had large reductions in absolute terms between 1990 and 2012.

Between 2011 and 2012, the CO_2 emissions increased by 4 % in the EU-28. The largest absolute emission increases occurred in Poland. In Romania the production and related natural gas consumption increased significantly. Emission reductions mainly occurred in Czech Republic.

In Lithuania a doubling of ammonia production and natural gas consumption occurred during 2006 and 2007 due to a new production line that was put into operation by the producing company. Nevertheless, a reduced demand for the product caused by the global economic crisis led to a drop in emissions in Lithuania 2008-2010, increasing again in 2011 and stable in 2012. Table 19.8 shows that no Member States uses default methodologies for the estimation of CO_2 emissions from ammonia production and that 69 % of EU-13 emissions are estimated with higher Tier methods for 2012.

Table 19.8 2B1 Ammonia Production: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	19 101	15 322	15 952	57%	630	4%	-3 149	-16%		
Bulgaria	1 672	526	378	1%	-148	-28%	-1 294	-77%	T2	PS
Croatia	466	476	503	2%	27	6%	37	8%	T1a	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	807	553	573	2%	21	4%	-233	-29%	T1	CS
Estonia	420	NO	25	-	25	-	-395	-	T1a	PS
Hungary	1 056	544	482	2%	-62	-11%	-574	-54%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1 291	2 231	2 319	8%	88	4%	1 028	80%	T3	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	2 811	3 968	4 316	16%	348	9%	1 505	54%	T2	CS
Romania	3 438	3 020	2 728	10%	-293	-10%	-711	-21%	T1a	PS
Slovakia	465	589	502	2%	-87	-15%	37	8%	T2	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**31 528**	**27 230**	**27 779**	**100%**	**549**	**2%**	**-3 749**	**-12%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.9 summarizes the methodological information for ammonia production use provided by EU-13 Member States in their national inventory reports.

Table 19.9 2B1 Ammonia Production: Summary of methodological information provided by Member States

Ammonia Production	
Member State	**Methodology overview**
Bulgaria	As recommended in revised 1996 IPCC Guidelines plant specific data were used to estimate CO_2 emissions from ammonia production. Taking into account that good practice guidance has not yet been developed for the ammonia production (2000 IPCC GPG, p. 3.8) a higher tier method – Tier 2, is applied. Data on COF are default (1, fraction) and they are taken from Table 3.1 from 2006 IPCC Guidelines (Chapter 3, p. 3.15). All other parameter and data are plant specific. Based on plant specific data of the currently operating plants emission factors for the whole time series are estimated. An implied emission factor is used to recalculate CO_2 emissions for the rest of the ammonia producing plants. For the whole time series (where available) plant specific activity data were used. An adjustment with statistical data from NSI has been made for the periods where no activity data for all the ammonia producing plants were available. In order to avoid double counting, the quantity of gas used is subtracted from the quantity reported under energy and non-energy use in the Energy Chapter. [NIR 2014]
Croatia	Only the CO_2 emission occurring from natural gas used as feedstock has been calculated for this subsector and included in the Industrial processes sector. Emission of CO_2 from natural gas used as fuel in the process of ammonia production is calculated separately and presented in the Energy sector. CO_2 from natural gas used as feedstock has been calculated by multiplying annual consumption of natural gas used as feedstock by average annual value of carbon content of natural gas used as feedstock and molecular weight ratio between CO_2 and carbon (44/12) (Tier 1a, Revised 1996 IPCC Guidelines). Data on consumption and composition of natural gas (see Table 4.3-1) used as a feedstock were collected by survey of ammonia manufacturer. [NIR 2014]
Cyprus	Not occurring. [NIR 2014]

Ammonia Production	
Member State	**Methodology overview**
Czech Republic	Emissions are calculated from the corresponding amount of ammonia produced, using the technologically-specific emission factor 2.40 Gg CO_2 / Gg NH_3 (Markvart and Bernauer, 2005 - 2012). This emission factor was derived from the relevant technical literature - Ullman's Encyclopedia (Wiley, 2005) corresponding to the ammonia production employed in the Czech Republic, including information required for deriving the carbon dioxide emission factor: 56.25 t NH_3 are produced from 44 t of residual oil containing 84.6% C. Simple stoichiometric calculation yields the value of the emission factor EF CO_2 = 2.402 t CO_2/t NH_3. This emission factor includes the efficiency of the conversion of carbon contained in the starting material to carbon dioxide, equal to 99% (i.e. an oxidation factor of 0.99). [NIR 2014]
Estonia	Estonia uses method Tier 1a in calculating CO_2 emissions from ammonia production. Emission factors were calculated by dividing CO_2 emissions from technological process with amount of ammonia produced. As activity data is received directly from plant and emissions are calculated based on amount of natural gas used and carbon content of gas provided by industry, the emission factors for calculations of CO_2 emissions from ammonia production are plant specific throughout time series. In Estonia, ammonia production emission factors are, depending on the year, between 1.243–1.446 t CO_2/tonne NH_3 produced. The annual ammonia production figures 1990–2012 have been obtained from the production plants. [NIR 2014]
Hungary	The operators report the amount of Natural gas used as feedstock separately from the Natural gas used for combustion. The tCO_2/tNH_3 IEF value is between 1.28 and 1.76. Existing factories have invested in several modernization and energy rationalization projects in recent years, which improved environmental performance and resulted decrease of emissions/unit of ammonia produced. From 2013, the extension of scope of EU ETS to ammonia production too is an incentive for further energy rationalization. [NIR 2014]
Latvia	Ammonia production and natural gas consumption data were provided by AB Achema company. Other fuels are not used in the ammonia production process. At the production plant, the natural gas is metered at the entrance point to the ammonia production unit, the flows for heating and ammonia production process are not separately metered. The CO_2 emissions were calculated using Tier 3 method (2006 IPCC Guidelines, page 3.13) and based on the following data provided by producer: annual production of ammonia; data on natural gas consumption; calorific values (annual average) of natural gas; and, country specific emission factor. The producer has provided complete data for the whole time series on ammonia production, natural gas consumption and lower calorific values (annual average) of natural gas. CO_2 emissions were calculated from the total fuel requirements data using Tier 3 method (2006 IPCC Guidelines, page 3.13).Data on average annual lower calorific value of natural gas is provided by the producer for the whole time series. Data is calculated on the basis of reports from the natural gas supplier. Calorific value of supplied natural gas is measured twice per month at Lithuania's natural gas supplier laboratory. [NIR 2014]
Lithuania	Not occurring. [NIR 2014]
Malta	Not occurring. [NIR 2014]

Ammonia Production	
Member State	**Methodology overview**
Poland	CO_2 emissions for ammonia production are estimated based on the data on natural gas use in this process. To estimate carbon content in natural gas, the emission factor 0.525 kg C/m3 from IPCC [IPCC 1997] was used. This method was used for all years: 1988-2012. n years 1989-1990, also coke-oven gas was used for ammonia production and this fact was reflected in the inventory calculations. The coke-oven gas consumption was taken in energy units and the carbon content factor is taken from IPCC [IPCC 1997]. [NIR 2014]
Romania	The CO_2 emissions from ammonia production are estimated according to the Tier 1a methodology. According with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories - Industrial Processes, the relevant parameters used for estimation the CO_2 emissions in line with 1a method are: - The annual amount of natural gas used as feedstock in Ammonia Production process, m3/an; - Carbon content of natural gas used as feedstock in Ammonia Production process, kg carbon/m3 gas; - The conversion factor of CO_2; - CO_2 emissions. Estimates of CO_2 emissions have taken into account the data provided directly from Ammonia Production plant considering the information from the questionnaires completed by all seven ammonia produces for all-time series from 1989 onwards. [NIR 2014]
Slovak Republic	The Tier 2 methodology according to the IPCC 2000 GPG was applied to category 2B1 ammonia production and the plant specific emission factors were used. The information on ammonia production and natural gas consumption for its production was provided directly by the company. The measured values of natural gas consumption from the plant were used for CO_2 emissions estimation. The emission factor is 2.075 t CO_2 per 1 t of ammonia produced and is based on plant specific data and calculated for ammonia produced by chemical reaction. The produced quantity of ammonia was 377.30 kt in 2012. Production of ammonia decreased in 2012 by 17% in comparison with 2011. The decreasing in 2012 is only relative because the production was similar as in the period 2006 – 2009. The producer supplied the data on the consumption of natural gas for the technological part of ammonia production in 2012. [NIR 2014]
Slovenia	Not occurring. [NIR 2014]

Source: NIR 2014.

CO_2 emissions from 2B5 Other were not reported by any new MS, except for Poland that reports CO_2 emissions from ethylene production under this source category.

Table 19.9 2B5 Other: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	(%)	Gg CO2 equiv.	(%)		
EU-15	10 666	15 471	14 976	100%	-495	-3%	4 310	40%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	IE,NA	IE,NA	IE,NA	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	61	NO	NO	-	-	-	-61	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	0.09	0.17	0.14	0.001%	-0.03	-18%	0.04	47%	T1	CR
Romania	NA,NE	NA,NE,NO	NA,NE,NO	-	-	-	-	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
EU-28	**10 727**	**15 471**	**14 976**	**100%**	**-495**	**-3%**	**4 249**	**40%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B2 Nitric acid production account for 0.1 % of total EU-28 GHG emissions in 2012. Between 1990 and 2012, N_2O emissions from this source in EU-28 decreased by 82 % (Table 19.10.). In 2012 Romania was responsible for 10 % of these emissions in the EU-28, followed by Poland with 9 %).

Hungary, Romania and Poland had large reductions in absolute terms between 1990 and 2012. Between 2011 and 2012, the N_2O emissions decreased by 14 % in the EU-28. Between 2011 and 2012 large emission reductions occurred in Bulgaria, Croatia, Lithuania, Romania and Slovakia. In Lithuania nitric acid was produced by one company in the past. As part of a Joint Implementation project a secondary catalyst was installed in 2008. The secondary catalyst (on Al2O3 basis with active metal oxides CuO and ZnO) was installed underneath the platinum gauze which led to a decrease of the IEF. Plant specific N_2O emission factors based on the measurements in automated monitoring system (AMS) were used.

Hungary has significantly reduced its emissions since 2005. The implementation of a new and more advanced was started in 2005 and installed in September 2007, resulting in drastic emission reductions. The new factory applying the EnviNO$_X$ technology reached a reduction of emissions of about 95-99%. At the same time the old production lines were closed.

Table 19.10 suggests that only one new Member State uses default methodologies and that only 38 % of EU-13 N_2O emissions from 2B2 Nitric acid production are estimated with higher Tier methods.

Table 19.10 2B2 Nitric acid production: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	35 723	5 886	5 231	57%	-655	-11%	-30 492	-85%		
Bulgaria	1 714	234	131	1%	-104	-44%	-1 583	-92%	T3	PS
Croatia	785	784	679	7%	-106	-13%	-106	-14%	T1	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1 127	418	427	5%	9	2%	-699	-62%	T1	PS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	3 214	16	23	0.2%	7	43%	-3 191	-99%	T2	PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	929	885	596	7%	-289	-33%	-333	-36%	T2	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3 163	824	811	9%	-12	-1%	-2 352	-74%	T1	CS
Romania	3 460	1 210	953	10%	-257	-21%	-2 507	-72%	D	CR,D
Slovakia	1 187	421	302	3%	-119	-28%	-885	-75%	T2	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**51 302**	**10 678**	**9 153**	**100%**	**-1 525**	**-14%**	**-42 149**	**-82%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.11 summarizes the methodological information for N_2O emissions from 2B2 Nitric Acid Production provided by EU-13 Member States in their national inventory reports.

Table 19.11 2B2 Nitric acid production: Summary of methodological information provided by Member States

Nitric Acid Production	
Member State	**Methodology overview**
Bulgaria	Taking into account the recommendations of the ERT for N_2O emissions from the nitric production, plant specific data are used and a country specific emission factor was developed. Following the Decision tree for N_2O emissions from nitric acid production (IPCC GPG, p. 3.32) plant specific data on N_2O emissions and destruction were obtained. A higher tier method (referred as Tier 3 in 2006 IPCC Guidelines, Chapter 3, p. 3.21) is applied, which means that the N_2O emissions are based on real measurement data. For completing the time series additional data from NSI were also used. For the years 2000 to 2010 a plant specific emission factor was calculated on the basis measured data from plants operators. For the period 1988 – 2000 the IEF was applied, assuming that technology and abatement types are similar. A default emission factor was applied for the third plant where no information is available and which stopped working in period 1999/2000. For the 2000 to 2012 emission data from plant operators were available; for the entire time series the production data were available. Following the recommendations of 2006 IPCC GL as a good practice in order to reduce uncertainty all activity data obtained were for 100 % HNO_3. For the third plant activity data from NSI were used. [NIR 2014]
Croatia	Emissions of N_2O from nitric acid production have been calculated by multiplying annual nitric acid production by plant-specific EFs. In previous reports, the EF of 7.8 kg N_2O/tonne nitric acid was applied to the total amount of nitric acid produced. Since the production of nitric acid is being performed in two separate production units and data on production in each unit as well as data on plant-specific EF for each unit (7.5 kg N_2O/tonne nitric acid for UNIT 1 and 7.8 kg N_2O/tonne nitric acid for UNIT 2) have been obtained from the manufacturer. Data on nitric acid production, collected by survey of manufacturer were cross-checked with nitric acid production data from Annual PRODCOM results published by Central Bureau of Statistics, Department of Manufacturing and Mining. [NIR 2014]
Cyprus	Not occurring. [NIR 2014]

Nitric Acid Production	
Member State	**Methodology overview**
Czech Republic	Nitrous oxide emissions from 2B2 Nitric Acid Production are generated as a by-product in the catalytic process of oxidation of ammonia. It follows from domestic studies describing conditions prior to 2004, that the resulting emission factor depends on the technology employed: higher emission factor values are usually given for processes carried out at normal pressure, while lower values are usually given for medium-pressure processes. Two types of processes were carried out in this country before 2004, at pressures of 0.1 MPa and 0.4 MPa. The amount of nitrous oxide in the exit gases is also affected by the type of process employed to remove nitrogen oxides, NO_X (i.e. NO and NO2). In this country, the process of Selective Catalytic Reduction (SCR) is mostly used, which slightly increases the amount of N_2O, and also to a certain degree Non-Selective Catalytic Reduction (NSCR), which also removes N_2O to a considerable degree. Studies recommend the following emission factors for various types of production technology and removal processes. The emission factors for the basic process (without $DENO_X$ technology) are in accord with the principles given in the above-cited IPCC methodology. The effect of the NO_X removal technology on the emission factor for N_2O was evaluated on the basis of the balance calculations presented in studies. Collection of activity data for HNO3 production is more difficult than for cement production because of the present legislation, which complicates the releasing of statistical data on manufactured products where the number of producers is smaller than (or equal to) three. Therefore, it was necessary to obtain them by questioning all three producers in the Czech Republic. In 2006 - 2012, a mitigation unit was utilized in a more effective way. The decrease in the emission factor for 0.7 MPa technology as a result of installation of the N_2O mitigation unit and gradual improvement of the effectiveness is documented. Two high temperature N_2O decomposition catalytic systems were used in the high pressure nitric acid technology (0.7 MPa) from 2009; these systems are more efficient in comparison with the catalytic systems used in previous years. [NIR 2014]
Estonia	Not occurring. [NIR 2014]

Nitric Acid Production	
Member State	**Methodology overview**
Hungary	Measured emission data were not available for a long time. Therefore, during the first phase of the recalculation project, the default specific emission factor recommended by IPCC (6 kg N_2O/t nitric acid) was used. In 2004, an emission measurement system was installed at one of the factories and this has resulted in fundamental changes in the previously estimated values. N_2O meter is placed after the catalyst which measures emissions continuously. The regular monitoring report is based on daily average measurement data but the system is capable to provide data for shorter time period, e.g. hourly averages. The factory makes available its measured data to the inventory compiler. Therefore, on the basis of almost one year of experience with measurements, the calculated emission factors of the factories using different technologies were between 10 to 19 kg/t. For calculation of emissions of the oldest factory (established in the 1950's), which was abandoned in 1988, the highest value recommended by the Good Practice was used (19 kg N_2O/t). 14.5 kg/t was used as specific emission factor for the three other abandoned factories including the one which was abandoned in September 2007. For the combined factory, a value of 10 kg/t was used. End of 2004, selective catalytic reduction was introduced in tail-gas treatment which led to emission reductions in the following years. In the second half of 2005 a new measuring instrument was installed which might partly explain the difference between IEFs. Thus, the weighted average ranges between 10.01 and 14.51 kg/t in the time series of the years before 2007, depending on the production volume. The new factory applies the EnviNO$_X$ technology consequently a drastic reduction of emission has been reached. N_2O emission from nitric acid production was decreased by 99% between base year and 2009. [NIR 2014]
Latvia	The N_2O emissions from the nitric acid production were estimated based on the following data: Annual production of nitric acid; Data on the level of production plant (1990- 2008); Data on the level of production units (2009-2012); Production unit specific N_2O emission factors; Prior to installation of catalyst (2007-2008 monitoring campaign data); After installation of catalyst (2009 - 2012); For the years 2009-2012 production unit specific N_2O emission factors were obtained from the producer The emission factors were measured and registered in automated monitoring system (AMS) by AB Achema. Annual emissions of N_2O from nitric acid production were estimated: 1990-2008, based on extrapolated unit specific activity data and the mean value of EFs of the actually operating units; 2009-2001, based on unit-specific activity data and unit-specific EFs. 1990-2008, Production of nitric acid for each operational unit was extrapolated from the data on total annual production of nitric acid in a particular year based on information on unit-specific output (share of each production unit as percentage of the total production based on 2009-2010 data. Mean value of EFs of the actually operating production units is based on 2007-2008 measurements in automated monitoring system prior to installation of the catalyst. 2009-2012, N_2O emissions were estimated using unit specific emission factors and unit specific production data provided by the producer. In 2008 JI project for N_2O emission reduction from the nitric acid plant in AB Achema started. During the implementation of the project, substantial emission reduction was achieved as monitored in an automated monitoring system. [NIR 2014]
Lithuania	Not occurring [NIR 2014]
Malta	Not occurring [NIR 2014]

Nitric Acid Production	
Member State	**Methodology overview**
Poland	Estimation of N_2O emission from nitric acid production for 2011 was based on annual HNO3 production data. The applied country specific emission factor: 1.23 kg/Mg nitric acid was estimated based on the reports from all producers of HNO3. The N_2O emission factors for years 2005-2010 were calculated also based on mentioned reports provided by installations of nitric acid production. Decrease of the N_2O EF value from nitric acid production in 2008 and its significant drop in 2009 - 2011 are the result of the implementation of the JI projects. Activity data (i.e. HNO3 production) for estimation of nitrous oxide emissions in 2.B.2 subcategory are available for the entire period 1988-2012. [NIR 2014]
Romania	Emissions have been calculated by multiplying annual Nitric Acid Production (tons HNO3 100% by each plant) by a default emission factor, which reflects the process, in line with IPCC GPG 2000 and CORINAIR Methodology. According with the Decision Tree for N_2O Emissions from Adipic Acid and Nitric Acid Production from IPCC GPG 2000 – pg. 3.32, in order to use of a higher Tier calculation method it is need to collect the information regarding emissions and destruction data directly from plants, but the data on plant specific emissions there are not sufficiently documented and explained by operators, therefore the data emissions could not be used in this report 2013. Specific questionnaires have been sent to the local EPA in order to collect information on Nitric Acid Production from economic agents. [NIR 2014]
Slovak Republic	Total nitric acid production decreased inter-annually (2011/2012) by 7%. However, the followed N_2O emissions decreased by 22% in 2012 in comparison with 2011. The reason of that decrease is in using of technology with the second YARA catalyst. This approach resulted in N_2O emissions decrease. This new technology was in operation during whole 2011, however, there was continuing optimization of this technology in 2012. Since 2005, emissions of N_2O and NO_X are continuously monitored by the nitric acid producer. Tier 2 methodology according to the IPCC 2000 GPG was used for time series in this category with the combination of plant specific emission factors. The nitric acid is produced by two providers in Slovakia. One of them produces nitric acid by two technologies: medium-pressure and high-pressure. The N_2O emissions are directly measured during these processes. According to that information the emission factors were estimated annually, based on certified measurements in this plant. According to the measured data, the EFs are 10.332 kg N_2O per 1 t of HNO3 for medium-pressure plant and 9.02 kg N_2O per 1 t of HNO3 for high-pressure plant, respectively in 2006 and 2007. The same value was used in the previous submissions. However, after thorough survey of published data supplied by plant in 2010, the above presented emission factors are correct for medium pressure plant in 2006 and 2007, only. There was a malfunction at the cooling of the reactor. After that, the measured emission factors were 7.3; 7.6 and 7.5 kg/t in 2005, 2008 and 2009, respectively. The average value of this emission factor (7.5 kg / 1 t of HNO3) is used for medium pressure plant for the period 1990 – 2004, as well. The same value was also measured before technological change in 2010. According to the ERT recommendation, the same EF should be used also for the other producer in the Slovak Republic. The technologies used are very similar. In September 2010, one of the producers with medium pressure and high pressure plant introduced the technology with secondary YARA catalyst resulting in significant decrease of N_2O emissions. The weighted EF was 5.706 kg N_2O/t of HNO3. [NIR 2014]

Nitric Acid Production	
Member State	**Methodology overview**
Slovenia	Emissions for the period 1997-2005 have been estimated according to IPCC methodology, applying an emission factor of 5.5 kg N_2O/ton nitric acid. Data on amount of nitric acid produced have been obtained from the Statistical Office of the Republic of Slovenia. Since 2006 there is no production of nitric acid in Slovenia. No emissions of N_2O have been originated from that sector since 2006. [NIR 2014]

Source: NIR 2014.

N_2O emissions from 2B3 Adipic Acid Production were not reported by any new MS in 2012, except for Poland and Romania in 1990. Romania stopped its adipic acid production in 2001 and thus suspended this activity from 2002 onwards and Poland stopped its adipic acid production in 1994 (Table 19.12).

Table 19.12 2B3 Adipic Acid Production: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	58 927	764	529	100%	-234	-31%	-58 397	-99%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Croatia	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	372	NO	NO	-	-	-	-372	-100%	NA	NA
Romania	574	NO	NO	-	-	-	-574	-100%	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**59 872**	**764**	**529**	**100%**	**-234**	**-31%**	**-59 343**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B5 Other account for 0.05% of total EU-28 GHG emissions in 2012 and are only reported by the Czech Republic and Poland. Both MS together are responsible for 14 % of these emissions in the EU-28 and both consider N_2O emissions from the production of caprolactam under 2B5.

The increase in Czech emissions by 13 % occurred between 2005 and 2006 due to the calculation method applied. Caprolactam production data are not provided by the official Czech statistics because of confidentiality (there is only one plant in the Czech Republic). Emissions of N_2O were estimated by external experts for years 1990 to 2005 by approximating the production capacity in that time period. After consultations with the producer, the N_2O emission factor was revised, resulting in higher emissions since 2006. N_2O emissions in Poland increased steadily from 1990 to 2005 (+54 %) and decreased afterwards until 2009 and increased again from 2009 to 2012 (Table 19.13). This trend is driven by the caprolactam production in the country.

Table 19.13 2B5 Other: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	4 631	2 141	1 970	86%	-171	-8%	-2 661	-57%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	84	94	94	4%	0	0%	11	13%
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	143	241	240	10%	-1	-1%	97	68%
Romania	NA,NE	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-28	**4 858**	**2 477**	**2 304**	**100%**	**-173**	**-7%**	**-2 554**	**-53%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

19.2.3 Metal production (CRF Source Category 2C) (EU-28)

CO_2 emissions from 2.C Metal production account for approx. 1 % of the total EU-28 GHG emissions (without LULUCF) in 2012. The Czech Republic, Poland, Romania and Slovakia are responsible for 28 % of EU-28 emissions from this sector. The Czech Republic is responsible for 11 % of the overall EU-28 emissions. Most MS reported decreasing emissions in this sector.

Table 19.14 2C1 Iron and Steel Production: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	47 093	35 746	33 345	72%	-2 401	-7%	-13 748	-29%		
Bulgaria	1 283	68	50	0.1%	-18	-26%	-1 233	-96%	T2	CS
Croatia	21	29	0.3	0.0007%	-29	-99%	-21	-99%	T2	D
Cyprus	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Czech Republic	12 431	5 503	5 250	11%	-253	-5%	-7 180	-58%	T2	D
Estonia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Hungary	446	334	218	0%	-117	-35%	-228	-51%	CS,T1	CS,D
Latvia	13	0.5	2	0.004%	1	294%	-11	-85%	T2	PS
Lithuania	21	4	3	0.01%	-1	-18%	-18	-86%	T1	D
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Poland	5 384	1 625	1 693	4%	68	4%	-3 692	-69%	CS,T3	CS
Romania	6 154	2 632	2 185	5%	-447	-17%	-3 970	-65%	T2	CS,D
Slovakia	3 897	3 224	3 587	8%	362	11%	-310	-8%	T2	CS,PS
Slovenia	30	47	46	0.1%	-1	-3%	16	55%	T2	PS
EU-28	**76 773**	**49 213**	**46 379**	**100%**	**-2 834**	**-6%**	**-30 394**	**-40%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.15 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions

	1990				2012			
Member State	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Bulgaria	**Iron and steel production**		**0.30**	**1283**	**Iron and steel production**		**0.08**	**50**
	steel production - kt	2180	0.59	1283	steel production - kt	654	0.08	50
	pig iron for production of steel - kt	C	NO	NO	pig iron for production of steel - kt	NO	NO	NO
	Sinter: aglomerate - kt	2081	NO	NO	Sinter: aglomerate - kt	NO	NO	NO
	Coke: Coke at 6% wet - kt	C	NO	NO	Coke: Coke at 6% wet - kt	NO	NO	NO
	Other			NA	Other			NA
Croatia	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**		**NA,NO**	**NA,NO**
	Steel	171	0.13	21	Steel	1	0.31	0
	Pig Iron	IE	IE	IE	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other			NO
Cyprus	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**		**NA,NO**	**NA,NO**
	Steel	0	NO	NO	Steel	0	NO	NO
	Pig Iron	0	NO	NO	Pig Iron	0	NO	NO
	Sinter	0	NO	NO	Sinter	0	NO	NO
	Coke	0	NO	NO	Coke	0	NO	NO
	Other			NA	Other			NA
Czech Republic	**Iron and steel production**		**0.39**	**12431**	**Iron and steel production**		**0.32**	**5250**
	Steel	10098	1.23	12431	Steel	5164	1.02	5250
	Pig Iron	6106	IE	IE	Pig Iron	3935	IE	IE
	Sinter	8469	IE	IE	Sinter	5089	IE	IE
	Coke	7285	IE	IE	Coke	2467	IE	IE
	Other			NA	Other			NA

	1990				2012			
Member State	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)
Estonia	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**		**NA,NO**	**NA,NO**
	(Steel)	NO	NO	NO	(Steel)	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	(Coke)	NO	NO	NO	(Coke)	NO	NO	NO
	Other			NA	Other			NA
Hungary	**Iron and steel production**		**0.53**	**446**	**Iron and steel production**		**0.61**	**218**
	Steel: crude steel	2963	0.11	328	Steel: crude steel	1542	0.11	170
	Pig Iron: Pig Iron production	1697	IE	IE	Pig Iron: Pig Iron production	1228	0.02	18
	Sinter: 0	IE	IE	IE	Sinter: 0	IE	IE	IE
	Coke: Consumption	1040	2.60	118	Coke: Consumption	661	2.88	29
	Other			NA	Other			NA
Lithuania	**Iron and steel production**		**0.20**	**21**	**Iron and steel production**		**0.81**	**3**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	106	0.20	21	Pig Iron	4	0.81	3
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other			NA
Latvia	**Iron and steel production**		**0.12**	**13**	**Iron and steel production**		**0.15**	**2**
	(crude steel produced from crude iron)	109	0.12	13	(crude steel produced from crude iron)	12	0.15	2
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other			NA
Malta	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**		**NA,NO**	**NA,NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other			NA

Member State	1990				2012			
	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Poland	**Iron and steel production**		**0.26**	**5384**	**Iron and steel production**		**0.16**	**1693**
	Steel	IE	IE	IE	Steel	IE	IE	IE
	Pig Iron	8657	0.16	1427	Pig Iron	3941	0.14	556
	Sinter: production	11779	0.07	841	Sinter: production	6672	0.05	351
	Coke: production	IE	IE	IE	Coke: production	IE	IE	IE
	Other			3116	Other			786
Romania	**Iron and steel production**		**0.22**	**6154**	**Iron and steel production**		**0.30**	**2185**
	steel production (BOF and EAF)	8946	0.06	549	steel production (BOF and EAF)	3447	0.07	255
	pig iron production	5916	0.95	5605	pig iron production	1468	1.31	1930
	sinter used	11357	IE	IE	sinter used	1706	IE	IE
	coke used	2060	IE	IE	coke used	700	IE	IE
	Other			IE	Other			IE
Slovenia	**Iron and steel production**		**0.05**	**30**	**Iron and steel production**		**0.07**	**46**
	Steel produced	632	0.05	30	Steel produced	671	0.07	46
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other			NA
Slovakia	**Iron and steel production**		**0.41**	**3897**	**Iron and steel production**		**0.84**	**3587**
	Steel	3562	1.09	3879	Steel	4236	0.84	3569
	Pig Iron	3561	IE	IE	Pig Iron	NA	IE	IE
	Sinter	151	IE	IE	Sinter	48	IE	IE
	Coke	2340	IE	IE	Coke	NA	IE	IE
	Other			18	Other			18

According to the IPCC methodology, processes including auto-producers (power and heat production facilities located in iron and steel plants) should be taken into account in sub-category 1A2a, while processes including consumption of carbonaceous reducing agents, oxidation of carbon contained in pig iron or scrap and the burning of carbonaceous electrodes should be reported in sub-category 2C1. Additionally, emissions originating from limestone and dolomite use in iron and steel plants should be included under 2A3 and emissions from heating of coke ovens should be reported under 1A1c.

However, some EU-28 Member States do not keep this boundary for various reasons (local circumstances, types of data available and in this context the aim to keep data series consistent). E. g. some Member States report emissions from blast furnace gas and from converter gas under 1A2a instead of 2C1 because they interpret them as emissions from energy supply.

Thus, for an overview of EU-28 total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for the EU12 Member States in the combined category 1A2a + 2C1 are given in Table 19.16.

Table 19.16 CO_2 Emissions of EU-28 Member States in 1A2a and 2C1 Iron and Steel

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2012	Share 2C1
	1A2a	2C1	Combined		
EU-15	100 026	33 345	133 371	81.6%	25%
Bulgaria	116	50	166	0.1%	30%
Croatia	51	0	51	0.0%	1%
Cyprus	12	NA,NO	12	0.0%	-
Czech Republic	3 080	5 250	8 330	5.1%	63%
Estonia	0	NA,NO	0	0.0%	-
Hungary	1 101	218	1 318	0.8%	17%
Latvia	111	2	113	0.1%	2%
Lithuania	NO	3	3	0.0%	100%
Malta	IE	NA,NO	0	0.0%	-
Poland	5 998	1 693	7 691	4.7%	22%
Romania	3 030	2 185	5 215	3.2%	42%
Slovakia	3 312	3 587	6 898	4.2%	52%
Slovenia	197	46	243	0.1%	19%
EU-28	**117 033**	**46 379**	**163 412**	**100.0%**	**28%**

Table 19.17 2C1 Iron and Steel Production: Information on activity data and methods used for CO_2 emissions

Member States	**Description of methods**
Bulgaria	Basic oxygen steelmaking: To estimate the CO_2 emissions for this category a Tier 2 balance approach is used – carbon contents in the raw materials and the final product. The emissions include the entire production process for this type of steel – including the intermediate pig iron production in the BOF. Electric steelmaking: To estimate the CO_2 emissions for this category a Tier 2 balance approach is used – carbon contents in the raw materials and the final product. The emissions include the entire production process for this type of steel – including the intermediate pig iron production in the BOF. Country specific data from EU ETS reports as well as from BAMI and WSA on total crude steel production were received.
Croatia	Pig Iron: Emissions of CO_2 have been calculated by multiplying annual production of pig iron by the emission factor proposed by Revised 1996 IPCC Guidelines. The activity data for pig iron were extracted from Annual PRODCOM results published by Central Bureau of Statistics, Department of Manufacturing and Mining and cross-checked with iron and steel manufacturer. Steel production: A method based on annual consumption of carbon donors in EAFs has been used for CO_2 emission calculation for each manufacturer. Methodology proposed by the Guidelines for the

Member States	Description of methods
	monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC has been used. For 2005-2012 CO_2 emissions have been taken for the inventory. The same methodology has been used for the entire time series. Calculation of CO_2 emissions is accomplished by applying an emission factor in tonnes of CO_2 released per tonne of carbon donors (input material) to the consumed quantity of the input material.
Cyprus	NO - There is no iron and steel production in Cyprus
Czech Republic	Since this submission CO_2 emissions in 2C1 category were determined based on the Tier 2 in line with 2000 Good Practice Guidance (IPCC, 2000). The computation is based on the amount of carbon produced during the iron and steel production. The total amount of emitted carbon was determined based on the amount of coke consumed in blast furnaces (C from coke in blast furnaces), on the amount of produced steel (C in produced steel), on the amount of C in scrap and on the amount of C in electrodes. All activity data are based on officially submitted statistic of CzSO and were examined and confirmed by the representative of The Steel Federation, Inc.
Estonia	NO – There is no iron and steel production in Estonia
Hungary	in 2012 and 2013 submission all the emissions from coke consumption in blast furnace (including emissions from blast furnace gas) were reported in subsector 2.C.1.4, however it was a planned improvement to report the recovered blast furnace gas in Energy sector. This planned improvement has been executed in present 2014 submission, so emissions from blast furnace gas have been separated and reported in 1.A.1.a and 1.A.2.a sectors from the year 1990 as blast furnace gas is used in the energy sector in the reality. So, in fact this recalculation is only a reallocation between 2.C.1.4 and1.A.1.a and 1.A.2.a subsectors. In 2.C.1.4 subsector, emissions from blast furnace gas are reported as recovery, and are subtracted from CO_2 emissions from the year 1990. Before the year 1990, for the time being, the CO_2 emissions from the recovered blast furnace gas are still reported in 2.C.1.4. Iron and steel production data were obtained from the reports of the International Iron and Steel Institute, World Steel Association (WORLDSTEEL) and the similar European agency (EUROFER). Data on Consumption of coke and natural gas in the blast furnace is extracted from the IEA Energy Statistics of Hungary as well as the amount of blast furnace gas (BFG) recovered and used.
Latvia	IPCC GPG 2000 Tier2 method is based on estimation of carbon losses through the production processes when remaining carbon is emitted to air. CO_2 emissions were estimated only from crude iron used. In steel production plant mostly steel is produced by melting scrap metal that doesn't produce CO_2 emissions by leaking carbon. The only amount of total produced steel is reported by steel production company that means that the total amount of steel produced by using crude iron and melting scrap metal is known. Therefore it is needed to estimate the crude steel amount that is produced only by using crude iron and that caused CO_2 emissions. This amount is then used as activity data. Carbon emitted from consumed electrodes in electric arc furnaces has to be taken into account. These emissions are estimated by multiplying emission factor with mass of steel produced in electric arc furnaces.
Lithuania	1990-2009 data on the total cast iron production were provided by Statistics Lithuania. Since 2010 the data on cast iron production in blast furnace is obtained from the facilities. The data on coke consumption for whole period were obtained from the plants. CO_2 emissions from blast furnaces were calculated from coke consumption using default emission factor 3.1 tonnes CO_2 per tonne coke (Revised 1996 IPCC Guidelines). Revised 1996 IPCC Guidelines do not provide emission factor for electric arc furnaces. Therefore emission factor 0,08 tonne CO_2 per tonne of steel produced is provided in 2006 IPCC Guidelines was used for evaluation of CO_2 emissions from electric arc furnace.
Malta	NO - There is no iron and steel production in Malta
Poland	Iron Ore Sinter Production: Estimation of carbon dioxide process emissions from iron ore sinter production for 2012 was based on the data from the verified reports on annual emissions of CO_2 from

Member States	Description of methods
	iron ore sinter installations in EU ETS. Sinter production amounts (not published from 2000 in statistical materials), data relating to main components of input and output in the sintering process were accepted according to mentioned EU ETS reports in order to estimate of country specific CO_2 emission factor for inventory purpose. Values of CO_2 emission and sinter production for 2005-2011 were also estimated in accordance with EU ETS reports. The data on CO_2 process emissions from steel cast production as well as on amount of cast steel was estimated according to the methodology given in [Holtzer 2007]. CO_2 emission estimated in mentioned study concerns only melt process of alloy since this is main sources of process emission. The data on CO_2 process emissions from iron cast production as well as on amount of cast iron was estimated according to the methodology from [Holtzer 2007]. Estimation of CO_2 emissions concerns only melting process of alloy since this is the main source of process emission. CO_2 emission occurring at pouring the liquid metal into the moulding sands was not taken into consideration. CO_2 process emission from pig iron production for the years 1988-2012 was estimated based on carbon balance in blast furnace process. Balances for individual years were founded on the statistical data for main components of input and output. Amount of CO_2 process emission from steel production in basic oxygen furnace was estimated based on the carbon balance in converter process (table 4.4.5). For the years 1988-2006 the Polish Steel Association (HIPH) study [HIPH 2007] was the main source of data for C balance purpose. The data was supplemented starting from 2005 with the data from verified reports concerning CO_2 emission, prepared as part of EU ETS. Process emissions of CO_2 from steel production in electric furnaces for particular years in the period 1988-2006 were estimated based on the data from Polish Steel Association study [HIPH 2007]. For the last years information from verified reports, prepared as part of EU ETS, was applied for emission calculation.
Romania	The method for calculating emissions of CO_2 from Iron and Steel Production is in line with Good Practice Guidance 2000 (Tier 2 method) and taking into account all the information provided by each Iron and Steel Production company. The recommended Tier 2 method, according to the IPCC Good Practice Guidance, is to base the calculations on the amount of reducing agent (coke oven coke) used in blast furnaces for the production of iron. Other information needed to use the Tier 2 method is the amount of pig iron produced as well as the amount used for steel production and produced steel (BOF and EAF), and the carbon content of all those parts. All these information have been collected at plant level. The coke consumption to reduce the iron has been subtracted from the Energy Sector consumption being considered within Iron and Steel Production category–Industrial Process Sector.
Slovakia	Pig iron and steel are produced mainly in blast furnaces and by the EAF processes. The plant with blast furnaces is one complex with many energy-related installations (coke ovens, heating plant, manufacturing of steel products, etc.). After discussion with plant operators, simplified scheme of the plant in order to carbon balance was proposed. All the streams were recalculated based on conversion unit and carbon EF used in energy sector (category 1.A.2a) or on the basis of content of carbon in iron ore and steel to total carbon. The technological emissions from pig iron (2.C.1.2), steel (2.C.1.1) and emissions from coke electrodes used by EAF steel production (2.C.1.5) are included in the category 2.C.1 iron and steel production. The CO_2 emissions originated from coke production in iron and steel industry and emissions originated from sinter production are included in the category 1.A.2a of energy sector. The CO_2 emissions from limestone consumption were reallocated into the category 2.A.3 limestone and dolomite use as it is good practice described in the IPCC 2000 GPG.
Slovenia	Activity data on the amount and carbon content of input and output material were obtained from three steel producers. For allocation plan purposes more detailed data were available from 1999 onwards, which enabled us to determine our own emission factor. For the period 2005-2012 we have used precise and verified data obtained from verified ETS reports in the scope of Greenhouse Gas Emission Trading System. Emissions and country specific implied emission factors were derived from amounts and carbon content of input and output material.

