EEA Technical report | No 8/2015

European Union emission inventory report 1990–2013 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)

ISSN 1725-2237

European Environment Agency

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Cover design: EEA
Cover photo: © iStockphoto
Layout: EEA/Henriette Nilsson

Luxembourg: Publications Office of the European Union, 2015

ISBN 978-92-9213-655-0
ISSN 1725-2237
doi:10.2800/031449

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Units, abbreviations and acronyms

AD	Activity data
As	Arsenic
B(a)P	Benzo(a)pyrene
B(b)F	Benzo(b)fluoranthene
BC	Black carbon
B(k)F	Benzo(k)fluoranthene
Cd	Cadmium
CDR	Central Data Repository (of the EEA's Eionet Reportnet)
CEIP	Centre on Emission Inventories and Projections under the CLRTAP
CH_4	Methane
CLRTAP	(UNECE) Convention on Long-range Transboundary Air Pollution
CO	Carbon monoxide
CO_2	Carbon dioxide
COPERT	COmputer Programme to calculate Emissions from Road Transportation
Cr	Chromium
CRF	(UNFCCC) common reporting format (for greenhouse gases)
Cu	Copper
DESTATIS	German Statistical Office
DG	Directorate-General
EAPA	European Asphalt Pavement Association
EEA	European Environment Agency
EF	Emission factor
Eionet	European Environment Information and Observation Network
ESP	Electrostatic precipitator
EMEP	European Monitoring and Evaluation Programme (Cooperative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe)
EPA	Environmental Protection Agency
EPER	European Pollutant Emission Register
E-PRTR	European Pollutant Release and Transfer Register
ERT	Expert Review Team
ESP	Electrostatic precipitators
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation of the EEA
ETS	Emissions Trading Scheme
EU	European Union
FGD	Flue-gas desulphurisation
Gg	Gigagram = 10^9 g = 1 kilotonne (kt)
GHG	Greenhouse gas
GLOBEMI	Global emission model
HCB	Hexachlorobenzene
HCE	Hexachloroethane
HCH	Hexachlorocyclohexane
HFC(s)	Hydrofluorocarbon(s)
Hg	Mercury
HM(s)	Heavy metal(s)
IE	Included elsewhere (notation key)
IIR	Informative inventory report
IP	Indeno(1,2,3-cd)pyrene
IPCC	Intergovernmental Panel on Climate Change

I-TEQ	International toxic equivalents
KCA	Key category analysis
kg	Kilogram = 10^3 g (gram)
LAIR	(Hungarian) Air Quality Protection Information System
LCP	Large combustion plant
LIISA	Calculation model for the road transport sector emissions at VTT Technical Research Centre of Finland
LIPASTO	Calculation system for traffic exhaust emissions and energy consumption at VTT Technical Research Centre of Finland
LPS	Large point source
LRTAP	Long-range Transboundary Air Pollution
LTO	Landing/take-off
Mg	Megagram = 10^6 g = 1 tonne (t)
Mt	Megatonne
N_2O	Nitrous oxide
NA	Not applicable (notation key)
NE	Not estimated (notation key)
NEC Directive	EU National Emission Ceilings Directive (2001/81/EC)
NEMO	Network Emission Model
NFR	Nomenclature for reporting/UNECE nomenclature for reporting of air pollutants
NH_3	Ammonia
Ni	Nickel
NMVOC(s)	Non-methane volatile organic compound(s)
NO	Not occurring (notation key)
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides
NR	Not relevant (notation key)
O_3	Ozone
PAH(s)	Polyaromatic hydrocarbon(s)
Pb	Lead
PCB(s)	Polychlorinated biphenyl(s)
PCDD/F(s)	Polychlorinated dibenzodioxin(s)/dibenzofuran(s)
PFC(s)	Perfluorocarbon(s)
PM	Particulate matter
PM_{10}	Particulate matter with a diameter of 10 µm or less
$PM_{2.5}$	Fine particulate matter with a diameter of 2.5 µm or less
POP(s)	Persistent organic pollutant(s)
PRTR	Pollutant Release and Transfer
PS	Plant specific
QA	Quality assurance
QC	Quality control
REP	Renewable Energy Plant
SCR	Selective catalytic reduction
Se	Selenium
SF_6	Sulphur hexafluoride
SNCR	Non-selective catalytic reduction
SO_2	Sulphur dioxide
SO_X	Sulphur oxides
t	Tonne (metric) = 1 megagram (Mg) = 10^6 g
T	Tier (method)
TFEIP	Task Force on Emission Inventories and Projections
TREMOD	Transport Emission Estimation Model
TSP	Total suspended particulate(s)
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VERSIT+	TNO state-of-the art road traffic emission model
VOCS(s)	Volatile organic compound(s)
Zn	Zinc

Acknowledgements

This report was prepared by the European Environment Agency (EEA) and its European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM, partner Umweltbundesamt Austria). The lead author of the report was Melanie Tista. Other authors (in alphabetic order) were Michael Gager, Elisabeth Kampel, Marion Pinterits and Bernhard Ullrich. The EEA project manager was Anke Lükewille. The desk officer at the European Commission's Directorate-General for the Environment (DG Environment) was André Zuber. The authors gratefully acknowledge the technical support received from Robert Wankmüller (ETC/ACM).

The EEA acknowledges comments received on the draft report from the Eionet national reference centres of EEA member countries and the European Commission (DG Environment).

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Executive summary

This document is the annual European Union (EU) emission inventory report to the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (CLRTAP) (UNECE, 1979). The report and its accompanying data constitute the official submission by the European Commission (EC) on behalf of the EU as a Party to the Executive Secretary of UNECE. The report is compiled by the European Environment Agency (EEA) in cooperation with the EU Member States.

Under the LRTAP Convention, Parties are obliged and invited to report emissions data for numerous air pollutants:

- main pollutants: NO_X, NMVOCs, SO_X, NH_3 and carbon monoxide (CO);
- PM emitted directly into the air (primary PM):
    - PM with a diameter greater than 2.5 microns ($PM_{2.5}$; also called fine particulate matter);
    - PM with a diameter greater than 10 microns (PM_{10});
    - BC, the most strongly light-absorbing component of PM; and
    - total suspended particulates (TSPs);
- priority heavy metals (HMs): lead (Pb), cadmium (Cd) and mercury (Hg);
- additional HMs: arsenic (As), chromium (Cr), copper (Cu), nickel (Ni), selenium (Se) and zinc (Zn);
- persistent organic pollutants (POPs): polychlorinated dibenzodioxins/dibenzofurans (PCDD/Fs), polycyclic aromatic hydrocarbons (PAHs), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs);
- additional reporting of the individual PAHs benzo(a) pyrene (B(a)P), benzo(b)fluoranthene (B(b)F), benzo(k)fluoranthene (B(k)F), indeno(1,2,3-cd)pyrene (IP), and their sum as total 1–4.

These pollutants harm human health and the environment (EEA, 2014a; EEA, 2014b). In addition, certain species also contribute to the formation of ground-level ozone (O_3) and secondary PM in the atmosphere. Some pollutants have an indirect and direct effect on the sunlight absorbed by the Earth and reflected back to space (radiative forcing) and hence on the climate.

This report describes:

- the institutional arrangements and preparation processes that underpin the EU's emission inventory, methods and data sources, the key category analyses, and information on uncertainty, completeness and underestimations (Chapter 1);

Box ES.1 The Gothenburg Protocol

The Gothenburg Protocol to the LRTAP Convention sets emission ceilings which Parties to the convention must meet: these ceilings, for 2010 and after, pertain to the pollutants nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), sulphur oxides (SO_X) and ammonia (NH_3). In addition to the ceilings for individual countries, the protocol also specifies ceilings for the EU, itself a Party to the protocol (UNECE, 1999). The protocol was amended in 2012 with new ceilings for 2020 and beyond. It has not yet been ratified by the EU (nor by single Member States which are Parties to the LRTAP Convention). However, Parties are encouraged to also report primary particulate matter (PM) and black carbon (BC) emissions, in line with the revised emission reporting guidelines (UNECE, 2014a) ([1]).

([1]) The EEA published its annual update of the NEC Directive status report (EEA, 2015b) in June 2015. The *NEC Directive status report 2014* analyses the 2013 emission data for EU Member States reported under Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants, known as the EU National Emission Ceilings (NEC) Directive (EC, 2001). For the EU Member States, the NEC Directive contains national emission ceilings that are either equal to or more ambitious than those set out in the Gothenburg Protocol.

Box ES.2 Status of reporting by EU-28 Member States

In 2015, Member States were requested to report emission inventory data and an Informative Inventory Report (IIR). Air emission inventories were provided by all Member States, except Greece. By 6 May 2015, 26 Member States had reported activity data, but only 19 Member States had reported activity data for the complete time-series (1990–2013). An IIR was provided by 25 Member States. No Member State reported gridded data, and only two Member States provided data on large point sources. Projections were reported by 18 Member States. Detailed information on Member States' submissions is presented in Appendix 3.

- emission trends for the EU-28 as a whole and for individual Member States, and the contribution made by important individual source-sectors to emissions (Chapter 2);
- sectoral analyses and emission trends for key pollutants (Chapter 3);
- information on recalculations as well as planned and implemented improvements (Chapter 4).

Emission data presented in this report are included in the accompanying annexes and are also available for direct download through the EEA's data service (EEA, 2015e). The following sections summarise the main findings.