PFC emissions from 2.C.3 are listed in Table 19.18. Only three of the new Member States report PFC emissions from Aluminum Production in 2012. Slovenia accounts for 5 % of overall PFC emissions from this sector, followed by Slovakia and Romania. All three Member States reported strong decreases of emissions between 1990 and 2012.

Table 19.18 2C3 Aluminum Production: PFC emissions of EU-28

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	13 190	775	458	85%	-317	-41%	-12 732	-97%		
Bulgaria	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Croatia	937	NO	NO	-	-	-	-937	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	271	NO	NO	-	-	-	-271	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	123	37	30	-	-7	-	-93	-	T1c	D
Romania	2 116	11	6	1%	-5	-42%	-2 109	-100%	T2	D,PS
Slovakia	271	17	22	4%	5	28%	-250	-92%	T3	PS
Slovenia	257	29	26	5%	-3	-10%	-232	-90%	T3	PS
EU-28	**17 165**	**869**	**541**	**100%**	**-328**	**-38%**	**-16 624**	**-97%**		

19.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-28)

Table 19.19 shows HFC emissions of sector 2E1. No new member state reported by-product emissions, EU-15 are responsible for 100% of all HFC emissions from this sector.

Table 19.19 2E1 By-Product Emissions: HFC emissions of EU-28

Member State	HFC (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	21 158	345	248	100%	-97	-28%	-20 910	-99%		
Bulgaria	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Croatia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Cyprus	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Estonia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Hungary	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Latvia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Lithuania	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Poland	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Romania	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Slovakia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
EU-28	**21 158**	**345**	**248**	**100%**	**-97**	**-28%**	**-20 910**	**-99%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

19.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-28)

HFC emissions from Refrigeration and Air Conditioning account for 87% of overall HFC emissions. The major share of emissions from this sector lies with the EU-15 (82%). Amongst the 13 new MS, Poland is by far the largest contributor to HFC emissions, and is responsible for 10% of the overall emissions from this sector (Table 19.20). The high increase in absolute terms of the EU-28 between 1995 and 2012 is due to the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, fire protection, foam production and as aerosol propellants). Hungary is the only new member state that reported a decrease in emissions between 2011 and 2012.

Table 19.20 2F1 Refrigeration and Air conditioning: HFC emissions of EU-28

Member State	HFC (Gg CO_2 equivalents)				Share in EU28 emissions in 2012	Change 2011-2012		Change 1995-2012		Method applied	Emission factor
	1990	1995	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	41	2 693	58 894	60 601	82%	1 707	3%	60 560	2249%		
Bulgaria	NO	2	364	417	1%	52	14%	417	17443%	T2	D
Croatia	NO	49	474	479	1%	4	1%	479	972%	T2	D
Cyprus	NE,NO	2.30	253	255	0.3%	1	0.5%	255	11059%	CS	OTH
Czech Republic	NO	0	1 873	2 038	3%	165	8.8%	2 038	1045974%	T2	CS
Estonia	NO	9	149	157	0.2%	8	5%	157	1842%	T2	CS
Hungary	NO	24	990	847	1%	-143	-14%	847	3545%	T2	CS,D
Latvia	IE,NA,NE, NO	0	66	76	0.1%	10	15%	76	27794%	T2	D,OTH
Lithuania	NA,NO	2	208	229	0.3%	21	10%	229	11524%	T2	CS
Malta	NO	NO	122	162	0.2%	40	32%	162	-	M	M
Poland	NO	181	7 118	7 437	10%	319	4%	7 437	4107%	T1a,T1b,T2	D
Romania	NO	2	898	986	1%	88	10%	986	57322%	T2	D
Slovakia	NO	10	416	428	1%	13	3%	428	4381%	T2	CS
Slovenia	NO	5	210	211	0.3%	2	1%	211	4642%		
EU-28	41	2 979	72 035	74 322	**100%**	**2 287**	**3%**	**74 281**	**2494%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from sector 2F4, Aerosols/Metered Dose Inhalers are reported Table 19.21. EU-15 are responsible for 95% of these emissions, Poland, Hungary and Romania account for 3% of emissions. Bulgaria, Croatia, Czech Republic, Latvia and Lithuania reported a decrease of emissions between 2011 and 2012. Malta (+9%), Cyprus (+8%), Hungary (+7%), Estonia (+1%), Poland (+1%) and Slovakia (+0.1%) reported an absolute increase of emissions.

Table 19.21 2F4 Aerosols/Metered Dose Inhalers: HFC emissions of EU-28

Member State	HFC (Gg CO_2 equivalents)				Share in EU28 emissions in 2012	Change 2011-2012		Change 1995-2012		Method applied	Emission factor
	1990	1995	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	32	1 409	5 332	5 149	95%	-182	-3%	5 118	363%		
Bulgaria	NO	NO	9	9	0.2%	-0.2	-2%	9	-	T2	D
Croatia	NO	NO	8	4	0.1%	-4	-49%	4	-	T2	D
Cyprus	NA,NO	NA,NO	2.060	2.220	0.04%	0.2	8%	2	-	CS	OTH
Czech Republic	NO	NO	25	15	0.3%	-10	-39%	15	-	D	D
Estonia	NO	0	3	3	0.05%	0.03	1%	3	6518%	T2	CS
Hungary	NO	14	43	46	1%	3	7%	46	333%	T2	D
Latvia	NE,NO	NE,NO	2	2	0.04%	-0.1	-6%	2	-		
Lithuania	NA,NO	1	6	6	0.1%	-0.2	-3%	6	748%	T1	D
Malta	NO	NO	3	3	0.06%	0.3	9%	3	-	CS	CS
Poland	NO	16	111	112	2%	1	1%	112	703%	T1a,T1b,T2	D
Romania	0	1	29	29	1%	0	0%	28	4338%	T2	D
Slovakia	NO	NO	8	8	0.1%	0.1	1%	8	-	T2	CS
Slovenia	NO	NO	4	4	0.1%	0.02	0.6%	4	-	T1	D
EU-28	**32**	**1 441**	**5 585**	**5 393**	**100%**	**-192**	**-3%**	**5 361**	372%		

Abbreviations explained in the Chapter 'Units and abbreviations'.

SF_6 emissions from sector 2F9, other are reported in Table 19.22. EU-15 are responsible for 99% of these emissions. Amongst the new Member States, only Hungary, the Czech Republic, Estonia and Lithuania reported emissions from this sector. Whilst the EU-15 reported an increase (+4%) of emissions between 2011 and 2012, no new Member State reported an increase. Hungary, Czech Republic and Lithuania reported a reduction in emissions.

Table 19.22 2F9 Other: SF_6 emissions of EU-28

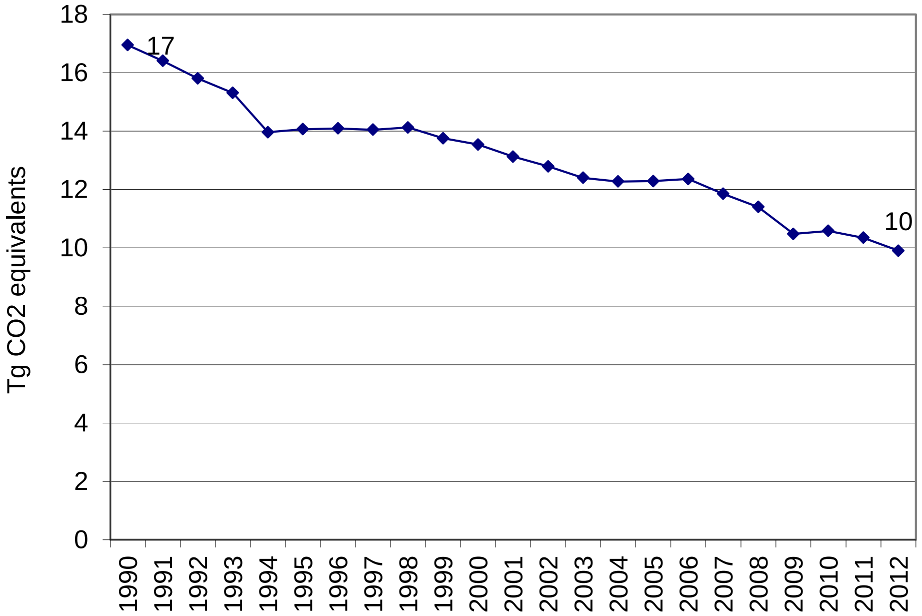
Member State	SF_6 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	4 632	3 730	3 873	99%	143	4%	-759	-16%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	NO	NO	NO	-	-	-	-	-
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	NO	4	3	0.1%	-0.04	-1%	3	-
Estonia	NO	0.07	0.07	0.002%	0	0%	0.1	-
Hungary	NO	62	50	1%	-12	-19%	50	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	0.3	0.2	0.004%	-0.1	-44%	0.2	-
Malta	NO	0.000003	NA	-	-0.000003	-	-	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	0	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
EU-28	**4 632**	**3 796**	**3 927**	**100%**	**132**	**3%**	**-705**	**-15%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

20 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

CRF Sector 3 Solvent and Other Product Use contribute 0.18 % to the total EU-28 GHG emissions (Table 20.5). The EU-28 Member States jointly achieved emission reductions of about 42 % from 16.948 Tg in 1990 to 9 902 Tg in 2012 (Figure 20.1 and Table 20.1).

Figure 20.1 Sector 3 Solvent and Other Product Use: EU-28 GHG emissions for 1990–2012 in CO_2 equivalents (Tg)



In 2012, the emissions decreased by 4 % compared to 2011 (Table 1.1).

Table 20.1 Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emission

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	13 241	7 987	7 552	76%	-435	-5%	-5 689	-43%
Bulgaria	898	41	41	0.4%	-0.2	-1%	-857	-95%
Croatia	117	143	156	2%	13	9%	39	33%
Cyprus	52	73	73	1%	-0.1	-0.1%	21	41%
Czech Republic	765	469	456	5%	-14	-3%	-309	-40%
Estonia	26	19	19	0.2%	-0.1	-1%	-8	-29%
Hungary	246	349	350	4%	1	0%	105	43%
Latvia	43	45	49	0.5%	3	7%	6	13%
Lithuania	198	86	84	1%	-2.15	-3%	-114	-58%
Malta	2	1	2	0.02%	1	45%	-0.58	-23%
Poland	629	787	760	8%	-27	-3%	130	21%
Romania	541	126	128	1%	2	2%	-413	-76%
Slovakia	147	171	173	2%	2.39	1%	26	18%
Slovenia	43	49	61	1%	11	23%	17	40%
EU-28	**16 948**	**10 347**	**9 902**	**100%**	**-445**	**-4.3%**	**-7 046**	**-42%**

In the following table the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU-15 and for all EU-28 Member States are listed.

Table 20.2 Sector 3 Solvent and Other Product Use: EU-15 and EU-28 emissions of CO_2, N_2O, NMVOC and GHG

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
				Gg	Gg CO_2 eq				Gg	Gg CO_2 eq
BG	A. Paint Application	7		3	7	B. Degreasing and Dry Cleaning	1	NA	0.2	1
CY		6		2	6		0.2	NE	0.1	0
CZ		97		31	97		26	NA	8	26
EE		5		2	5		2	NO	1	2
HU		28		13	28		7	NO	3	7
LV		6		3	6		0.01	NO	0.002	0.005
MT		NA		IE	NA		NA	NA	IE	NA
PL		336		IE	336		55	NA	IE	55
RO		16		5	16		26	NE	8	26
SI		NE		1	NE		NE	NA	0.03	NE
SK		58		20	58		5	NO	2	5
LT		42		13	42		11	NE	3	11
EU15		1 954		789	1 954		292	0	133	292
EU28		2 566		887	2 566		439	0	165	439
BG	C. Chemical Products, Manufacture and Processing	0.4		0.2	0.4	D. Other	14	0.1	6	33
CY		NE		0	NE		4	0.2	1	NE
CZ		38		12	38		61	1	20	294
EE		1		0	1		6	0.01	3	10
HU		39		18	39		NO	1	NO	277
LV		4		2	4		38	0.00002	17	38
MT		NA		IE	NA		NA	0.01	2	2
PL		80		IE	80		165	0.4	IE,NA	289
RO		NO		13	NO		86	NE	28	86
SI		NE		3	NE		NA	0.2	6	61
SK		18		8	18		NO	0.3	0.2	91
LT		NE		2	NE		28	0.01	9	31
EU15		299		264	299		2 792	7	1 285	5 007
EU28		484		323	484		3 271	10	1 404	6 414
BG	Total Solvent and Other Product Use	22	0.1	10	41					
CY		10	0.2	3	NE					
CZ		223	1	71	456					
EE		14	0.01	7	19					
HU		74	1	34	350					
LV		49	0.0	22	49					
MT		NA	0.01	2	2					
PL		636	0.4	IE,NA	760					
RO		128	NE	54	128					
SI		NA,NE	0.2	10	61					
SK		82	0.3	31	173					
LT		81	0.01	28	84					
EU15		5 337	7	2 472	7 552					
EU28		6 759	10	2 779	9 902					

Table 20.3 Sector 3 Solvent and Other Product Use: EU-28 CO_2 emissions as well as their share

	Unit	1990	2012
CO_2 emission in 'Solvent and Other Product Use'	[Gg]	11 802	6 759
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	16 948	9 902
Share of CO_2 emission in Total GHG in 'Solvent and Other Product		*70%*	*68%*
Total National CO_2 Emissions and Removals (excluding net CO2 from LULUCF)	[Gg]	4 437 028	3 717 117
Share of CO_2 emission from 'Solvent and Other Product Use' in Total CO2 Emissions and Removals		*0.3%*	*0.2%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5 626 260	4 544 224
Share of CO_2 emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.2%*	*0.1%*

Table 20.4 Sector 3 Solvent and Other Product Use: EU-28 N_2O emissions as well as their share

	Unit	1990	2012
N_2O emission in 'Solvent and Other Product Use'	[Gg]	17	10
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	16 948	9 902
Share of N_2O emission in Total GHG in 'Solvent and Other Product Use'		*30%*	*32%*
Total National N_2O Emissions	[Gg]	1 721	1 099
Share of N_2O emission from 'Solvent and Other Product Use' in Total National N_2O Emissions		*1%*	*0.9%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5 626 260	4 544 224
Share of N_2O emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.09%*	*0.07%*

Table 20.5 Sector 3 Solvent and Other Product Use: EU-28 GHG emissions as well as their share

	Unit	1990	2012
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	16 948	9 902
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5 626 260	4 544 224
Share of GHG emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.3%*	*0.2%*

21 AGRICULTURE (CRF SECTOR 4)

21.1 Overview of sector (EU-28)

Figure 21.1 Sector 4-Agriculture: EU-28 GHG emissions for 1990–2012 in CO_2 equivalents (Tg)

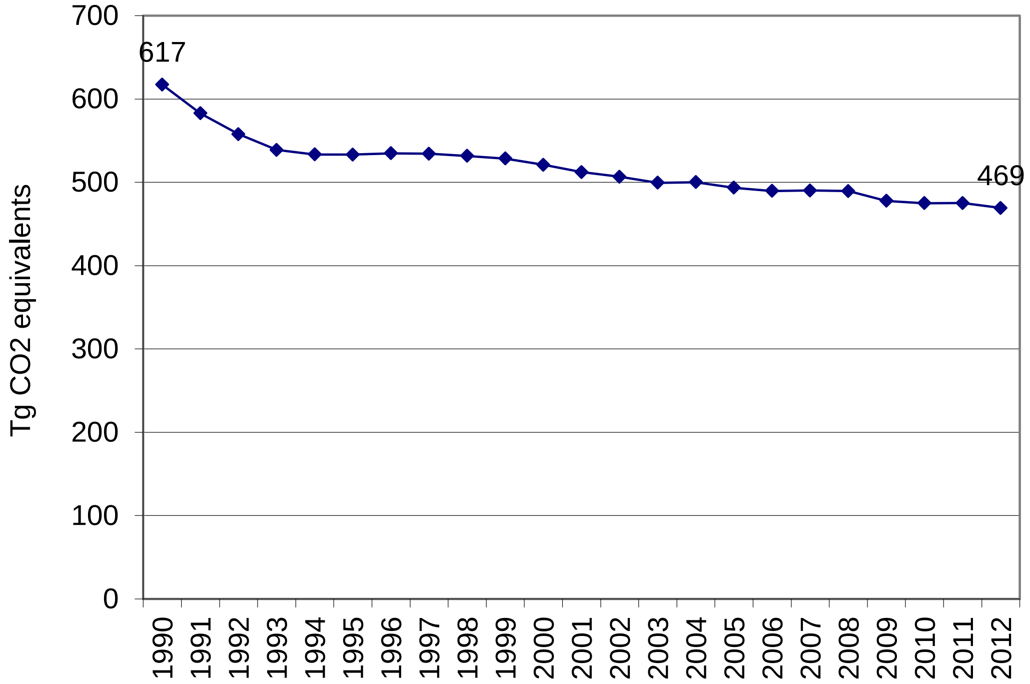
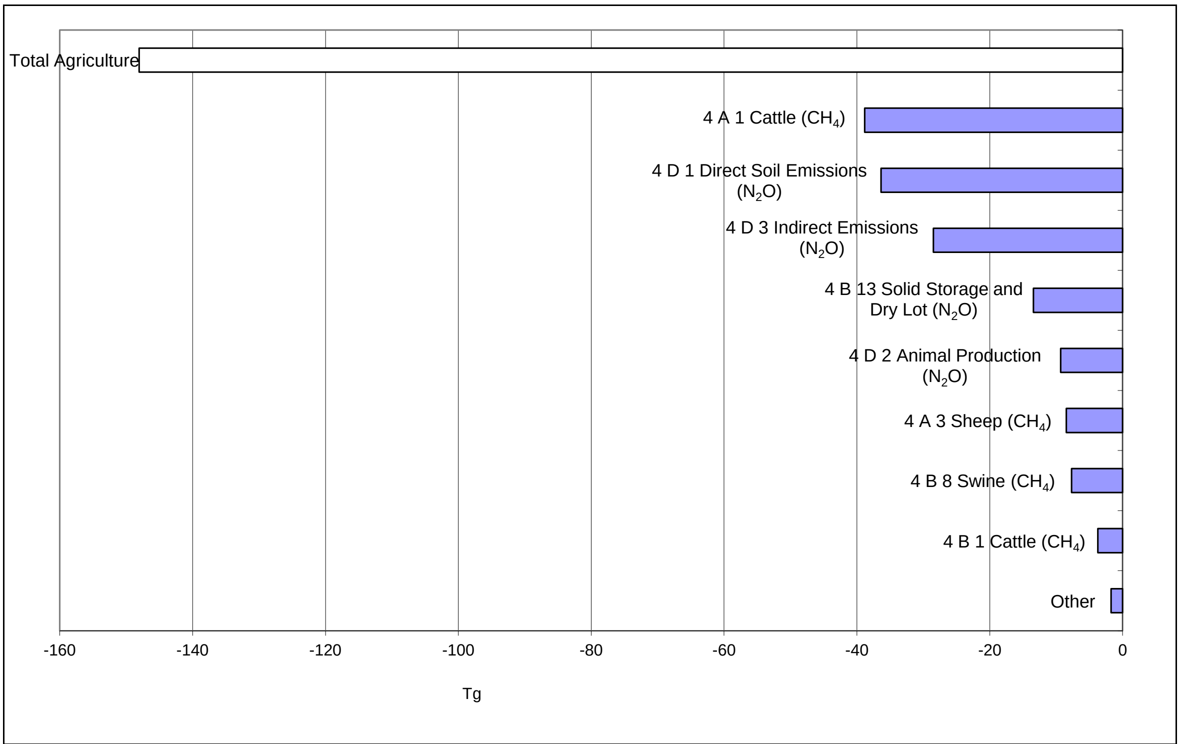
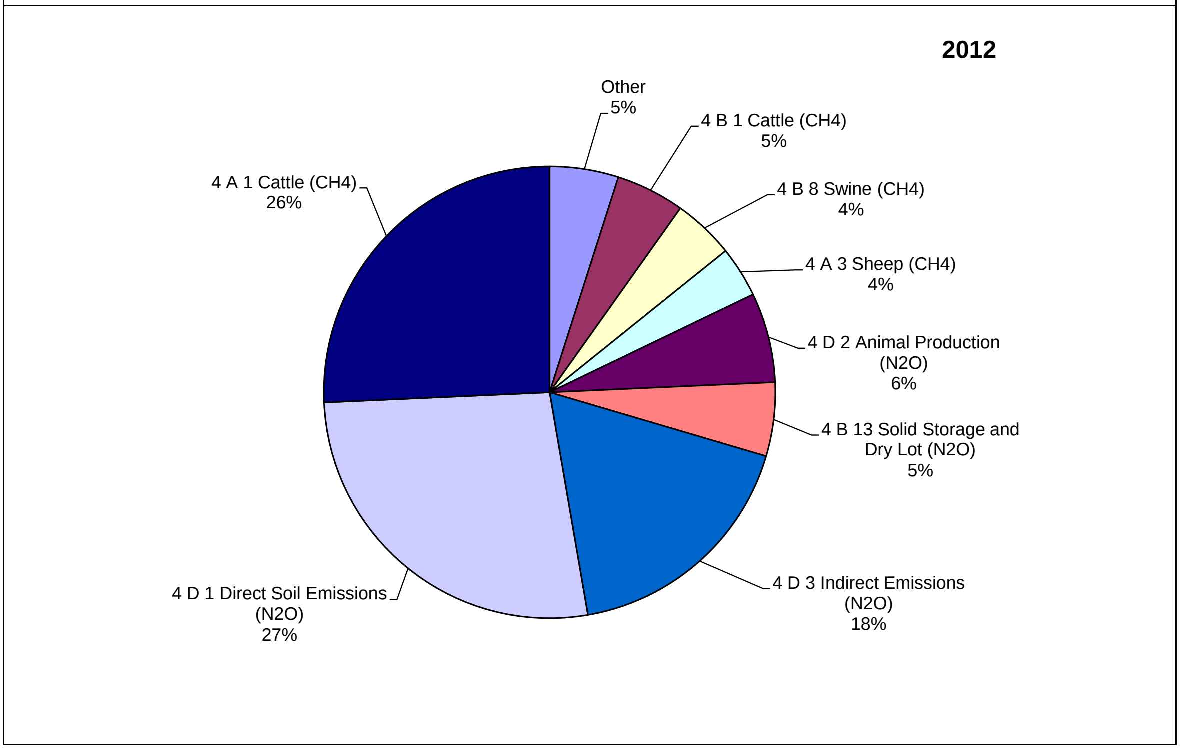


Figure 21.2 Sector 4-Agriculture: Absolute change of GHG emissions by large key source categories 1990–2012 in CO_2 equivalents (Tg) and share of largest key source categories in 2012





21.2 Source categories (EU-28)

21.2.1 Enteric fermentation (CRF Source Category 4A) (EU-28)

Table 21.1: 4A1 Cattle: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	118 105	100 676	100 591	83%	-85	-0.1%	-17 514	-15%
Bulgaria	2 275	961	930	1%	-32	-3%	-1 345	-59%
Croatia	1 231	681	664	1%	-16	-2%	-567	-46%
Cyprus	77	83	85	0.1%	2	3%	8	10%
Czech Republic	3 982	1 898	1 925	2%	27	1%	-2 057	-52%
Estonia	973	386	400	0.3%	14	4%	-573	-59%
Hungary	2 342	1 106	1 160	1%	54	5%	-1 182	-50%
Latvia	2 065	637	657	0.5%	19	3%	-1 408	-68%
Lithuania	3 126	1 152	1 135	1%	-17	-1%	-1 991	-64%
Malta	15	22	23	0.02%	1	2%	7	49%
Poland	14 269	8 364	8 476	7%	112	1%	-5 794	-41%
Romania	8 564	3 178	3 199	3%	21	1%	-5 365	-63%
Slovakia	1 802	747	772	1%	25	3%	-1 030	-57%
Slovenia	625	612	609	0.5%	-2	-0.4%	-16	-3%
EU-28	**159 451**	**120 503**	**120 626**	**100%**	**123**	**0%**	**-38 824**	**-24%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.2: 4A3 Sheep: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	16 912	12 833	12 582	74%	-251	-2%	-4 331	-26%
Bulgaria	1 211	197	196	1%	-1	-0.4%	-1 015	-84%
Croatia	126	107	114	1%	7	6%	-12	-10%
Cyprus	49	60	59	0.3%	-1	-2%	10	21%
Czech Republic	72	35	37	0.2%	2	6%	-35	-49%
Estonia	23	14	13	0.1%	-1	-8%	-10	-44%
Hungary	329	192	192	1%	0.1	0.04%	-137	-42%
Latvia	28	13	14	0.1%	1	5%	-14	-49%
Lithuania	14	14	18	0.1%	4	27%	4	27%
Malta	0	2	2	0.01%	-0.03	-2%	2	461%
Poland	677	42	43	0.3%	1	2%	-634	-94%
Romania	5 959	3 557	3 682	22%	125	4%	-2 276	-38%
Slovakia	125	86	84	0.5%	-2	-2%	-41	-33%
Slovenia	3	20	19	0.1%	-1	-5%	16	463%
EU-28	**25 529**	**17 173**	**17 055**	**100%**	**-118**	**-1%**	**-8 474**	**-33%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.2.2 Manure management (CRF Source Category 4B) (EU-28)

Table 21.3: 4B1 Cattle: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	22 549	20 566	20 335	88%	-231	-1%	-2 214	-10%
Bulgaria	60	26	26	0.1%	-1	-4%	-35	-58%
Croatia	93	83	79	0.3%	-4	-4.6%	-14	-15%
Cyprus	18	19	19	0.1%	0.6	3%	2	9%
Czech Republic	718	330	334	1%	5	1%	-384	-53%
Estonia	22	26	27	0.1%	1	3%	5	21%
Hungary	1 052	496	521	2%	25	5%	-531	-50%
Latvia	67	54	58	0.3%	4	8%	-9	-13%
Lithuania	425	254	254	1%	0.3	0.1%	-171	-40%
Malta	7	10	10	0.04%	0.2	2%	3	49%
Poland	759	885	874	4%	-11	-1%	115	15%
Romania	542	123	124	0.5%	1	1%	-418	-77%
Slovakia	230	76	77	0.3%	1	1%	-153	-66%
Slovenia	212	296	295	1%	-1	-0.4%	83	39%
EU-28	**26 753**	**23 244**	**23 033**	**100%**	**-211**	**-1%**	**-3 720**	**-14%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.4: 4B8 Swine: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	17 758	16 940	17 048	83%	108	1%	-710	-4%
Bulgaria	3 658	501	449	2%	-52	-10%	-3 210	-88%
Croatia	132	104	98	0.5%	-6	-5%	-34	-26%
Cyprus	58	92	83	0.4%	-9	-10%	25	42%
Czech Republic	302	110	99	0.5%	-11	-10%	-202	-67%
Estonia	42	15	16	0.1%	0.5	3%	-26	-62%
Hungary	1 989	741	702	3%	-40	-5%	-1 288	-65%
Latvia	118	32	30	0.1%	-2	-5%	-88	-75%
Lithuania	636	223	232	1%	9	4%	-404	-64%
Malta	13	10	9	0.05%	-0.2	-2%	-3	-27%
Poland	2 140	1 631	1 370	7%	-261	-16%	-770	-36%
Romania	1 002	350	336	2%	-13	-4%	-666	-66%
Slovakia	212	49	53	0.3%	4	9%	-159	-75%
Slovenia	245	101	88	0.4%	-13	-13%	-157	-64%
EU-28	**28 306**	**20 898**	**20 613**	**100%**	**-285**	**-1%**	**-7 692**	**-27%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.5: 4B13 Solid Storage and Dry Lot: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	20 923	16 143	16 129	65%	-14	-0.1%	-4 794	-23%
Bulgaria	1 541	534	525	2%	-9	-2%	-1 016	-66%
Croatia	320	203	195	1%	-8	-4%	-125	-39%
Cyprus	117	143	146	1%	3	2%	29	25%
Czech Republic	1 583	602	600	2%	-1	-0.2%	-983	-62%
Estonia	303	96	98	0.4%	2	2%	-205	-68%
Hungary	1 309	636	631	3%	-6	-1%	-679	-52%
Latvia	564	118	118	0.5%	0.4	0.3%	-446	-79%
Lithuania	846	244	243	1%	-1	-0.2%	-603	-71%
Malta	2	2	2	0.01%	0.03	2%	-0.05	-2%
Poland	7 886	5 062	4 833	20%	-229	-5%	-3 053	-39%
Romania	1 478	772	777	3%	4	1%	-701	-47%
Slovakia	1 055	312	319	1%	7	2%	-736	-70%
Slovenia	252	123	127	0.5%	4	3%	-125	-50%
EU-28	**38 179**	**24 990**	**24 744**	**100%**	**-247**	**-1%**	**-13 436**	**-35%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.6: 4B14 Other: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	2 201	3 098	2 902	80%	-196	-6%	702	32%
Bulgaria	0.3	0.1	0.1	0.003%	-0.0002	-0.1%	-0.2	-59%
Croatia	61	44	44	1%	0.1	0%	-17	-28%
Cyprus	6.893	8.356	6.770	0.2%	-2	-19%	-0.1	-2%
Czech Republic	44	28	27	1%	-1	-2%	-17	-38%
Estonia	NO	6	6	0.2%	0.3	5%	6	-
Hungary	432.272	207.833	216.039	6%	8	4%	-216	-50%
Latvia	NO	1	1	-	0.1	-	1	-
Lithuania	26	10	10	0.3%	-0.1	-1%	-16	-63%
Malta	NO	NO	NO	-	-	-	-	-
Poland	NO	NO	NO	-	-	-	-	-
Romania	579	416	418	12%	3	1%	-161	-28%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	3	2	2	0.04%	-0.3	-15%	-1	-40%
EU-28	**3 353**	**3 821**	**3 633**	**100%**	**-187**	**-5%**	**280**	**8%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.2.3 Agricultural soils (CRF Source Category 4D) (EU-28)

Table 21.7: 4D1 Direct soil emissions: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	114 580	97 775	95 256	75%	-2 519	-3%	-19 324	-17%
Bulgaria	4 309	2 059	2 244	2%	185	9%	-2 066	-48%
Croatia	1 345	1 221	1 113	1%	-109	-9%	-232	-17%
Cyprus	197	196	194	0.2%	-3	-1%	-3	-2%
Czech Republic	5 484	2 989	2 837	2%	-152	-5%	-2 647	-48%
Estonia	997	404	423	0.3%	18	5%	-574	-58%
Hungary	4 197	3 042	2 931	2%	-111	-4%	-1 267	-30%
Latvia	1 619	962	1 011	1%	49	5%	-608	-38%
Lithuania	2 702	1 898	1 964	2%	65	3%	-739	-27%
Malta	14	20	20	0.02%	-1	-3%	5	37%
Poland	15 645	12 478	12 421	10%	-57	-0.5%	-3 224	-21%
Romania	9 088	5 349	4 630	4%	-719	-13%	-4 458	-49%
Slovakia	2 450	1 231	1 258	1%	27	2%	-1 193	-49%
Slovenia	412	374	363	0.3%	-11	-3%	-49	-12%
EU-28	**163 040**	**129 998**	**126 662**	**100%**	**-3 336**	**-3%**	**-36 377**	**-22%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.8: 4D2 Pasture, Range and Paddock Manure: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	33 001	27 725	27 407	91%	-318	-1%	-5 594	-17%
Bulgaria	1 081	276	272	1%	-4	-1%	-809	-75%
Croatia	263	185	185	1%	0	0%	-78	-30%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	317	254	258	1%	4	2%	-59	-19%
Estonia	202	74	76	0.3%	2	2%	-126	-62%
Hungary	258	221	227	1%	6	3%	-32	-12%
Latvia	358	87	88	0.3%	1	1%	-271	-76%
Lithuania	493	195	191	1%	-3	-2%	-302	-61%
Malta	NO	NO	NO	-	-	-	-	-
Poland	1 390	465	467	2%	3	1%	-923	-66%
Romania	1 824	831	834	3%	4	0.4%	-989	-54%
Slovakia	222	65	66	0.2%	0.4	1%	-156	-70%
Slovenia	22	51	50	0.2%	-1	-2%	28	129%
EU-28	**39 433**	**30 429**	**30 122**	**100%**	**-307**	**-1%**	**-9 310**	**-24%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.9: 4D3 Indirect Emissions: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	80 474	65 845	64 535	78%	-1 310	-2%	-15 939	-20%
Bulgaria	3 049	1 207	1 377	2%	170	14%	-1 673	-55%
Croatia	941	816	788	1%	-28	-3%	-153	-16%
Cyprus	159	161	160	0.2%	-1	-1%	1	1%
Czech Republic	3 503	1 776	1 806	2%	29	2%	-1 697	-48%
Estonia	572	234	250	0.3%	15	7%	-322	-56%
Hungary	2 749	1 884	1 929	2%	45	2%	-820	-30%
Latvia	1 034	389	414	0.5%	26	7%	-619	-60%
Lithuania	1 889	934	950	1%	16	2%	-939	-50%
Malta	8	6	6	0.01%	0.2	4%	-1.96	-25%
Poland	10 088	7 556	7 423	9%	-133	-2%	-2 665	-26%
Romania	5 858	2 892	2 788	3%	-104	-4%	-3 070	-52%
Slovakia	995	401	433	0.5%	32	8%	-563	-57%
Slovenia	314	285	280	0.3%	-5	-2%	-33	-11%
EU-28	**111 633**	**84 386**	**83 139**	**100%**	**-1 248**	**-1%**	**-28 494**	**-26%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.3 Methodological issues

21.3.1 Enteric Fermentation (CRF source category 4.A)

CH_4 emissions in the source category Enteric Fermentation stem for 7 EU-13 Member States to over 85% from the sub-category "Cattle" with a maximum of 40% in Lithuania and Latvia. Substantial emissions from the sub-category "Sheep" are reported by Bulgaria, Cyprus, Hungary, Romania (up to 46% of emissions in category 4.A. for Romania). Emissions accounting for more than 5% of the emissions in this category are further reported only for the sub-category "Goats" (Cyprus, 17%).

An overview of the CH_4 emissions from enteric fermentation, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EU-13-level) and also goats and swine are given in Table 21.10. Data are given for 2012 as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers which are partly compensated by higher emissions per head due to intensification of livestock production in Europe. Compared to the trend in EU-15 countries, the reduction of animal numbers for cattle, sheep and swine is much stronger in the EU-13 countries.

Table 21.10: Total CH_4 emissions in category 4A and implied Emission Factor at EU-13 level for the years 1990 and 2012

1990[1)]	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2,697	2,927	805	76	134
Animal population [1000 heads]	13,256	16,361	31,001	2,121	58,423
Implied EF (kg CH_4/head/yr)	91	47	13	11	1

2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2,153	2,637	599	67	138
Animal population [1000 heads]	5,774	7,415	13,674	2,260	25,987
Implied EF (kg CH_4/head/yr)	102	49	16	12	1

2012 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	80%	90%	74%	88%	103%
Animal population [1000 heads]	44%	45%	44%	107%	44%
Implied EF (kg CH4/head/yr)	113%	105%	118%	110%	99%

Information source: CRF for 1990 and 2012, submitted in 2014

21.3.1.1 Methodological Issues

CH_4 emissions from enteric fermentation is a key source category for cattle and sheep. For cattle, this is also true for all member states. Accordingly, most Member States have used Tier 2 methodology for calculating enteric CH_4 emissions, as shown in Table 21.11, even though the overall Tier-level for non-dairy cattle is with Tier 1.9 somewhat lower for EU-13 than for EU-15 (Tier 1.9). In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category "enteric fermentation", the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States. On EU-13 level, 72% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach compared to 88% for EU-15. For EU-28, this gives 88% of emissions estimated with a Tier 2 approach.

Table 21.11: Total CH_4 emissions in category 4A and implied Emission Factor at EU-28 level for the years 1990 and 2012

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep		
	Gg CO_2-eq	b	a	b	a	b	c	a	b	c
Bulgaria	1,273	Tier 1.9	54%	Tier 2.0	20%	Tier 2.0	y	15%	Tier 2.0	y
Cyprus	193	Tier 1.3	26%	Tier 2.0	18%	Tier 1.0	y	30%	Tier 1.0	y
Czech Republic	2,027	Tier 1.5	46%	Tier 2.0	49%	Tier 1.0	y	2%	Tier 1.0	y
Estonia	424	Tier 2.0	63%	Tier 2.0	31%	Tier 2.0	y	3%	Tier 1.0	y
Croatia	832	Tier 1.8	46%	Tier 2.0	34%	Tier 2.0	nr	14%	Tier 1.0	y
Hungary	1,502	Tier 1.8	44%	Tier 2.0	33%	Tier 2.0	y	13%	Tier 1.0	y
Latvia	688	Tier 2.0	59%	Tier 2.0	36%	Tier 2.0	y	2%	Tier 1.0	y
Lithuania	1,185	Tier 2.0	63%	Tier 2.0	32%	Tier 2.0	y	1%	Tier 2.0	y
Malta	29	Tier 1.0	46%	Tier 1.0	32%	Tier 1.0	y	7%	Tier 1.0	y
Poland	8,977	Tier 1.3	60%	Tier 1.0	34%	Tier 2.0	y	0%	Tier 1.0	y
Romania	8,009	Tier 1.9	27%	Tier 2.0	13%	Tier 2.0	y	46%	Tier 2.0	y
Slovakia	883	Tier 2.0	53%	Tier 2.0	34%	Tier 2.0	y	10%	Tier 2.0	y
Slovenia	649	Tier 1.9	37%	Tier 2.0	57%	Tier 2.0	y	3%	Tier 1.0	y
EU-13	**26,670**	**Tier 1.7**	**46%**	**Tier 1.6**	**29%**	**Tier 1.9**		**17%**	**Tier 1.9**	
EU-15	**120,622**	**Tier 1.9**	**37%**	**Tier 2.0**	**46%**	**Tier 1.9**		**10%**	**Tier 1.7**	
EU-28	**147,292**	**Tier 1.8**	**39%**	**Tier 1.9**	**43%**	**Tier 1.9**		**12%**	**Tier 1.8**	
EU-13: Tier 1	28%		44%		14%			11%		
EU-13: Tier 2	72%		56%		86%			89%		

a Contribution to CH_4 emissions from enteric fermentation
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 6.15.

Table 21.12: Methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	*Methodology*
Bulgaria	*Cattle and sheep - tier 2, other animals - tier 1*
Cyprus	*Tier 1*
Czech Republic	*Cattle: Tier 2 method, other animal types: Tier 1*
Estonia	*The Tier 2 method (IPCC, 2000) is used to estimate CH_4 emissions from enteric fermentation of dairy cattle and mature non-dairy and young cattle (bovine cattle, calves 0–6 months and 6–12 months). A disaggregation at county level is applied. Tier 2 is used to estimate CH_4 emissions from enteric fermentation of swine. The estimation is carried out for the main sub-categories of pigs, broken down by weight of animals. Tier 1 is used for other animals. For fur animals, the Norwegian emission factor is used.*
Hungary	*In the frame of the methodological development the conversion into the Tier 2 method is in progress, but some of the country-specific information related to the characteristics of livestock (body mass, net energy requirements, composition of feed rations, methane conversion rate, etc.) is to be confirmed and has to be further elaborated for the entire time series. So it was decided that the simplified Tier 1 method is kept in order to maintain the consistency of time series in the current state of the methodology development.*
Lithuania	*CH_4 emissions from enteric fermentation by dairy cattle and non-dairy cattle, pigs and sheep were calculated using the IPCC Tier 2 methodology. For other animals, Tier1 methodology was used. Data on average weight of each non-dairy cattle sub-category was based on national references and expert judgment.*
Latvia	*CH_4 emissions from enteric fermentation have been estimated using the Tier 1 methodology. In Tier 1 method, total emissions have been calculated by multiplying the number of the animals in each category with the IPCC default emission factor of each animal category.*
Malta	*Tier 1, a constant figure of dairy cows is being used for the 1990s, whereas reliable published statistics are available for the year 2000 and onwards. Not all households who own rabbits and poultry and are not on the farms register or do not have commercial activity, have been captured during the census, since it was not considered feasible and practical to cover them during the inventory.*
Poland	*Cattle and sheep: Tier 2 method. Horses, goats, and swine: Tier 1.*
Romania	*Tier 2*
Slovenia	*Tier 2 for dairy and non-dairy cattle and Tier 1 for other animals.*

Slovakia	*Tier 2 methodology based on national data about animal number in detailed categories (for dairy, non-dairy cattle and other cattle and for sheep) and more advance characteristics about feed and milk conditions. Tier 1 methodology for other animals categories (Horses, Goats).*
Croatia	*Tier 1 methods for all animal categories except for cattle*

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2012 are given in Table 6.16. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Estonia has chosen to use the option B for the classification of cattle. In order to allow the calculation of an EU implied emission factor for the categories listed under option A, these numbers were "converted" using the following rule: Mature Dairy Cattle → Dairy Cattle; Mature Non-dairy Cattle + Young Cattle → Non-dairy cattle.

Some information on the source of the animal numbers for the different Member States is given in Table 21.14.

Table 21.13: Animal population [1000 heads] in 2012

Member State 2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Bulgaria[1)]	298	244	1,408	318	570	14,958
Cyprus	24	35	350	307	395	3,488
Czech Republic	373	981	221	24	1,579	20,691
Estonia[1)]	97	149	77	5	375	2,171
Croatia	191	270	679	72	1,166	10,608
Hungary	255	473	1,141	86	2,952	42,908
Latvia	165	229	84	13	355	4,911
Lithuania	326	366	78	14	807	9,086
Malta	6	9	12	5	45	801
Poland	2,578	3,199	267	90	11,581	130,596
Romania	1,147	842	8,834	1,266	5,234	80,136
Slovakia	203	269	410	35	631	11,850
Slovenia	111	349	114	26	296	4,839
EU-13	**5,774**	**7,415**	**13,674**	**2,260**	**25,987**	**337,043**
EU-15	**17,536**	**57,108**	**83,820**	**11,205**	**118,429**	**1,196,519**
EU-28	**23,310**	**64,523**	**97,494**	**13,465**	**144,416**	**1,533,562**

Information source: CRF for 1990 and 2012, submitted in 2014

[1)] Numbers for cattle have been calculated using the figure given under option B.

Table 21.14: Information on the source of animal population data

Member State	*Methodology*
Bulgaria	*Data is collected from the Agricultural Statistics Department of the Ministry of Agriculture and Food, FAO Database and National Statistics Institutes yearbooks.*
Cyprus	*Data used for the estimation on emissions is obtained from the National Statistical Service. The number of animals used for the calculation of methane emissions is the annual average.*
Czech Republic	*The Czech Statistical Office provides detailed categorization of cattle: calves younger than 6 months of age, young cattle 6 – 12 months (young bulls, young heifers), bulls over 1 year, including bullocks (over 2 years), heifers 1-2 years and heifers over 2 years of age. More disaggregated sub-categories an+C24d more accurate data for animal numbers are given in the study by external agricultural consultants according to the national study (Hons and Mudrik, 2003) and more accurate data on numbers.*
Estonia	*Activity data are used from official Estonian statistics (the Statistical Office of Estonia [ESO], Estonian Animal Recording Center (EARC). Estonian statistics do not collect separately data on calve population (0–6 months),but data are collected and reported on the population of calves less than 1 year old. Hence, population of calves (0–6 months) was separated from the total population of calves based on the data on*

Member State	Methodology
	number of calves born in each quarter (it was applied that about 50% of the total population of calves (0–12 months) are calves less than 6 months old, for the entire time-period). the number of swine population for 1990–1998 is reported for three sub-categories of swine (breeding sows, fattening pigs and young swine); however, the number of swine population for 1999–2008 is reported for six sub-categories of swine.
Hungary	*Livestock population is obtained from the Department of Production Statistics, Main Department of Hungarian Central Statistical Office (HCSO). Since 2000, the HCSO has been registering the livestock three times a year (1 April, 1 August, 1 December), using a method which is equal to that of the EU.*
Lithuania	*Data on livestock number is provided by the Register of Agricultural Information and Rural Business Centre (AIRBC) and Statistics Lithuania. During the period 1990-2006 the number of livestock was obtained from the database of Statistics Lithuania (as of 1st of January). Since 2007 the average annual number of cattle and sheeps is provided by the AIRBC.*
Latvia	*The number of cattle, sheep, horses, swine and goats are obtained from the Statistical yearbooks of Latvia. The source of data on the number of livestock in state farms and statutory companies are statistical surveys while sample surveys are used to collect information from peasant farms, household plots and private subsidiary farms. The survey was first launched in 1995 and since then it is conducted twice a year.*
Malta	*Population figures are taken from the Census of Agriculture, the Farm Structure Survey, the Cattle Survey, the Pig Census the Sheep and Goats Survey, Agriculture and Fisheries 2010. 62.5% of the total cattle stock is found on farms with 100 cattle units or more. The data available from the Sheep and Goats Survey 2011 shows that just over 77% of holdings involved in sheep rearing have less than 10 sheep and amount for 31.2% of the sheep population. On the other hand, while only 22.4% of all holdings have more than 10 sheep they account for 68.8% of the sheep stock. The distribution of the goat stock is somewhat similar,*
Poland	*Activity data were obtained from national statistics of the Central Statistical Office (GUS). They were compiled on the basis of: (-) generalized results of the sample survey on land use, sown area, and livestock, conducted in June 2011 in individual farms, (-) generalized results of panel sample surveys on livestock in individual farms, i.e. the surveys on cattle, sheep and poultry in June and the surveys on pigs at the end of July, (-) statistical reports in the scope of livestock in state-owned and cooperative farms, and in companies with public and private property share, and (-) information from voivodship experts about the horses and goats stock.*
Romania	*Total animal number data are provided by Romanian National Institute for Statistics (NIS) and expert judgement. It includes data on eight different livestock types: cattle (nine different categories), buffalo (buffalo milk and other buffalo), sheep (ewes of milk and fitted, reproducers rams and other sheep), goats (female goats for milk/females by first mount and other goats), horses, mules and asses, swine (pigs under 20 kg, pigs between 20 and 50 kg, pigs fattening, boars, and breeding sows) and poultry (adult poultry for eggs, poultry for meat). Data before 2003 are available only in large aggregates and were extrapolated from the reference year 2004, based on the share of the sub-categories, taking the assumption that livestock structure did not change drastically even though the absolute numbers did. The number of mules and asses was obtained from FAO.*
Slovenia	*The majority of activity data were obtained from the Statistical Office of the Republic of Slovenia (SORS). They are also available on the web page: http://www.stat.si/eng/index.asp The agriculture statistics are on the SI-STAT data portal, under Environment and natural resources: http://www.stat.si/pxweb/Database/Environment/Environment.asp. The number of calves per cow and year, the concentration of fat in milk for the period before the year 2000 and the average daily gains in fattening cattle, were obtained from Central database CATTLE that is managed by Agricultural Institute of Slovenia (reported by Božic et al., 2009).*
Slovakia	*The Ministry of Agriculture of the Slovak Republic issued annual statistics "Green Report", part agriculture and food industry on a yearly basis. The datasets are published in the Green Reports of the Slovak Republic (www.land.gov.sk), in the statistical yearbooks and census. Detailed input data on cattle and sheep are available since 1997 on regional basis. Before 1997 extrapolation of bottom-up data was provided. Regional data are verified by district offices statistical farm information (bottom-up approach).*
Croatia	

Emission Factors and other parameters

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 89 kg CH_4 head^{-1} yr^{-1} (Romania) and 131 kg CH_4 head^{-1} yr^{-1} (Estonia) for dairy cattle, and 43 kg CH_4 head^{-1} yr^{-1} (Estonia) and 59 CH_4 head^{-1} yr^{-1} (Romania) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production. The IEF for the EU-13 Member States and the CH_4 conversion factors used are given in Table 6.18. For EU-13, the implied emission factor for dairy cattle in 2012 was 102 kg CH_4 head^{-1} yr^{-1} and lower than the value for EU-15 giving an overall IEF of 118 for EU-28.

More detailed information on the development of the emission factors for category 4A is given in Table 21.16.

Table 21.15: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	Implied EF (kg CH_4/head/yr) [1]					CH_4 conversion (%) [1]				
2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Bulgaria	109	49	6.6	5.0	1.5	6.0	6.0	0.1	0.1	0.6
Cyprus	98	48	8.0	5.0	1.5	6.0	NA	NA	NA	NA
Czech Republic	119	48	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
Estonia	131	43	8.0	5.0	1.0	6.0	5.5	6.0	5.0	0.6
Croatia	95	50	8.0	5.0	1.5	6.0	6.0	NE	NE	NE
Hungary	123	51	8.0	5.0	1.5	6.3	5.9	6.0	5.0	0.6
Latvia	118	52	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
Lithuania	110	50	10.7	5.0	1.1	6.0	6.0	NA	NA	NA
Malta	100	48	8.0	5.0	1.5	NA	NA	NA	NA	NA
Poland	100	46	7.7	5.0	1.5	6.0	6.0	7.0	NA	NA
Romania	89	59	19.8	17.1	1.5	6.0	6.0	7.0	5.0	0.9
Slovakia	110	54	9.8	5.0	1.5	6.0	6.0	7.0	NE	NE
Slovenia	104	50	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
EU-13	**102**	**49**	**15.6**	**11.8**	**1.5**	**7.8**	**8.0**	**6.1**	**4.1**	**0.8**
EU-15	**123**	**47**	**7.1**	**6.0**	**1.2**	**6.1**	**6.0**	**6.6**	**5.0**	**0.7**
EU-28	**118**	**47**	**8.3**	**7.0**	**1.2**	**6.5**	**6.2**	**6.5**	**4.8**	**0.7**

abbreviations'. 1) For Bulgaria and Estonia, numbers for cattle have been calculated using the figure given under option B.

Table 21.16: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	*Methodology*
Bulgaria	*Country specific feed intake data and energy content of food are used. The Agrostatistics department at the Ministry of Agriculture and Food calculates the milk production by adding up the amount of milk collected by the dairy industry directly from the farmers. Weight data are based on expert judgment.Country specific feed intake data and energy content of food are used. The Agrostatistics department at the Ministry of Agriculture and Food calculates the milk production by adding up the amount of milk collected by the dairy industry directly from the farmers. Weight data are based on expert judgment.*
Cyprus	*IPCC default. Particularly difficult was the choice of emission factor for cattle: the average annual milk production per cow is similar to the average milk production for North America, whereas the description of the sector is more similar to Western Europe.*
Czech Republic	*The activity data of milk production comes from the official statistics (CzSO). The CzSO provides population values for cows and other cattle, the numbers for animal population are based on surveys of livestock (up to 1991 as at 1.1., from 1992 to 2002 as at 1.3., since 2003 as at 1.4.). Based on the individual OMD (organic matter digestibility) values for the most common feed (e.g. corn silage, hay and straw, green fodder – alfalfa and clover, etc.) the average digestibility for cattle was estimated. The estimated average digestibility corresponds to approximately 70 % determined the conservative average digestibility values for 3 basic cattle subcategories (Dairy cattle DE = 67 %, Suckler cows DE = 62 %, Other cattle DE = 65 %).*
Estonia	*Country specific for cattle, swine and tier 1 for other animals. Calves get milk and milk substitute until the age of 3 months, which assume zero emissions from enteric fermentation; at the age of 3–6 months, calves feed on mineral fodder (Lehtsalu et al., 2010). Hence, it was assumed that methane conversion rate of calves (0–6 months) is 3%, the rate was estimated as arithmetic mean based on the rate of calves between 0 and 3 months (which is zero) and from 3 to 6 months (Ym is 6%).*
Hungary	*IPCC default for developed countries. Development of the country-specific emission factor for the entire time series will have been done by July 2007.*
Lithuania	*For the estimation of the EF for dairy and non-dairy cattle gross energy was calculated using the detailed characterisation of livestock herds on the basis of feed accumulation standards indicated in the national reference book of livestock production. Feed intake for non-dairy cattle was collected from national data. The productivity of the cows is established in accordance with the data of the Department of Statistics. Milk fat data is taken from the register of the herds in control. For determining CH_4 emission from swine, gross energy was also calculated on the basis of feed accumulation standards presented in the above mentioned national reference book for animal production. For determining CH_4 emission from sheep, gross energy was calculated using the same methods as for cattle,based on the feed accumulation standards. IPCC default emission factors were used for remaining animal categories (Tier 1 method). As no IPCC and*

Member State	Methodology
	national default emission factors for fur-bearing animals, rabbits and nutria are available, the Norwegian emission factor for fur-bearing animals and Russian emission factors for rabbits and nutria were used in calculations.
Latvia	*IPCC default for Tier 1 and tier 2. National values of GE of cattle have been used, using an equation slightly modified from 4.11 (IPCC 2000)*
Malta	*EF for cattle, sheep and goats, horses and swine from CORINAIR (2006). Default EF for poultry IPCC (1996), EF for rabbit APAT (2005)*
Poland	*GE was calculated for dairy cattle and for and non-dairy cattle disaggregated for: calves under 1 year, young cattle 1-2 years and other matured cattle (over 2 years). Country specific parameters like pregnancy, milk production, percentage of fat in milk come from national statistics. DE was estimated by Walczak (2006) and change from 58.6% in 1988 through 60% in 1995 up to 62.8% in 2004 and later due to improved diets. For sheep GE factor was calculated for two subcategories: lambs up to 1 year and mature sheep above 1 year.*
Romania	*Calculation of GE based on an average rations, both in summer and in winter following the method of (Stoica, 1997). GE is calculated from the caloric value of the main feeding stuff categories (proteins, fat, pulp, and unnutrous substances). DE (%) is calculated using animal type specific feed rations, and considering the feed-specific coefficients of gross energy and digestable energy. For default parameters, values for developing countries and Eastern Europe were used. For Ym, default values are used; for swine Ym of 0.6% is used, because GE value from country's ration is similar to that given in Reference Manual (38 MJ/day for developed countries). For categories where GE value is close to 13 MJ/day (pigs under 20 kg, pigs between 20 and 50 kg), an Ym of 1.3% is used. For sheep, national emission factors were developed in the context of the implementation in 2011 of the study `Elaboration of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Process, Agriculture and Waste, to allow for the higher tier calculation methods`-the emissions factors were based on national gross energy intake- GE (based on national forage rations and the associated caloric content) and default methane conversion factors (Ym).*
Slovenia	*Dairy cattle: Based on data from milk records (the monitoring service performs monthly measurements of the milk yield of every individual cow) a total of 705.860 lactation curves were calculated for the period between 01.01.2000 and 01.06.2009. On the basis of the results, typical lactation curves for the range between 3500 and 12000 kg of milk in standard lactation were calculated for the intervals of 500 kg. The proportion of concentrates in the diets for dairy cows increased and dual purpose Simmental and Brown Swiss cows were in part replaced by cows of specialized Holstein-Frisian breed.*
Slovakia	*Emission factors for dairy cattle, non-dairy cattle and sheep were estimated on the basis of milk production, average gross energy intake and they are specific for the Slovak Republic and calculated as annual average.*
Croatia	*Croatia uses the default EFs for developing countries for the years 1990-2007 and the default EFs for developed countries for the years after 2007.*

21.3.2 Manure Management CH_4 (CRF source category 4.B(a))

Table 21.17 shows in contrast to EU-15, where swine and cattle contribute more or less equally to CH_4 emissions from manure management, swine are the main source of CH_4 emissions from manure management in EU-13 (72%). For cattle, the contributions of non-dairy cattle are slightly prevailing with percentages of total emissions in this category amounting to 17% and 11%, respectively. The highest contribution of cattle to CH_4 emissions from manure management are observed in Slovenia (75%) and the Czech Republic (71%); the lowest in Bulgaria and Cyprus, where cattle contribute with only 5% and 17%, respectively. This is compensated with the emissions from swine manure where Bulgaria has a share of 87%, while swine contributes only 21% in Czech Republic. For EU-13 level, CH_4 emissions from manure management have decreased significantly for cattle and swine.

Table 21.17: Total CH_4 emissions in category 4A and implied Emission Factor at EU-13 level for the years 1990 and 2012

	Dairy Cattle	Non-dairy cattle	Sw ine
	1990		
Total Emissions of CH_4 [Gg CH_4]	120	80	502
Total Population [1000 heads]	13,256	16,361	58,423
Implied Emission Factor [kg CH_4 / head / year]	9.1	4.9	8.6
	Dairy Cattle	Non-dairy cattle	Sw ine
	2012		
Total Emissions of CH_4 [Gg CH_4]	84	45	170
Total Population [1000 heads]	5,774	7,415	25,987
Implied Emission Factor [kg CH_4 / head / year]	14.5	6.0	6.5
	Dairy Cattle	Non-dairy cattle	Sw ine
	2012 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	70%	56%	34%
Total Population [1000 heads]	44%	45%	44%
Implied Emission Factor [kg CH_4 / head / year]	160%	124%	76%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2012, submitted in 2014
Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

21.3.2.1 Methodological Issues

CH_4 emissions from manure management are a key source category for cattle and swine at EU-13 level. This is true also for many Member States. Table 6.27 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it reports whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management has been done as described in Chapter 6.3.2.2. and 6.4.1. Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.0 and Tier 2.0 with a Tier level for EU-13 of Tier 1.5 (corresponding to 50% of the emissions being calculated with country-specific data). Some additional information on the methodological approaches for some Member States is given in Table 21.19.

Table 21.18: Total emissions and contribution of the main sub-categories to CH_4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine.

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine		
	Gg CO_2-eq	b	a	b	a	b	c	a	b	c
Bulgaria	515	Tier 1.8	4%	Tier 1.9	1%	Tier 1.9	y	87%	Tier 1.9	y
Cyprus	114	Tier 1.0	8%	Tier 1.0	8%	Tier 1.0	y	72%	Tier 1.0	y
Czech Republic	470	Tier 1.0	33%	Tier 1.0	38%	Tier 1.0	y	21%	Tier 1.0	y
Estonia	47	Tier 1.9	46%	Tier 1.9	12%	Tier 1.9	y	33%	Tier 1.9	y
Croatia	198	Tier 1.0	28%	Tier 1.0	11%	Tier 1.0	y	49%	Tier 1.0	y
Hungary	1,252	Tier 1.8	22%	Tier 2.0	20%	Tier 2.0	y	56%	Tier 1.3	y
Latvia	97	Tier 1.2	44%	Tier 1.8	16%	Tier 1.8	y	31%	Tier 1.0	y
Lithuania	507	Tier 1.8	34%	Tier 1.8	16%	Tier 1.8	y	46%	Tier 1.9	y
Malta	21	Tier 1.0	27%	Tier 1.0	18%	Tier 1.0	y	44%	Tier 1.0	y
Poland	2,466	Tier 1.5	29%	Tier 1.8	6%	Tier 1.8	y	56%	Tier 1.0	y
Romania	584	Tier 2.0	15%	Tier 2.0	6%	Tier 2.0	y	58%	Tier 2.0	y
Slovakia	152	Tier 1.1	36%	Tier 1.8	15%	Tier 1.8	y	35%	Tier 1.0	y
Slovenia	392	Tier 1.2	34%	Tier 1.8	41%	Tier 1.8	y	22%	Tier 1.0	y
EU-13	**6,814**	**Tier 1.5**	**26%**	**Tier 1.7**	**14%**	**Tier 1.6**		**52%**	**Tier 1.3**	
EU-15	**40,286**	**Tier 1.8**	**27%**	**Tier 1.9**	**24%**	**Tier 2.0**		**42%**	**Tier 1.8**	
EU-28	**47,099**	**Tier 1.7**	**26%**	**Tier 1.9**	**22%**	**Tier 1.9**		**44%**	**Tier 1.7**	
EU-13: Tier 1	50%		25%			32%		67%		
EU-13: Tier 2	50%		75%			68%		33%		

a Contribution to CH_4 emissions from manure management
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 21.19: Methodology used by Member States for calculating CH_4 emissions in category 4B(a)

Member State	*Methodology*
Bulgaria	*Cattle (dairy and non-dairy) and swine: Tier 2 method with country-specific parameters for the systems for management and storage of manure. For other animals Tier 1 is used.*
Cyprus	*Tier 1*
Czech Republic	*Tier 2 is used for cattle and Tier 1 for other livestock categories.*
Estonia	*Tier 2 is used for cattle, tier 1 for other animals.*
Hungary	*Tier 1, except for the Dairy Cattle and the Non-Dairy Cattle categories, where country-specific emission factors were calculated on the basis of Tier 2 method. In the Dairy Cattle category gross energy intake was determined on the basis of the data of the Hungarian Nutrition Codex, 2004.*
Lithuania	*CH_4 emissions from manure management systems of cattle, swine and sheep were calculated using Tier 2 method. CH_4 emissions from horses, goats, sheep and poultry were calculated according to the Tier1 method.*
Latvia	*Dairy cattle: Tier 2. Other animal types: Tier 1*
Malta	
Poland	*Cattle, sheep and swine: Tier 2. Goats, horses and poultry: Tier 1.*
Romania	*Tier 2*
Slovenia	*For dairy cows IPCC Tier 2, on the basis of a national publication (Tomsoc et al., 2000), which enables a direct estimation of the amount of excreted decomposable organic matter on the basis of annual milk yield. Other categories of bovine animals: Tier 1.*
Slovakia	*Tier 1 modified with the national approach is based on the number of animals per regions, the calculation of volatile solid excretion (VS) and methane conversion factor (MCF) as inputs to the formula for the estimation of national EFs.*
Croatia	*Tier 1 method.*

Activity Data

Table 21.20 summarizes the allocation of the produced manure over the animal wastes management systems ‘liquid systems’, ‘solid storage and dry lot’ and ‘pasture, range and paddock’ for the animal categories dairy and non-dairy cattle and swine in 2012. While in EU-15 the liquid systems dominate for swine with 66%, only 36% of swine manure is treated in liquid management systems in EU-13, however, with very large shares of 85% in Latvia and the Lithuania. Still the share of liquid system for swine is higher than that for cattle, but differently from the situation in EU-15, more manure from non-dairy cattle (16%) are managed in liquid systems than from dairy cattle (11%). Daily spread occurs for dairy cattle only in the Czech Republic (1%) and Croatia (1%). Pasture, range and paddock ranges up to 50% (Romania) and 48% (Latvia) for dairy and non-dairy cattle, respectively.

Only few countries in EU-13 report dynamic shares of manure management systems. Substantial changes are reported for cattle in Slovenia, where liquid systems increased in importance between 1990 and 2012. In the Czech Republic, the share of manure in pasture, range and paddock increased for dairy cattle from 5% in 1990 to 7%, while the contribution for non-dairy cattle remained constant.

For some countries, background information in addition to what is reported in Table 21.20 on the activity data used for the estimation of CH_4 emissions from manure management is given in the respective National Inventory Reports and is listed in Table 6.37.

Table 21.20: Allocation to AWMS systems in 2012

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
2012	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Bulgaria	NO	NO	83%	17%	NO	NO	82%	18%	84%	NO	16%	NO
Cyprus	NO	NO	97%	NO	NO	NO	97%	NO	NO	NO	NO	NO
Czech Republic	27%	1%	65%	7%	52%	1%	27%	20%	76%	NO	23%	NO
Estonia	25%	NO	35%	40%	4%	NO	47%	40%	74%	NO	26%	0%
Croatia	18%	1%	68%	13%	47%		52%		29%			27%
Hungary	5%	NO	37%	15%	9%	NO	31%	24%	25%	NO	22%	NO
Latvia	28%	NO	50%	21%	21%	NO	30%	48%	85%	NO	13%	1%
Lithuania	21%	NO	39%	40%	24%	NO	46%	28%	87%	NO	11%	NO
Malta	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Poland	11%		79%	10%	5%		83%	12%	24%		76%	
Romania	2%	NO	48%	50%	1%	NO	53%	46%	35%	NO	17%	NO
Slovakia	5%	NO	75%	20%	5%	NO	85%	10%	77%	NO	23%	NO
Slovenia	57%	NO	31%	12%	57%	NO	31%	12%	63%	NO	23%	NO
EU-13	11%	0%	65%	21%	16%	0%	61%	20%	36%		43%	1%
EU-15	50%	0%	19%	24%	27%	0%	27%	42%	66%	0%	6%	1%
EU-28	40%	1%	31%	23%	25%	2%	28%	41%	61%	1%	13%	1%

Source of information: CRF 4.B(a) for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Anaerobic lagoon + Liquid system. Missing fraction belong to the category 'Other'

Table 21.21: Member State's background information on manure management systems

Member State	*Methodology*
Bulgaria	*A survey conducted with the Agricultural University of Plovdiv, provided data about the distribution of AWMS. The survey provided data for 4 pillar years – 1995, 2000, 2005 and 2010.*
Cyprus	*The distribution among waste management systems was prepared in consultation with the national experts on animal waste management. Dairy, non-dairy cattle, sheep and goats are mainly stall or housed. Only for a small share of their life they are in pasture. Thus the manure produced from them is mainly managed in Solid storage and dry lot systems. The majority of swine in Cyprus remain in properly designed building infrastructures and their manure is mainly managed with liquid systems according to national legislation.*
Czech Republic	
Estonia	*The data on cattle and swine livestock population and the data on location of manure management systems (MMS) were collected by SE in the framework of Agricultural Survey. According to the information presented in the environmental permits, which were submitted by large poultry holdings to the Environmental Board, the holdings use 'solid storage MMS' for all amount of waste generated by poultry. Manure, generated by poultry kept by private holdings (farms), is stored in 'solid storage MMS'. In addition, in the summer time during solar time, poultry are kept outside of hen-house, which could be classified as 'pasture' MMS.*
Hungary	*Hungarian conditions for manure management were analysed on the basis of expert consultations (Mészáros, 2000) and a paper by Ráki (2003). This paper includes the processing of three databases: General Agricultural Census 2000 (HCSO), data from the legally required registration of agricultural producers in 2000 (this includes data for agricultural enterprises), and a survey of animal production holdings performed in October and*

Member State	Methodology
	November 2001, which covered the capacity, capacity exploitation and the conditions of buildings andequipment. This survey allows conclusions to be drawn in connection with the entireanimal keeping sector because it covers 70% to 100% of the livestock populationsdepending on the given category.
Lithuania	*The information about manure management systems is given from the institute of Water of the University of Agriculture of the Republic of Lithuania. Pasture-cowshed time estimations are based on the data of the national zoo-technical activity data. Bulls, partly calves and cows for slaughter, normally are kept in stalls all the time. Calves, heifers for breeding and milk production and beef cattle are grazed in pastures for approximately 145 days per year, the same as dairy cattle. For cattle category, the average duration of grazing on pasture periods and the average time spent in milking stalls are used to divide excrement into pasture and stable portions. In 2012 data about manure management systems were updated.*
Latvia	*The distribution of different manure management systems received from research made by Latvian State Institute of Agrarian Economics (2005). Manure management systems reported in the inventory are liquid system, solid storage and dry lot, pasture range and paddock and anaerobic digester.*
Malta	
Poland	*Country specific data on the fraction of manure managed per AWMS and animal typeis used (Walczak 2003, 2006, 2011, 2012). For cattle, annual basis is taken for the period 1988-2002 and since 2004, with interpolation for 2003. Swine estimation based on AWMS shares and pig population by age categories for 1988 [Walczak 2006] and since 2004. Interpolation for the years 1988-2004. For other animals permanent shares of AWMS are taken: for sheep 20% on pastures and 80% solid storage, for goats and horses 22% on pastures and 78% on solid storage and for poultry 11% on liquid systems and 89% on solid storage.*
Romania	*Distribution of AWMS according expert opinion, varying with the years. Systems considered: anaerobic lagoo, liquid slurry, daily spread, solid storage, dry lot, pasture/range/paddock, pit storage, poultry manrue with bedding, and poultry manure without bedding. For 4B(b), dry lot is reported together with solid storage, and poultry manure with/without bedding is reported together with pit storage under 'other'.*
Slovenia	*The fraction of individual manure management systems has been estimated on the basis of the results of a farm census done in 2000. After 2000, data on farm size and structure were reported by the Statistical Office for the years 2003, 2005 and 2007. The fraction of grazing animals and the fraction of liquid manure management systems have increased while the fraction of bovine animals in straw based systems has decreased. For poultry, floor system on bedding was assumed for broilers, and combined floor system (1/4) and battery-cage systems (3/4) were assumed for layers and allocated to the other systems.*
Slovakia	*Information on animal housing, pasture and production of manures and slurries was collected on the base of questionnaires published in national papers. Some additional information was based on expert estimation. Solid storage of manure was found as the most frequent AMWS in the conditions of the Slovak Republic. Liquid storage of slurries is also frequently used especially in category pigs. Housing on grasslands since April to October is frequent for sheep, goats and horses. The allocation to the AWMS was made by the Research Institute of Animal Production in Nitra. It is supposed that sheep, goats and horses can stay on pasture 200 days a year, 40% of dairy cattle only 150 days especially in mountainous regions. During winter period sheep and goats produce 9% of waste as slurry and 91% as manure (Brestenský et al., 1998).*
Croatia	

Emission Factors and other parameters

The implied emission factors for CH_4 emissions from manure management vary substantially among the EU-13 Member States, as shown in Table 6.32. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers about one order of magnitude, as has already been observed for EU-15. The ratio of the highest and the smallest IEF used by the Member States is 18 for dairy cattle, and 25 for non-dairy cattle and 3, 4, and 19 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Slovenia with 58 kg CH_4/head/year (higher than the highest value found in EU-15) and the smallest by Bulgaria with 3.2 kg CH_4/head/year.