EU-28 emission trends

Figure ES.1 to ES.3 present the aggregated EU-28 emission trends of air pollutants for the period from 1990 to 2013 ([2]).

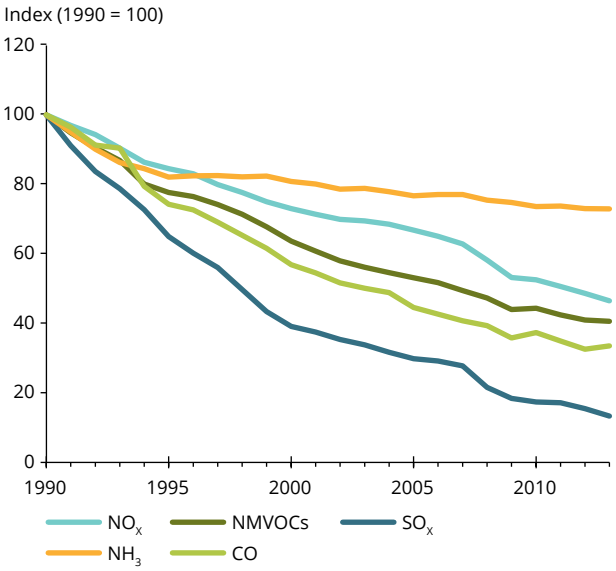
Emission trends of main air pollutants between 1990 and 2013

Across the EU-28, the largest emission reduction in the main pollutants was of SO_X. Emissions in 2013 were 87% less than in 1990 (Figure ES.1). This reduction is the result of a combination of measures:

- fuel-switching in energy-related sectors — away from high-sulphur–containing solid and liquid fuels to low-sulphur fuels such as natural gas;
- the fitting of flue-gas desulphurisation (FGD) abatement techniques in industrial facilities; and
- the impact of EU directives relating to the sulphur content of certain liquid fuels.

Emissions of the other main air pollutants have also dropped considerably since 1990, including emissions of the three air pollutants primarily responsible for the formation of ground-level O_3: CO (66% reduction), NMVOCs (59% reduction) and NO_X (54% reduction). For these main pollutants, the rate at which emissions are decreasing has slowed over the last decade.

Figure ES.1 EU-28 emission trends for the main air pollutants



([2]) By 15 February each year, Member States must report emission data for years up until the current year, minus two. Thus, by 15.02.2015, Member States were obliged to report for the years until 2013. Emission inventory data (both for air pollutants and greenhouse gases (GHGs)) can typically only be compiled and reported by countries with a 12–15 month delay approximately. This delay is mainly a result of the time needed for official national and/or trade statistics to become available (typically up to 12 months following a calendar year), together with the time needed for subsequent data processing, calculations and quality assurance and quality control (QA/QC) checks.

Box ES.3 Changes of main pollutant emissions between 2012 and 2013

NO_X and SO_X emissions dropped by 4.4% and 14.0%, respectively between 2012 and 2013. Emissions of NH_3 decreased by 0.1% and of NMVOCs by 0.9%. CO emissions increased by 3%.

The drop in NO_X emissions is mainly due to reductions reported by Spain, the United Kingdom and the Czech Republic. The 'Energy production and distribution' sector recorded the largest reductions of NO_X (in absolute terms) from 2012 to 2013.

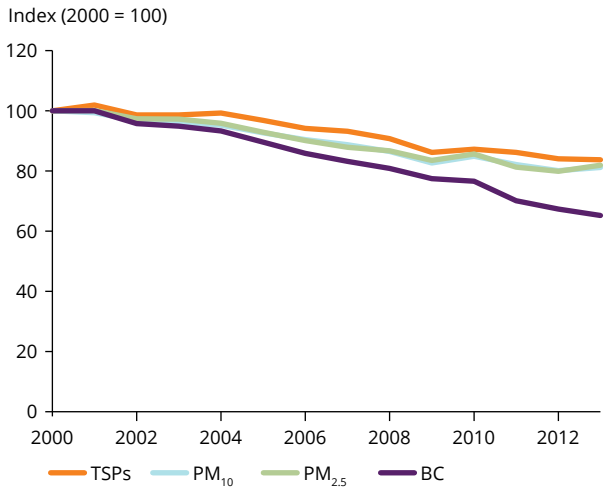
In absolute terms, NMVOC emissions decreased in 19 Member States between 2012 and 2013. The highest reductions were reported by Romania, Spain and the United Kingdom. The main emitter of NMVOCs is the 'Industrial processes and product use' sector. Significant reductions were achieved in the 'road transport' and 'energy production and distribution' sectors. However, they were almost counterbalanced by increases in the 'Commercial, institutional and households' sector.

From 2012 to 2013, the largest reductions in SO_X emissions in absolute terms were noted for Bulgaria, Spain and Greece. The sectors 'Energy production and distribution' and 'Energy use in industry' contributed most to the reduction of SO_X. CO emissions increased, mainly due to a strong rise reported by Italy. The sectors 'Commercial, institutional and households', contributed most to the increase in CO emissions. NH_3 emissions remained almost constant. Increased NH_3 emissions reported by Germany were mainly counterbalanced by decreased emissions in Italy, Bulgaria and Romania.

In the 'Road transport' sector, emissions reductions since 1990 were achieved for CO, NMVOCs and NO_X primarily through legislative measures requiring abatement of vehicle exhaust emissions. NO_X emissions also decreased considerably in the electricity/energy generation sectors as a result of certain technical measures, mainly:

- introduction of combustion modification technologies (e.g. use of low NO_X burners);
- implementation of flue-gas abatement techniques (e.g. NO_X scrubbers, and selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) techniques);
- fuel-switching from coal to gas.

Figure ES.2 EU-28 emission trends for PM



Note: For BC, not all Member States reported data.

NH_3 emissions fell less than emissions of the other main pollutants (− 27%) since 1990.

Emission trends of particulate matter between 2000 and 2013

Parties to the LRTAP Convention are formally requested to report emissions of PM from the year 2000 onwards. Hence emission trends are shown for these years only. For TSPs the aggregated EU-28 emission reduction achieved since 2000 is 52% from 1990 (Figure ES.2). Emissions of primary PM_{10} and $PM_{2.5}$ have seen a reduction of 19% and 18% respectively, and BC a reduction of 39%.

Total PM emissions dropped mainly thanks to the introduction or improvement of abatement measures across the 'Energy', 'Road transport', and 'Industry' sectors, coupled with other developments in industrial sectors, such as fuel-switching from high-sulphur-containing to low-sulphur-containing fuels.

Emission trends of HMs and POPs between 1990 and 2013

Emissions for the main HMs (Pb, Cd, Hg), dioxins and furans, HCB and PCBs have also dropped substantially since 1990, in the order of 70% or more (Figure ES.3).

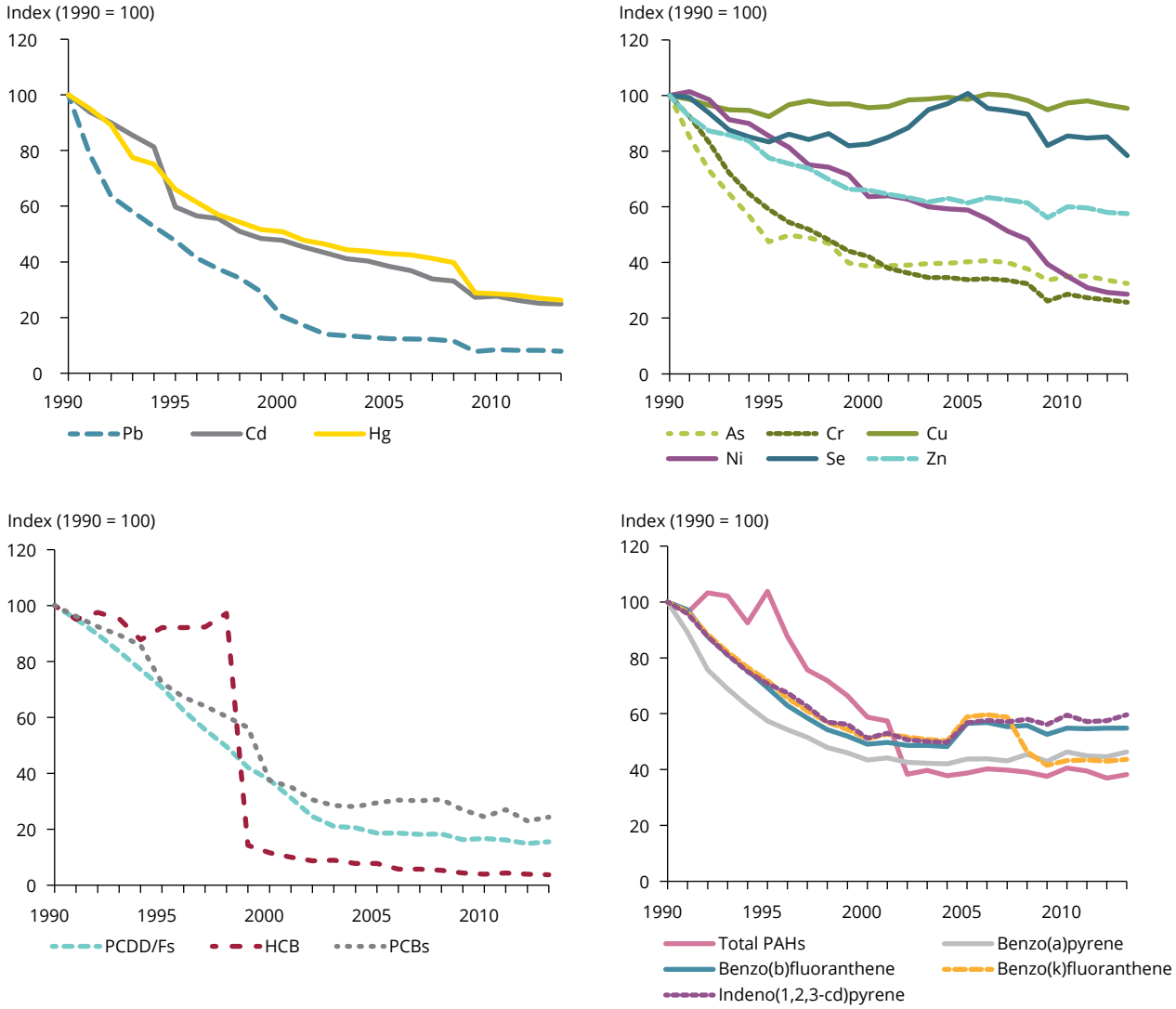
Much progress has been made since the early 1990s in reducing point-source emissions of these substances, particularly from industrial facilities. This has been achieved partially through improved abatement techniques for wastewater treatment and incinerators in metal refining and smelting industries.