The two most important factors influencing the amount of CH_4 emitted from manure management systems are the climate region and if solid or liquid systems are dominating. We have already discussed the large range of systems used in the EU-13 Member States. The other two factors, the excretion rate of volatile solids and the methane producing potential, are not significantly influencing the order of magnitude.

More detailed information on the development of the emission factors for category 4A is given in Table 21.23.

Table 21.22: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory 2012

Member State	Implied EF (kg CH_4/head/yr)					
2012	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Bulgaria	3	1	0.12	0.18	37	0.1
Cyprus	19	13	0.28	0.18	10	0.1
Czech Republic	20	9	0.19	0.12	3	0.1
Estonia	11	2	0.19	0.12	2	0.1
Croatia	14	4	0.19	0.12	4	0.1
Hungary	50	25	0.19	0.12	11	0.0
Latvia	12	3	0.19	0.12	4	0.1
Lithuania	25	11	0.24	0.12	14	0.1
Malta	44	20	0.28	0.18	10	0.1
Poland	13	2	0.16	0.12	6	0.1
Romania	4	2	0.38	0.46	3	0.0
Slovakia	13	4	0.19	0.12	4	0.1
Slovenia	58	22	0.19	0.12	14	0.1
EU-13	**14**	**6**	**0.30**	**0.33**	**7**	**0.1**
EU-15	**29**	**8**	**0.34**	**0.24**	**7**	**0.1**
EU-28	**25**	**8**	**0.34**	**0.25**	**7**	**0.1**

Source of information: CRF 4.B(a) for 2012, submitted in 2014 Abbreviations explained in the Chapter 'Units and abbreviations'.
Note: Data for Romania are reported in a wrong unit

Table 21.23: Implied Emission factors for CH_4 emissions from manure managementMember State's inventory

Member State	*Methodology*
Bulgaria	
Cyprus	*For sheep, goats, horses and poultry, default EFs are used corresponding to temperate developed countries, for dairy and non-dairy cattle and for swine, EFs for temperate Eastern Europe.For sheep, goats, horses and poultry, default EFs are used corresponding to temperate developed countries, for dairy and non-dairy cattle and for swine, EFs for temperate Eastern Europe.*
Czech Republic	*Default EFs for Western Europe. New national data on the distribution of manure management practices across AWMS were collected and updated (Kvapilík J. 2010).*
Estonia	*For dairy and non-dairy cattle: country-specific data and default emission factors. For other animals: default parameters. The value of Ym for calves (0–6 months) was estimated taking into account feed intake diet of animals and development conditions of rumen: namely, the development of rumen of calves is complete between the 7th and 9th week of life, but may take several additional weeks (German NIR, 2012). Ratios of feed digestibility were obtained from (Kaasik et al., 2002). CH_4 emissions from slurry treated in biogas plants were taken into consideration, based on the experience of Denmark. Results of their studies indicate that CH_4 emissions from biogas treated slurry are lower than non-biogas treated slurry: namely, from pig treated slurry emissions are lower by 40% than from untreated slurry.*
Hungary	*Available parameters of animal production systems were compared to the criteria listed for the Tier 1 factors in the IPCC Guidelines. National conditions on the basis of expert consultations (Mészáros 2000) and a paper by Ráki (2003). In the case of Non-Dairy Cattle category the default values of the Revised 1996 IPCC Guidelines were used for the Tier 2 calculations. In the case of Buffalo, Sheep, Goats, Horses, Asses & Mules, Swine, Poultry and Rabbits categories GPG Tier 1 and IPCC default emission factors were used.*
Lithuania	*Default. The emission factor for dairy cattle has increased as a result of the increasing milk yield and the changes in housing types of animals when solid manure management was replaced by slurry-based system. Animal manure treatment in a biogas device has reduced emission of CH_4, all the biogas collected and digested in the anaerobic digester and therefore, amount of CH_4 used as fuel was not included into the total emission.*
Latvia	*For animals other than dairy cattle, default values for the cool climate region were chosen because annual temperature in Latvia is 6.0 ºC (reference period 1971-2000). For dairy cattle and other cattle for period since 2000, Tier 2 is used to calculate the emission factor (using equation 4.16 of IPCC GPG 2000).*
Malta	*EF for cattle, sheep and goats, horses, swine and poultry from CORINAIR (2006). EF for rabbit from APAT (2005)*
Poland	*Country specific data for dairy and non-dairy cattle, sheep and swine*
Romania	*GE and DE as for enteric fermentation. Fracion of ash (for VS calculation) is IPCC default, using the value for developed countries for developed countries for swine and cattle, and for other animal categories the default values for cattle. B_0 default for Eastern European region Other parameters from IPCC (2000) for Eastern*

Member State	*Methodology*
	Europe.
Slovenia	*The energy digestibilities for individual categories were estimated on the basis national feeding standards (Verbic and Babnik, 1999) and the expected feed intake was estimated according to Kirchgeßner et al. (2008). Since 2005, more precise average daily gains for young bovine animals for fattening have been obtained. They were calculated on the basis of data on slaughtering date and carcass weight from slaughter houses and on the basis of birth dates of individual animals which were recorded in the Central database CATTLE (Verbic and Jeretina, 2009, unpublished).*
Slovakia	*Methane emissions from manure management are base on country specific emission factors used constantly during time series.*
Croatia	*Default for developing countries for the years 1990-2007 and for developed countries thereafter for sheep, goats, horses, mules/asses, and poultry.*

21.3.3 Manure Management N_2O (CRF source category 4.B(b))

Generally, GHG emissions (in $CO_{2\text{-eq}}$) from manure management are predominantly as CH_4 rather than as N_2O. For four countries in EU-13 (Malta, Slovenia, Lithuania, Hungary), emissions from manure management are lower for N_2O than for CH_4. For Slovenia and Malta, the CH_4/N_2O ratio is of 2.9 and 5.7, respectively. In Poland, the CH_4/N_2O ratio is 0.4. As Poland accounts for 51% of N_2O emissions and 36% of CH_4 emissions from manure management, the average ratio for EU-13 countries is 0.7 compared to the values of EU-15 (1.9) and EU-28 (1.5).

The differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 6.46.

Table 6.46 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value and that only small changes in the IEF occurred in the time between 1990 and 2012 with a 0.1% increase of the IEF for solid systems and a 1% increase for liquid systems.

Table 21.24: Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-13 level for the years 1990 and 2012

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0.25	1	56
Total Nitrogen excreted [Gg N]	157	413	1778
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	1.99%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2012		
Total Emissions of N_2O [Gg N_2O-N]	0.07	0	28
Total Nitrogen excreted [Gg N]	43	235	893
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	1.98%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2012 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	28%	57%	50%
Total Nitrogen excreted [Gg N]	28%	57%	50%
Implied Emission Factor [kg N2O-N / kg N]	100%	100%	99%

21.3.3.1 Methodological Issues

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems, this is even more true for EU-13 countries (91%) than for EU-15 countries (77%); however, the range is large in EU-13 with lowest share of 54% in Malta, followed by 64% in Romnia and highest share of 99% in Slovakia.

Table 6.47 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that ‘solid storage’ is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.

The quality of the emission estimates are calculated from the Nex factor and the emission factor as described in Section 6.3.3.2 and 6.4.1.3.

Most countries use default factors for both nitrogen excretion rates for most animals and emission factors with the exception of Slovakia for the IEFs, and several countries for N-excretion rates; for all EU-13 countries, a level of Tier 1.9 is obtained for N excretion and Tier 1.0 for the emission factors. Thus, the overall quality level is Tier 1.7 for N_2O emissions from manure management in EU-13 countries. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used.

Additional background information on the methodology, if available, is summarised in Table 6.48.

Table 21.25: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems

	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Bulgaria	527	Tier 1.7	100%	Tier 1.7	y	0%	Tier 1.7
Cyprus	153	Tier 1.4	96%	NO	y	0%	Tier 1.4
Czech Republic	661	Tier 1.8	91%	Tier 1.7	y	5%	Tier 1.7
Estonia	107	Tier 1.7	92%	Tier 1.7	y	3%	Tier 1.7
Croatia	241	Tier 1.4	78%	Tier 1.4	y	3%	Tier 1.5
Hungary	852	Tier 1.7	74%	Tier 1.7	y	1%	Tier 1.7
Latvia	123	Tier 1.1	96%	Tier 1.0	y	3%	Tier 1.0
Lithuania	263	Tier 1.6	92%	Tier 1.7	y	4%	Tier 1.6
Malta	4	Tier 0.0	54%	NO	y	46%	NO
Poland	4,870	Tier 1.7	99%	Tier 1.7	y	1%	Tier 1.7
Romania	1,214	Tier 1.6	64%	Tier 1.7	y	0%	Tier 1.6
Slovakia	323	Tier 1.1	99%	Tier 1.7	y	1%	Tier 1.7
Slovenia	137	Tier 1.7	93%	Tier 1.7	y	6%	Tier 1.7
EU-13	**9,557**	Tier 1.7	**91%**	Tier 1.6		**1%**	Tier 1.7
EU-15	**21,005**	Tier 1.8	**77%**	Tier 1.7		**9%**	Tier 1.9
EU-28	**30,562**	Tier 1.9	**81%**	Tier 2.0		**7%**	Tier 1.9
EU-13: Tier 1	30%		30%			32%	
EU-13: Tier 2	70%		70%			68%	

a Contribution to N_2O emissions from manure management

b Quality level (betw een Tier 1 and Tier 2)

c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 21.26: Member State's background information on the methodology for estimating N_2O emissions in category 4.B(b)

Member State	*Methodology*
Bulgaria	*Tier 1*
Cyprus	*Tier 1*
Czech Republic	*Key source, tier 2 methodology is used for emission estimation for the cattle category (tier 1 for other animals).*
Estonia	*Cattle and swine tier 2. Other animals tier 1*
Hungary	*Tier 1*
Lithuania	*Tier 1*
Latvia	*Tier 1 and local expert assumptions.*
Malta	*Tier 2 for cattle, swine and poultry. Tier 1 for other animal types*
Romania	
Slovenia	*Tier 1 with national specifications.*
Slovakia	*The methodology used for the estimation of manure management is based on tier 2 IPCC methodology using country specific parameters and activity data.*
Croatia	*Tier 1*

Activity Data

In EU-13, a total of 1,670 Gg N was managed in manure management systems or excreted on pasture range and paddock in 2012. Together with the 7,869 Gg N from EU-15 countries, this gives a total of 9,539 Gg N for EU-28. The largest share of this manure-nitrogen was managed in solid storage systems (893 Gg N in EU-13), followed by liquid systems (235 Gg N) and manure excreted by grazing animals (278 Gg N). Compared with 1990, this was a decrease of manure-nitrogen by 49%. The decreases were similar for the different manure management systems. The decrease of nitrogen was particularly pronounced in Latvia and Bulgaria, where in 2012 only about 30% of manure was excreted as compared to 1990.

The nitrogen managed in the various manure management systems in 2012 is given in Table 6.49. Nitrogen excretion data per head will be discussed below. Some information on the source of the animal numbers for the different Member States is given in Table 21.14.

Table 21.27: Member State's nitrogen managed in the manure managed systems anaerobic lagoon, liquid systems, daily spread, and other systems, manure excreted on pasture range and paddock, and total nitrogen excreted in 2012

Member State 2012	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Bulgaria	4	0		54	0	28	86
Cyprus				24	7		30
Czech Republi		68	1	62	11	27	168
Estonia		6		10	1	8	24
Croatia	1	17	0	19	18	19	75
Hungary		11		65	38	23	137
Latvia		9		12	1	9	31
Lithuania		14		25	4	20	63
Malta							
Poland		76		496		48	620
Romania	38	2	36	80	102	86	343
Slovakia		8		33		7	48
Slovenia		18		13	1	5	37
EU-13	**43**	**228**	**37**	**892**	**184**	**278**	**1,663**
EU-15	**20**	**2,485**	**16**	**1,866**	**712**	**2,769**	**7,869**
EU-28	**63**	**2,713**	**53**	**2,758**	**896**	**3,048**	**9,531**

Information source: CRF Table 4.B(b) for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

As all countries are using IPCC default values for the IEF or values that are close to it (with the exception of the IEFs used by Slovakia (both liquid and solid systems) and Hungary for liquid systems. Poland is the largest source of excreted manure in EU-13 accounting for 37% of nitrogen in manure for EU-13. An overview of the implied emission factors is given in Table 6.50.

Table 21.28: Implied Emission factors for N_2O emissions from manure management used in Member State's inventory 2012

Member State	Implied EF (kg N_2O-N / kg N)			
2012	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Bulgaria	0.10%	0.10%	2.0%	0.1%
Cyprus	NO	NO	1.3%	0.2%
Czech Republic	NO	0.10%	2.0%	0.5%
Estonia	NO	0.10%	2.0%	2.0%
Croatia	0.10%	0.10%	2.0%	0.5%
Hungary	NO	0.10%	2.0%	1.2%
Latvia	NA	0.10%	2.0%	0.10%
Lithuania	NA	0.10%	2.0%	0.5%
Malta	NO	NA,NE,NO	NA,NE,NO	NO
Poland	NO	0.10%	2.0%	NO
Romania	0.10%	0.10%	2.0%	0.8%
Slovakia	NO	0.10%	2.0%	NO
Slovenia	NO	0.10%	2.0%	0.3%
EU-13	**0.10%**	**0.10%**	**2.0%**	**0.8%**
EU-15	**0.10%**	**0.16%**	**1.8%**	**0.8%**
EU-28	**0.10%**	**0.16%**	**1.8%**	**0.8%**

Information source: CRF Table 4.B(b) for 2012, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

An important parameter in the calculation of N_2O emissions from manure management is nitrogen excretion rate per head and year, which is given in Table 6.51 for EU13 countries and the main animal types. The table shows a range by a factor of up to 4.5 between the highest and the lowest value. For example, for dairy cattle, we have a range of about 80 kg N head^{-1} y^{-1} from 54 kg N head^{-1} y^{-1} used in many countries to 136 kg N head^{-1} y^{-1} for Czech Republic. Very large ranges are found for non-dairy cattle with values between 38 (Romania) and 70 kg N head^{-1} y^{-1} (Cyprus) and sheep with values between 4.5 kg N head^{-1} y^{-1} (Romania) and 20.0 kg N head^{-1} y^{-1} (Czech Republic).

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 6.52. Additional background information on the calculation of nitrogen excretion rates are summarised in Table 6.53.

Table 21.29: Total Nitrogen excretion by AWMS [Gg N] for dairy and non-dairy cattle, sheep, swine, and poultry in 2012

Member State 2012	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Bulgaria	72	41	15	8	0.9	50	17	25	43
Cyprus	100	70	12	16	0.6	NO	40	40	40
Czech Republic	136	69	20	20	0.6	NO	25	25	NO
Estonia	118	42	16	10	0.6	NA	25	25	NA
Croatia	100	50	16	20	0.6	NO	25	25	25
Hungary	100	50	20	10	0.6	70	18	60	25
Latvia	70	50	13	10	0.6	NA	13	48	NA
Lithuania	101	49	16	11	0.6	NO	16	25	NO
Malta	NA	NA	NA	NA	NA	NO	NA	NA	NE
Poland	87	58	7	14	0.3	NO	7	28	NO
Romania	54	38	4	18	1.1	54	5	55	37
Slovakia	88	43	8	11	0.8	NO	5	60	NO
Slovenia	111	42	20	12	0.6	NO	25	25	NO
EU-13	**85**	**52**	**8**	**14**	**0.6**	**54**	**13**	**43**	**41**
EU-15	**117**	**50**	**8**	**9**	**0.6**	**91**	**12**	**50**	**37**
EU-28	**109**	**50**	**8**	**10**	**0.6**	**88**	**12**	**48**	**38**

Information source: CRF Table 4.B(b) for 2012, submitted in 2014
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.30: Member State's background information on the emission factor for calculation of N_2O emissions in category 4.B(b)

Member State	*Methodology*
Bulgaria	*Default IPCC EF for Eastern Europe*
Czech Republic	*Default IPCC EFs for Western Europe.*
Hungary	*The factors were selected on the basis of expert consultations (Gundel 2004, Várhegyi 2004) and relevant literature (Walther et al. 1994; Várhegyiné et al. 1999; Babinszky et al. 2002; Borka 2003).*
Romania	*EF for other systems: pit storage 0.001; poultry manure with bedding 0.02; poultry manure without bedding 0.005.*
Slovakia	*Tier 1 with national specifications regarding pasture.*
Croatia	*Default*

Table 21.31: Member State's background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions in category 4.B(b)

Member State	***Methodology***
Bulgaria	*Default*
Cyprus	
Czech Republic	*Revised the Nex values for dairy and non-dairy cattle and change of distribution ratio of manure per AWMS according to the national conditions based on expert judgment. Other animals - default Nex*
Estonia	*Nitrogen excretion rates for cattle livestock are calculated based on nitrogen balance. Nitrogen excretion rates for swine livestock were used from country-specific literature (Keskkonnaministri määrus nr 48, 5.12.2008). For other animals IPCC default.*
Hungary	*National data from HCSO (2000), Mészáros (2000) and Ráki (2003). On the basis of expert consultations (Gundel 2004, Várhegyi 2004, Fébel 2007) and literature data (Várhegyiné et al. 1999, Babinszky et al. 2002, Fébel and Gundel 2007) it was asserted that production level and feeding technology of animal breeding in Hungary are close to the Western European standards, therefore the default IPCC factors for Western Europe were used.*
Lithuania	
Latvia	*Annual N excretion per animal until 2004 obtained from national studies. Since 2005, annual N excretion*

Member State	*Methodology*
	per animal is corrected according to results of newest studies on development of manure normative and livestock units carried out by the State Ltd." Agrochemical Research Centre". N excretion by farm livestock was estimated with the mass balance approach (N intake- N products). National studies showed that average Nex for sheep and goats in Latvia is very low as compared to IPCC default value. The reason is (i) sheep and goats nutrition as they receive usually no feed additions; (ii) mainly local breeds are used which are not very productive. Commercial pig production in Latvia mainly includes four or five phases, to take account of changes in nutrient requirements with increasing age of the pig: piglets with live weight 7-30 kg, fattening pigs 30-100 kg or 7-100 kg, young breeding sows and breeding sows. There are no data on N excretion by young pigs with live weight 20-50 kg. N excretion for breeding sows is calculated taken into account N excretion by sucking piglets. In average, swine excretion is 10 kg N/animal and year, around half the IPCC default values.
Malta	*Country-specific values for cattle, swine and poultry from Sustech (2008)*
Poland	*Nitrogen excretion rate for cattle, horses and swine were calculated with the use of SFOm model, where the amount of animals manure were determined for livestock categories and utility subgroups based on quantity, sort and digestibility of fodder applied. Then the nitrogen content in livestock manure was assessed based on manure management systems of collection and storage used (Jadczyszyn 2000). For goats the weighted mean value estimated for sheep in 1988-2010 was used. For poultry Nex parameters come from publication (Jadczyszyn et al 2009). Country specific Nex values are in line with parameters published in UNECE (2001).*
Slovenia	*The nitrogen excretion rates for cattle and pigs were harmonized with the methodology for ammonia emissions (Verbic, 2004). In dairy cows the nitrogen excretion has been linked to productivity, i.e. milk production. N excretion rates from Menzi, IPCC 1997 for cattle and EMEP/CORINER for swine.*
Slovakia	
Croatia	

21.3.4 Agricultural Soils - N_2O (Source category 4.D)

For EU-13, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.63). This was most significant for emission related to manure application or manure excretion on pasture, range and paddock and is a direct consequence of decreasing animal numbers. The implied emission factor remains constant for all sub-categories.

The decrease in the input of nitrogen to agricultural soils was significant for all sub-categories and was 32% for synthetic fertilizer application, 48% for application of manure, 8% of the area of histosols cultivated and 58% of nitrogen excreted by grazing animals. This translated to a reduction of volatilized and re-deposited nitrogen by 43% and of the amount of nitrogen leached by 40%.

Table 21.32: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-13 level in 2012 and 1990 and relative changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	69	42	14	21	17	84
Total Nitrogen input [Gg N]	3,532	2,141	11,217	660	1,066	2,133
Implied Emission Factor [kg N_2O-N / kg N]	1.25%	1.25%	8.0	2.00%	1.00%	2.50%

2012	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	47	22	13	9	9	51
Total Nitrogen input [Gg N]	2,406	1,103	10,312	279	603	1,287
Implied Emission Factor [kg N_2O-N / kg N]	1.25%	1.25%	8.0	2.00%	1.00%	2.50%

2012 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O	68%	52%	92%	42%	57%	60%
Total Nitrogen input	68%	52%	92%	42%	57%	60%
Implied Emission Factor	100%	100%	100%	100%	100%	100%

Source of information: Tables 4.D for 1990 and 2012, submitted in 2014

[1)] Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

21.3.4.1 Methodological Issues

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). In contrast to EU-15 countries, default factors are used also to estimate the emissions from indirect emissions. Table 6.64 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. Thus, the vast majority of the emissions are calculated with the Tier 1 approach with the important exception of the emission factor from synthetic fertilizer in Poland. Direct N_2O fluxes from synthetic fertilizer in Poland are the single largest emission flux in this category for EU-13 (12% of total emissions).

For each single sub-category we calculated a ‘Tier-level’ scoring between 1 and 2 according to the methodology described in Section 6.4.1.5. and 6.3.5.2. As a result, we estimate that a minimum of 83% of the emissions reported in category 4D are estimated with country-specific information. Highest share of country-specific calculations is obtained for direct N_2O emissions (82%). All countries in EU-13 use IPCC default methodology.

Table 21.33: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year .

	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Bulgaria	3,893	Tier 1.1	58%	Tier 1.1	y	7%	Tier 1.4	y	35%	Tier 1.1	y	5%	Tier 1.0	30%	Tier 1.1
Cyprus	354	Tier 1.1	55%	Tier 1.2	y		Tier 1.0	y	45%	Tier 1.1	y	9%	Tier 1.0	36%	Tier 1.1
Czech Republic	4,901	Tier 1.1	58%	Tier 1.1	y	5%	Tier 1.4	y	37%	Tier 1.1	y	6%	Tier 1.0	31%	Tier 1.1
Estonia	748	Tier 1.2	56%	Tier 1.2	y	10%	Tier 1.4	y	33%	Tier 1.1	y	5%	Tier 1.0	28%	Tier 1.1
Croatia	2,085	Tier 0.7	53%	Tier 0.5		9%	Tier 1.0		38%	Tier 1.1		6%	Tier 1.0	32%	Tier 1.1
Hungary	5,087	Tier 0.7	58%	Tier 0.5	y	4%	Tier 1.0	y	38%	Tier 1.1	y	6%	Tier 1.0	32%	Tier 1.1
Latvia	1,513	Tier 0.8	67%	Tier 0.6	y	6%	Tier 1.4	y	27%	Tier 1.1	y	4%	Tier 1.0	23%	Tier 1.1
Lithuania	3,105	Tier 1.3	63%	Tier 1.2	y	6%	Tier 1.0	y	31%	Tier 1.5	y	5%	Tier 1.6	26%	Tier 1.5
Malta	25	Tier 1.2	77%	Tier 1.2	y		Tier 1.4	y	23%	Tier 1.5	y	17%	Tier 1.0	6%	Tier 1.6
Poland	20,311	Tier 1.3	61%	Tier 1.5	y	2%	Tier 1.0	y	37%	Tier 1.1	y	6%	Tier 1.0	31%	Tier 1.2
Romania	8,252	Tier 1.1	56%	Tier 1.1	y	10%	Tier 1.4	y	34%	Tier 1.1	y	6%	Tier 1.0	28%	Tier 1.1
Slovakia	1,756	Tier 1.2	72%	Tier 1.2	y	4%	Tier 1.4	y	25%	Tier 1.1	y	6%	Tier 1.0	19%	Tier 1.1
Slovenia	694	Tier 1.0	52%	Tier 1.0	y	7%	Tier 1.4	y	40%	Tier 1.0	y	7%	Tier 1.0	33%	Tier 1.0
EU-13	**52,725**	**Tier 1.1**	**60%**	**Tier 1.1**	**y**	**5%**	**Tier 1.4**	**y**	**35%**	**Tier 1.1**	**y**	**6%**	**Tier 1.0**	**30%**	**Tier 1.2**
EU-15	**188,293**	**Tier 1.1**	**51%**	**Tier 1.3**	**y**	**15%**	**Tier 1.5**	**y**	**34%**	**Tier 1.2**	**y**	**6%**	**Tier 1.3**	**28%**	**Tier 1.2**
EU-28	**241,018**	**Tier 1.1**	**53%**	**Tier 1.2**	**y**	**12%**	**Tier 1.5**	**y**	**34%**	**Tier 1.2**	**y**	**6%**	**Tier 1.2**	**28%**	**Tier 1.2**
EU-13: Tier 1	83%		82%			77%			90%			97%		84%	
EU-13: Tier 2	17%		18%			23%			10%			3%		16%	

a Contribution to N2O emissions from agricultural soils
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Activity Data

Activity data for category 4.D are given in in Table 6.66. Additional background information on the source of the data used in the Member States's inventories is given in Table 6.67.

Table 21.34: Member State's activity data to calculate direct and indirect N_2O emissions in category 4D

Member States	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Atmosph. Deposition (Gg N)	Nitrogen Leaching and run-off (Gg N)
2012	Direct						Indirect	
Bulgaria	212	46	0.4	109	NO	28	41	97
Cyprus	4	24	0.1	2	37	NO	7	11
Czech Republic	223	113	28	102	NO	27	58	125
Estonia	30	13	6.6	5	226	8	8	17
Hungary	282	91	23	85	NO	23	59	135
Latvia	59	18	0.3	8	1,263	9	13	29
Lithuania	136	29	5	40	1,756	20	29	66
Malta	0.4	1.0	0.0	1.2	NO	NO	0.9	0.4
Poland	985	458	21	127	6,934	48	234	516
Romania	261	206	217	76	NO	86	98	190
Slovakia	91	33	18	64	NO	7	22	27
Slovenia	24	25	2	4	69	5	10	19
EU-13	**2,406**	**1,103**	**334**	**650**	**10,312**	**279**	**603**	**1,287**
EU-15	**7,256**	**3,627**	**753**	**2,505**	**23,610**	**2,769**	**2,367**	**4,384**
EU-28	**9,662**	**4,730**	**1,087**	**3,154**	**33,922**	**3,048**	**2,970**	**5,670**

Source of information: Tables 4.D for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.35: Member State's background information on the activity data used for the calculation of N_2O emissions in category 4.D

Member State	Methodology
Bulgaria	The synthetic fertiliser quantities are provided by the National Service for Plant Protection at the Ministry of Agriculture and Food Supplies. Annual crop production data is provided by the Agrostatistics department at the Ministry of Agriculture and Food and is cross-checked with FAO database and National Statistics Institute's yearbooks.
Cyprus	The data regarding the annual quantities of synthetic fertilisers consumed in the country have been collected from the Statistical Service.
Czech Republic	Annual amount of nitrogen applied in the form of industrial nitrogen fertilisers. All crop statistics were taken from the Statistical Yearbooks of the Czech Republic.
Estonia	Activity data for fertilisers and the production of N-fixing crops were taken from official Estonian statistics (the Statistical Office of Estonia [ESO]). Activity data on amount of synthetic fertilizers applied on agricultural fields and crop production were obtained from the datasets of SE. The data on amounts of sludge used on agricultural lands were used from the EEIC. The data on areas of histosols under cultivation in Estonia were obtained in the framework of National Forest Inventory (Chapter LULUCF).
Hungary	Activity data for the sector (total harvested production of plants, N-fertiliser) were obtained from the Agricultural Statistics Yearbook of HCSO.
Lithuania	Data about consumption of synthetic fertilisers were collected from different sources: for the period 1990-1994 data was obtained from Statistics Lithuania; for the period 1995-2006 from International fertiliser Industry Association (IFA) and since 2007 UAB Agrochema. Data on harvested crops (thous. tonnes) by type of crop were provided by database of Statistics Lithuania.
Latvia	There are differences between Central Statistical Bureau of Latvia (CSB) and FAO data about N synthetic fertiliser use. CSB officially submitted data on fertiliser application to FAO starting from year 2005. Information for other years was probably taken by FAO from other Latvian instititutions. Calculations of CSB are more precise (they have been the ones used in inventory and should not be revised).
Malta	The activity data on nitrogen based fertiliser use per year (FSN) in kg N was obtained as follows: · for 1990 to 1994: FAOSTAT – Nitrogenous Fertiliser Consumption; · since 1995: Nitrogen fertiliser import figures, as provided by the National Statistics Office.
Poland	Data regarding consumption of mineral fertilisers are elaborated on the basis of reporting from production and trade units, statistical reports of agricultural farms: state-owned, co-operatives and companies with share of public and private sector, expert's estimates as well as Central Statistical Office estimates.
Romania	Data on the amount of synthetic fertiliser applied to soils data are provided by Romanian National Institute for Statistics (NIS) Statistical Yearbooks.
Slovenia	The consumption of nitrogen from mineral fertilisers on agricultural soil in Slovenia has been obtained from the Statistical Yearbook. SORS collect data on fertilisers used in enterprises, companies and co-operatives involved in crop production. Likewise, they are taking into account the data on import, export, and production. The difference between all fertilisers sold in this country and the amount that is used by enterprises, is the consumption of mineral fertilisers on family farms. Fertilisers that are not appropriate for agricultural production (mineral fertilisers for balcony flowers, lawns and similar) are not included.
Slovakia	According to Statistical Yearbook and Green Report of Slovak Republic it is not possible to split fodder crops and grasslands into year subcategories. The crop and root residuals were observed from 29 crop species on three to seven different soil-climate sites in the Slovak Republic (partly on the small parcels production and partly an the large scale production. The sampling was provided according the plant specification (numbers of plants per hectare). This analysis based on the questionnaires from 222 agricultural subjects shows that 14.7% of total agricultural land is cultivated and 15.2% is arable land.
Croatia	

Emission Factors and other parameters

Table 6.68 and Table 6.69 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2012 in EU-13 countries. As discussed already above, emission factors are largely IPCC default, while other parameters are more frequently country-specific. Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. Only Malta uses a different emission factor for synthetic fertilizer nitrogen and applied manure than IPCC default. Indirect emissions are estimated with default values for both volatilization/leaching fractions and emission factors.

Table 21.36: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in 2012

Member States 2012	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
	Direct						Indirect	
Bulgaria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Cyprus	1.25%	1.25%	1.25%	1.25%	5.0	NO	1.0%	2.5%
Czech Republic	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Estonia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Hungary	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Latvia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Lithuania	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Malta	1.00%	2.00%	1.25%	1.25%	NO	NO	1.0%	0.7%
Poland	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
Romania	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Slovakia	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.0%	2.5%
Slovenia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.0%	2.5%
EU-13	**1.25%**	**1.25%**	**1.25%**	**1.25%**	**8.0**	**2.0%**	**1.0%**	**2.5%**
EU-15	**1.2%**	**1.24%**	**1.25%**	**1.25%**	**7.8**	**2.0%**	**1.0%**	**2.5%**
EU-28	**1.24%**	**1.24%**	**1.25%**	**1.25%**	**7.8**	**2.0%**	**1.0%**	**2.5%**

Source of information: Tables 4.D for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.37: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2012

Member States	$Frac_{BURN}$	$Frac_{FUEL}$	$Frac_{GASF}$	$Frac_{GASM}$	$Frac_{GRAZ}$	$Frac_{LEACH}$	$Frac_{NCRBF}$	$Frac_{NCR0}$	$Frac_{R}$
Bulgaria	3%		10%	20%	33%	30%	3.0%	1.5%	50%
Cyprus	10%	NA	10%	20%	NA	30%	NA	NA	50%
Czech Republic	NO	NO	10%	20%	16%	30%	3.0%	1.5%	45%
Estonia	NO	NO	10%	20%	32%	30%	3.0%	2.0%	
Hungary	NO	NO	10%	20%	17%	30%	2.8%	0.7%	NO
Latvia	NO	NO	10%	20%	29%	30%	2.0%	3.0%	45%
Lithuania	NO	NO							
Malta			10%	20%		30%	1.4%	NE	45%
Poland	3%	NO	10%	20%	8%	30%	2.6%	1.4%	51%
Romania	10%	NO	10%	20%	25%	30%	2.7%	1.6%	NA
Slovakia	NO	NO	10%	20%	17%	30%	NA	NA	NE
Slovenia	NO	NO	10%	20%	14%	30%	2.9%	0.7%	46%
EU-13	NA	NA	10%	20%	21%	30%	2.6%	1.8%	47%
EU-15	NA	NA	6%	22%	34%	25%	2.6%	1.2%	57%
EU-28	NA	NA	8%	21%	28%	28%	2.6%	1.5%	52%

Source of information: Tables 4.D for 2012, submitted in 2014. Abbreviations explained in the Chapter 'Units and ab

1) Arithmetic average over the MS that reported.

22 LULUCF (CRF SECTOR 5, EU-28)

EU MS additional to EU-15, referred here as EU-13, have in place national inventory systems following relevant UNFCCC and EU legislation. For the LULUCF sector, national systems generally have high capability of reporting forest land and low for non-forest land categories. Differences among MS in how GHG inventory systems are designed derive from historical differences in data collection, in land management and in economic development. Nevertheless, EU-13 MS benefit from experience gained by EU-15 MS through the implementation of various common programs and direct support projects (e.g. COST actions, JRC workshops, and several European Commission support projects).

Activity data are available mainly from non-spatially explicit statistics, so being generally scarce for tracking land across time. Net change in forest biomass pool is estimated with data from forest inventories (either based on statistic sampling or on management plans). Soil carbon data are generally poor and limited to few sampling not realized under permanent monitoring programmes. For dead organic matter, especially the litter pool, data are generally missing; consequently DOM is often reported at Tier 1 (i.e. the DOM pool is assumed to be in balance in forest land).

The contribution of the LULUCF sector to total net GHG emissions varies among MS according to the size of the sink and to the country's total emissions (Table 21.1). EU-13 aggregated LULUCF net removals offset 12% of total emissions from other sectors, ranging, among MS, from 0 to 112 %. At level of EU-28, LULUCF offsets 7% of total GHG emissions.

Table 22.1 Sector 5 LULUCF contributions to total GHG emissions of EU-28 (GgCO_2 eq.)

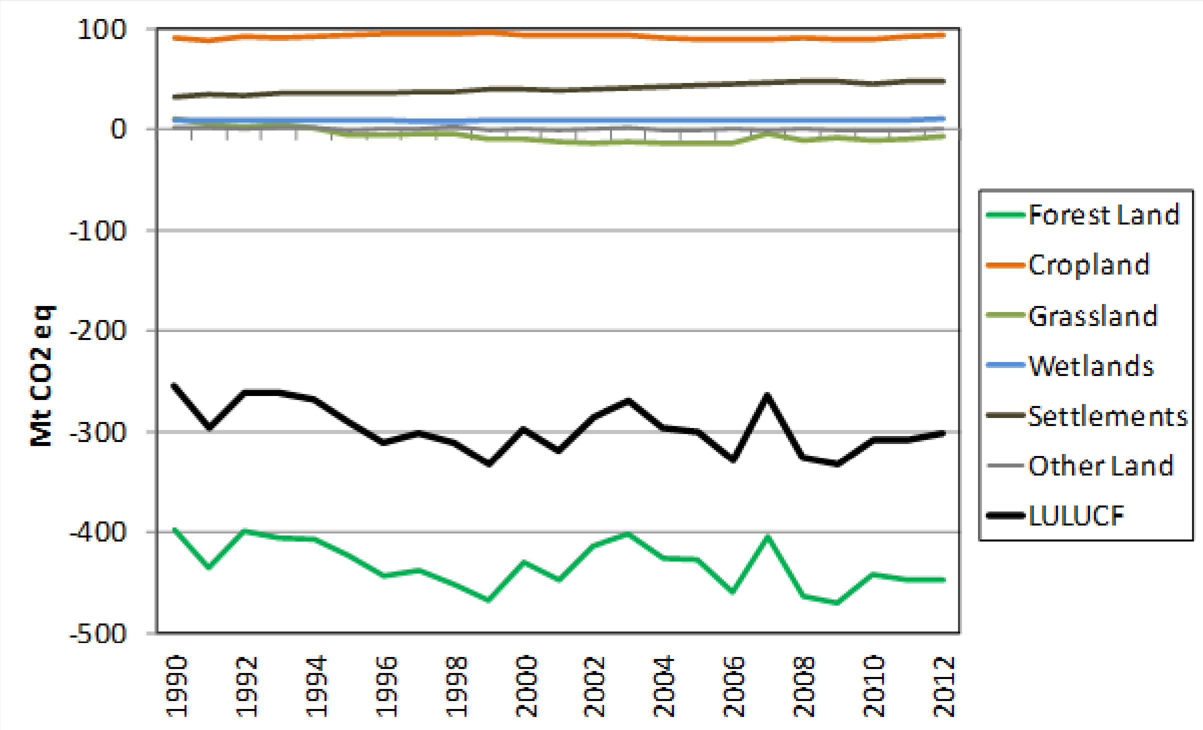
Member State	LULUCF sector	Total National emissions (without LULUCF)	Share of emissions offset by LULUCF sector
EU-15	-190.583	3.619.471	5%
Bulgaria	-8.207	61.046	13%
Croatia	-5.891	26.419	22%
Cyprus	-19	9.259	0%
Czech Republic	-7.252	131.466	6%
Estonia	-1.951	19.188	10%
Hungary	-4.407	61.981	7%
Latvia	-12.301	10.978	112%
Lithuania	-8.077	21.622	37%
Malta	-7	3.140	0%
Poland	-31.855	399.268	8%
Romania	-20.544	118.764	17%
Slovakia	-8.103	42.710	19%
Slovenia	-4.356	18.911	23%
EU-13	**-112.970**	**924.753**	**12%**
EU-28	**-303.553**	**4.544.224**	**7%**

22.1 Overview of the sector (EU-28)

The LULUCF sector of the EU-28 is a net sink of -303 553 GgCO_2 eq. for 2012, including estimations for each of the 6 land use categories and net removals of -1 496 GgCO_2 eq as a result of emissions from Harvested Wood Products and lime application on forests reported by Cyprus and Czech Republic respectively, and removals from Harvested Wood Products and emissions from other fires reported by Latvia.

Overall for EU-28, only forest land (5A) and grassland (5C) are net sinks. Compared to 1990, net annual CO_2 removals increased by 18%, due to the increase of 12% on forest land, 170% on grassland (which turned from source to sink) and 54% on settlements. Net emissions form cropland (5B) remained rather stable, 2%.

Figure 22.1 Sector 5 LULUCF: EU-28 net CO_2 emissions in the time period 1990–2012 from CRF tables in CO_2 eq. (Mt)



Most of the methodological considerations expressed for EU-15 are also valid for the EU-13 MS, with 5A, 5B and 5C estimates reported with higher completeness and accuracy in comparison with other land categories where mostly only emissions/removals associated with land use conversions are reported (Table 22.2).

Table 22.2 Sector 5 LULUCF: Coverage of CO_2 emissions and removals of EU-13 MS for the year 2012

Party	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A1. F-F	5.A2. L-F	5.B.1. C-C	5.B.2. L-C	5.C.1. G-G	5.C.2. L-G	5.D.1. W-W	5.D.2. L-W	5.E.1. S-S	5.E.2. L-S	5.F.1. O-O	5.F.2. L-O
Bulgaria	R	R	E	E		R		E		E		
Croatia	R	R	E	E	E	R		E		E		
Cyprus	R							E				
Czech Republic	R	R	E	E	E	R		E		E		
Estonia	R	R	E	E	E	R	E	E		E		E
Hungary	R	R	R	E	E	R		E		E		
Latvia	R	R	E	E	E	R	E	E	R	E		
Lithuania	R	R	E	E	E	R	E	E		E		E
Malta	R		R									
Poland	R	R	E	E	E	R	E	E	R	E		
Romania	R	R	R	E	E	E		R		E		E
Slovakia	R	R	R	E		R				E		E
Slovenia	R	R	E	E	E	E		E		E		E

Legend: R: net Removal; E: net Emission; empty cells can be: NE-not estimated /NO-not occurring/NA-not applicable/IE-included elsewhere

Most EU-13 MS reported less sub-categories and pools (Table 22.3) than most of the EU-15 MS because of the lack of national data or often because of lack of national capacity for processing existing data (e.g. rich dataset related to forest management).

Actions that the EU-13 MS have taken to enhance the quality of their GHG inventories include: improving the coverage of activity data to report more land use and land use change categories; adjusting and improving the NFI design according to reporting needs; improving the association of data related to carbon stock changes and associated GHG emissions with activity data; implementation of research projects; estimating uncertainties and improving the transparency of the reporting; and active participation in European projects and actions aimed at improving the GHG inventory reporting. Several EU-13 MS indicate in their GHG inventory that programs and planned actions for improvements of their supplementary information reported under the Kyoto Protocol are ongoing and are being implemented year by year.

Pools reported are shown in Table 22.3 and information on data and methods applied are reported in Table 22.4

The following subcategories of the LULUCF sector are listed as key categories among EU-13 MS:

- 5A1 Forest Land remaining Forest Land: CO_2
- 5A2 Land converted to Forest Land: CO_2
- 5B1 Cropland remaining Cropland: CO_2
- 5B2 Land converted to Cropland: CO_2
- 5C1 Grassland remaining Grassland: CO_2
- 5C2 Land converted to Grassland: CO_2

Table 22.3 Sector 5 LULUCF: Reporting of carbon pools for the major land sub-categories for the year 2012

	Reporting category																															
	Forest land								Cropland								Grassland								Wetlands							
Party	5.A1.				5.A2.				5.B.1.				5.B.2.				5.C.1.				5.C.2.				5.D.1.			5.D.2.				
	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOCorg	LB	DOM	SOCmin	SOC org	LB	DOM	SOCmin	SOCorg	LB	DOM	Soil org	LB	DOM	SOCorg		
Bulgaria	R				R	R	E		E		E		E		E						E		R					E		E		
Croatia	R				R		R		E		R	E	R		E						E	E	E	E				E		E		
Cyprus	R																															
Czech Rep.	R				R		R		R		R		E	E	E				R		E	E	R					E	E			
Estonia	R	R	R	E	R	R	E	E	E		R	E	E	E	E	E	E	E		E	E	E	R	E			E	E	E	E		
Hungary	R			E	R				R		R		R	E	E				E		E	E	R				E	E				
Latvia	R	R		E	R	R		R				E			E	E	R	R		E			R	R			E					
Lithuania	R	R		E	R	R		E	R			E	E		E	E				E	R		R	E			E					
Malta	R								R																							
Poland	R	E	R	E	R		R	E	R		E	E			E				E	E			R		E			E				
Romania	R			E	R	R	R		R	R	R		E		E						E		E					E	E	R		
Slovakia	R				R	R	R		R		R		E	E	E						R	E	R									
Slovenia	R	E			R		R		R		E	E	E	E	E					E	E	E	E					E	E	R		

Pools: DOM – dead organic matter, LB –living biomass, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated" (reported in CRF as "NE" alone or in combination with other keys), assumed as "no C stock change" (following IPCC tier 1), or assumed as "not occurring" (notation keys used "NO" and/or "NA")

Table 22.4 Sector 5 LULUCF: Method for reporting of carbon pools by the EU-13 MS for the most important categories for the year 2012, as derived from Table 5A, 5B and 5C of the CRF tables 2014

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	LB	DOM -1	SOC Min	SOC Org -2	LB	DOM	SOC Min	SOC Org -2	LB -3	DOM	SOC Min -4	SOC Org -2	LB -5	DOM	SOC Min	SOC Org -2	LB	DOM	SOC Min -4	SOC Org -2	LB	DOM	SOC Min	SOC Org -2
BG	CS	D	D	NO	CS	D	CS	NO	CS,D	CS	CS	NO	CS,D	NO	CS	NO	NO	NO	NO	NO	CS,D	NO	CS	NO
HR	CS	D	NO	NO	CS	D	CS	NO	CS,D	NO	CS	D	CS	NO	CS	NO	NO	NO	NO	D	CS,D	NO	CS	NO
CY	CS	D	D	NE	NE	D	NE	NO	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CZ	CS	D	D	NO	CS	D	CS	NO	D	D	CS,D	NO	CS,D	CS	CS	NO	D	D	CS,D	NO	CS,D	CS	CS	NO
EE	CS	CS,D	D	CS,D	CS	CS	NE	CS,D	CS	NE	NE	CS,D	IE,NO	NO	NE	CS,D	CS,D	CS	NE	CS,D	CS	CS	NE	CS,D
HU	CS	D	D	NO	CS	D	D	NO	D	NO	D,D	NO	CS,D	D	D	NO	D	D	D,D	NO	CS	CS	D	NO
LV	CS	D	D	CS	CS	D	NE	CS	NO	NO	NO	D	CS,NO	CS	CS	CS	NE	NO	NO	D	NO	NO	NE	IE
LT	CS	CS	CS	CS	CS	D	NE	NE	D	NA	NA	CS	D	NA	D	NA	NA	NA	NA	CS	D	NA	D	CS
MT	CS	D	D	NE	NO	NO	NO	NO	D	NE	NE	NE	CS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
PL	CS	D	CS	CS	CS	CS	CS	CS	D	D	CS	CS	NA,NO	NO	CS	NO	NO	NO	CS	CS	NO	NO	CS	IE
RO	CS	D	D	NE	CS	D	NE	NE	D	CS	CS	D	NO	NO	CS	NO	NO	NO	NO	NE	NO	NO	CS	NO
SK	CS	D	D	NO	CS	D	CS	NO	D	D	NO	NO	CS,D	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
SV	CS	CS	D	NO	CS	CS	CS	NO	CS	D	CS	CS	CS	CS	CS	NA,NO	D	D	NA	CS	CS	CS	CS	NA

(D: default; CS: country specific; NA: not applicable; NE – not estimated; NO- not occurring)

Source: CRFs 2013

"CS" country specific data, associated either with IPCC method (tier 2) or country-specific method (tier 3, if data are highly disaggregated). Note that sometimes not all parameters involved in the estimation are truly "CS" (e.g. root/shoot ratio and BEF are often taken by IPCC). However it is expected that if "CS" is reported, the most important parameters are truly "CS

"D" means that the default IPCC emission factors are used in the estimation. D is typically associated with IPCC default method (tier 1).

"NE" means either country assumes the emission/removal is negligible or not enough data is available for estimation

"NO" means emissions or removals "not occurring" in a MS (it includes also "NA" - not applicable)

(1) for DOM under "FL r FL" the 2 notations separated by a comma means: first one refers to DW (dead wood), second to LT (litter)

(2) for ORGANIC SOIL any notation key reported for a MS showing some activity data of org soil for any land (sub)category is assumed as NE. D refers to the use of IPCC default emissions factors

(3) BIOMASS C stock change in CL-CL is assumed only for perennial woody crops. Biomass of annual crops is always assumed zero C stock change by definition.

(4) for SOC MIN on CL and GL the 2 notation keys separated by comma mean that the MS uses IPCC default method (which is tier 1 if associated with D data or tier 2 if associated with CS data); in this case, the first notation key refers to "reference C stock", and second to "C stock change factor" (see IPCC-GPG for details). A cell with a single "CS" indicate a country-specific method and data (i.e. tier 3 if data are highly disaggregated)

(5) for BIOMASS under L - CL, "conversion to cropland", the 2 notation keys used mean: first one refers to FL-CL and second to GL-CL

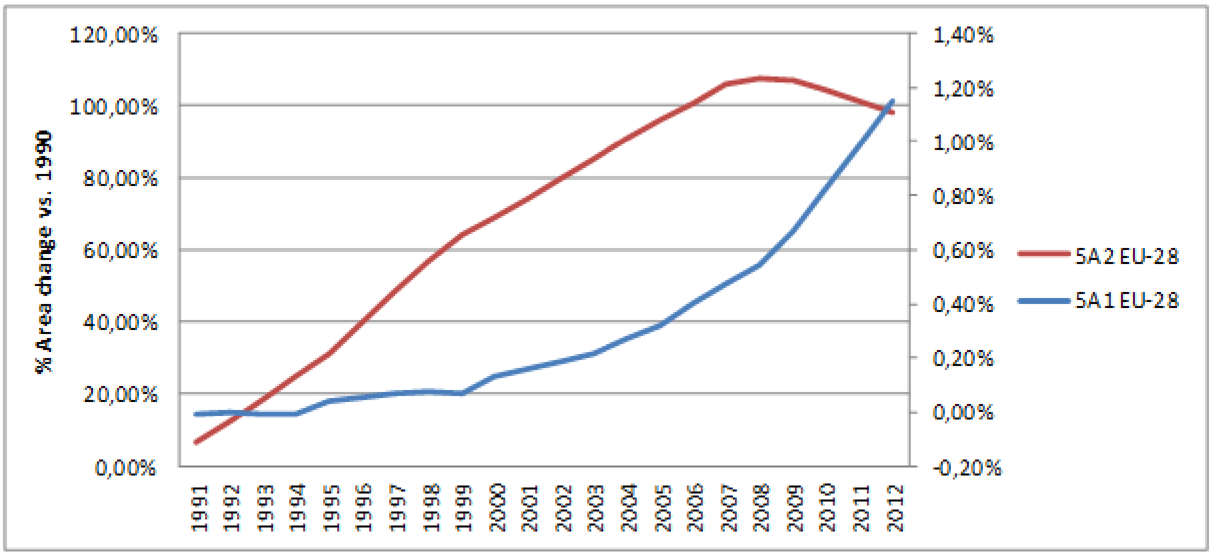
Grey heading means that for these pools IPCC TIER 1 allows to assume no change in C stock (note that if the category is a key category, in theory higher tiers should be used)

22.2 Source and sink categories (EU-28)

22.2.1 Forest land (5A; EU-28)

EU-28 has a forest area of about 164 872 kha, out of which 38 147 kha in EU-13 MS territories (23 % of total EU-28 forest land). Since 1990, all EU-13 MS have reported an increase of the forest land area, with an overall increase of some 4 % compared to 1990

Figure 22.2 The percentage increase compared to 1990 of the forest land area between 1990 and 2012 in the EU-28 (axis on the left shows % increase of 5A2, axis on the right shows % increase of 5A1)



22.2.1.1 EU-13 MS Forest land

Among EU-13 MS, the largest area of forest is reported by Poland and Romania. As in EU-15, the category 5A gives the major contribution to the LULUCF sector GHG balance. In 2012, EU-28 5A1 is a net sink of 397 547 GgCO_2, 6% higher than in 1990 (Table 22.5). Several MS reported a decrease of net sink since 1990.

Within the EU-13 MS, Czech Republic, Hungary, Lithuania, Poland, Slovakia and Slovenia reported an increased sink in 5A1 compared to 1990, while notable decreases of the annual removal in 5A1 are reported by Cyprus, Bulgaria, Estonia, Romania and Latvia. Overall, EU-13 MS report a net-sink from 5A1 of 119 376 GgCO_2 in 2012.

Table 22.5 5A1 Forest Land remaining Forest Land: Net CO_2 emissions of EU-13 MS

Member State	Net CO_2 emissions (Gg)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
EU-15	-242.067	-273.662	-278.171	70%	-4.509	2%	-36.104	15%
Bulgaria	-14.247	-9.812	-9.625	2%	187	-2%	4.622	-32%
Croatia	-6.875	-6.693	-6.519	2%	174	-3%	356	-5%
Cyprus	-157	-94	-46	-	48	-51%	111	-71%
Czech Republic	-4.567	-6.694	-6.980	2%	-286	4%	-2.413	53%
Estonia	-9.119	-4.035	-3.035	1%	1.001	-25%	6.085	-67%
Hungary	-2.233	-1.839	-2.721	1%	-882	48%	-488	22%
Latvia	-22.315	-11.555	-12.901	3%	-1.345	12%	9.414	-42%
Lithuania	-6.799	-10.056	-8.395	2%	1.662	-17%	-1.596	23%
Malta	-5	-5	-5	0%	0	0%	0	0%
Poland	-34.851	-40.777	-36.889	9%	3.888	-10%	-2.038	6%
Romania	-21.719	-20.055	-19.482	5%	573	-3%	2.237	-10%
Slovakia	-6.638	-4.995	-6.880	2%	-1.885	38%	-242	4%
Slovenia	-2.773	-5.924	-5.900	1%	24	0%	-3.127	113%
EU-28	**-374.364**	**-396.197**	**-397.547**	**100%**	**-1.351**	**0%**	**-23.183**	**6%**

For lands in conversion to forest, the rate of annual removals is 89% higher compared to 1990 (Table 22.6). Largest sinks are estimated by Poland and Romania.

Table 22.6 5A2 Land converted to Forest Land: Net CO_2 emissions of EU-13

Member State	Net CO_2 emissions (Gg)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
EU-15	-22.770	-44.714	-43.147	80%	1.567	-4%	-20.377	89%
Bulgaria	-564	-751	-775	1%	-23	3%	-211	37%
Croatia	-272	-175	-189	0%	-15	8%	83	-30%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	-221	-322	-340	1%	-18	6%	-119	54%
Estonia	0	-28	-38	0%	-11	38%	-38	35944%
Hungary	-312	-1.110	-1.097	2%	13	-1%	-785	251%
Latvia	-3	-328	-354	1%	-26	8%	-351	11384%
Lithuania	-1033	-1112	-1143	0	-32	0	-110	0
Malta	NO	NO	NO	-	-	-	-	-
Poland	-137	-2.647	-2.684	5%	-37	1%	-2.547	1861%
Romania	-165	-2.917	-3.034	6%	-117	4%	-2.869	1736%
Slovakia	-2.218	-338	-344	1%	-6	2%	1.874	-85%
Slovenia	-838	-838	-838	2%	0,00	0%	0,00	0%
EU-28	**-28.533**	**-55.279**	**-53.984**	**100%**	**1.295**	**-2%**	**-25.451**	**89%**

Concerning the methods applied, MS mainly use Tiers 2 and 3, where country-specific methods and own data sources dominate in both subcategories, although some default factors are used (root-to-shoot ratios, biomass expansion factors and wood density). Regarding the methods, 5 MS use the "stock change" and other 6 use the "gain loss" method (Table 22.7). Noteworthy, many rely on non-NFI (i.e. non-systematic grid forest inventory, but based on forest management principles) data sources like stand wise forest inventory as management planning database.

Table 22.7 Estimation method and parameters used by EU-13 MS for the C stock change in Living Biomass pool. In italics there are non-NFI based estimation methods.

MS	Estimation method	BEF	R	D
Bulgaria	**Stock change method based on FMP database**	CS	D	CS
Croatia	*Gain-loss method based on FMP database and harvest statistics*	D	D	CS
Czech Republic	*Gain-loss method based on FMP database and harvest statistics*	CS	D	nr
Cyprus	*Gain-loss method based on forest statistic, including harvest statistics*	D	D	D
Estonia	**Stock change method based on FMP database (before 1993) and NFI data**	D	D	D
Hungary	**Stock change method based on FMP database**	nr	D	CS
Latvia	*Gain-loss method based on FMP (before 2004), NFI and harvest statistics*	nr	D	D
Lithuania	**Stock change method based on FMP (before 2000) and NFI data**	CS	D	D
Poland	*Gain-loss method based on FMP database and harvest statistics*	D	D	CS
Romania	*Gain-loss method based on FMP database, national statistics and harvest statistics*	nr	CS	CS
Slovakia	*Gain-loss method based on FMP database, harvest statistics and firewood estimate*	CS	CS	CS
Slovenia	**Stock change method based on NFI data**	D	D	D
Malta	*Gain-loss method*	D	D	D

D- default factor/ CS - country specific factor/ nr- no relevant (e.g. countries using BECF do not need to use D since it is already included)

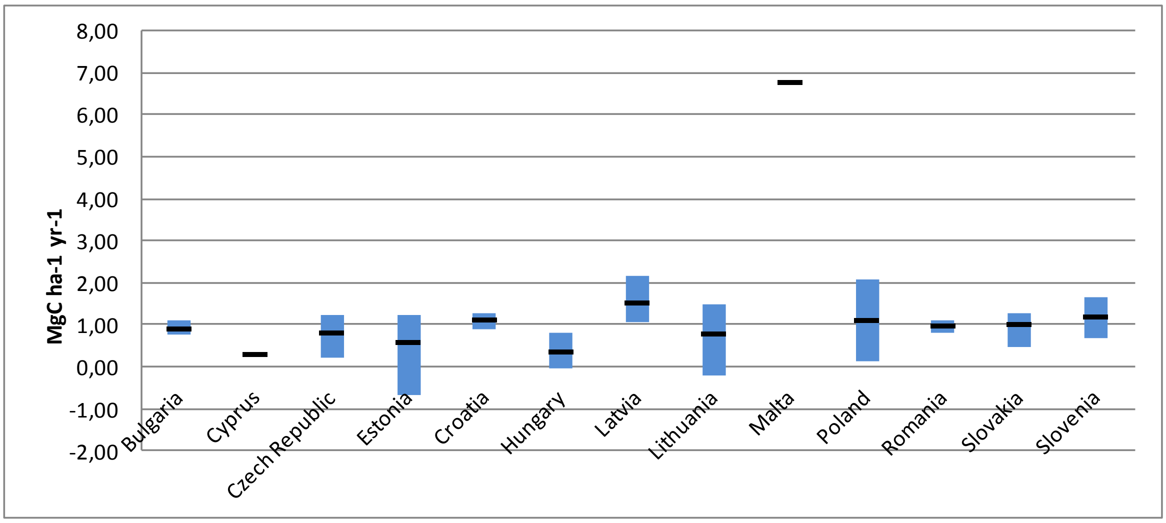
Information on the data sources used for estimation of 5A1 and 5A2 (Table 22.8) shows a wide range of methods and approaches.

Table 22.8 Relevant information on the Forest Inventories in the EU-13 MS (FMP - Forest management plan database, NFI - national forest inventory)

Country	Type of survey (for 1990 and the latest cycle): sampling design, country coverage of the grid, stand measurement plot area	Cycle length	Frequency / First NFI in …	Data source for 1990	Data source for 2008-2012
Bulgaria	Forest management planning purpose assessment of the whole territory of the country is carried out within 10 years with data collected annually and statistics updated annually (i.e. area) or every 5 years (i.e. standing stock).	10	-	FMP database	FMP database
Croatia	The Forest management plans appoints activities which will be performed in the forests for the next 10 years but also, to some extent, describes the former management (management in the previous 10-year period) and the status of forests at the beginning of the new 10-year period. So far, three FMAPs have been prepared. Summarized, the total forest land in Croatia constitutes of one forest management area which is established in order to ensure the unique and sustainable management of the forest land	10	FMAP 1986-1995	FMP database	FMP database
Czech republic	Forest management planning database aggregated up in the permanent inventory and covering entire country in 10 years cycles. Grid cell of 2x2km with two 500m^2 circular plots covering entire country.	10	Stand wise forest inventory since '50. First NFI 2001-2004	FMP database	FMP database
Estonia	Systematic sampling without pre-stratification Continuous inventory with 1/5 plots measured in a year in 5x5km grid. 25 % of the 800m side squares clusters with permanent plot of 10m radius and temporary with 7m radius. NFI follows FL conversions.	5	First NFI 1999-2002	FMP database (10 years cycles)	NFI 2012-2013
Hungary	Forest Inventory and Planning System is a GIS-based system contains geographical information on the distribution of existing forests, broad tree species categories, forest soils, designated nature and landscape areas, river catchments and archaeological sites.	10	Stand wise forest inventory database since 1970.	FMP database	FMP database
Latvia	Sampling inventory 4x4km grid of permanent clusters with four sampling plots and 2x2km grid temporary clusters with eight plots (temporary plots are 1/3 of total). Temporary clusters area is 4x that of permanent plots. Each year one fifth of the plots in the permanent sample plots are assessed. Conversions are followed. Plot consists in three concentric areas and a band within a total of 500m^2.	5	First NFI 2004–2008.	FMP database	NFI 2013-2013
Lithuania	Continuous, multistage sampling and GIS technology based inventory since 1998. 4x4km systematic grid with a random starting point. 1/3 if plots are temporary. Four permanent plots are settled in cluster of 6250m2 and temporary plots are 4x larger. Plot consists in two concentric areas with a total of 500 m^2.	5	Stand wise forest inventory database since 1922. First sampling based inventory in 1967–1969.	FMP database	NFI 2008-2013
Poland	Permanent sample plots in "L" shape clusters in 4x4km nationwide grid. A group of 5 clusters are further grouped into blocks, with one cluster measured annually. Plots consist in two concentric plots with max area of 500m^2.	5	FMP database since 1946. First sampling based inventory in 1983	FMP database	NFI 2008-2013
Romania	Forest management planning database aggregated up in 1985 and covering entire country in 10 years cycles. Continuous forest inventory with a 5-years cycle covering entire country in a year. 4 plots clustered in a grid is 4x4km grid (in plain areas 2x2 km). Plot consists in three concentric area of 2000 m2. Some 15 % of plots are temporary. Sample based forest inventory in a grid of 4x4 km. Plot consists in three concentric area of 500 m2.	6	First statistic NFI 2007-2013	FMP in 1985 (for C stock change factors) and national statistics (for activity data)	National statistics (for activity data) and NFI 2007-2013 (for C stock change factors)
Slovakia	Forest management planning database aggregated up in the permanent inventory and covering entire country in 10 years cycles.	2	First statistic NFI 2005-2006	FMP database	FMP database
Slovenia	Cluster of two/four of 6-tree sample plots on 8x8km/16k16km grid and one concentric permanent sample plot. Inventory is annually on the 16x16km grid and periodically on the 4x4km grid.	1/5–10 years	First statistic sampling 1985	Forest Ecosystem Condition Survey 2000	Forest Ecosystem Condition Survey 2013

For EU-13 MS, the average implied C stock change factor for the net change in living biomass is in the range reported by the EU-15. With the exception of Malta, which has so far reported inconsistently, the highest net change in biomass is reported by Latvia and the smallest by Cyprus and Hungary. The implied C stock change factor is negative, i.e. a net source, in case of Lithuania, Hungary and Estonia (between 1999 and 2004, harvesting double than the average, and in 2006 and 2008 wildfires).

Figure 22.3 Implied net C stock change factor (average, min and max across the time period 1990-2012) for the net change in living biomass C pool (5A1) in the EU-13. (MgC $ha^{-1}yr^{-1}$)



Dead organic matter net C stock changes are only reported by 5 MS, with values ranging from – 0.04 to 0.04 MgC $ha^{-1}yr^{-1}$. Estimates are prepared applying the on C stock-change method (i.e. Estonia, Latvia, Lithuania, Poland and Slovenia).

C stock changes in mineral soils are only reported by 2 MS: Estonia and Poland, with reported implied C stock change factors of 0.11 and 0.15 MgC $ha^{-1}yr^{-1}$ for the entire time series 1990 - 2012.

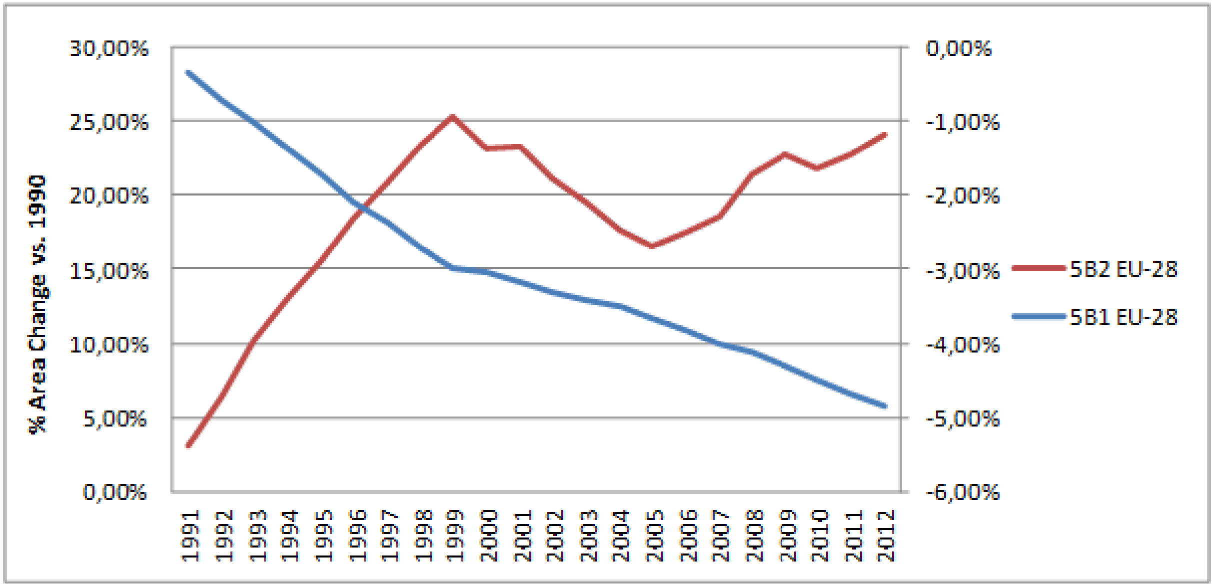
IEFs for CO_2 emissions from organic soils are between -0.27 to -0.68 MgC $ha^{-1}yr^{-1}$, as reported by 6 MS.

22.2.2 Cropland (5B; EU-28)

In the EU-28, cropland area (5B) decreased by 3%, from 132 681 in 1990 to 128 636 kha in 2012. Area of land under conversion to cropland increased by 24% compared to 1990 (Figure 22.4).

In EU-13 there was a decrease of 2 098 kha compared to 1990, shared among all MS. In absolute terms, the highest reduction of cropland areas was in Poland (526 kha).

Figure 22.4 The percentage increase of the cropland area between 1990 and 2012 in the EU-28. (axis on the left shows % increase of 5B2, axis on the right shows % increase of 5B1)



Subcategory 5B1, cropland remaining cropland is a source of GHGs of about 42 634 GgCO_2 for EU-28 (Table 22.9): 3% lower than in 1990 and 2% more than in 2011.

22.2.2.1 EU-13 MS Cropland

Within EU-13 MS, Bulgaria reports a significant increase of emissions compared to 1990, while Hungary, Slovakia and Romania report cropland as a sink in 2012. The methodologies are still largely based on Tier 1 and most MS are reporting incompletely estimates for subcategory 5B2 (other than conversions from forest land which are completely reported).

Table 22.9 5B1 Cropland remaining Cropland: Net CO_2 emissions of EU-13

Member State	Net CO_2 emissions (Gg)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
EU-15	39.980	42.350	43.088	101%	737	2%	3.108	8%
Bulgaria	370	685	687	2%	1	0%	317	86%
Croatia	180	151	235	1%	84	55%	55	30%
Cyprus	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Czech Republic	1.089	61	93	0%	32	52%	-996	-91%
Estonia	176	117	116	0%	-2	-2%	-60	-34%
Hungary	223	-1.585	-1.591	-4%	-6	0%	-1.814	-814%
Latvia	1.312	1.203	1.198	3%	-5	0%	-113	-9%
Lithuania	509	35	32	0%	-3	-9%	-478	-94%
Malta	NE,NO	-2	-2	0%	0,11	-5%	-	-
Poland	3.107	1.257	1.204	3%	-53	-4%	-1.903	-61%
Romania	-2.190	-1.607	-1.661	-4%	-54	3%	529	-24%
Slovakia	-911	-898	-947	-2%	-49	5%	-36	4%
Slovenia	217	188	185	0%	-3	-1%	-32	-15%
EU-28	**44.060**	**41.955**	**42.636**	**100,0%**	**680**	**2%**	**-1.425**	**-3%**

Lands under conversion to cropland are reported as a source almost equal to 5B1, whose area is much larger. Net emissions from lands converted to cropland are 5% larger than in 1990. Among EU-13, Lithuania reported highest emissions (Table 22.10).

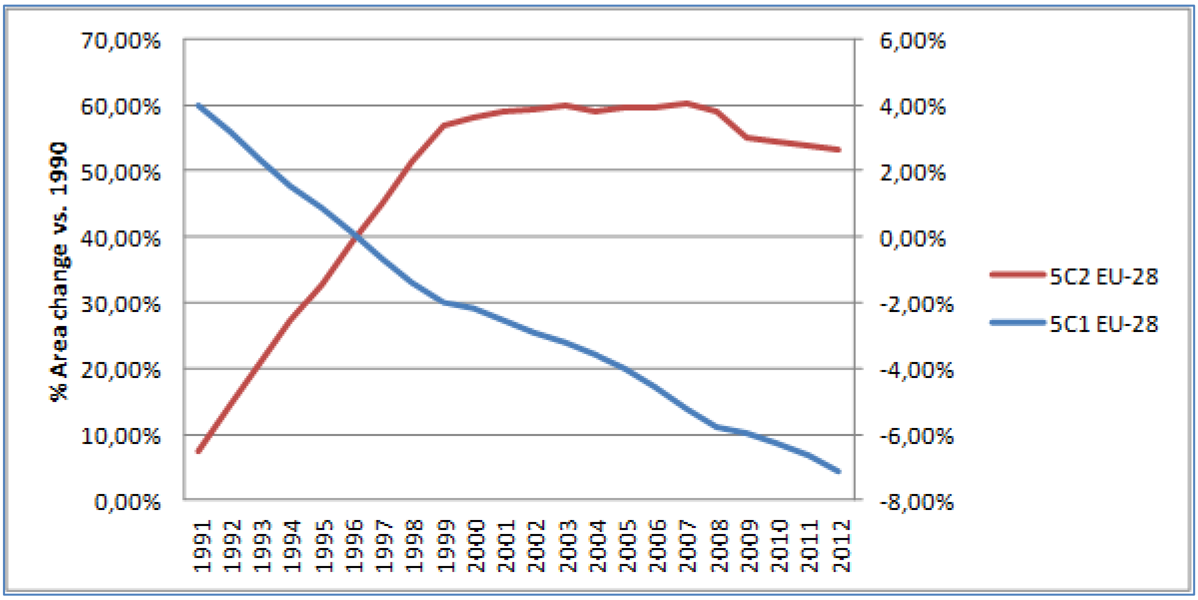
Table 22.10 5B2 Land converted to Cropland: Net CO_2 emissions of EU-13

Member State	Net CO_2 emissions (Gg)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
EU-15	36.544	40.663	40.655	88%	-8	0%	4.110	11%
Bulgaria	770	770	770	2%	0,00	0%	0,00	0%
Croatia	23	44	48	0%	4	8%	24	103%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	109	85	82	0%	-3	-4%	-27	-25%
Estonia	NO	73	74	0%	1	1%	74	-
Hungary	125	328	339	1%	11	3%	214	171%
Latvia	542	197	147	0%	-50	-25%	-395	-73%
Lithuania	5.268	3.640	3.794	8%	154	4%	-1.474	-28%
Malta	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Poland	NA,NO	104	104	0%	0	0%	104	-
Romania	-17	20	61	0%	41	199%	78	-453%
Slovakia	538	112	72	0%	-40	-36%	-465	-87%
Slovenia	256	281	283	1%	1,49	1%	27	11%
EU-28	**44.158**	**46.319**	**46.429**	**100,0%**	**110**	**0%**	**2.271**	**5%**

22.2.3 Grassland (5C; EU-28)

EU-28 grassland area (5C) has decreased across the time series to 98 568 kha, i.e. 3 % less compared to 1990, while an increase of 7 % is reported by EU-13.