In some countries, the emissions reduction follows the closure of older industrial facilities due to economic restructuring. However, the decrease rate in total emissions was higher between 1990 and 2000 than in the following years.

With the exception of Cu, whose emissions remained roughly stable over the years (− 4.6%; 2013 compared to 1990), reductions over the period 1990 to 2013 are also reported for other HMs (As − 68%, Cr − 74%, Ni − 71, Se − 22% and Zn − 42%). The decrease was − 62% for total PAHs ([3]).

For individual PAHs, the reductions were: − 54% for B(a)P, − 45% for B(b)F, − 56% for B(k)F and − 40% for IP over the period 1990 to 2013. In spite of the clear decreases over the last 25 years, emissions of PAHs have remained broadly stable since year 2000 (Figure ES.3).

Figure ES.3 EU-28 emission trends for HMs and POPs



Note: The drop in HCB emissions between 1998 and 1999 is due to a considerable reduction reported by the United Kingdom.

For certain pollutants, not all Member States reported data.

([3]) Comparisons between the reduction of total PAHs and reductions of the other PAHs are difficult within this report, as the reporting completeness for the EU (sum of reporting/gap-filling of the Member States) differs strongly between total PAHs and the other PAHs.

Box ES.4 Effects of recalculated data for previously reported 2012 emissions

Recalculations by Member States for one or more years, that were submitted in 2015 resulted in changes of emission inventories for all pollutants for the year 2012.

In their informative inventory reports (IIRs) (see Appendix 5), the following Member States gave an account of their reasons for recalculating parts of time series or whole time-series (e.g. methodological improvements, revision of emission factors, reallocations, revision of activity data and correction of errors): Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. Information on the rationale behind recalculations was not always provided.

EU-28 key categories and main emission sources

EU-28 key categories are the individual sources that contributed overall the most to 2013 emissions of pollutants, determined by a level assessment ([4]) for NO_X, NMVOCs, SO_X, NH_3, CO, $PM_{2.5}$, PM_{10}, Cd, Pb, Hg, PCDD/Fs, total PAHs, B(a)P, HCB and PCBs.

A total of 52 different emission inventory source categories were identified as being key categories for at least one pollutant. A number of emission categories were identified as being key categories for more than one of the 15 pollutants assessed. The most relevant key categories are listed in Table ES.1.

Figure ES.4 shows the share of EU-28 emissions by sector group. As observed in past years, each of the main air pollutants has one major source category: for NO_X this is 'Road transport'; for SO_X, 'Energy production and distribution'; for NH_3, 'Agriculture'; for NMVOCs, 'Industrial processes and product use'; and for CO, 'Commercial, institutional and households'.

NO_X emissions from the 'Road transport' sector decreased by 56% between 1990 and 2013. The road transport group is nevertheless a major source of the ground-level O_3 precursors NO_X, CO and NMVOCs in the EU; in 2013 it contributed 39%, 22% and 12% of total EU-28 emissions, respectively. It is also a major source of primary $PM_{2.5}$, PM_{10} and of Pb emissions. Passenger cars and heavy duty vehicles and buses are the principal contributors to NO_X emissions from this sector; for CO in 2013, passenger cars alone contributed around 55% of emissions from the 'Road transport' sector.

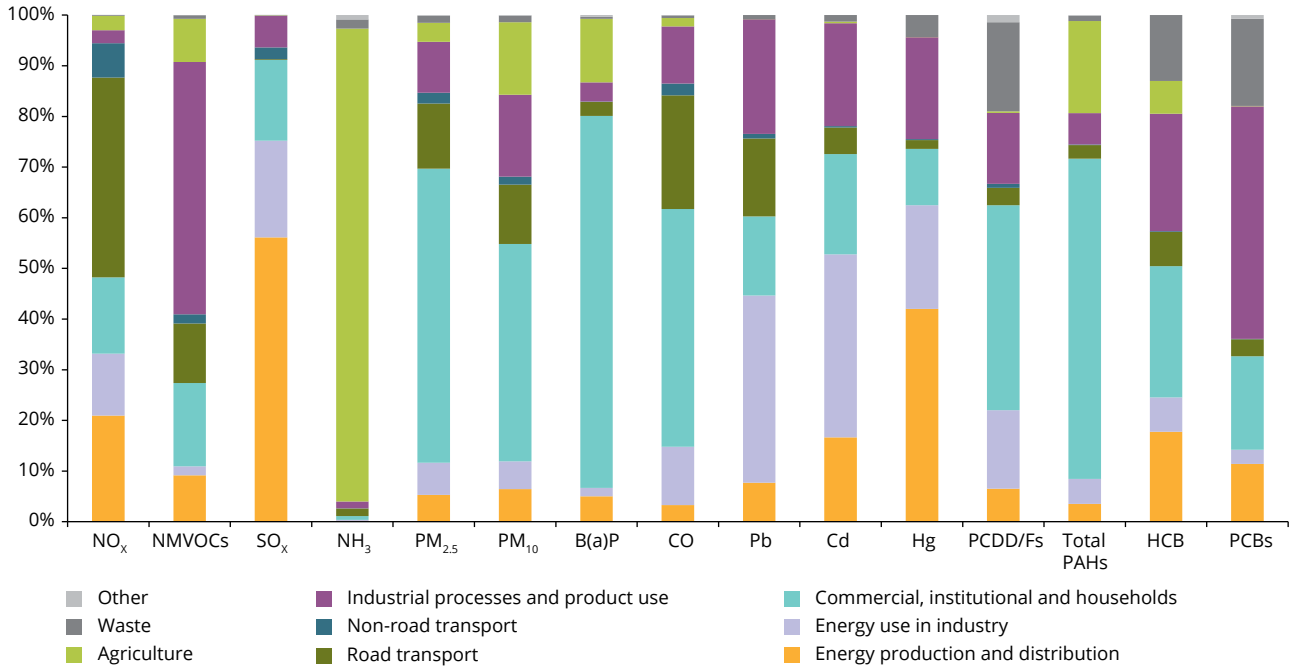
The 'Commercial, institutional and households' sector is the most important source of B(a)P, CO, $PM_{2.5}$, PM_{10}, dioxins and furans, total PAHs and HCB. Energy- and process-related emissions from industry contribute considerably to the overall emissions of a number of the HMs and POPs.

Table ES.1 Most relevant key categories for air pollutant emissions

Name of key category	Number of occurrences as key category
Residential: stationary (combustion) (NFR 1A4bi)	14 times (NO_X, SO_X, NMVOCs, CO, Pb, Cd, Hg, $PM_{2.5}$, PM_{10}, PCDD/Fs, total PAHs, B(a)P, HCB, PCBs)
Public electricity and heat production (NFR 1A1a)	11 times (NO_X, SO_X, CO, Pb, Cd, Hg, $PM_{2.5}$, PM_{10}, PCDD/Fs, HCB, PCBs)
Stationary combustion in manufacturing industries and construction: Other (NFR 1A2gviii)	10 times (NO_X, SO_X, CO, Pb, Cd, Hg, $PM_{2.5}$, PM_{10}, PCDD/Fs, total PAHs)
Iron and steel production (NFR 2C1)	9 times (CO, Pb, Cd, Hg, $PM_{2.5}$, PM_{10}, PCDD/Fs, HCB, PCBs)
Road transport: Passenger cars (NFR 1A3bi)	8 times (NO_X, NMVOCs, CO, $PM_{2.5}$, PM_{10}, Pb, PCDD/Fs, HCB)

([4]) A key category level assessment identifies those source categories that have a significant influence on a country's total inventory in terms of their absolute level of emissions. In this report, the categories that are collectively responsible for 80% of the total emissions of a given pollutant are classified as key categories (EMEP/EEA, 2013).

Figure ES.4 Share of EU-28 emissions of the main pollutants, by sector group



EU progress in meeting its 2010 emission reduction targets under the Gothenburg Protocol

Table ES.2 shows the aggregated emissions for the year 2013 (as reported by the EU-15 Member States originally listed in the Gothenburg Protocol), as compared to the respective 2010 emission ceilings specified for the EU. For all pollutants, emissions in 2013 were below the respective pollutant ceilings.