Figure 22.5 The percentage increase compared to 1990 of the grassland area between 1990 and 2012 in the EU-28 (axis on the left shows % increase of 5C2, axis on the right shows % increase of 5C1)



Subcategory 5C1, grassland remaining grassland, is reported as a small source, overall less than half of the emissions from 5B. 5C1 total emission is 16.095 $GgCO_2$ in 2012, 34% less than in 1990 and 8% larger compared to previous year (Table 22.11).

22.2.3.1 EU-13 MS Grassland

Across the time series 1990-2012, the highest decrease in area of grassland is reported by Bulgaria (193 kha less than 1990), while highest increase by Malta (1 742 kha). Methodologies are largely based on Tier 1 together with default factors, although few EU-13 MS uses also country-specific factors.

Table 22.11 5C1 Grassland remaining Grassland: Net CO_2 emissions of EU-13

Member State	Net CO_2 emissions (Gg)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
EU-15	23.160	13.096	14.078	87%	983	8%	-9.082	-39%
Bulgaria	NO	NO	NO	-	-	-	-	-
Croatia	26	23	42	0%	19	84%	16	63%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	58	3	5	0%	2	64%	-53	-92%
Estonia	-17	601	541	3%	-60	-10%	558	-3290%
Hungary	80	509	463	3%	-46	-9%	383	476%
Latvia	207	115	125	1%	10	8%	-82	-40%
Lithuania	87	80	83	1%	3	3%	-4	-4%
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Poland	828	422	393	2%	-30	-7%	-435	-53%
Romania	30	15	358	2%	343	2324%	328	1099%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	13	7	7	0%	0	0%	-5	-43%
EU-28	**24.472**	**14.871**	**16.095**	**100%**	**1.223**	**8%**	**-8.377**	**-34%**

Land conversion to grassland result in a total net removal; and it is increasing across the time series 1990-2012 (Table 22.12). Only Slovenia and Romania reports it as a net source.

Table 22.12 5C2 Land converted to Grassland: Net CO_2 emissions of EU-13

Member State	Net CO_2 emissions (Gg)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO_2	%	Gg CO_2	%
EU-15	-12.404	-20.175	-19.894	83%	281	-1%	-7.490	60%
Bulgaria	-633	-633	-633	3%	0,00	0%	0,00	0%
Croatia	-85	-129	-157	1%	-28,15	22%	-72,77	86%
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Czech Republic	-141	-328	-306	1%	22	-7%	-165	118%
Estonia	16	-128	-109	0%	19,17	-15%	-125	-
Hungary	-31	-250	-115	0%	135	-54%	-84	269%
Latvia	0	-642	-663	3%	-21	3%	-663	20942153%
Lithuania	-2.449	-3.261	-2.968	12%	292	-9%	-519	21%
Malta	NO	NO	NO	-	-	-	-	-
Poland	-7	-15	-15	0%	0	-2%	-7	101%
Romania	-628	188	138	-1%	-50	-27%	766	-122%
Slovakia	-227	-275	-233	1%	43	-16%	-6	-
Slovenia	780	947	958	-4%	11,61	1%	178	23%
EU-28	**-15.809**	**-24.702**	**-23.996**	**100%**	**705**	**-3%**	**-8.188**	**52%**

22.3 Wetlands, Settlements and Other land

EU-28 Wetlands area in 2012 is around 23 752 kha, slightly decreasing as compared to 1990; 5% of the area is lands converted to wetlands. Within EU-13, total wetlands area (5D) is largest in Poland (1 369 kha) and Romania (838 kha).

EU-28 settlements area in 2012 is 28 000 kha; 22% of the area is lands converted to settlements. Areas under conversion to settlements come from cropland (45%), grassland (34%) and from forest land (15%). Within EU-13, the largest area of settlements is reported by Poland (2 146 kha) and by Romania (1 141 kha).

EU-28 Other Land area in 2012 is 12 751 kha (much less compared to previous year because of the recalculation of the land representation of Spain); 8% of the area is land converted to settlements. Within EU-13 the largest area of other land is reported by Bulgaria (535 kha) and Romania (499 kha).

Where estimated, GHG emissions are mainly computed based on IPCC default methods and factors, otherwise are reported as NE (planned to be estimated) or NO. In case of conversion from forest land, emissions from biomass are often estimated based on country specific values.

In the year 2012, for the EU-28 GHG net emissions are 10 826 GgCO_2 eq. for 5D, 48 124 GgCO_2eq. for 5E and 20 GgCO_2eq. on 5F .

22.4 Non-CO_2 GHG emissions from land use in EU-13 MS

Direct N_2O emissions from N fertilization of Forest Land and Other are mainly reported and justified as NO, as activities of fertilization on forest land do not occur in all EU-13 MS.

Non-CO_2 emissions from drainage of forest land organic soils and wetlands are reported as NO or not estimated in case of drainage of peatland (i.e. Estonia, Latvia and Lithuania). The largest area is reported by Latvia. Where estimated, emissions from drainage of forest land organic soils have been prepared applying IPCC default methods and factors.

N_2O emissions from disturbance associated with land-use conversion to cropland are reported for an area of 708.15 kha for EU-28.Within EU-13 Hungary reports the largest area (103.32 kha). All EU-13 MS use IPCC default methods and factor.

CO_2 emissions from agricultural lime application With exception of Bulgaria, Cyprus and Malta, all EU-13 MS report estimates. They all use IPCC default method and factors.

GHG emissions (CO_2, CH_4, N_2O) from biomass burning (controlled burning and wildfires), with the exception of Malta, GHG emissions from biomass burning are reported by all EU-13 MS, although often the areas are very small. In 2012 largest emissions from Biomass Burning are reported by Bulgaria and Poland.

22.5 Recalculations

Changes in activity data and factors implemented by several EU-13 MS are resulted in a larger sink for the LULUCF sector of 21 281 GgCO_2 (Table 22.13). The largest number of recalculations has been implemented in forest lands, (Table 22.14) and has been performed by Poland and Slovenia (both increased substantially the net sink reported for category 5A1).

Table 22.13 Quantitative recalculations in total LULUCF by EU-13 MS (difference between 2014 and 2013 submissions, for specified years), in Gg CO_2 eq Negative sign means removals increase compared to previous year

MS	1990	1995	2000	2005	2011
Bulgaria	541	608	581	150	-415
Croatia	-99	-77	141	516	883
Cyprus	0	0	0	110	0
Czech republic	180	270	244	262	947
Estonia	29	81	707	48	1379
Hungary	52	59	73	126	146
Latvia	2439	3027	5153	4597	5349
Lithuania	-7	-137	-147	-89	-91
Malta	51	50	49	50	52
Poland	-9177	-8650	-22302	-23248	-13705
Romania	3070	115	3542	2502	2259
Slovakia	1011	976	960	1494	1264
Slovenia	7572	7492	4548	4494	5220
EU-28	-3419	-13583	-22093	-30583	-21281

Table 22.14 Quantitative recalculations in 5A by EU-13 MS (difference between 2014 and 2013 submissions, for specified years), in Gg CO_2 eq. Negative sign means removals increase compared to previous year

MS	1990	1995	2000	2005	2011
Bulgaria	-437	-391	-363	-207	-286
Croatia	-163	-130	100	460	770
Cyprus	0	0	0	110	0
Czech republic	265	310	253	259	948
Estonia	93	27	564	59	1121
Hungary	16	16	16	16	16
Latvia	752	1352	3548	3649	4367
Lithuania	-12	-23	-28	-20	-24
Malta	43	43	43	43	43
Poland	-8835	-8836	-22592	-23003	-12085
Romania	227	150	91	53	393
Slovakia	1259	1150	1030	1485	1234
Slovenia	7187	7231	4440	4458	5281
EU-28	-16976	-18619	-35662	-45796	-51586

Small recalculations occurred also for these categories: cropland, grassland and settlements.

23 WASTE (CRF SECTOR 6)

23.1 Overview of sector (EU-28)

CRF Sector 6 Waste is the fourth largest sector in the EU-28, after energy, agriculture and industrial processes, contributing 3 % to total EU-28 GHG emissions. Total emissions from Waste have been decreasing by 32 % from 206 Tg in 1990 to 141 Tg in 2012 (Figure 23.1).

Figure 23.1 Sector 6 Waste: EU-28 GHG emissions 1990–2012 from CRF in CO_2 equivalents (Tg)

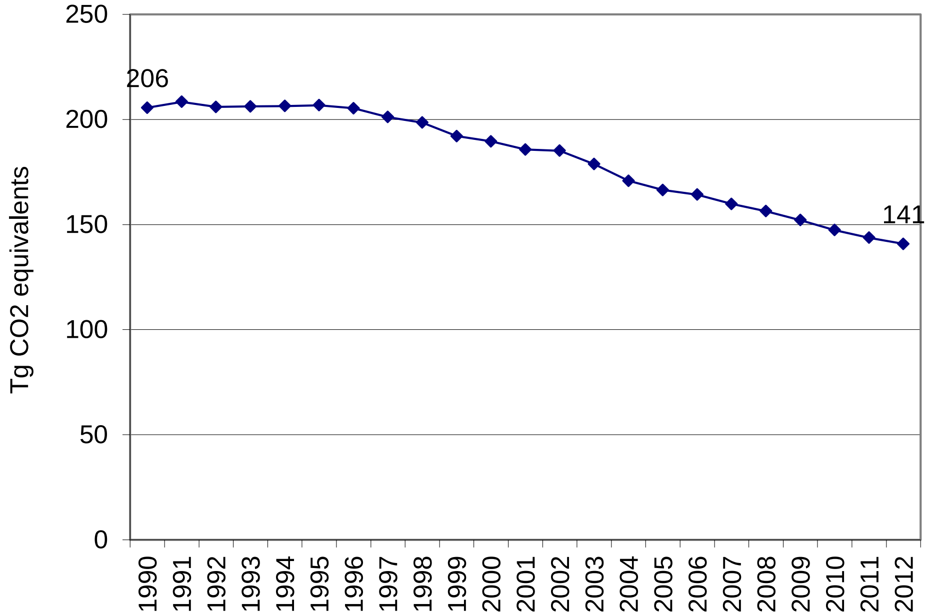
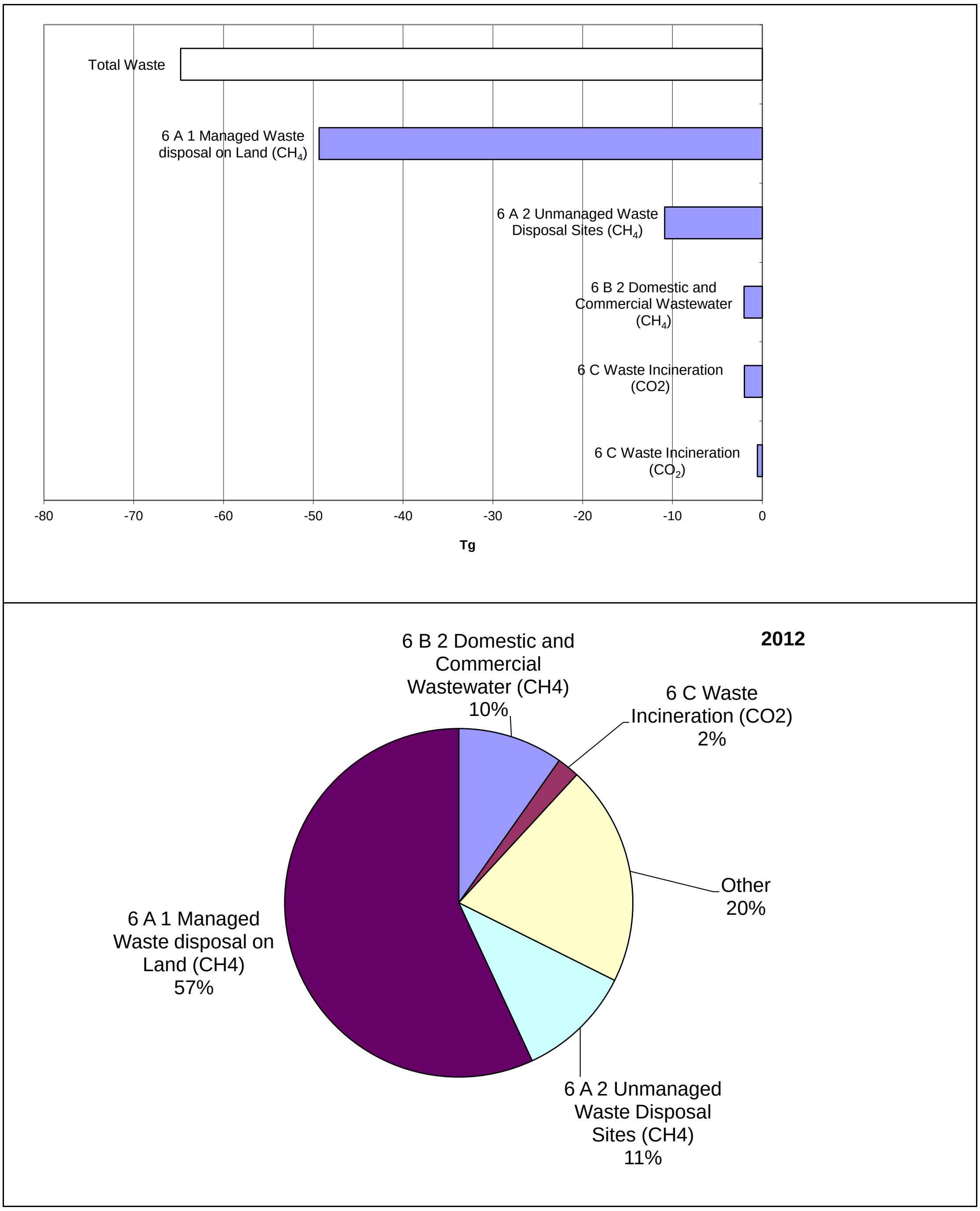


Figure 23.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 57 % of waste-related GHG emissions in the EU-28.

Figure 23.2 Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2012 in CO_2 equivalents (Tg) and share of largest key source categories in 2012



23.2 Source categories (EU-28)

23.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-28)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. The twenty largest EU key categories cover more than 75 % of total GHG emissions, one of which is the managed waste disposal on land (CRF 6A1). More information on this category in the EU-28 is provided in the following.

Table 23.1 provides information on emission trends of the key source CH_4 from 6A1 Managed Waste Disposal on Land by member state. CH_4 emissions from this source account for 2 % of total EU-28 GHG emissions. Between 1990 and 2012, CH_4 emissions from managed landfills declined by 38 % in the EU-28.

Between 1990 and 2012, eleven out of the 28 Member States reduced their emissions from this source, France, Greece, Italy, Portugal, Spain, Bulgaria, Cyprus, the Czech Republic, Croatia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia did not. In 2012, CH_4 emissions from landfills decreased by 2 % compared to 2011. A main driving force for CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal going to managed landfills declined by 41 % between 1990 and 2012. CH_4 emissions from landfills are also influenced by the amount of CH_4 recovered and utilized or flared. Compared to 2011, the share of CH_4 recovery increased in five EU-13 Member States, with a significant increase in Malta (+73.4%). For six Member states the share of CH_4 recovery decreased with a significant decrease in Romania (-44%). In comparison to last year´s submission 2013 there was a significant decrease of 27% in the share of methane recovery for Poland. This decrease is due to a correction of the methodology for estimating the methane content in landfill gas. Figure 23.7 gives an overview of CH_4 recovery in EU-13 member states.

EU-13 member states contributing most to CH_4 emissions from this source were the Czech Republic and Poland, accounting for 7 % of EU-28 emissions in 2012. Thus the new member states only have a minor contribution to total EU-28 GHG emissions in 2012. No EU-13 member state reduces its emissions between 1990 and 2012. Large emission increases are found for Poland and the Czech Republic. In both countries, a significant increase of waste deposited on managed landfills occurred during this period. In the case of Poland, this was also due to a corresponding decrease of landfilling on unmanaged waste disposal sites. Between 2011 and 2012 large increases are found for Romania (+166%). This increase is due to an error in data reporting for CH_4 recovery in 2011.

Almost all new MS used higher tier methodologies for estimating CH_4 emissions; the table suggests that 99 % of CH_4 emissions from managed waste disposal on land are calculated with higher tier methodologies.

Table 23.1 6A1 Managed Waste Disposal on Land: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	125 187	70 664	67 687	84%	-2 977	-4%	-57 499	-46%		
Bulgaria	NO	404	424	1%	21	5%	424	-	T2	CS,D
Croatia	12	566	559	1%	-6	-1%	547	4555%	T2	CS
Cyprus	451	791	936	1%	145	18%	485	108%	T1	D
Czech Republic	1 663	2 745	2 770	3%	25	1%	1 107	67%	T2	CS,D
Estonia	NO	254	240	0.3%	-14	-6%	240	-	T2	D
Hungary	268	1 187	1 313	2%	126	11%	1 045	390%	T2	D
Latvia	NO	117	144	0.2%	26	22%	144	-	T2	D
Lithuania	575	592	594	1%	3	0%	20	3%	T2	D
Malta	NA	77	20	0.0%	-57	-74%	20	-	M	M
Poland	1 014	3 092	3 241	4%	149	5%	2 227	220%	T2, T3	D
Romania	NO	325	865	1%	540	166%	865	-	T2	CS,D
Slovakia	IE	998	1 009	1%	11	1%	1 009	-	T2	CS
Slovenia	345	366	359	0.4%	-7	-2%	14	4%	T2	CS,D
EU-28	**129 514**	**82 177**	**80 162**	**100%**	**-2 015**	**-2%**	**-49 352**	**-38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Although it is good practice to calculate the emissions for key sources using the First Order Decay (FOD) method (Tier 2), one MS uses a lower tier methodology. For Cyprus, there are no sufficient historical data series available to estimate the amount of the collected waste. Table 23.2 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites.

Table 23.2 6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions in the new member states

Managed Waste Disposal on Land new member states	
Member State	**Description of methods**
Bulgaria	Emissions from solid waste disposal on land have been calculated using the First Order Decay (FOD) method, which is the IPCC Tier 2 method given in the IPCC Good Practice Guidance. Activity data for the whole period (1950-2012) stems from NSI.
Croatia	The method used to calculate CH_4 emissions according to Revised 1996 IPCC Guidelines is the First Order Decay (FOD) method. The quantity of disposed MSW is taken into account from 1955 onwards, which is in line with IPCC Good Practice Guidance.
Cyprus	Methane emissions were calculated using the default method proposed by the IPCC 1996 Guidelines. IPCC default values have been applied. For managed waste disposal on land, Methane Conversion Factor (MCF) was assumed as 1, while for unmanaged waste disposal on land MCF was assumed as 0.4 (default values from IPCC1996 Guidelines).
Czech Republic	The method used for the estimation of methane emissions from this source category is the Tier 2 FOD approach (first-order decay model). The first-order decay (FOD) model assumes gradual decomposition of waste disposed in landfills. GHG emissions were calculated using the spreadsheet for estimating methane emissions from solid waste disposal sites, which is part of the IPCC 2006 Guidelines.
Estonia	In order to estimate CH_4 emissions from solid waste disposal on landfills, the First Order Decay (the FOD) approach was employed, which is the IPCC Tier 2 method given in the IPCC Good Practice Guidance. Due to obtainable waste disposal activity data for the current inventory year and available waste disposal activity data for previous years, however country-specific key parameters are not available, the FOD method with default parameters and country-specific activity data were used. Calculating CH_4 emissions IPCC 2000 GPG FOD method is applied, although waste model presented in IPCC 2006 Guidelines is used in the estimates, which is in accordance with IPCC 2000 GPG. Some of the parameters and EF-s used in the calculations are derived from IPCC 2006 Guidelines as in the model more waste types (sewage sludge, industrial wastes) in addition to MSW are included, therefore more accurate DOC and k values are needed which are only presented in IPCC 2006 Guidelines (GPG 2000 gives DOC values for wood, food, garden and paper/textiles wastes and k value for total MSW).
Hungary	Emissions were calculated using a first order decay methodology, as response to the recommendations of the ERT in 2007. For the calculations, the IPCC Waste Model from the 2006 IPCC Guidelines was used. The FOD method produces a time-dependent emission profile which may better reflect the true pattern of the degradation process as it is claimed by the IPCC GPG. From 1990, yearly data in mass units published by the central statistical office was used. From 2006, data from the Waste Management Information System maintained by the Ministry of Environment and Water were analyzed and used for calculations.
Latvia	To estimate CH_4 emissions with the First Order Decay (Tier2) method from landfills, time series for disposed waste amounts till 1970 was developed. The base year for disposed amount estimation is 1996, when research about biggest landfills was done. All calculations are done according to 1996

Managed Waste Disposal on Land new member states	
Member State	**Description of methods**
	year amount. Disposed amount are divided between rural and urban areas, according population proportion between these areas. Methane correction factors (MCF) for CH_4 emissions calculations in urban areas (deep sites - 0.8) and rural areas (shallow sites - 0.4) are used.
Lithuania	CH_4 emissions from solid waste disposal sites were estimated using FOD model provided in the 2006 IPCC Guidelines. Parameters required for calculation are provided in the GHG 2000, however certain reservations concerning their use are provided in the guidelines. Therefore, the parameters provided in the GHG2000 were compared to parameters provided in the 2006 IPCC guidelines.
Malta	A First Order Decay (FOD) spreadsheet model has been used to work out methane emissions from the solid waste category. This model method uses IPCC 1996 default parameters as well as country specific activity data. In the waste model, 1950 was chosen as the starting year for waste deposition into landfills. Waste generation levels were calculated using back extrapolation of GDP (for industrial waste and population data for municipal waste. The extrapolation is based on UN data on population and GDP of the 2006 IPCC Guidelines Volume 5. Actual data (1997-2010) on population, GDP and waste generated were used to calculate Generation rates (per unit GDP for industrial and per million inhabitants for Municipal.
Poland	The methane emissions from solid waste disposals were calculated using the IPCC Waste Model (Tier 2) published in the IPCC 2006 Guidelines. The model establishes multiyear series when methane is generated from organic matter decomposition in anaerobic conditions. The emission of CH_4 is diminished by recapturing of this gas. IPCC default values have been applied, only methane recovery was taken from a national study.
Romania	CH_4 emissions from managed and unmanaged SWDS were calculated using the First Order Decay method, in accordance with the IPCC Good Practice Guidance. To estimate methane emissions from managed landfills historical data were not necessary, because the first managed landfill was opened in 1995. For unmanaged SWDS methane emissions were estimated based on data for 1950 to 2012, according to the IPCC Good Practice Guidance.
Slovak Republic	The estimation of methane emissions from SWDSs by the FOD method were calculated using a spreadsheet model. The methane emissions for MSW are included into category Managed waste disposal on land (6A1) from 2001, before this year the waste disposal sites were uncategorized and emissions were included in category Other municipal waste uncategorized (6A3).
Slovenia	The First Order Decay (FOD) method is used to calculate emissions.

Source: NIR 2014, NIR 2013

The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. In the following section an overview of the most important parameters and methodological aspects of the FOD method applied by member states is presented. The main factors influencing the quantity of CH_4 produced are the amount of waste disposed of on land and the concentration of biodegradable C in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the new member states are summarized in Table 23.3.

Table 23.3 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data in new MS

Managed Waste Disposal on Land new MS	
Member State	**Data sources used for generating time series (6A1)**
Bulgaria	The main source of activity data is NSI. Data on the waste generation rate and on the quantity of MSW disposed to SWDSs etc. are available as well as other data (such as waste composition with differing data quality depending on the year). Following the IPCC Good Practice Guidance, the historical amount of waste disposal was estimated assuming it to be proportional to population for the period 1950-1998 (based on review recommendations). After 1999, the source of information is NSI, which applies new methodology for collecting waste data and thus increase the quality of collecting and analysing information on waste generated and disposed. From this year, the respondents to submit the required information are municipalities that are primarily responsible for waste management at municipal level.
Croatia	Main source for activity data on MSW is Environmental Pollution Register database and Landfill Inventory database, operated by CEA from 2005 onwards. By the Ordinance on the Environmental Pollution Register (OG No. 35/08), adopted according to Environment Protection Act, the CEA is collecting data on the quantities and types of waste produced, collected, recovered or disposed. Data on quantities are available for each waste code (based on European LoW- List of Waste) and NACE activity. Historical data for the total amount of generated and disposed MSW for the period 1955-1989 have been estimated based on assumptions on national waste generation rate. Total annual MSW disposed to SWDSs for the period 1990-1998 has been evaluated from available relevant data compiled in the Report "Estimation of the Quantities of Municipal Solid Waste in the Republic of Croatia in the period 1990 – 1998 and 1998 – 2010". Insufficient data for the quantity of disposed MSW in 1999 were evaluated by interpolation method. Data for the quantity of disposed MSW in 2000 were obtained from Report of Environment Condition, Ministry of Environmental and Nature Protection. Data for the quantity of disposed MSW in 2005 were obtained from Waste Management Plan in the Republic of Croatia. Taking into account the pattern over 2000 and 2005, quantity of disposed MSW for the period 2001 to 2004 were assessed by interpolation method. Data for the quantity of disposed MSW for the period 2006-2009 was obtained from the Environmental Pollution Register. Due to low quality of data provided by operators of landfills, the data was taken from the reports of companies collecting the MSW (reporting destination of MSW). Data on the quantity of disposed MSW for the period 2010-2012 was obtained from the Environmental Pollution Register - reports delivered by the operators of active landfills.
Cyprus	Data on total MSW production and annual per capita production are available for the period 1996-2012 from the National Statistical Service. The data for the period 1990-1995 was obtained using the linear trend equation of 1996-2008. The years 2009 to 2012 were excluded from the trend, because during those years there are considerable changes in (a) the economy of the country and (b) the waste management practices of the country, which resulted in a decrease of the waste production. Data on MSW disposed at SWDS is available for the period 1996-2012 from the National Statistical Service. For the period 1990-1995 it was assumed that the fraction of waste disposed to SWDS is the same as 1996. Data on the composition of waste to disposal sites is available for the period 1996 to 2011. For the period 1990-1995 it is assumed that the composition is the same as 1996 and for the year 2012 that the composition is the same as 2011. No data is available on the depth of the

Managed Waste Disposal on Land new MS	
Member State	**Data sources used for generating time series (6A1)**
	unmanaged disposal sites. According to the consultations with the Ministry of Interior, all unmanaged disposal sites should be assumed to have depth smaller than 5m, and therefore be assumed shallow.
Czech Republic	Key activity data consists in the amount of waste disposed in landfills. Data for annual disposal are from mixed sources because correct application of the FOD model requires data from 1950 to the present day. These data are not available in the country and therefore assumptions about the past must have been used. These assumptions are described in a working paper, but the method can be simply described as interpolation and extrapolation between points in time; waste production was correlated with the social product (predecessor of current GDP) as a test method. The higher of the two estimates was used in the quantification. Data used for present dates are based on information system of waste management (ISOH) managed by CENIA – Czech Environmental Information Agency. The system contains bottom up data from about 60,000 respondents and reporting obligation to this system is based on national legislation.
Estonia	For calculating emissions from solid waste disposal sites, the total amount of municipal and industrial waste generated and deposited in 2012 (collected from Estonian Environment Agency (EtEA)) and amount of methane recovered (obtained from the EtEA Air bureau) are used as activity data. Since 1992 the EtEA has started to collect data in accordance with the Estonian waste classification, however in 1999 the adapted classification system was changed and the European Waste Catalogue was employed. The data for 1990–1991 were interpolated based on the data of 1992–1998. The forecast function of the Excel software was used to calculate the quantities of waste generated in the period 1990–1991.
Hungary	For activity data collection, the main data sources were the following: from 1975: Statistical Yearbooks; 1990-2002: Statistical Yearbooks, Environmental Statistical Yearbooks, Eurostat; 2003-2006: Data provision by the Ministry of Environment and Water, Statistical yearbooks, Eurostat; 2006 onwards: Waste Management Information System, Statistical Yearbooks, Eurostat. As the eldest data which can be found in statistical publications are for 1975, extrapolation had to be made. For the period 1950-1975, instead of using constant values for disposed waste as in previous submission, the assumptions were made that the amount of disposed waste between 1950 and 1975 is assumed to be proportional to urban population. Urban population increased by more than 50 per cent between 1950 and 1975 based on information from the statistical office. Published data on landfilled waste was futher available for 1980 and 1985.
Latvia	The amount of waste stems from different sources. Historical data from national statistics are partly available, all other years are estimated according to these figures. Disposed amount are estimated according to GDP and population changes. Waste amounts 1997 – 2001 was estimated like equal growth between 1996 and 2002 amount. Amounts 1970 – 1995 were estimated according to GDP and population changes. Landfills from 1970 – 2001 are estimated as unmanaged. Disposed amount are divided between rural and urban areas, according population proportion between these areas. Data about waste disposal on land for 2002 - 2012 are taken from database “3-Wastes”. Starting from year 2002, according to data base information, biggest sites could be estimated as managed sites (polygons) and MCF-1 is starting to use. For each year (2002- 2012) in polygons disposed amount are determined according to disposing site profile from “3- Wastes” data base.

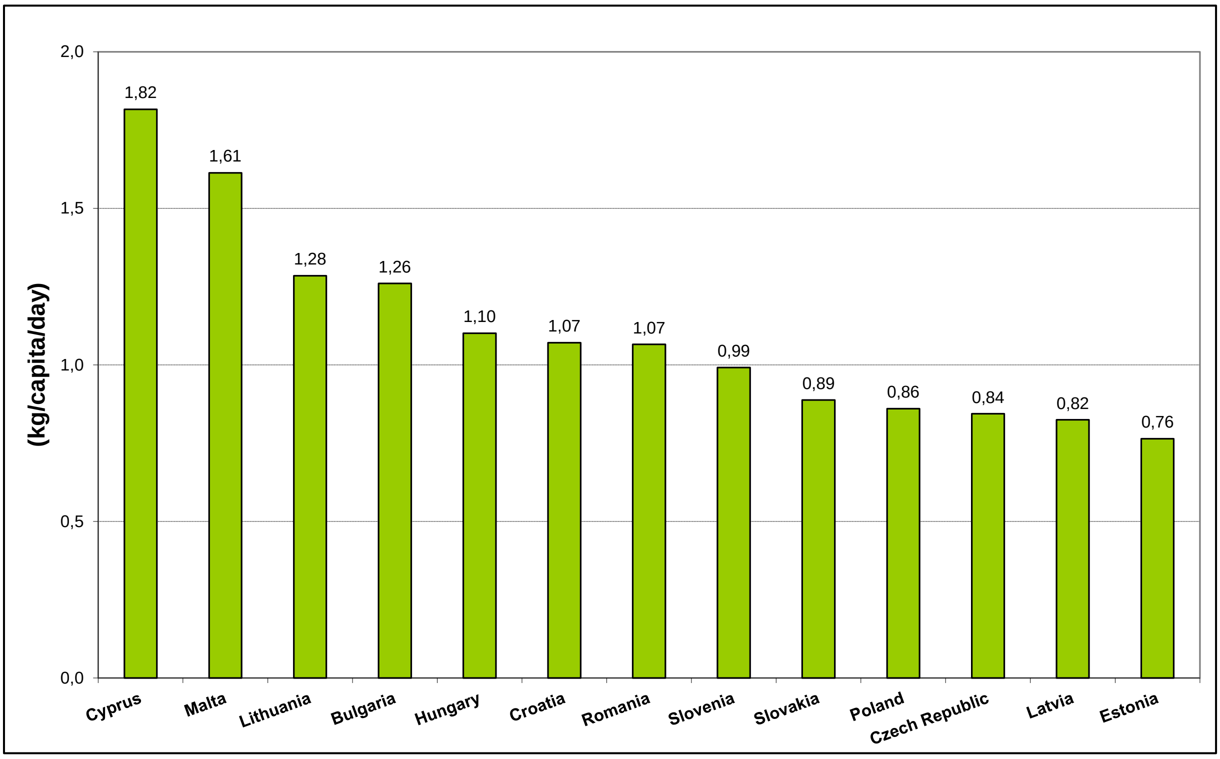
Managed Waste Disposal on Land new MS	
Member State	**Data sources used for generating time series (6A1)**
Lithuania	Data on waste generation and disposal were collected in Lithuania only from 1991, data on disposal before 1991 are not available. Waste disposal data for 1991-1998 is based on assumption that annual change of per capita amount of waste disposed to landfills makes 10% of per capita GDP change provide much more realistic information than the data collected by statistics. Actual statistical data on municipal waste disposal to landfills were used for calculation of CH_4 emissions from landfills during 1999-2012. For the period 1990-1998 waste disposal was evaluated using estimated annual changes and population number provided by the Statistics Lithuania. The data is provided by the Lithuanian Environmental Protection Agency (EPA), which is responsible for environmental statistics in Lithuania. The amount of waste disposed of in landfills in 1950-1989 was evaluated on the basis of the several considerations.
Malta	In this waste model, 1950 was chosen as the starting year for waste deposition into landfills. Waste generation levels were calculated using back extrapolation of GDP (for industrial waste and population data for municipal waste. The extrapolation is based on UN data on population and GDP as referred to in 3.2.2 of the 2006 IPCC Guidelines Volume 5 [2]. Actual data (1997-2010) on population, GDP and waste generated were used to calculate Generation rates (per unit GDP for industrial and per million inhabitants for Municipal. The results were then back extrapolated to estimate historic rates of waste production.
Poland	Generated municipal solid waste – for the years 1970 – 2004 data was extrapolated according to the amount of collected municipal solid waste. For 2012, statistical data is available of the shares of waste treatment as follows: 0.5% incineration, 9.7% biological treatment, 74.7% landfills, 15.1% recycling). Distribution of solid waste disposal sites for managed and unmanaged landfills until 2001 was made following a national study. According to this publication, 14% of disposal sites are managed, 86% are unmanaged. In accordance to data from Waste Management Department of Ministry of Environment about amount of MSW landfilled on landfills fulfilling requirements of the Directive the share of MSW on managed and unmanaged SWDSs was updated. Since 2012 all SWDSs in Poland fulfill the Directive and can be considered as „managed”.
Romania	For 2003-2011, the data on the amounts of MSW disposed to managed and unmanaged SWDS were provided by Waste Directorate from National Environmental Protection Agency, as a result of surveys conducted each year by NEPA and National Institute for Statistics (NIS). For 2012, the statistical survey on waste has not yet been finalised; therefore data estimated based on the waste generation rate was used. The historical data on MSW storage were estimated in the context of a study in 2011.
Slovak Republic	The Statistical office of the Slovak Republic publishes data on MSW generation and disposal since 1993. Although this creates a timeline of 15 years, this is not sufficient for the use of FOD method. A longer timeline of data is needed, thus it was decided to generate a MSW data from 1960, i.e. for 48 years. Latest indication on MSW generation in the Slovak Republic was found for 1960 and 1970. Since 1992, data from annual monitoring are available. Annual MSW generation was interpolated.
Slovenia	There are no data on the amount of waste prior to 1995. The first regulated municipal solid waste disposal site started its operation in 1964. An estimate for the period 1964-1994 was made based on the assumption that in 1964, 50% of the population was included in a municipal waste collection system and that this share increased to 60% in 1977 and 76% in 1995. The amount of waste in the period 1995-2000 is provided by the SURS. The total annual amount of municipal waste and the

Managed Waste Disposal on Land new MS	
Member State	Data sources used for generating time series (6A1)
	fraction of landfilled municipal waste between 2001 and 2012 stems from the Environmental Agency of the Republic of Slovenia, which on a regular basis collects data on the formation and handling of all types of waste in Slovenia.

Source: NIR 2014, NIR 2013

In the additional information box of the CRF tables, the waste generation rate is not very well defined. No clear definition is available on which waste fractions should be included for comparability; neither the UNFCCC reporting guidelines, nor the CRF, nor the IPCC Guidelines provide an exact definition which waste types and waste streams should be included in the estimation of the waste generation rate. Therefore Figure 23.3 provides an overview for EU-13 based on data derived from EUROSTAT. To conform to the Regulation on waste statistics (EC) No. 2150/2002, amended by Commission Regulation (EU) No. 849/2010, data on the generation and treatment of waste is collected from the member states and prepared in a homogenous way.

Figure 23.3 Waste Generation Rate for EU-13

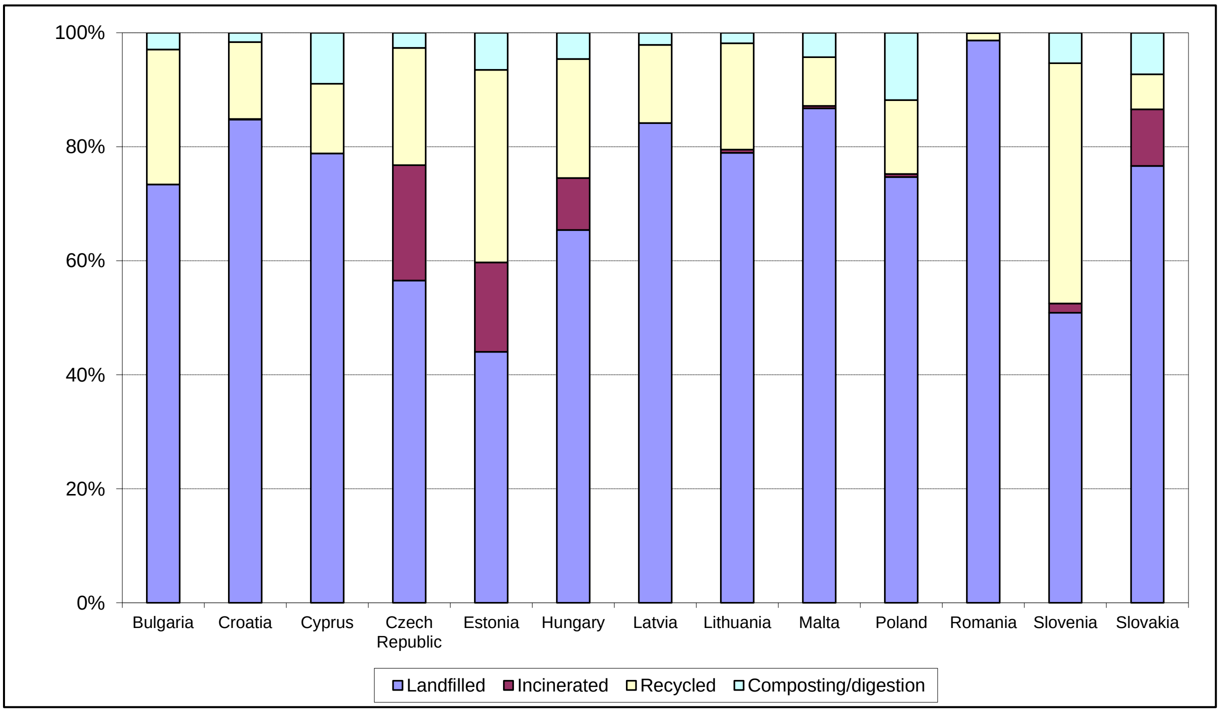


Source: EUROSTAT 2013

The waste generation rate per capita varies significantly among the new member states (0.76 kg/capita/day for Estonia to 1.82 kg/capita/day for Cyprus).

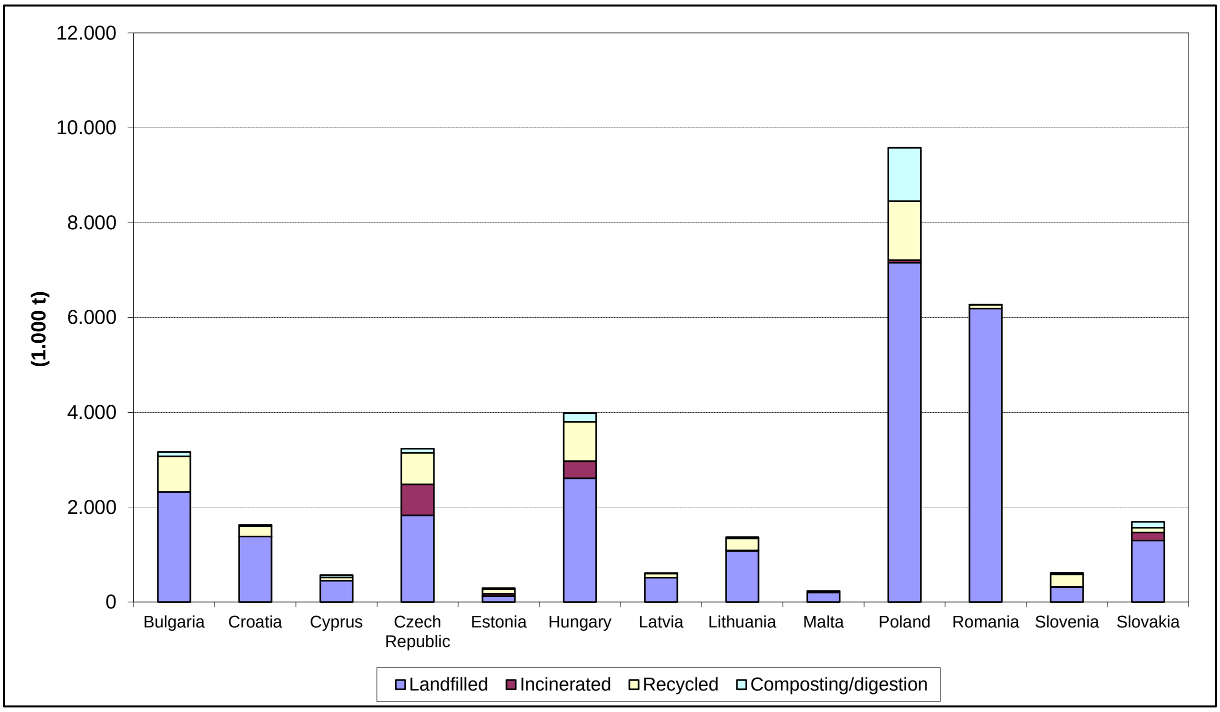
The amount of waste generated on SWDS is strongly influenced by the waste management practices or the share of waste incinerated, recycled and composted (Figure 23.4). Compared to the management practices in EU-15, recycling is still of minor importance in the new MS, only 12 % of municipal waste was recycled in EU-13 MS, compared to 29 % for the EU-15. The recycling rate of waste is highest in Slovenia (42 % of treated waste) and Estonia (34% of treated waste) and thus higher than the average rate for EU-28 (27 %). Figure 23.5 shows absolute values for waste management practices.

Figure 23.4 Waste management practices for the new EU-13 MS (shares) in 2012



Source: EUROSTAT 2014

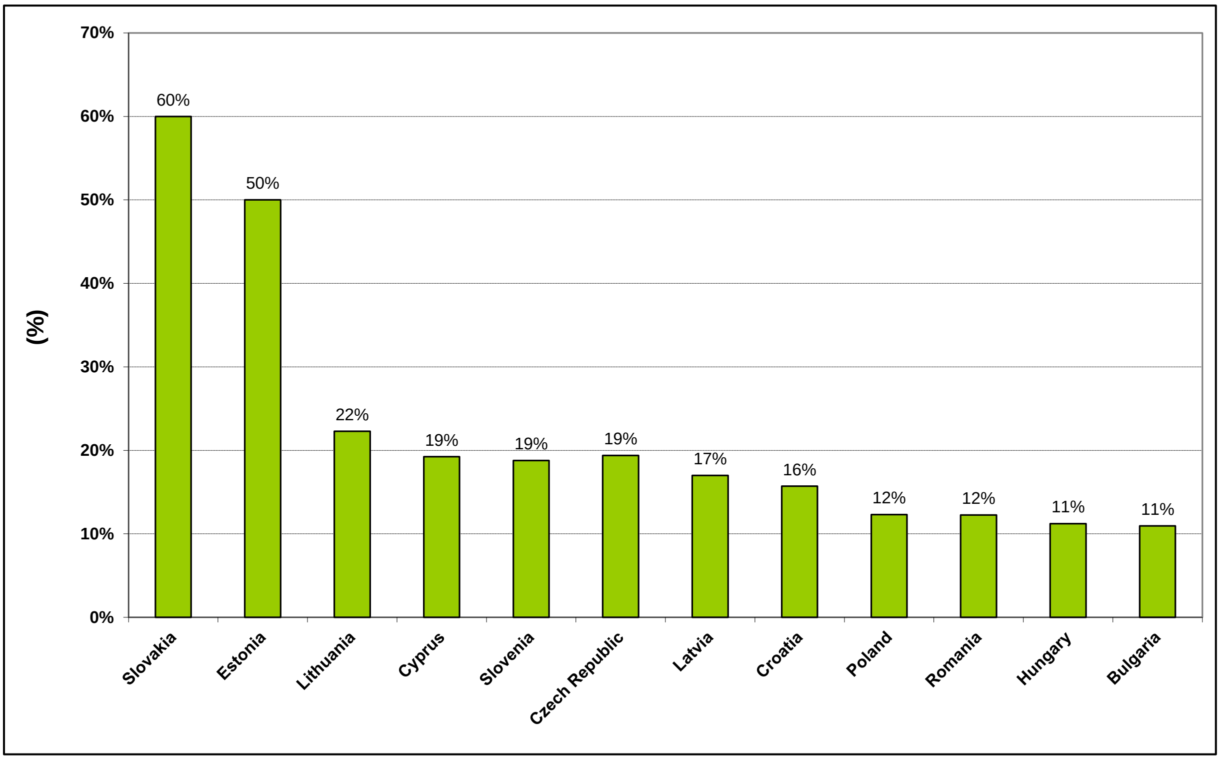
Figure 23.5 Waste management practices for the new EU-13 MS (absolute values) in 2012



Source: EUROSTAT 2014

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. The DOC is likely to vary due to the strong influence of waste management practices and policies, whereas the first three parameters do not vary strongly among the member states. The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream; different countries are known to have MSW with widely differing waste compositions. Figure 23.6 illustrates the average DOC value for different waste fractions in MSW for EU-13 for the year 2012.

Figure 23.6 6A1 Managed Solid Waste Disposal: Fraction of DOC in MSW for EU-13, average for different waste fractions in 2012

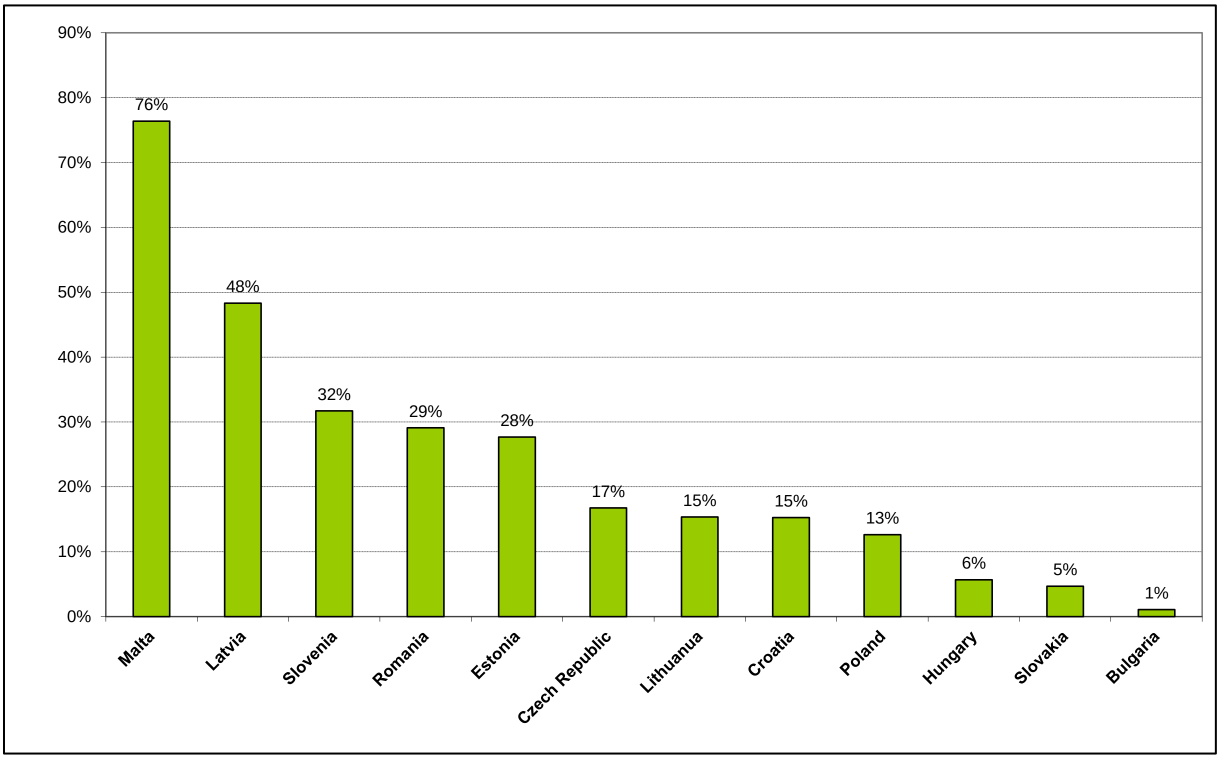


Source: CRF 2014 Table 6A,C Additional information.

Besides lower quantities of organic carbon deposited into landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills. The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered varies among the member states, tending to be low in the new member states, except for Malta, Latvia; Slovenia, Romania and Estonia. Compared to 2011, Malta significantly increased its recovery (73.4 %[84]). In Malta methane recovery from managed sites increased drastically in 2012 through the implementation of gas recovery at the major active managed landfill in operation locally. Romania collects data on methane recovery from operators. In 2012 eight managed sites recovered methane for flaring. In Latvia, according to Latvia's Waste Management plan 2006-2012, CH_4 recovery from landfills is one of the priorities in waste management. In 2010, in three waste facilities CH_4 recovery was available.

84 Values refer to percentage points.

Figure 23.7   6A1 Managed Solid Waste Disposal: Methane recovery for EU-13



*CH_4 recovery in % = CH_4 recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions in Gg)*100*
Source: CRF 2014 Table 6A,C

CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land account for 0.1 % of total EU-28 GHG emissions in 2012. Between 1990 and 2012, CH_4 emissions from this source in the EU-13 decreased in most new member states, except for Croatia, Malta and Romania. In the case of Romania, despite a significant increase of waste disposal on managed landfills since 1990, waste disposal on unmanaged landfills received larger amounts of waste than managed landfills until 2009. Due to the kinetics of anaerobic decay, increasing CH_4 emissions from unmanaged landfills can therefore be explained.

Thus the overall reduction of CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land for the EU-28 was lower than for EU-15 (-61 %), amounting to -42 % between 1990 and 2012 (Table 23.4). Emission reductions both in absolute and relative terms were highest in Poland, Bulgaria and Hungary. In Bulgaria, this was due to the decrease in population and a corresponding decrease in waste generation and the increasing quantity of waste deposited on managed sites. In Poland, waste generation was also reduced significantly since 1990 and managed landfills receive larger shares of waste than unmanaged landfills since 2004. In comparison to the previous submission Hungary revised its waste disposal data. In the last submission, all disposal sites were considered as managed. However, based on a survey of landfill sites in 2002, it turned out that 85% of all disposed wastes went to unmanaged sites. Consequently, Bulgaria reallocated 85% of disposed waste from managed to unmanaged for the years before 2000. From 2001, all disposal is considered as managed. Cyprus reports NO for CH_4 emissions from unmanaged landfills for the first time in 2012, as all waste is going to managed landfills. As Cyprus applies the IPCC default method for calculating CH_4 emissions from landfills the emissions stop in the same year in which waste disposal is stopped.

The share in EU-28 emissions 2012 was highest for Poland (22 %) and Bulgaria (16 %). Romania had the largest increase in absolute terms between 1990 and 2012. Table 23.4 suggests that in 2012 all CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land are calculated with higher tier methodologies.

Table 23.4 6A2 Unmanaged Waste Disposal on Land: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012		Method applied	Emission factor
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%		
EU-15	13 948	5 707	5 409	36%	-298	-5%	-8 538	-61%		
Bulgaria	3 326	2 496	2 404	16%	-92	-4%	-922	-28%	T2	CS,D
Croatia	231	205	234	2%	28.6	14%	3	1%	T2	CS
Cyprus	91	65	NO	-	-64.9	-	-91	-100%	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	1 515	1 214	1 159	8%	-56	-5%	-356	-23%	T2	D
Latvia	330	320	305	2%	-15	-5%	-25	-8%	T2	CS,D
Lithuania	252	190	172	1%	-18	-10%	-80	-32%	T2	D
Malta	14	32	31	0.2%	-2	-5%	17	120%	M	M
Poland	4 983	3 510	3 280	22%	-230	-7%	-1 703	-34%	T2, T3	D
Romania	1 279	2 162	2 101	14%	-61	-3%	822	64%	T2	CS,D
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-28	**25 967**	**15 903**	**15 095**	**100%**	**-808**	**-5%**	**-10 872**	**-42%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

23.2.2 Wastewater handling (CRF Source Category 6B) (EU-28)

CH_4 emissions from 6B2 Domestic and Commercial Wastewater account for 0.1 % of total EU-28 GHG emissions. Between 1990 and 2012, EU-28 emissions decreased by 4 %. Large decreases in absolute terms are reported from Hungary and Romania, only Poland reported a significant increase of emissions (by 268%) (Table 23.5). This increase is reported for the first time in this submission. After an in-country review in 2013 Poland revised the value for methane recovery to avoid underestimation, which resulted in a trend change from decreasing to increasing emission. Emissions reductions in Romania are due to a significant reduction of the organic load in domestic and commercial wastewater since 1990.

Romania, Poland and Bulgaria are responsible for 55 % of the EU-28 emissions from this source in 2012. Between 2011 and 2012, CH_4 from 6B2 Domestic and Commercial Wastewater remained almost constant for the EU-28.

Table 23.5 6B2 Domestic and commercial wastewater: CH_4 emissions of EU-28

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	7 907	4 999	4 980	36%	-18	0%	-2 927	-37%
Bulgaria	515	436	406	3%	-29.8	-7%	-109	-21%
Croatia	237	202	190	1%	-12	-6.1%	-47	-20%
Cyprus	106	47	38	0.3%	-10	-21%	-68	-65%
Czech Republic	214	196	196	1%	-0.002	0%	-18	-9%
Estonia	8	1	1	0.0%	-0.03	-3%	-7	-91%
Hungary	757	302	283	2%	-19	-6%	-474	-63%
Latvia	158	92	88	1%	-5	-5%	-70	-44%
Lithuania	174	102	102	1%	0.3	0.3%	-72	-41%
Malta	12	3	0	0.0%	-3	-100%	-12	-100%
Poland	1 378	4 933	5 066	37%	133	3%	3 688	268%
Romania	2 370	2 110	2 101	15%	-9	-0.4%	-269	-11%
Slovakia	367	291	289	2%	-2	-1%	-78	-21%
Slovenia	123	61	51	0.4%	-10	-17%	-72	-58%
EU-28	**14 325**	**13 776**	**13 791**	**100%**	**15**	**0.1%**	**-533**	**-4%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 6B2 Domestic and Commercial wastewater account for 0.3 % of total EU-28 GHG emissions. Between 1990 and 2012, EU-28 emissions remained almost constant (Table 23.6). Six out of thirteen new member states increased their emissions in that period (Croatia, Cyprus, Malta, Poland, Romania and Slovenia), but these member states are responsible for only 20 % of EU-28 N_2O from 6B2 Domestic and Commercial wastewater in 2012.

Romania's emissions increased since 1990 (with few exceptions) due to a significant increase in daily protein intake. The new member states contributed to keeping total emissions in EU-28 stable. Largest reductions in absolute terms could be found for Bulgaria, Slovakia and Hungary. Poland's share in EU-28 emissions in 2012 is highest among EU-13. The member states neither increased nor decreased its emissions significantly during the time series.

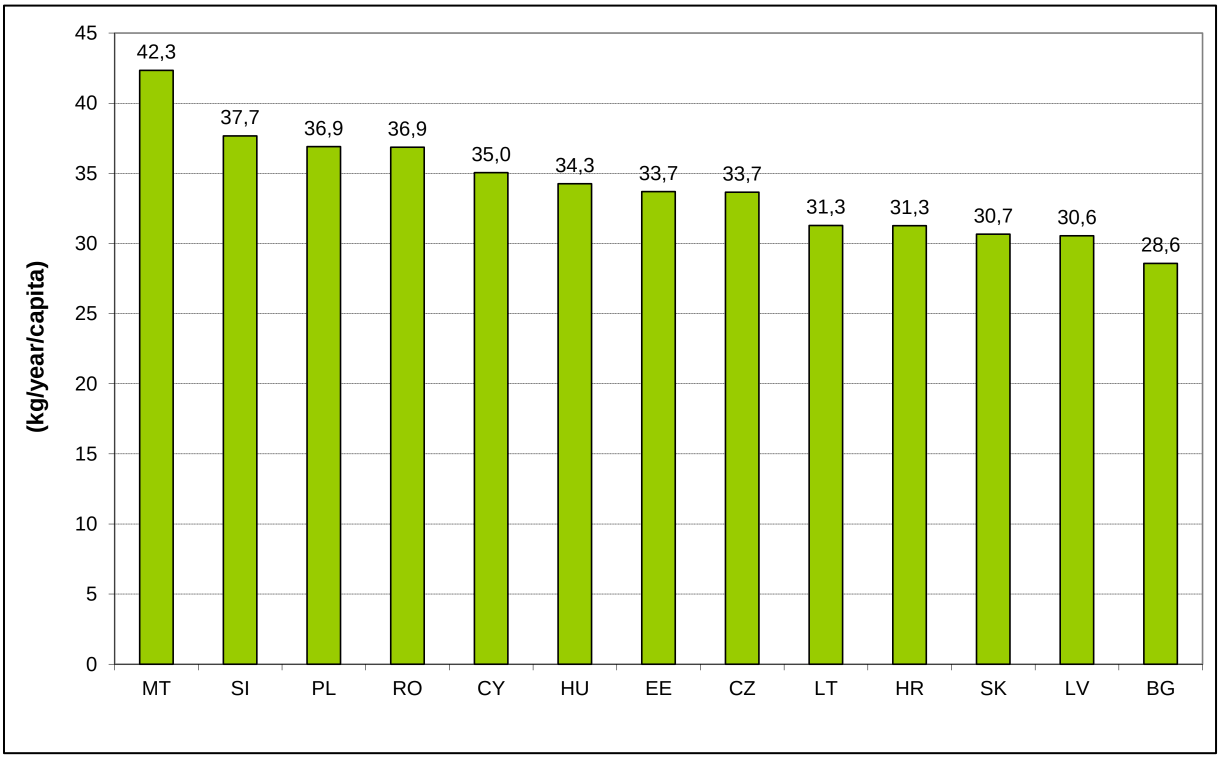
Table 23.6 6B2 Domestic and Commercial Wastewater: N_2O emissions of EU-28

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	9 534	9 428	9 452	77%	24	0.3%	-82	-1%
Bulgaria	237	163	162	1%	-1	-1%	-74	-31%
Croatia	85	104	104	1%	0.4	0.3%	19	23%
Cyprus	16	24	24	0.2%	0.1	0.5%	7	46%
Czech Republic	312	275	276	2%	0.3	0.1%	-36	-12%
Estonia	46	35	34	0.3%	-1.2	-3%	-12	-26%
Hungary	309	266	265	2%	-1	-0.3%	-44	-14%
Latvia	64	49	49	0.4%	-0.61	-1%	-15	-23%
Lithuania	80	73	73	1%	-0.33	-0.5%	-7	-9%
Malta	12	14	14	0.1%	0.2	1%	2	18%
Poland	1 099	1 108	1 108	9%	-0.1	-0.01%	9	1%
Romania	601	627	614	5%	-14	-2%	13	2%
Slovakia	105	63	64	1%	1	1%	-41	-39%
Slovenia	60	60	60	0.5%	0.1	0.2%	1	1%
EU-28	**12 558**	**12 290**	**12 299**	**100%**	**8**	**0.1%**	**-260**	**-2%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Emissions are mainly driven by the annual per capita protein consumption, being one relevant component for the calculation of nitrous oxide emissions from household wastewater according to the IPCC method. An overview of daily protein intake by member state is given in Figure 23.8.

Figure 23.8 6B Waste Water Handling: Protein consumption



Source: CRF 2014, Table 6 B

23.2.3 Waste incineration (CRF Source Category 6C) (EU-28)

This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture. Table 23.7 summarizes greenhouse gas emission trends by Member State. CO_2 emissions from waste incineration account for 0.1 % of total EU-28 GHG emissions.

Between 1990 and 2012, CO_2 emissions from waste incineration decreased by 41 % in the EU-28. Bulgaria, Croatia, the Czech Republic, Malta and Slovenia increased their CO_2 emissions from waste incineration between 1990 and 2012. The largest increase in absolute terms could be found for the Czech Republic contributing the second most to EU-13 emissions (7 % of EU-28 emissions in 2012). This increase could be explained by the increased amount of municipal solid waste being incinerated. Consequently there is a significant share of waste going to waste incineration (20% in 2012, compare Figure 23.4).

Between 1990 and 2012, Poland and Slovakia had the largest decreases in absolute terms. Poland, has the largest share in EU-13 emissions, see Table 23.7. In Slovakia, the reduction in emissions was caused by the decrease of the number of incineration plants due to the expiration of transition period for selected incinerators in 2006, as defined in the EU accession agreement.

Table 23.7 6C Waste incineration: CO_2 emissions of EU-28

Member State	CO_2 emissions in Gg			Share in EU28 emissions in 2012	Change 2011-2012		Change 1990-2012	
	1990	2011	2012		Gg CO2 equiv.	%	Gg CO2 equiv.	%
EU-15	4 348	2 495	2 288	79%	-208	-8%	-2 060	-47%
Bulgaria	20	10	21	0.7%	10	97%	0.3	1%
Croatia	0.04	0.05	0.1	0.003%	0.03	62%	0.03	80%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	23	187	207	7%	19	10%	184	794%
Estonia	0.03	NO	0.003	0.0001%	0.003	-	-0.03	-92%
Hungary	NA	93	93	3%	0.1	0.1%	93	-
Latvia	NO	0.3	0.3	0.01%	-0.02	-6%	0.3	-
Lithuania	4	7	2	0.1%	-5	-77%	-3	-62%
Malta	0.4	0.7	0.6	0.02%	-0.1	-10%	0.2	66%
Poland	447	227	279	10%	52	23%	-168	-38%
Romania	NE,NO	7	8	0%	1	15.5%	8	-
Slovakia	63	10	8	0.3%	-2	-17%	-55	-87%
Slovenia	1	5	5	0.2%	0.2	3%	4	304%
EU-28	**4 907**	**3 043**	**2 911**	**100.0%**	**-132**	**-4%**	**-1 997**	**-41%**

Abbreviations explained in the Chapter 'Units and abbreviations'

24 OTHER (CRF SECTOR 7)

The 2012 GHG inventory does not include any GHG emissions in CRF sector 7.

25 RECALCULATIONS AND IMPROVEMENTS

25.1 Explanations and justifications for recalculations

Table 25.1 to Table 25.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2011 for each Member State, which provided the relevant information, and by source categories, for the largest recalculations (>+/- 500 Gg). For more details see the information provided by the Member States' submissions in Annex 2.12.

Table 25.1 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	Croatia	7127	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1A1_Energy Industries CO_2	Hungary	-2161	-10	Activity data reallocation based on IEA data. Inclusion of blast furnace gas.
1A1_Energy Industries CO_2	Romania	1568	2	Correction of the activity data in the Energy Balance.
1A1_Energy Industries CO_2	Slovakia	2741	16	The reallocation of solid fuels into liquid fuels was performed based on the ERT recommendation and in line with the IPCC 2000 GPG. The "NO" notation key was used for all emissions and all years. The reallocation of solid fuels into liquid fuels was performed based on the ERT recommendation and in line with the IPCC 2000 GPG. The "NO" notation key was used for all emissions and all years.
1A2_Manufacturing Industries and Construction CO_2	Croatia	5843	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1A2_Manufacturing Industries and Construction CO_2	Cyprus	-548	-51	New data, previously reporte NE.
1A2_Manufacturing Industries and Construction CO_2	Hungary	4601	39	Activity data based on IEA.
1A2_Manufacturing Industries and Construction CO_2	Romania	687	1	Correction of the activity data and net calorific values in the Energy Balance .
1A2_Manufacturing Industries and Construction CO_2	Slovakia	-1312	-7	The recalculation of the category 1.A.2c in the liquid fuels is connected with the recalculation of the category 1.A.1b, where the energy plant inside the refinery is reported in the category 1.A.1b in this submission.
1A3_Transport CO_2	Croatia	4019	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1A3_Transport N_2O	Romania	534	1689	1A3a: Due to changes of value AD by the National Institute of Statistics. 1A3b: AD due to update of value of Net Caloric Value (NCV). AD used in the model Copert 4, due to was changed of values for monthly average min. and max. temperatures. AD used in the model Copert 4, due to was changed of values for monthly average min. and max. temperatures. 1A3cand 1A3e: Due to update of value of Net Calorific Value.
1A4_Other sectors CO_2	Croatia	3606	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1A4_Other sectors CO_2	Hungary	-1083	-5	Allocation based on IEA data.
1B2_Oil and natural gas CH_4	Croatia	1202	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1B2_Oil and natural gas CO_2	Croatia	640	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
2A_Mineral products CO_2	Croatia	1305	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
2A_Mineral products CO_2	Poland	627	7	Use of soda ash consumption instead of soda ash production for CO_2 emission estimation from soda ash use. Change of AD in emission estimation from soda ash use.
2B_Chemical industries N_2O	Croatia	785	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
2C_Metal production CO_2	Hungary	-2593	-81	2C12: revised data in IEA statistics. 2C14: separation of recovered amount reported in 1.A.1.a.
2C_Metal production CO_2	Poland	524	9	Changes in allocation of fuels between 1.A.2.a and 2.C.1.
2C3_Aluminium production PFC	Croatia	937	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
4A_Enteric fermentation CH_4	Croatia	1443	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
4D_Agricultural soils N_2O	Croatia	2549	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
4D_Agricultural soils N_2O	Poland	4278	19	Correction of AD for young cattle in 1988-1997; amendment of AD sewage sludge used for agricultural purposes for 1988-2002. Correction of AD for indirect emissions (organic fertilisers); correction of AWMS for sheep/goats.
6A_Solid waste disposal on land CH_4	Poland	1805	24	Change of method of calculating amount of methane in recovered biogas. Correction of AD on industrial waste on disposal sites. Addition of estimation of emissions from composting waste.

Table 25.2 Main recalculations by source category for 2011 and Member States' explanations for recalculations given in the CRF or in the NIR

		2011		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	Croatia	6253	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1A1_Energy Industries CO_2	Hungary	1144	7	Activity data reallocation based on IEA data. Inclusion of blast furnace gas.
1A1_Energy Industries CO_2	Romania	-1091	-3	Correction of the activity data in the Energy Balance.
1A1_Energy Industries CO_2	Slovakia	589	6	The reallocation of solid fuels into liquid fuels was performed based on the ERT recommendation and in line with the IPCC 2000 GPG. The "NO" notation key was used for all emissions and all years. The reallocation of solid fuels into liquid fuels was performed based on the ERT recommendation and in line with the IPCC 2000 GPG. The "NO" notation key was used for all emissions and all years.
1A2_Manufacturing Industries and Construction CO_2	Croatia	3175	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1A2_Manufacturing Industries and Construction CO_2	Czech Republic	886	5	New CS EF.
1A2_Manufacturing Industries and Construction CO_2	Hungary	763	20	Activity data based on IEA.
1A2_Manufacturing Industries and Construction CO_2	Romania	-1207	-8	Correction of the activity data and net calorific values in the Energy Balance .
1A2_Manufacturing Industries and Construction CO_2	Slovakia	-853	-9	The recalculation of the category 1.A.2c in the liquid fuels is connected with the recalculation of the category 1.A.1b, where the energy plant inside the refinery is reported in the category 1.A.1b in this submission.
1A3_Transport CO_2	Croatia	5825	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1A4_Other sectors CO_2	Croatia	3257	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1B2_Oil and natural gas CH_4	Croatia	1427	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
1B2_Oil and natural gas CO_2	Croatia	577	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
2A_Mineral products CO_2	Croatia	1220	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
2A_Mineral products CO_2	Poland	801	7	Use of soda ash consumption instead of soda ash production for CO_2 emission estimation from soda ash use. Change of AD in emission estimation from soda ash use.
2B_Chemical industries N_2O	Croatia	784	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.

		2011		Main explanations
		Gg CO_2 equiv.	Percent	
2C_Metal production CO_2	Hungary	-1901	-85	2C12: revised data in IEA statistics. 2C14: separation of recovered amount reported in 1.A.1.a.
2C_Metal production CO_2	Poland	-3841	-64	Changes in allocation of fuels between 1.A.2.a and 2.C.1.
2F_Consumption of halocarbons HFC	Czech Republic	794	70	2F3: Revised methodology implementation. 2F5: Notation key and error correction.
2F_Consumption of halocarbons HFC	Poland	1184	19	Rectified error in foam blowing.
2F_Consumption of halocarbons HFC	Romania	505	115	
4A_Enteric fermentation CH_4	Croatia	843	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
4D_Agricultural soils N_2O	Croatia	2222	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
4D_Agricultural soils N_2O	Poland	2801	16	Correction of AD for young cattle in 1988-1997; amendment of AD sewage sludge used for agricultural purposes for 1988-2002. Correction of AD for indirect emissions (organic fertilisers); correction of AWMS for sheep/goats.
6A_Solid waste disposal on land CH_4	Croatia	771	100	Croatia joined the EU in July 2013 and therefore is included in the GHG inventory for the first time.
6A_Solid waste disposal on land CH_4	Poland	1338	18	Change of method of calculating amount of methane in recovered biogas. Correction of AD on industrial waste on disposal sites. Addition of estimation of emissions from composting waste.
6B_Waste water handling CH_4	Poland	4024	362	Change in estimating methane recovery from sewage and sludge. New data on recovery of methane from wastewater treatment plants.