Figure ES.5 shows whether the Gothenburg ceilings were met in 2013, for EU Member States. Five Member States (Austria, Belgium, France, Ireland and Luxembourg) reported NO_X emissions higher than their ceilings, and six (Austria, Finland, Germany, the Netherlands, Spain and Croatia) exceeded their NH_3 ceiling. Three Member States (Denmark, Germany and Ireland) exceeded their NMVOCs ceilings. In 2013, the SO_X ceiling was not exceeded by any Member States.

Table ES.2 Emissions reported for 2013 by EU-15 Member States compared with Gothenburg Protocol EU emission ceilings

Pollutant	EU-15 emissions year 2013 (Gg)	European Union (EU-15) Gothenburg Protocol 2010 ceilings (Gg)	Difference (%)	Sum of individual EU-15 ceilings (Gg) ([a])
NO_X	6 106	6 671	– 8%	6 519
NMVOCs	5 344	6 600	– 19%	6 510
SO_X	1 848	4 059	– 54%	3 850
NH_3	3 078	3 129	– 2%	3 110

Note: ([a]) Emission ceilings are also specified for the individual EU-15 Member States. The sum of these ceilings is, in some instances, different to the ceilings specified for the EU-15 as a whole.

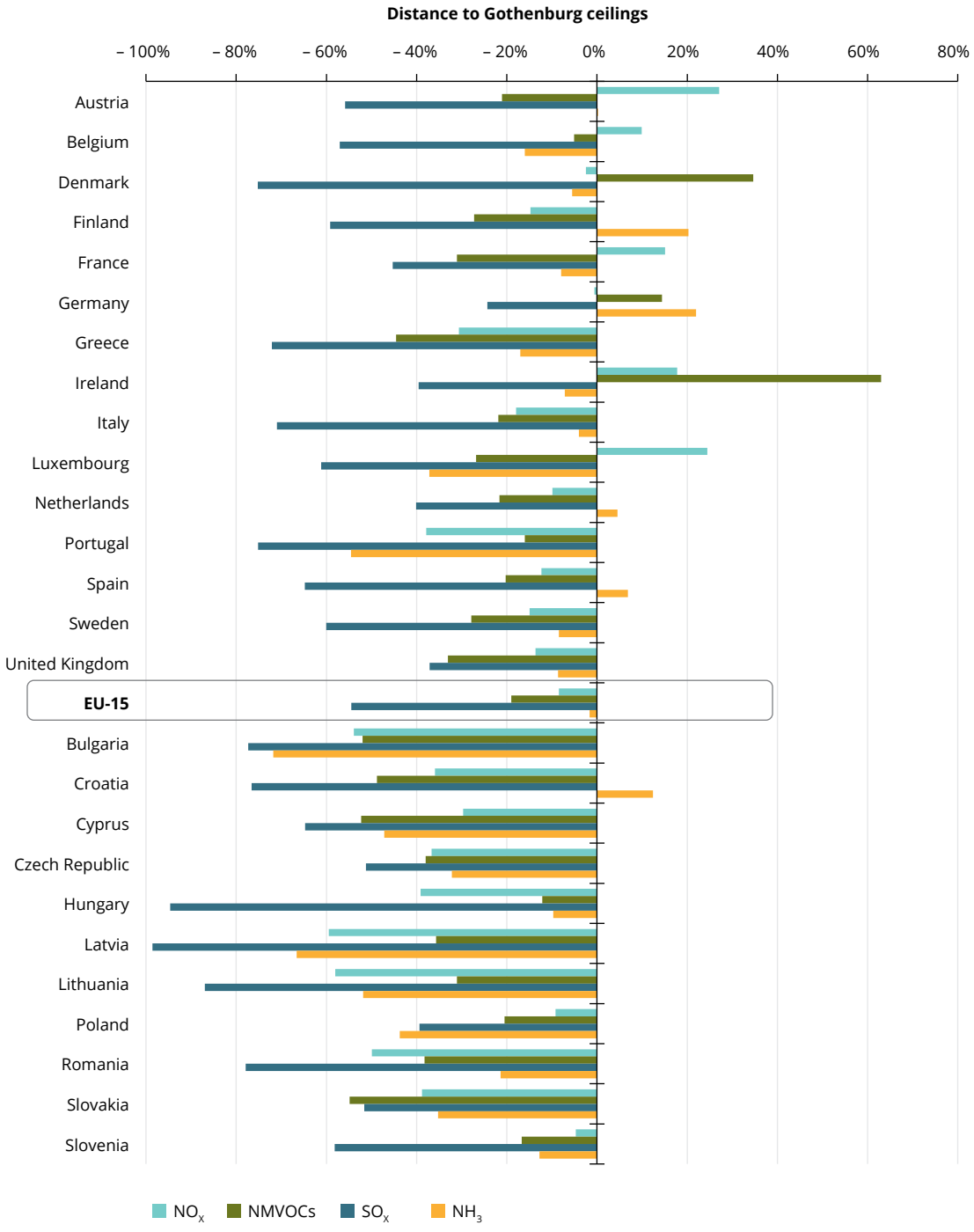
For Spain, data for emission comparisons exclude emissions from the Canary Islands.

The comparison with emission ceilings is based on reporting on the basis of fuel sold, except for Austria, Belgium, Ireland, Lithuania, Luxembourg, the Netherlands and the United Kingdom. These countries may choose to use the national emissions total calculated on the basis of fuel used in the geographic area of the Party as a basis for ceilings comparisons instead (UNECE, 2014a).

Under the Gothenburg Protocol, inventory adjustment applications ([5]) for emissions from Germany (for NO_X) and Denmark (for NH_3) were accepted by the EMEP Steering Body in 2014. In this table, these adjusted data for Germany and Denmark are taken into account.

([5]) In 2012, the Executive Body for the LRTAP Convention decided that adjustments to emission reduction commitments, or to inventories for the purposes of comparing total national emissions with them, may be applied in some circumstances (UNECE, 2012b).

Figure ES.5 Distance to Gothenburg ceilings for EU Member States



Note: Estonia and Malta have not signed the Gothenburg Protocol and therefore do not have ceilings.
For Spain, data for emission comparisons exclude emissions from the Canary Islands.
In this figure, these 'adjusted' emission inventory data for Germany and Denmark are taken into account.

Progress by non-EU EEA member countries in meeting 2010 emission ceilings under the Gothenburg Protocol

Three non-EU EEA member countries (Liechtenstein, Norway and Switzerland) have emission ceilings for 2010 and onwards specified under the Gothenburg Protocol of the LRTAP Convention (UNECE, 1979, 1999). Emission data for Liechtenstein, Norway and Switzerland are the latest reported data under the LRTAP Convention (2015 submission round), and are compared with the respective emission ceilings of the Gothenburg Protocol. Liechtenstein has signed but not yet ratified the protocol. The EEA member countries Iceland and Turkey have not yet signed the Gothenburg Protocol.

Data reported by these countries show that Liechtenstein exceeded its NO_X and NH_3 emissions ceilings for all years; although Norway exceeded its NO_X ceiling from 2010 to 2012, it complied in 2013, while its NH_3 emissions ceilings were exceeded in all years. Switzerland complied with all ceilings for all pollutants, except for NH_3 in the year 2010 (see Table ES.4).

Recommendations for improved data quality

Despite clear progress in recent years in terms of reporting completeness, a number of data gaps remain in the official data sets received from Member States. The completeness of Member State submissions can therefore be further improved, particularly for historic 1990–2000 data and for certain pollutants such as HMs and POPs. In order to compile a compete as possible EU inventory, missing emission data are gap-filled to the extent feasible (for details see Section 1.8).

This report also contains several recommendations that may further improve the quality of the EU inventory in future. Member States should submit complete inventories and use proper notation keys for instances where estimated values are not available. They should recalculate emissions data for past years when new methods or new scientific knowledge become available. In this context, it is recommended that Member States review and apply the information contained in the updated *EMEP/EEA air pollutant emission inventory guidebook — 2013* (*EMEP/EEA Guidebook*; EMEP/EEA, 2013) when compiling their emission inventory data sets.

Further, all Member States are encouraged to report their emission inventories on the basis of fuel sold for the 'Road transport' sector, in line with the reporting guidelines (UNECE, 2014a). Reporting of 'fuel sold' is a minimum requirement although a number of countries *may* choose to additionally report road transport emissions on the basis of 'fuel used' for compliance checking purposes.

Member States are encouraged to follow up on requests from the EEA or ETC/ACM during the compilation of the EU-28 inventory, by either resubmitting inventory data (in the new NFR14 format) or by updating next year's inventory to reflect new insights gained or errors identified.

Finally, national emission inventory experts are encouraged to participate as expert reviewers in the joint annual EMEP/EEA inventory review process. Such activities (aimed specifically at supporting and improving the quality of national inventories) are of key importance for ensuring that high-quality data are available for the EU's own inventory.

Table ES.4 Progress by other EEA member countries in meeting Gothenburg Protocol emission ceilings

Country	NO_X				NMVOCs				SO_2				NH_3			
	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013
Liechtenstein	×	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×
Norway	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×
Switzerland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓

Note: '✓' indicates that the final (2010, 2011, 2012) or provisional (2013) emission data reported by a country meet or lie below its respective emission ceiling.

'×' indicates that a ceiling is not met.

1 Introduction

This report and its accompanying data are provided by the European Commission (on behalf of the EU) as an official submission to the secretariat for the Executive Body of the Long-range Transboundary Air Pollution (LRTAP) Convention.

The report covers the following subjects: the formal institutional arrangements that underpin the EU's emission inventory (Chapter 1); emission trends reported by Member States, and the contribution of key categories to total emissions (Chapter 2); sectoral analysis and emission trends for key pollutants (Chapter 3); and information on recalculations and planned improvements (Chapter 4).

EU-28 emission totals are estimated for the pollutants for which data should be reported under the LRTAP Convention (see Appendix 2), i.e. emissions of:

- main pollutants: nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs), sulphur oxides (SO_x), ammonia (NH_3), carbon monoxide (CO);
- particulate matter (PM): primary PM (PM_{10} and $PM_{2.5}$, the latter also called fine PM) total suspended particulates (TSPs) and black carbon (BC);
- priority heavy metals (HMs): lead (Pb), cadmium (Cd) and mercury (Hg);
- additional HMs: arsenic (As), chromium (Cr), copper (Cu), nickel (Ni), selenium (Se) and zinc (Zn);
- persistent organic pollutants (POPs): polychlorinated dibenzodioxin/polychlorinated dibenzofurans (PCDD/Fs), polycyclic aromatic hydrocarbons (PAHs), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs);
- additional reporting of the individual PAHs benzo(a) pyrene (B(a)P), benzo(b)fluoranthene (B(b)F), benzo(k)fluoranthene (B(k)F) and indeno(1,2,3-cd) pyrene (IP).

Emission estimates are not always available for all pollutants in each year, due to gaps in the data reported by Member States. A more complete gap-filling process was trialled in 2010 for the compilation of the EU inventory, and was refined in 2011. Nevertheless, for certain pollutants (i.e. PM, TSPs, HMs and POPs), some Member States did not report data for any year, which meant that such gap-filling techniques could not be applied. For these pollutants, the EU-28 total thus remains incomplete. Details of the gap-filling methodology applied are provided in Section 1.4.

Several annexes accompany this inventory report.

- Annex A provides a copy of the formal LRTAP Convention data submission of the EU for the years from 1990 to 2013 for the EU-28, in the required United Nations Economic Commission for Europe (UNECE) reporting format (NFR14).
- Annex B provides the updated EU NO_X emissions data for the period between 1987 and 1989, provided under the requirements of the 1988 NO_X protocol of the LRTAP Convention.
- Annex C provides results of the key category analysis (KCA) for the EU-28, showing the main emitting sectors for each pollutant.
- Annex D provides the gap-filled inventory of the EU-28, colour-coded for the different data sources used and the different additional gap-filling methods applied.
- Annex E provides Member States' projections for NO_X, NMVOCs, SO_X, NH_3, $PM_{2.5}$ and PM_{10} emissions for the years 2015, 2020, 2025, 2030, 2040 and 2050.
- Annex F-I provides the LRTAP Convention data submission of the EU for the years from 1990 to 2013 for the EU9, EU-12, EU-15 and EU-27. Information on the country grouping is given in Table A2.2 of Appendix 2.

1.1 Background

1.1.1 Reporting obligations under the Convention on Long-range Transboundary Air Pollution (LRTAP)

The EU ratified the UNECE's Convention on LRTAP (UNECE, 1979) in 1982. Article 2 of the convention states that 'the Contracting Parties, taking due account of the facts and problems involved, are determined to protect man and his environment against air pollution and shall endeavour to limit and, as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution'.

The convention has an established process for negotiating measures to control specific pollutants through legally binding protocols. Since 1984, eight protocols have come into force. The most recent, the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (the so-called Gothenburg Protocol) (UNECE, 1999), came into force on 17 May 2005.

Table 1.1 presents the status of ratification of each protocol by the EU. The status differs across Member States.

On 4 May 2012, the Executive Body for the UNECE LRTAP Convention adopted amendments to the Gothenburg Protocol (UNECE, 2012a). The new text of the protocol includes national emission reduction commitments for the main air pollutants NO_X, NMVOCs, SO_X and NH_3, to be achieved in 2020 and beyond. Further, the revised protocol will include emission reduction commitments for fine PM ($PM_{2.5}$). BC (a short-lived climate forcer) is included as a component of PM. Several of the protocol's technical annexes were revised with updated sets of emission limit values (emission standards), both for key stationary sources and for mobile sources of air pollution. For the EU, the emission reduction commitments from 2005 emission levels for 2020 and beyond are 59% for SO_2, 42% for NO_X, 6% for NH_3, 28% for NMVOCs and 22% for $PM_{2.5}$ (UNECE, 2012a). The amended Gothenburg Protocol has not yet been ratified by the EU.

The Executive Body of the LRTAP Convention adopted revised *Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution* (reporting guidelines) at its 32nd session in March 2014 (UNECE, 2014a), for application in 2015 and subsequent years. These reporting guidelines describe the data that Parties should report under the LRTAP Convention and its protocols. A summary of the reporting requirements is provided in Appendix 2.

In 2015, Parties were requested to report emissions data for NO_X, NMVOCs, SO_X, NH_3, CO, HMs, POPs and PM, as well as associated activity data. As in the last two years, the EU inventory also includes pollutants

Table 1.1 EU ratification status of the LRTAP Convention and related protocols

LRTAP Convention and its protocols	Status of ratification
Convention on Long-range Transboundary Air Pollution (1979) ([a])	Signed and ratified (approval)
Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (1984) ([b])	Signed and ratified (approval)
Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30% (1985) ([c])	Not signed
Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes (1988) ([d])	Ratified (accession)
Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes (1991) ([e])	Signed
Protocol on Further Reduction of Sulphur Emissions (1994) ([f])	Signed and ratified (approval)
Protocol on Persistent Organic Pollutants (1998) ([g])	Signed and ratified (approval)
Protocol on Heavy Metals (1998) ([h])	Signed and ratified (approval)
Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (1999) ([i])	Ratified (accession)

Note: ([a]) UNECE, 1979 (Geneva Convention).
([b]) UNECE, 1984 (Geneva Protocol).
([c]) UNECE, 1985 (Helsinki Protocol).
([d]) UNECE, 1988 (Sofia Protocol).
([e]) UNECE, 1991 (Geneva Protocol).
([f]) UNECE, 1994 (Oslo Protocol).
([g]) UNECE, 1998a (Aarhus Protocol).
([h]) UNECE, 1998b (Aarhus Protocol).
([i]) UNECE, 1999 (Gothenburg Protocol. Amendments to the protocol were adopted on 4 May 2012).

that can be reported additionally (As, Cr, Cu, Ni, Se, Zn, B(a)P, B(b)F, B(k)F, IP, BC and TSPs). The deadline for individual Parties to submit data to the LRTAP Convention is 15 February of each year, with a separate deadline of 15 March for submitting the accompanying inventory reports. The EU has separate reporting dates specified in the reporting guidelines, which allow time for the compilation of an aggregated inventory based on the individual submissions from Member States. EU-28 inventory data should be submitted to the Executive Secretary of the UNECE by 30 April, and the accompanying inventory report by 30 May, each year.

The reporting guidelines also request Parties to report emission inventory data using the new European Monitoring and Evaluation Programme (EMEP) NFR14 format.

In 2012, the Executive Body of the LRTAP Convention decided that adjustments to emission reduction commitments, or to inventories for the purposes of comparing total national emissions with them, may be applied in some circumstances, in the event that such a circumstance contributes to a party being unable to meet one of its reduction commitments (UNECE, 2012b).

These circumstances are as follows:

(a) emission-source categories are identified that were not accounted for at the time the emission reduction commitments were set;

(b) emission factors used to determine emission levels for particular source categories for the year in which emission reduction commitments are to be attained are significantly different than the emission factors applied to these categories at the time the emission reduction commitments were set;

(c) the methodologies used for determining emissions from specific source categories have undergone significant changes between the time when emission reduction commitments were set and the year they are to be attained.

The EMEP Steering Body reviews any supporting documentation and assesses whether the adjustment is consistent with the circumstances and the guidance for adjustments (UNECE, 2012c). The review is made available to the Parties, who have the option of making a submission to the Implementation Committee under Decision 2006/2 (UNECE, 2006).

In 2014, inventory adjustment applications for emissions from Germany (for NO_X) and Denmark (for NH_3) were accepted by the EMEP Steering Body (UNECE, 2014b). Adjusted emission data for Germany and Denmark are shown in this report in Table 2.4 and Table 2.7, respectively. For Belgium, France and Spain, the adjustment application process was not completed in 2014, and so were left pending (UNECE, 2014b).

1.1.2 Reporting obligations under the National Emission Ceilings (NEC) Directive and the EU Greenhouse Gas Monitoring Mechanism

EU Member States report their emissions of NO_X, NMVOCs, SO_2 and NH_3 under Directive 2001/81/EC

Table 1.2 Overview of air emission reporting obligations in the EU, 2014–2015

Legal obligation	Emission reporting requirements ([a])	Annual reporting deadline for EU Member States	Annual international reporting deadline for the EU
LRTAP Convention	Emissions ([b]) of NO_X (as NO_2), NMVOCs, SO_X (as SO_2), NH_3, CO, HMs, POPs ([c]) and PM	15 February 2015	30 April 2015
NEC Directive	Emissions of NO_X, NMVOCs, SO_2 and NH_3	31 December 2014	n/a
EU Monitoring Mechanism/ UNFCCC	Emissions ([d]) of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NO_X, CO, NMVOCs and SO_2	15 January 2015 to the European Commission and 15 April 2015 to the UNFCCC	15 April 2015

Note: ([a]) The European Community and European Union have signed a number of protocols over the years, with varying numbers of Member States included in the commitments. Therefore, emission reporting must be provided separately for the EU-9, EU-12, EU-15, EU-27 and EU-28 (see Table A2.2 in Appendix 2 for more information on EU country groupings).