25.2 Implications for emission levels

In the EU-28, 1990 GHG emissions excluding LULUCF have increased by 51 835 Gg (0.9 %). For 2011, they increased by 53 033 Gg (1.2 %) (Table 25.3).

Table 25.3 Overview of recalculations of EU-28 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	2000	2006	2007	2008	2009	2010	2011
Total CO_2 equivalent emissions including LULUCF (absolute)	48 400	44 932	33 034	21 057	50 934	28 938	28 959	22 109	31 659
Total CO_2 equivalent emissions including LULUCF (percent)	0.9%	0.9%	0.7%	0.4%	1.1%	0.6%	0.7%	0.501%	0.7%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	51 835	58 554	55 188	56 548	59 633	54 080	49 000	45 860	53 033
Total CO_2 equivalent emissions excluding LULUCF (percent)	0.9%	1.1%	1.1%	1.1%	1.2%	1.1%	1.1%	1.0%	1.2%

Table 25.4 and Table 25.5 give an overview of absolute and percentage changes of new Member States' emissions due to recalculations for 1990 and 2011. Croatia joined the EU on 1 July 2013 and is included in the EU inventory for the first time this year. Therefore, the national total emissions of Croatia appear as recalculations of the EU inventory for the years 1990-2011. From the remaining countries large recalculations in absolute terms were made in Hungary, Poland, Romania and Slovakia. Recalculations in relative terms of more than 2 % were made by Cyprus, Hungary, Latvia and Poland.

Table 25.4 Contribution of Member States to EU-28 recalculations of total GHG emissions without LULUCF for 1990–2011 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	7 596	24 690	18 860	10 307	18 828	19 860	17 558	11 545	12 975	19 310
Bulgaria	-402	-134	-30	-37	-62	-65	-100	-80	-80	-138
Croatia	31938	23 502	26 626	30 688	31254	32 744	31401	29 390	28 893	28 542
Cyprus	-3	58	330	575	503	574	493	496	545	528
Czech Republic	107	1097	444	706	-17	-379	38	719	-415	1781
Estonia	72	26	15	-56	-91	-98	-72	-73	-96	-472
Hungary	-1378	-1821	-1936	-1078	-563	-389	-260	-405	-307	-114
Latvia	-111	-71	-69	-41	-70	-106	-66	-33	-47	-354
Lithuania	-33	11	-15	-25	-40	-38	13	9	-2	68
Malta	-15	40	10	-15	-14	-14	-4	14	-3	6
Poland	9 357	8 642	10 723	8 596	8 137	7 588	5 867	7 114	5 804	6 352
Romania	3 260	2 474	548	-247	-1 104	100	-652	-377	-822	-1832
Slovakia	1445	20	-351	-333	-185	-124	-113	734	-514	-599
Slovenia	1	19	33	5	-28	-18	-22	-54	-71	-47
EU-28	**51 835**	**58 554**	**55 188**	**49 045**	**56 548**	**59 633**	**54 080**	**49 000**	**45 860**	**53 033**

Note: Croatia joined the EU on 1 July 2013 and is included in the EU inventory for the first time this year. Therefore, this table includes national total emissions of Croatia in order to make transparent the recalculations of the EU inventory for the years 1990-2011.

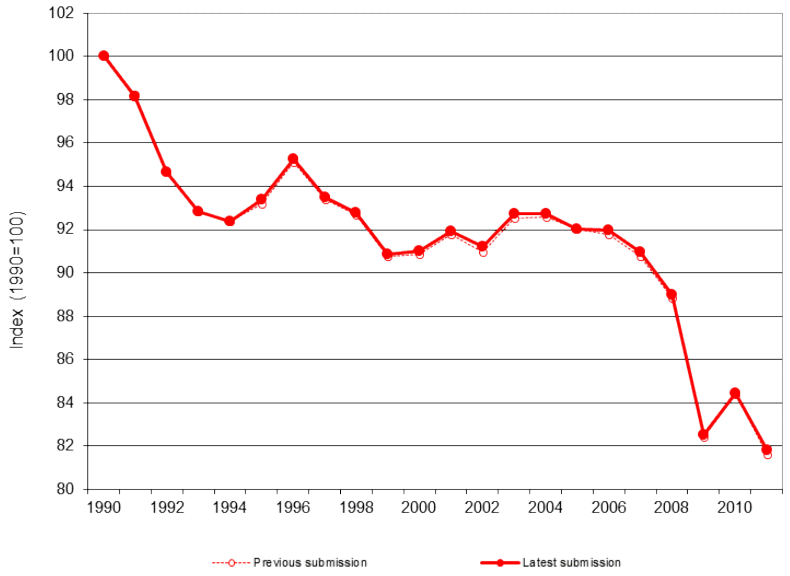
Table 25.5 Contribution of Member States to EU-28 recalculations of total GHG emissions without LULUCF for 1990–2011 (difference between latest submission and previous submission in percentage)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
EU-15	0.2	0.6	0.5	0.2	0.5	0.5	0.4	0.3	0.3	0.5
Bulgaria	-0.4	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
Croatia	-	-	-	-	-	-	-	-	-	-
Cyprus	0.0	0.8	3.9	6.2	5.3	5.8	4.9	5.1	5.8	5.8
Czech Republic	0.1	0.7	0.3	0.5	0.0	-0.3	0.0	0.5	-0.3	13
Estonia	0.2	0.1	0.1	-0.3	-0.5	-0.5	-0.4	-0.4	-0.5	-2.3
Hungary	-14	-2.3	-2.5	-14	-0.7	-0.5	-0.4	-0.6	-0.5	-0.2
Latvia	-0.4	-0.6	-0.7	-0.4	-0.6	-0.9	-0.6	-0.3	-0.4	-3.1
Lithuania	-0.1	0.1	-0.1	-0.1	-0.2	-0.1	0.1	0.0	0.0	0.3
Malta	-0.7	17	0.4	-0.5	-0.5	-0.5	-0.1	0.5	-0.1	0.2
Poland	2.0	2.0	2.8	2.2	2.0	19	15	19	14	16
Romania	13	14	0.4	-0.2	-0.8	0.1	-0.5	-0.3	-0.7	-15
Slovakia	2.0	0.0	-0.7	-0.7	-0.4	-0.3	-0.2	17	-11	-13
Slovenia	0.01	0.1	0.2	0.03	-0.1	-0.1	-0.1	-0.3	-0.4	-0.2
EU-28	**0.9**	**1.1**	**1.1**	**1.0**	**1.1**	**1.2**	**1.1**	**1.1**	**1.0**	**1.2**

25.3 Implications for emission trends, including time series consistency

As the recalculations were made for across all years in a similar order of magnitude, the trend was not affected by the recalculations. In the EU-28, the trend of GHG excluding LULUCF between 1990 and 2011 was – 18.4 % in the previous submission and -18.2 % in the latest submission (Figure 25.1).

Figure 25.1 Comparison of EU-28 GHG emission trends 1990–2011 (excl. LULUCF) of the latest and the previous submission



25.4 Recalculations, including in response to the review process, and planned improvements to the inventory

25.4.1 EU response to UNFCCC review

The EU-28 inventory has not been reviewed.

25.4.2 Member States' responses to UNFCCC review

Since the improvement of the EU inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 25.6 provides an overview of Member States' responses to the UNFCCC review (85). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 25.6 Improvements made by new Member States in response to the UNFCCC review

Member State	**Cross-cutting issues as identified by the review team**	**Improvements in response to UNFCCC review as indicated in the NIR**
Bulgaria	Recalculations and time-series consistency: Report consistent and complete information on recalculations in chapter 10 of the NIR and also complete CRF table 8(b) for all recalculations **(table 3)**	Not yet addressed.
	Quality assurance/quality control(QA/QC): Describe any improvements and recalculations arising from category-specific QA checks **(table 3)**	Not yet addressed.
	Recalculations and time-series consistency: Report consistent and complete information on recalculations in chapter 10 of the NIR and also complete CRF table 8(b) for all recalculations **(Table 3)**	Not yet addressed.
	Institutional arrangements: Provide additional information on the roles of large industrial plants and business associations in the description of the national system **(para 12)**	Not yet addressed.
	Uncertainty: Check the AD uncertainties currently assumed in the estimation (e.g. by comparing with some other countries, and revise the assumed uncertainties, as appropriate) **(Table 4)**	Not yet addressed.
Cyprus **(late availablility of 2013 ARR)**	Not reviewed.	
Czech Republic **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) The maintenance and enhancement of the capacity of the national system, in particular through: (i) The improved coordination of QA/QC procedures; and the updating and full implementation of the QA/QC plan, including the provision of enhanced documentation on the sectoral QA/QC procedures in the energy, industrial processes and waste sectors;	"Within the UNFCCC Review recommendations (v6) it is written that during the review, the Czech Republic explained that those improvements are included in its inventory improvement plan. Work on an updated QA/QC plan has been completed (see Chapter 1); the improvement plan, which includes also gradual implementation of higher Tiers, is presented in this chapter, together with an overview of the main improvements implemented so far in comparison with the 2011 submission." [NIR 2012, p. 268]
	(ii) The allocation of resources for the application of higher-tier methods for the key	See comment above.

(85) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	categories in all sectors;	
	(iii) Ensuring the transition of expertise and the provision of training for newly appointed experts in the industrial processes sector;	Not mentioned in the NIR.
	(iv) The improvement of the archiving system by assembling all relevant information together in a centralized location;	"…Due to financial limitations and employment difficulties, development of the new archiving system has been delayed. However, during the improvement plan generation period in 2011 a new archiving scheme emerged. Full implementation is planned after April 2012 (the end of submission period)." [NIR 2012, p. 24]
	(v) The maintenance of an improvement plan prioritized by the key category and uncertainty analyses, and reviewed and managed through the coordination meetings of the national inventory system;	"Development of Improvement plan focused on gradual implementation of higher tiers methods." [NIR 2012, Tab. 10-9].
	(b) The improvement of the completeness of the inventory submission by completing CRF table 8(b);	"Information on recalculation provided not only in NIR, but also in CRF, Table 8(b)." [NIR 2012, Tab. 10-9].
	(c) The enhancement of the documentation on the expert judgement used for the uncertainty analysis; and the improvement of the quantitative uncertainty estimates for all categories. **(FCCC/ARR/2011/CZE, para 193)**	Only mentioned in the sub chapters of the sector agriculture. [NIR 2012, p. 175, 181, 187]
Estonia	No cross-cutting review recommendations.	
Hungary (late availability of 2013 ARR)	The ERT identifies the following cross-cutting issues for improvement: (a) The review of the elements of the national system that would enable the timely submission of the annual submission, and the submission of the next annual submission by 15 April 2012 (see para. 6 above);	Submission was not in time. *NIR 2013 was submitted in time.*
	(b) The provision of a transparent overview of the annual inventory preparation process in the NIR of the next annual submission, including information on the responsibilities of the institutions involved in the preparation of the inventory and the provision of a timeline for the application of QA/QC procedures during the inventory preparation process (see para. 16 above);	Table with timeline and institution is presented. "The inventory cycle can be summarized with the following table based on our QA/QC plan:" [NIR, April 2012, p. 15]
	(c) The allocation of CO_2 emissions from non-energy use of fuels/feedstocks and coke as a reducing agent under the industrial processes sector in line with the IPCC good practice guidance and the UNFCCC reporting guidelines, taking into account the reporting of CO_2 emissions from combustion of secondary fuels under the relevant stationary combustion categories in the energy sector, and the inclusion of information, where relevant, on how the calculation and allocation of the CO_2 emissions was performed (see para. 61 above);	"Following the recommendations of the ERT, three main changes occurred in this source category: · Coke used as reducing agent has been removed from the energy sector and allocated to the industrial processes sector; · Emissions from coke oven gas has been added, where necessary; · We started the report emissions by non-ferrous metals separately from iron and steel. More details in chapter 10.2.2 and 10.2.3." [NIR, April 2012, p. 53]
	(d) The further improvement of the transparency of the inventory by including, where relevant, further information on the methodological tiers used, and justification and references for country-specific parameters and EFs, in particular for F-gas emissions under the industrial processes sector (see paras. 65, 66, and 67 above);	*"Since 2013 JAN submission Hungary applies a more reliable and complete activity data time serie and Tier2 method for estimation of emissions from Fire extinguishers. All the details and description of new method are included in NIR of 2013 MARCH submission." [NIR 2013, Annex 8, p. A84]*
	(e) The completion of the uncertainty analysis by including quantitative estimates for all categories, in particular for categories under	New chapter '11.3.1.5 Uncertainty estimates' is included in the NIR, April 2012 p. 316- 323 with detailed descriptions.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	the LULUCF sector;	
	(f) The finalization of the archiving manual and reporting on the progress made thereon in the next annual submission (see para. 32 above);	*"Notation keys 'NE' were corrected to the required emissions under information items in CRF Table 5. (See also para. 97 below). Uncertainty analysis is now complete for the LULUCF sector. (See also para 21.) The main issues of the archiving manual have been finalized in the new general record management regulation of the HMS (see also para. 31)." [NIR 2012, May, Annex 8, A78]*
	(g) The inclusion, in annex 8 to the NIR or in the relevant section, a table describing Hungary's responses and follow-up actions to the recommendations of previous review reports. (**FCCC/ARR/2011/HUN, para 156)**	*Implementation of table "Annex 8 Responses to the review of the 2012 inventory submission" [NIR 2012 and NIR 2013, Annex 8]*
Latvia **(late availability of 2013 ARR)**	The ERT identifies the following cross-cutting issues for improvement: (a) Improve the use of notation keys in the CRF tables;	"7.2.7 Category-specific recalculations No recalculations were done in this category except minor updates in the notation keys." [NIR, April 2012, p. 252]
	(b) Resolve inconsistencies in the NIR and between the NIR and the CRF tables, as part of the implementation of the QA/QC procedures;	Under the chapters source-specific QA/QC and verification mentioned: "If errors or inconsistencies are found they are documented and corrected. The QC checklist is used during the inventory." [NIR, April 2012, p. 224, 230, 258, 263, 270]
	(c) Improve the use of country-specific EFs and parameters and move to higher tier methods for some categories, including energy (CH_4 emissions from oil and natural gas), industrial processes (CO_2 emissions from cement production, and HFCs and SF_6 from the production and use of fire extinguishers, consumption of halocarbons and SF_6), agriculture (CH_4 emissions from enteric fermentation, N_2O emissions from manure management, direct N_2O emissions from soils), and LULUCF (CO_2 emissions/removals from forest land remaining forest land, CO_2 emissions from cropland remaining cropland);	For agriculture: "As the milk yield is higher (according to national statistic) then ERT (2009) recommended using higher tier method for estimating emissions for dairy cattle. Latvia provided ERT with some background information available in country and therefore ERT recommended that Latvia utilize the available information to estimate the country specific EF that permit the use of a higher tier method in order to improve the accuracy of estimates. " [NIR, April 2012, p.216]
	(d) Improve transparency and provide further clarification for the methods and trends in emissions for subcategories in the following sectors: energy (road transportation: liquid fuels – CO_2 and N_2O, and stationary combustion: all fuels – CO_2, navigation: liquid fuels – CO_2, CH_4 and N_2O and civil aviation: liquid fuels – CO_2, CH_4 and N_2O); industrial processes (lime production and limestone and dolomite use – CO_2); agriculture (enteric fermentation – CH_4 , manure management – CH_4); LULUCF (cropland remaining cropland – CO_2, land converted to forest land – CO_2, grassland remaining grassland – CO_2); and waste (solid waste disposal on land – CH_4, wastewater handling – CH_4);	Details are described under chapter 10.4., Table 10.4, NIR, April 2012.
	(e) Improve the completeness and the transparency of the inventory in the LULUCF sector and for KP-LULUCF, specifically: report all mandatory categories in LULUCF and pools from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (paying particular attention to the consistent representation of land area and changes in carbon stocks and emissions/removals from different pools);	"11.3.1.4 Changes in data and methods since the previous submission (recalculations) Two types of changes are included into this KP LULUCF reporting: updates of values, like use of the same number of decimal signs in representation of land areas in different years; correction of notation keys, setting of NE instead of NO in the land use categories, where absence of the emissions / removals are scientifically approved and where research work is initiated to obtain necessary values. Changes made to the KP LULUCF reporting are

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
		relevant to those implemented under the Convention reporting. More detailed information is available in section 7.2.7. Category specific recalculations." [NIR, April 2012, p. 313]]
	(f) Implement a qualitative key category assessment; (g) Include the list of key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol and demonstrate that these key categories have been identified according to the IPCC good practice guidance for LULUCF;	"Article 3.3 Deforestation (CO_2): The associated UNFCCC subcategory CO_2 emissions from deforestation have been identified as key category. Total CO_2 emissions and removals from deforestation (Art. 3.3) is larger than the smallest UNFCCC key category. Therefore D is stated to be a key category. " [NIR, April 2012, p. 317]
	(h) Provide tier 2 uncertainty estimates;	*"The tier 2 uncertainty estimation will be elaborated for the whole NIR (all categories) until the next inventory. The implementation of the Tier 2 uncertainty estimation is subordinated to available funding to contract external experts." [NIR 2013, Table 10.4, p.334]*
	(i) Conduct and report the uncertainty assessment associated with estimates of changes in carbon stocks in pools and emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;	"Latvia is still developing methods for estimation of emissions and removals of greenhouse gases and their uncertainties. For that reason, the estimates presented in this submission for 2008-2009 might change for the final report of the commitment period." [NIR, April 2012, Chapter 11.3.1.6, p. 314]
	(j) Elaborate on changes in Regulation No. 157 in order to include activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, as well as QA/QC updates and other changes which improve the national system;	Not yet addressed.
	(k) Explore further steps in implementing the provisions under Article 3, paragraph 14, of the Kyoto Protocol and report on how Latvia is striving to implement its commitments under Article 3, paragraph 14, of the Kyoto Protocol;	Not yet addressed.
	(l) Enhance the reporting of changes in the national registry since the last annual submission, in accordance with section I.G of the annex to decision 15/CMP.1 by clearly stating whether each item was changed or not compared with information reported the previous year. **(FCCC/ARR/2010/LVA, para 27)**	"No significant technical, functional or documentary changes were made in Latvia's ETR during 2011." [NIR, April 2012, Chapter 14, p. 320]
Lithuania (late availability of 2013 ARR)	<u>Key category analysis:</u> Use the key category analysis to prioritize the development and improvement of the inventory. **(para 19 and 50)**	"In 2013 submission prioritization of inventory improvements using key category assessment results are described in Chapter 1.5 and 1.7" [NIR 2013, Annex VIII, p. 635] "Recalculation of CH_4 and N_2O at new Tier 2 method for Civil aviation during 2006-2011 was done. Recalculation of Road transport emissions of CH_4 and N_2O at new Tier 3 method for LPG was done. Lithuania investigated the possibility to apply Tier 2 for railways transport. It was concluded that data is not complete to improve the accuracy and reduce uncertainty." [NIR 2013, Annex VIII, p. 640]
	<u>Uncertainties:</u> Perform the uncertainty analysis for each category for all gases combined and improve the consistency of the information. **(para 22)**	"Responding to ERT recommendations uncertainty analysis is reported according to GPG 2000 Tier 1 (table 6.1) and for each category for all gases combined. Results of combined uncertainty were the same as Tier 1 and enable us to identify subcategories for national GHG inventory improvements. Solvent and other product use sector is included in the uncertainty analysis and reported in annex II of the NIR. Typing error in page 48 in the NIR is corrected." [NIR 2013, Annex VIII, p. 635]
	<u>Information on Kyoto Protocol units:</u> Implement the recommendations contained in the standard independent assessment report **(para 161)**	"The only recommendation was related to the reporting of discrepancies. The R-2 table is submitted as a part of this NIR." [NIR 2013, Annex VIII, p. 636]
	<u>Minimization of adverse impacts in accordance with Article 3, paragraph 14, of</u>	"In this submission only changes to information on minimization of adverse impacts in accordance with

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	the Kyoto Protocol: Report any changes in its information provided under Article 3, paragraph 14, in accordance with decision 15/CMP.1, annex, chapter I.H, "Minimization of adverse impacts in accordance with Article 3, paragraph 14" **(para 170) (FCCC/ARR/2012/LTU, Table 6)**	Article 3, paragraph 14, of the Kyoto Protocol comparing to previous NIR were reported" [NIR 2013 Annex VIII, p. 636]
Malta	National system: During the review, the ERT was not provided with the requested additional information on institutional arrangements and inventory planning, preparation and management. Considering the large number of categories not estimated in the energy, industrial processes and LULUCF sectors and the inconsistencies between methods in the IPCC Good Practice Guidance and methodologies applied for estimating GHG emissions and removals in the energy and LULUCF sectors, the ERT recommends that Malta strengthen and enhance its institutional arrangements for GHG inventory compilation in terms of both institutional framework and technical capacity. Further, the ERT encourages the Party to explore the possibility of receiving assistance from the EU, through EU-financed activities and/or technical services of the European Commission, or, for example, to set up a twinning programme with another EU member State for mutual support in inventory planning and other activities **(FCCC/ARR/2013/MLT, para 8).**	"To this effect, the Climate Change Unit at MRA has taken the initiative to submit a report "Establishing a National Greenhouse Gas Inventory System for Malta"7 to the relevant local authorities in order to instigate and inform the decision-making process. In the absence still of a formal national inventory system, the Climate Change Unit has to manage the inventory process within the limited legal, institutional and administrative capabilities that it has. This is particularly evident in respect of gathering of data. It is anticipated that a formal legal and institutional set-up that is in-line with requirements for national inventory systems will help address such limitations and will facilitate the annual preparation of a much improved national GHG gas emissions and removals inventory for Malta." [NIR, April 2013, p. 6]
	Inventory preparation: The information provided in the NIR on the inventory preparation process is rather limited in terms of the description of the allocation of specific responsibilities in the inventory development process, including those related to the choice of methods, and the processing, archiving and approval of the inventory. The ERT recommends that Malta provide more detailed information on the inventory preparation process.. **(para 10, FCCC/ARR/2013/MLT)**	Not yet addressed
	Uncertainties: The ERT reiterates the recommendation made in the previous review report that Malta improve the transparency of the uncertainty analysis by including information on the assumptions used to calculate the uncertainty of AD and EFs at the category level and provide information to explain how the uncertainty analysis is used to prioritize further inventory improvements **(Table 4 FCCC/ARR/2013/MLT)**	Not yet addressed, explanations for the calculation of AD and EF uncertainties are only provided for transport and solid waste disposal
	Quality assurance/quality control (QA/QC): Develop a QA/QC plan, in particular tier 1 QC procedures, such as that described in the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (the IPCC good practice guidance), and provide information on the QA/QC plan in the national inventory report (NIR). **(para 17),** recommendation reiterated in 2013 review report (**Table 3, FCCC/ARR/20122013/MLT**)	"Admittedly, a formally documented greenhouse gas inventory QA/QC system has yet to be developed in respect of the Maltese inventory process. However, this does not mean that the inventory process is not already subject to quality checks. Indeed, the inventory is subject to at least two peer review processes every year: a peer review in-line with requirements set out in the EU's Monitoring Mechanism and a peer review under UNFCCC rules. (NIR 2014, p. 12)." [NIR, April 2013, chapter 1.6.1, p. 30]
	Verification: Improve the QA/QC and verification procedures. **(para 18)**	EU and UNFCCC review seen as peer reviews (see quote above).
	Transparency: Although the energy sector is generally transparent, the ERT identified several issues related to transparency in multiple sectors, including in the provision of background data used to support the	To be addressed in sectoral parts.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	calculation of emissions in the industrial processes, agriculture, land use, land-use change and forestry and waste sectors. Improve the transparency of the information on the QA/QC procedures and uncertainty analysis. **(para 19, Table 3, FCCC/ARR/20122013/MLT)**	
	Inventory management: Malta does not yet have a centralized archiving system and the information on archiving in the NIR is limited. In response to a question raised by the ERT during the review, Malta explained that the activity data (AD) and emission factors (EFs) used are logged in an Excel spreadsheet and given a unique data identifier. The ERT reiterates the recommendation made in the previous review report that Malta provide further information on current practices relating to data collection, data assessment and archiving, including documentation on QA/QC procedures.**. (para 11)** (**FCCC/ARR/2013/MLT)**	Not yet addressed
	Key categories: The ERT noted that Malta does not use the key category analysis to improve the inventory. The Party indicated that it plans to improve categories based on resource availability. The ERT reiterates the recommendation made in the previous review report that Malta use the results of the key category analysis to prioritize the development and improvement of the inventory and report on this process in the NIR. **(Table 4)** (**FCCC/ARR/2013/MLT)**	Not yet addressed.
	Completeness: Mandatory: "NE" is reported for CO_2, CH_4 and N_2O emissions from gasoline consumption in navigation (1990–2004); CH_4 and N_2O emissions from biomass consumption in residential; CO_2, CH_4 and N_2O emissions from all fuels in agriculture/forestry/fisheries (1990–2001); CO_2 emissions from lime production (1990–1994); and direct soil N_2O emissions for N-fixing crops and crop residue. The ERT recommends that Malta estimate emissions for these categories in order to ensure completeness and/or time-series consistency (**Table 3, FCCC/ARR/2013/MLT)**	Agriculture/forestry/fisheries: only gasoline reported as NE, all other fuels as NO, Early emissions from lime production are estimated, other issues not yet addressed.
	Completeness LULUCF: Mandatory: "NE" is reported for carbon stock change in living biomass, dead organic matter and mineral soils for other land converted to forest land; net carbon stock change in living biomass (2003, 2004, 2006 and 2010) and soils (2003, 2004 and 2006) for other land converted to cropland; and biomass burning on cropland remaining cropland. Further, some categories and pools reported as "NO" but the ERT has reason to believe the correct notation key is "NE" (see paras. 71 and 75 below). The ERT recommends that Malta estimate emissions in order to ensure completeness. (**Table 3, FCCC/ARR/2013/MLT)**	
Poland **(late availability of 2013 ARR)**	Uncertainty: The ERT reiterates the recommendation made in the previous review report that Malta improve the transparency of the uncertainty analysis by including information on the assumptions used to calculate the uncertainty of AD and EFs at the category level and provide information to explain how the uncertainty analysis is used to prioritize further inventory improvements **(Table 4)** (**FCCC/ARR/2013/MLT)**	Not yet addressed.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	Recalculations and time-series consistency. Improve reporting on recalculations with justification and information on the impact of the recalculations at category-specific level. **(para 22, 59, 78, 98, 135)** Ensure time series consistency and include further information on the measures for ensuring time-series consistency. **(para 24, 39)** Strengthen the QA/QC procedures and improve reporting of sectoral QA/QC. **(para 25, 41, 118)** Improve the transparency of reporting trends, justifying country-specific emission factors (EFs) and assumptions, correcting notation key use. **(para 26, 38, 48, 61, 62, 83, 100, 101)** (**FCCC/ARR/2012/POL, Table 6)**	Reporting on recalculations and time series consistency: Partly done. Improve the transparency of reporting trends, justifying country-specific emission factors: not yet addressed.
Poland **(late availability of 2013 ARR)**	CPR: Report consistent commitment period reserve in the NIR **(para 146)**	"The new value of reserves - 2 012 046 833 tons of eq. CO_2 has been calculated on the basis of 2010 emissions (402 409 367 tones of eq. CO_2), which were approved during the review in 2012." [NIR 2013, chapter 12.5, p. 234]
	National systems: Include information on actions taken and planned to address previous recommendations **(para 147)**	Not yet addressed.
	Article 3, paragraph 14: Report any changes in the information provided under Article 3, paragraph 14 **(para 149)** (**FCCC/ARR/2012/POL, Table 6)**	"According to chapter I.H of the annex to the decision 15/CMP.1 and recommendation of ERT from 2011 below Poland provides new information (since the last NIR 2012) on how it is implementing its commitment under Article 3.14 of the Kyoto Protocol related to striving to implement its commitment under Article 3.1 of the Kyoto Protocol in such a way as to minimize potential adverse social, environmental and economic impacts on developing countries." [NIR 2013, chapter 15, p.239]
	Completeness: Enhance the completeness of the inventory by providing estimates for the soil carbon stock changes for the missing pools **(para 11, 119 and 148)**	Not yet addressed.
	Inventory improvement plans: Continue efforts to implement the planned studies and increase the quality of the inventory **(para 15, 27, 40, 48, 61, 67 and 111)**	Not yet addressed.
	Uncertainties: Update the uncertainty analysis and include uncertainty estimates for all categories under the LULUCF sector and for all KP-LULUCF activities **(para 27, 49, 113, 132, 135 and 145)**	Not yet addressed.
Romania	Recalculations: Enhance the reporting of the recalculations in CRF table 8(b) **(para 29, 47 and 60)**	Not yet addressed.
	QA/QC: Strengthen QC procedures **(para 22, 33, 50, 52, 57, 67, 70, 73, 74, 82, 90, 91, 112, 116, 131, 133 and 153)**	Not yet addressed.
	National registry: Publicly available information: Update the reports posted on the public website with complete and up-to-date data and remove duplicate or outdated links **(para 161)**	Not yet addressed.
	The ERT identifies the following cross-cutting issues for improvement:	"Questions of implementation on national system and QA/QC procedures and two adjustments were identified by the ERT during the review. In the

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	(a) The development of procedures and institutional arrangements in order to ensure the consistency of and harmonization between the AD used in the inventory, national statistical data and data reported under other international obligations and a reliable data flow for the preparation of the inventory (see paras. 21(b) and (e) above);	conclusions and recommendations summarized in the draft ARR the ERT concludes that the inventory submission has been prepared and reported mostly in accordance with the UNFCCC reporting guidelines but the national system of Slovakia does not fully comply with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (annex to decision 19/CMP.1). The annual submission is complete in terms of geographical coverage, years and sectors, as well as mostly complete in terms of categories and gases." [NIR, 2012, p. 268]
Slovakia **(late availability of 2013 ARR)**	(b) The establishment of clear communication channels with regard to the principles, purposes and procedures of the UNFCCC reporting guidelines and the review processes with external experts, ensuring that these experts fully understand the formal requirements of these guidelines and the importance of the timely submission of their contributions (see para. 21(d) above);	"During the 6 weeks period, sectoral expert for energy (Profing, Mr. Judak), national coordinator and the colleagues from the Dpt. of Climate Change Policy (Ministry of Environment) in cooperation with the Statistical Office of the Slovak Republic (SO SR) provided several comparisons of the national energy statistics, international energy statistics (IEA) and the fuel balance in the National Emission Information System (NEIS). The following steps were taken in order to increase transparency, consistency and comparability of the national reporting in energy sector." [NIR, 2012, Tab. 10.5, p. 269]
	(c) The implementation of a fully operational QA/QC system, including all the provisions of the QA/QC plan, and independent checks of the resulting emission estimates involving experts from collaborating institutions, particularly data providers and different data sources (e.g. EU ETS, NEIS, statistical data), prior to the submission of the inventory (see para. 21(a) and 38 above);	"In response to the ERT recommendation Slovakia prepared during the 6-weeks period detailed plan of action w ith proposed measures and deadlines to deliver results. Prioritizing the key sources, tier 2 key categories analyses were performed. updating QA/QC plan mostly for agriculture and LULUCF sectors" [NIR, 2012, Tab. 10.5, p. 269]
	(d) The improvement of the transparency of the emission estimates in the energy sector, in particular the information on the parameters and assumptions of the COPERT IV model methodology and the information on AD (e.g. by providing an energy balance in the NIR), and in the industrial processes sector, in particular with regard to the provision of a carbon mass balance covering activities related to the iron and steel category and clear information on the use of F-gases under the category consumption of halocarbons and SF_6 (see paras. 49, 57, 69 and 73 above). **(FCCC/ARR/2011/SVK, para 230)**	For the sector energy, road transport: please see under (b) and "New estimation of N_2O emissions for CNG fuel in the category 1.A.3b - Road Transportation using default EF. " [NIR, 2012, Tab. 10.5, p. 269] For the industrial processes: not yet addressed. For the use of F-gases: "New estimation of actual emissions HFC245ca and HFC365mfc f rom PUR foam in the category 2IIA.F.2.1 – Consumption of halocarbons and SF_6 (hard foam)." [NIR, 2012, Tab. 10.5, p. 269]
	The ERT identifies the following cross-cutting issues for improvement: (a) The maintenance of time-series consistency when performing recalculations due to methodological improvements;	"All improvements have been done for the submission 2012. See relevant chapters in the NIR." [NIR 2012, Table 10.7, p. 266]
Slovenia **(late availability of 2013 ARR)**	(b) The improvement of QC procedures in order to minimize inconsistencies in the CRF tables and the NIR, and between them;	"All improvements have been done for the submission 2012. See relevant chapters in the NIR." [NIR 2012, Table 10.7, p. 266]
	(c) The further improvement of the transparency of the NIR (see para. 24 above). **(FCCC/ARR/2011/SVN, para 123)**	"See para 41, 42, 44, 59, 60, 67, 78, 80, 81, 82, 89, and 92. See relevant chapters in the NIR". [NIR 2012, Table 10.7, p. 265]

Note: Review findings of submission 2012, which were also commented in the NIR 2014 were added in italics.

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27 UNITS AND ABBREVIATIONS

t	1 tonne (metric) = 1 megagram (Mg) = 106 g
Mg	1 megagram = 106 g = 1 tonne (t)
Gg	1 gigagram = 109 g = 1 kilotonne (kt)
Tg	1 teragram = 1012 g = 1 megatonne (Mt)
TJ	1 terajoule

AWMS	animal waste management systems
BEF	biomass expansion factor
BKB	lignite briquettes
C	confidential
CCC	Climate Change Committee (established under Council Decision No 280/2004/EC)
CH_4	methane
CO_2	carbon dioxide
COP	conference of the parties
CRF	common reporting format
CV	calorific value
EC	European Community
EEA	European Environment Agency
EF	emission factor
Eionet	European environmental information and observation network
EMAS	Ecomanagement and Audit Scheme
ETC/ACC	European Topic Centre on Air and Climate Change
ETS	European Emissions Trading System
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
GHG	greenhouse gas
GPG	good practice guidance and uncertainty management in national greenhouse gas inventories (IPCC, 2000)
GWP	global warming potential
HFCs	hydrofluorocarbons
JRC	Joint Research Centre
F-gases	fluorinated gases (HFCs, PFCs, SF_6)
IE	included elsewhere

IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LULUCF	land-use, land-use change and forestry
MNP	Milieu-en Natuurplanbureau
MS	Member State
MRG	monitoring and reporting guidelines
N	nitrogen
NH_3	ammonia
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NFI	national forest inventory
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA	quality assurance
QA/QC	quality assurance/quality control
QM	quality management
QMS	quality management system
RIVM	National Institute of Public Health and the Environment (The Netherlands)
SF_6	sulphur hexafluoride
SNE	Single National Entity
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	Volatile Organic Compounds

Abbreviations in the source category tables in Chapters 3 to 9 and 18-24

Methods applied	**EF: methods applied for determining the emission factor**	**AD: methods applied for determining the activity data**	**Estimate: assessment of completeness**	**Quality: assessment of the uncertainty of the estimates**
CR — Corinair	CR — Corinair	AS — associations, business organizations	All — full	H — high
CS — country-specific	CS — country-specific	IS — international statistics	F — full	M — medium
COPERT X — Copert Model X = version	D — default	NS — national statistics	Full — full	L — low

D — default	M — model	PS — plant specific data	IE — included elsewhere	
M — model	MB — mass balance	Q — specific questionnaires, surveys	NE — not estimated	
NA — not applicable	PS — plant-specific	RS — regional statistics	NO — not occurring	
OTH - other				
RA — reference approach			P — partial	
T1 — IPCC Tier 1			Part — partial	
T1a — IPCC Tier 1a				
T1b — IPCC Tier 1b				
T1c — IPCC Tier 1c				
T2 — IPCC Tier 2				
T3 — IPCC Tier 3				