([b]) Parties are formally required to report only on the substances and for the years set forth in protocols that they have ratified and that have entered into force.

([c]) Starting with the 2010 reporting round, the list of POPs has been reduced to PCDD/Fs, total PAHs, HCB and PCBs.

([d]) Greenhouse gases (GHGs): methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF_6).

on national emission ceilings for certain atmospheric pollutants, known as the EU National Emission Ceilings (NEC) Directive (EC, 2001). They also report emissions of NO_X, SO_2, NMVOCs and CO (contributions to emissions of) under EU regulation No 525/2013), known as the EU Greenhouse Gas Monitoring Mechanism (EU, 2013). This information should also be copied by Member States to the EEA European Environment Information and Observation Network (Eionet) Reportnet Central Data Repository (CDR) (Eionet, 2015a). Table 1.2 provides an overview of these different reporting obligations for EU Member States.

Reporting obligations under the LRTAP Convention and NEC Directive have now been harmonised since the adoption of the updated reporting guidelines. They differ from the UNFCCC obligations in terms of the inclusion of domestic and international aviation and navigation in the reported National Totals. The main differences between the different reporting instruments are summarised in Table 1.3. The overall impact of these differences is small for most Member States.

1.2 Institutional arrangements

1.2.1 Member States

Member States are responsible for selecting the activity data, emission factors and other parameters used for their national inventories. Member States should also follow the reporting guidelines (UNECE, 2014a) and apply the methodologies contained in the latest version of the EMEP/EEA guidebook, which at the time of writing, is the *EMEP/EEA Guidebook* (EMEP/EEA, 2013).

Member States are also responsible for establishing quality assurance (QA) and quality control (QC) programmes for their inventories. The Member States' inventory report should include a description of the QA and QC activities and recalculations.

In addition to submitting their national LRTAP inventories and inventory reports, through participation in the Eionet network (see Section 1.2.2 below), Member States also take part in the annual review and commenting phase of the draft EU inventory

Table 1.3 Air pollutant reporting obligations comparison: the LRTAP Convention, NEC Directive and UNFCCC/MMR

Reporting item	Included in National Totals	Not included in National Totals: memo item
Domestic aviation (LTO)	NEC, LRTAP, UNFCCC/MMR	n/a
Domestic aviation (cruise)	UNFCCC/MMR	NEC, LRTAP
International aviation (LTO)	NEC, LRTAP	UNFCCC/MMR
International aviation (cruise)	n/a	NEC, LRTAP, UNFCCC/MMR
National navigation (domestic shipping)	NEC, LRTAP, UNFCCC/MMR	n/a
International inland shipping	NEC, LRTAP	UNFCCC/MMR
International maritime navigation	n/a	NEC, LRTAP, UNFCCC/MMR
Road transport (fuel sold) (*)	NEC, LRTAP, UNFCCC/MMR	n/a

Note: (*) In addition, Parties may also report emission estimates based on fuel used as an additional 'memo item'.

International inland shipping refers to shipping activity on continental waters, and international maritime navigation to shipping activity on marine water. Air emissions resulting from inland shipping are included, as they are more relevant in terms of air quality for the surrounding environment.

n/a: not applicable.
LTO: Landing and take-off.
LRTAP: NO_X, NMVOCs, SO_X, NH_3, CO, HMs, POPs, PM.
NEC: NO_X, NMVOCs, SO_2, NH_3.
UNFCCC/MMR: NO_X, NMVOCs, SO_X, CO.

report. Member States check their national data and information used in the inventory report, and if necessary, send updates. General comments on the inventory report are also provided.

1.2.2 The EEA, European Commission, Eionet and ETC/ACM

European Environment Agency (EEA)

The EEA assists the European Commission's Directorate General for the Environment (DG Environment) in compiling the annual EU LRTAP inventory.

EEA activities include:

- overall coordination and management of the inventory compilation process;
- coordination of activities of the EEA's European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), which undertakes the data checking, compilation and draft report-writing tasks;
- communication with the European Commission;
- communication with Member States;
- circulation of the draft EU emission inventory and inventory report;
- hosting the official inventory database, and carrying out web dissemination of data and the inventory report.

Since 2004, the EEA and EMEP have supported a separate annual quality review of emission data submitted by countries. Findings are provided to countries each year with the objective of improving the quality of emission data reported. A joint report summarising the review findings is published each year by EMEP. Section 1.6 below provides further details of the annual data review process.

European Commission

The European Commission formally submits the EU emission inventory data and inventory report to EMEP through the Executive Secretary of UNECE.

European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM)

With regard to the EU's LRTAP Convention emissions inventory, the main ETC/ACM ([6]) activities include:

- initial checks, tests and centralised review of Member State submissions in cooperation with the EMEP Centre on Emission Inventories and Projections (CEIP), and compiling results from those checks (status reports, country synthesis and assessment reports, country review reports);
- consulting with Member States (via the EEA) in order to clarify data and other information provided;
- preparing the gap-filled EU emission inventory and inventory report by 30 April, based on Member State submissions (subsequently submitted by the Commission to UNECE);
- preparing the updated EU emission inventory and inventory report by 30 May.

European Environment Information and Observation Network (Eionet)

The work of the EEA and the ETC/ACM is facilitated by Eionet (EC, 1999), which comprises the EEA (supported by its European Topic Centres), a supporting network of experts from national environment agencies, and other bodies that deal with environmental information (Eionet, 2015b). Member States are requested to use the CDR of the Eionet Reportnet tools to make their LRTAP Convention submissions available to the EEA.

1.2.3 Planning, preparation and management

Each year, Member States upload their individual emission estimates and inventory reports to the CDR. The EEA (via the ETC/ACM) compiles the data from the CDR and performs a QA and QC analysis. Should any clarifications be needed or inconsistencies detected, Member States are contacted directly by the ETC/ACM (via the EEA). Data gaps in Member States' inventories are gap-filled, and the gap-filled data are compiled into an EU total inventory. The European Commission formally submits the EU's emission inventory data and informative inventory report (IIR) to EMEP through the Executive Secretary of UNECE.

([6]) The current ETC/ACM was established by contract between the lead organisation, the National Institute for Public Health and the Environment (RIVM, Rijksinstituut voor Volksgezondheid en Milieu), and the EEA in 2014. It works with 14 organisations and institutions across 10 European countries.

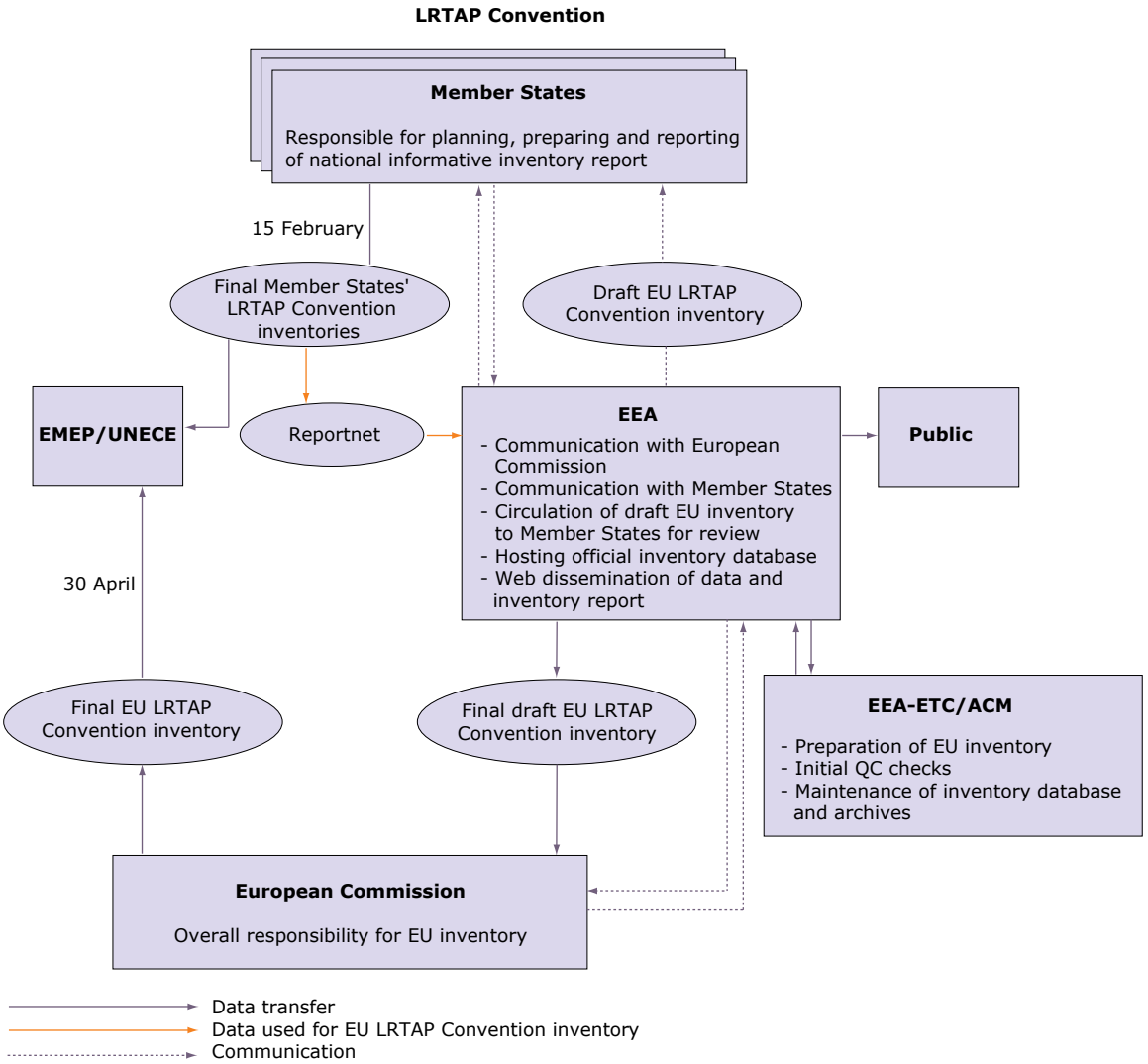
Throughout this process, the EEA acts as the main contact point for the European Commission, the ETC/ACM and the Member States. It manages the timely and complete submission under the LRTAP Convention and its protocols.

1.3 Inventory preparation process

No specific EU directive implements the LRTAP Convention's requirements for estimating air emissions and preparing air emission inventories. The basis of reporting for individual Member States and for the EU remains the LRTAP Convention (UNECE, 1979), its protocols (Table 1.1) and subsequent decisions taken by the Executive Body. As noted earlier, the reporting guidelines describe the data that Parties should report under the LRTAP Convention and its protocols. Under the agreement between Eionet countries and the EEA concerning priority data flows, EU Member States are requested to post a copy of their official submission to the LRTAP Convention in the CDR, by 15 February each year. The ETC/ACM subsequently collects the data from the CDR, compiles the gap-filled EU LRTAP Convention emission inventory database, and produces a EU LRTAP Convention emission inventory and inventory report.

Within this legal and procedural framework, the preparation of the annual LRTAP Convention emission inventory involves the following: provision of data by Member States; receipt of data on behalf of the European Commission and the EEA; and finally, data compilation, gap-filling of missing data and preparation of the inventory itself by the EEA and its ETC/ACM. The inventory and accompanying documentation are then made publicly available through the EEA website. Figure 1.1 presents a flow chart illustrating the data flow used to compile the EU's LRTAP Convention emission inventory.

Figure 1.1 Data flow for compiling the EU LRTAP Convention emission inventory



1.4 Methods and data sources

The EU LRTAP Convention emission inventory is based on an aggregation of data reported by Member States. Member States should have reported inventory data to UNECE (and were requested also to provide a copy of these data to the EEA) no later than 15 February 2015.

In total, all 27 Member States which submitted data used the new NFR14 reporting templates. Table 1.4 indicates which information the Parties provided, but does not indicate the completeness of each category. Detailed information on Member States' submissions is presented in Appendix 3.

The recommended structure for an IIR involves a general description of the methodologies and data sources used. This includes an overview of the emission factors used in the national inventory: country specific or default (i.e. of the *EMEP/EEA Guidebook,* EMEP/EEA, 2013), and specification of the sources of default emission factors and methods. It also includes an elaborated description of activity data sources where data differ from national statistics. The following two subsections summarise the information provided by Member States in their IIRs, helping readers understand the foundation of the EU inventory. For detailed descriptions of methodologies and data sources, see the IIRs of Member States (see Appendix 5).

1.4.1 Data sources

The data source for the EU inventory is Member States' emission inventories. Data sources for these underlying inventories may vary across the different Member States, but all should follow the recommendations of the *EMEP/EEA Guidebook* (EMEP/EEA, 2013). This ensures that although inconsistencies might occur, the best

Figure 1.2 Dates of first data submissions received from Member States (as of 6 May 2015)

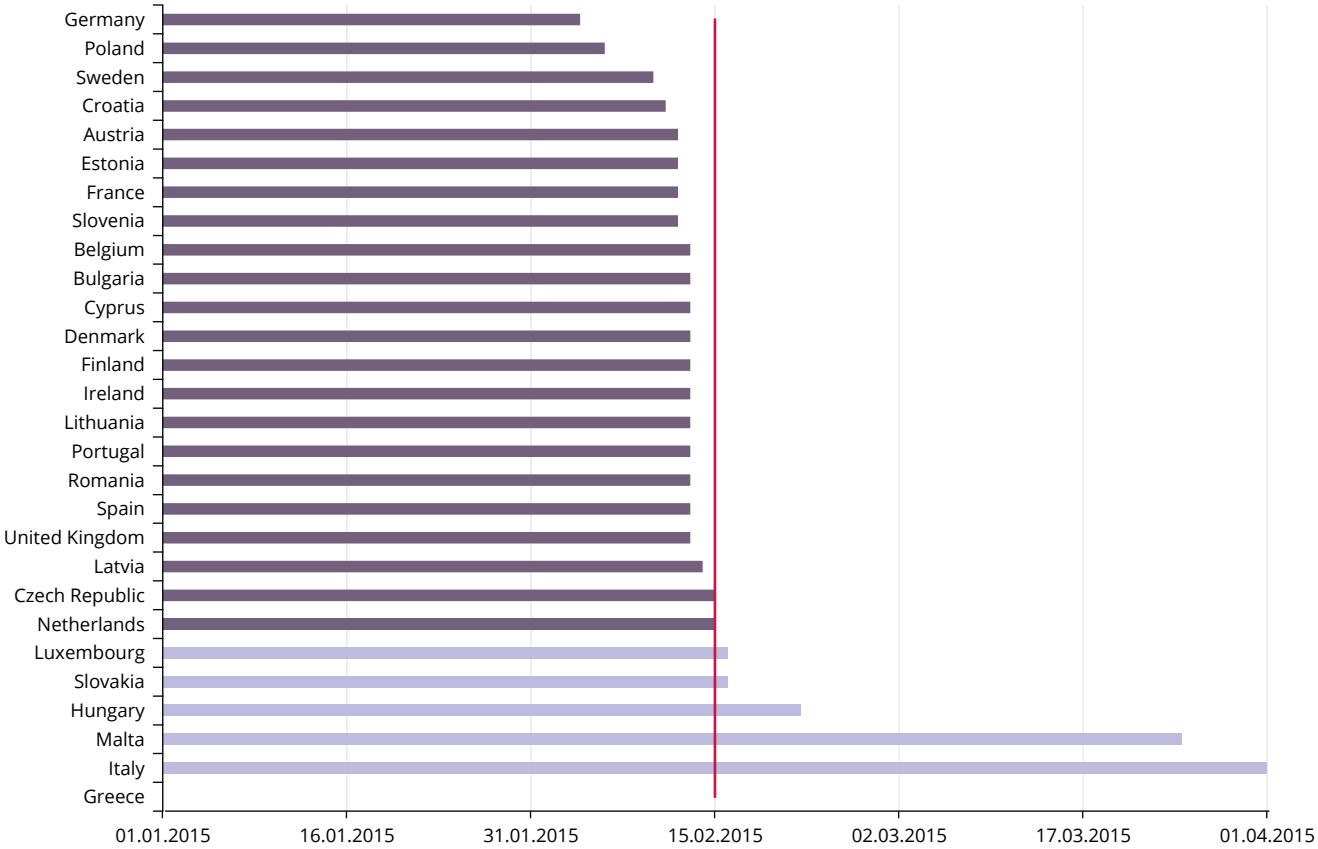


Table 1.4 Status of reporting by Member States (as of 6 May 2015)

Member State	Air emission inventory	Activity data	Informative inventory report	Gridded data	Large point sources	Projections
Austria	x	x	x	n/a	n/a	n/a
Belgium	x	x	x	n/a	n/a	x
Bulgaria	x	x	x	n/a	n/a	x
Croatia	x	x	x	n/a	x	x
Cyprus	x	x	x	n/a	n/a	x
Czech Republic	x	x	n/a	n/a	n/a	x
Denmark	x	x	x	n/a	n/a	x
Estonia	x	x	x	n/a	n/a	x
Finland	x	x	x	n/a	x	x
France	x	x	x	n/a	n/a	x
Germany	x	x	x	n/a	n/a	x
Greece	n/a	n/a	n/a	n/a	n/a	n/a
Hungary	x	x	x	n/a	n/a	n/a
Ireland	x	x	x	n/a	n/a	n/a
Italy	x	x	x	n/a	n/a	n/a
Latvia	x	x	x	n/a	n/a	x
Lithuania	x	x	x	n/a	n/a	x
Luxembourg	x	x	x	n/a	n/a	n/a
Malta	x	x	n/a	n/a	n/a	n/a
Netherlands	x	n/a	x	n/a	n/a	x
Poland	x	x	x	n/a	n/a	n/a
Portugal	x	x	x	n/a	n/a	n/a
Romania	x	x	x	n/a	n/a	x
Slovakia	x	x	x	n/a	n/a	n/a
Slovenia	x	x	x	n/a	n/a	x
Spain	x	x	x	n/a	n/a	x
Sweden	x	x	x	n/a	n/a	x
United Kingdom	x	x	x	n/a	n/a	x

Note: An 'x' indicates that the Member State submitted information, but does not provide an indication of the completeness of the provided information. For example, 'x' marked in the category 'Air emission inventory' only indicates that at least some pollutants for some years have been reported. For detailed information on the completeness of reporting, see Appendix 3.

available method is used to compile the EU inventory. The main data sources are national statistics, energy balances, agricultural statistics, etc. or any other reporting in line with national/international reporting requirements (e.g. the Large Combustion Plants Directive (2001/80/EC), the Emissions Trading Directive (2009/29/EC), and European Pollutant Release and Transfer Register (E-PRTR) Regulation No 166/2006).

Detailed information on the data sources used by Member States should be documented in the IIRs. The level of detail varies widely across Member States, although the main data sources are official national statistics. Table 1.5 summarises commonly used data sources for the various sectors.

Sources for emission factors vary according to the tier method used. One main source for emission factors is the *EMEP/EEA Guidebook* (EMEP/EEA, 2013), but they can also be country or even plant specific. A survey on the emission factors used by the Member States for all emission sources cannot be carried out, as this information is not uniformly available: some countries report details on their methodologies, while others do not. Detailed information is available in the IIRs submitted by Member States; references to these reports are provided in Appendix 5.

Table 1.5 Data sources commonly used for inventory sectors

Energy	Energy balances, EU Emissions Trading Scheme (EU ETS) data, large combustion plant data and large point-source (LPS) surveys
Transport	Energy balances, vehicle fleet statistics
Industry and product use	National production statistics, trade statistics, data from plant operators (facility reports), reporting under the European Pollutant Emission Register (EPER) and E-PRTR
Agriculture	National agricultural statistics, specific studies
Waste	Landfill databases, national studies, national statistics, information from municipalities

1.4.2 Comparison of Member State emissions calculated on the basis of fuel sold vs fuel consumed in road transport

In Article V/A, paragraph 22, the reporting guidelines (UNECE, 2014a) specify how emissions from transport should be reported: 'For emissions from transport, all Parties should calculate emissions consistent with national energy balances reported to Eurostat or the International Energy Agency. Emissions from road vehicle transport should therefore be calculated on the basis of the fuel sold in the party concerned. In addition, Parties may voluntarily calculate emissions from road vehicles based on fuel used or kilometres driven in the geographic area of the Party. The method for the estimate(s) should be clearly specified in the IIR.'

In paragraph 23 of the guidelines, the basis for compliance checking is detailed: 'For Parties for which emission ceilings are derived from national energy projections based on the amount of fuel sold, compliance checking will be based on fuels sold in the geographic area of the party. Other Parties within the EMEP region (i.e. Austria, Belgium, Ireland, Lithuania, Luxembourg, the Netherlands, Switzerland and the United Kingdom of Great Britain and Northern Ireland) may choose to use the national emission total calculated on the basis of fuels used in the geographic area of the Party as a basis for compliance with their respective emission ceilings.'

When fuel purchased within a country is actually used outside the country (and vice versa), transport emissions estimated using the amount of fuel sold within a country can differ significantly from those estimated using fuel consumed. In the EU inventory, emissions from road transport are based on fuel sold, except for the Netherlands and the United Kingdom. These both countries reported their inventories (National Total and data for the categories) on the basis of fuel used. As there are no fuel sold data available for the categories, emission data based on fuel used were used to compile the EU inventory. Only Belgium, Ireland, Luxembourg and Spain reported additional National Totals for compliance in the NFR templates based on fuel used. For these countries, Table 1.6 shows the difference between total emissions for the year 2013.

The other decisive factor for achieving consistent EU numbers is the method Member States use to calculate their emissions from road transport. Table 3.5 indicates that the COmputer Programme to calculate Emissions from Road Transportation (COPERT) (EMEP/EEA, 2013) is not used by all countries; moreover, even where COPERT is used, different versions of the programme may be applied. The impact of using these different approaches for EU transport emissions has not been quantified within this report.

1.4.3 General methods

Methods used by Member States should follow those described in the *EMEP/EEA Guidebook* (EMEP/EEA, 2013). Overall, Member States do follow this recommendation, which ensures that the best available methods are used for estimating national emissions and that inventories are improved continuously. Moreover, the technical review procedures set up by EMEP CEIP check and assess Parties' data submissions as per the review guidelines, with a view to improving the quality of emission data and associated information reported to the LRTAP Convention.

1.4.4 Data gaps and gap-filling

Ideally, there should be no need to gap-fill the reported inventory data, as it is the responsibility of Member States to submit full and accurate inventory data sets. However, as Table 1.7 and Table 1.8 indicate, Member State submissions contain various data gaps for particular pollutants or years in the time series.

Table 1.6 Comparison of Member States' total emissions calculated on the basis of fuel sold and fuel consumed ('National Total for compliance'), 2013

Member States		NO_X	NMVOCs	SO_X	NH_3	PM_{10}	$PM_{2.5}$	Benzo(a)-pyrene	CO	Cd	Hg	Pb	Dioxin	Total PAH	HCB	PCB
		Gg	Gg	Gg	Gg	Gg	Gg	Mg	Gg	Mg	Mg	Mg	g	Mg	kg	kg
Belgium	National total	208	137	46	62	43	33	NE	553	2	2	26	43	28	14	5
	National total for compliance (*)	199	137	46	62	42	33	NE	547	2	2	26	47	29	14	5
	Difference	**– 4%**	**– 1%**	**0%**	**0%**	**– 1%**	**– 1%**		**– 1%**	**0%**	**0%**	**– 1%**	**10%**	**3%**	**0%**	**0%**
Ireland	National total	79	90	25	108	26	16	8	123	0	1	14	30	33	2	14
	National total for compliance (*)	77	90	25	108	25	16	8	119	0	1	14	30	33	2	14
	Difference	**– 3%**	**0%**	**0%**	**0%**	**– 1%**	**– 1%**	**0%**	**– 4%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Luxembourg	National total	31	8	2	5	4	2	0	30	NR	NR	NR	0	1	0	2
	National total for compliance	14	7	2	4	3	2		19							
	Difference	**– 56%**	**– 14%**	**– 2%**	**– 4%**	**– 23%**	**– 29%**		**– 37%**							
Spain	National total	812	551	287	379	95	67	IE	1 709	8	5	175	115	171	4	27
	National total for compliance	743	534	272	377	93	65	IE	1 693	7	4	171	114	170	4	27
	Difference	**– 9%**	**– 3%**	**– 5%**	**– 1%**	**– 2%**	**– 3%**		**– 1%**	**– 14%**	**– 21%**	**– 2%**	**– 1%**	**– 1%**	**0%**	**0%**

Note: (*) Without adjustments.

Frequently observed problems occur when:

- submissions (whole national inventory) are not provided for the most recent year and/or other years;
- emissions of some pollutants (e.g. PM, HMs and POPs) are not provided, for a single year, several years or the entire time-series;
- sectoral emissions are missing, and only National Totals are provided.

The EMEP reporting guidelines (UNECE, 2014a) require that submitted emission inventories be complete. Before 2010, the inventory for the European Community was already partially gap-filled; official data reported by Member States under other reporting obligations (e.g. the NEC Directive (EC, 2001) and the EU Greenhouse Gas Monitoring Mechanism (EC, 2004)) were used to fill gaps. Nevertheless, this process still resulted in the European Community's inventory being incomplete for certain pollutants and years.

Reflecting the need to submit a more complete data set, several discussions were held in 2008 and 2009 with Member State representatives, to agree on approaches that would achieve more complete gap-filling of the EU emission inventory. At a meeting in September 2009 ([7]), Member State representatives agreed to test an improved procedure in 2010. In line with this agreement, the gap-filling procedure used during the compilation of the EU's 2010, 2011, 2012 and 2013 emissions inventory was performed following a methodology paper developed by the EEA and the ETC/ACM (EEA, 2009). This procedure is also consistent

([7]) Meeting of the Air and Fuels Committee under Directive 96/62/EC: Information on the Member States reporting under the NEC Directive (2001/81/EC), 28.09.2009, Brussels.

with the suggested techniques to fill emission data gaps described in the *EMEP/EEA Guidebook* (EMEP/EEA, 2013). In 2015, the gap-filling procedure has changed slightly, as there are currently no data reported under the EU Greenhouse Gas Monitoring Mechanism available (NO_X, NMVOCs, SO_2 and CO).

A stepwise approach was used to fill gaps in the national data sets, as described below.

1. Emission trends of all pollutants were compiled from 1990 onward using the Member State LRTAP Convention emission inventories provided to the EEA in 2015.

2. For Member States that did not report complete data sets, emissions data officially reported in 2015 by Member States under the NEC Directive (NO_X, NMVOCs, SO_2 and NH_3) were used in the first instance to fill gaps. In this step, notation keys were not used.

3. In a further step, notation keys reported in 2015 by Member States under the NEC Directive (NO_X, NMVOCs, SO_2 and NH_3) were used to fill any remaining gaps.

4. LRTAP Convention data submitted to EMEP CEIP in 2015 was the next source used to fill remaining gaps (there should be no difference between the Member States' LRTAP Convention emission inventories provided to the EEA and the data submitted to EMEP CEIP).

5. In the next step, Member State LRTAP Convention emission inventories provided to the EEA in previous years were used to fill still remaining gaps, followed by emission data reported in previous years under the EU Greenhouse Gas Monitoring Mechanism.

6. Older LRTAP Convention data submitted to EMEP CEIP were the final source of official information used to fill gaps.

7. Finally, for all remaining cases of missing data, further gap-filling procedures were applied in line with procedures set out by the EEA, 2009.

The further gap-filling procedures described in Step 7 are summarised below.

(a) Linear interpolation was performed if one or several years in the middle of a time series were missing.

(b) Linear extrapolation was performed if one or several years at the beginning or at the end of a time series were missing, and if at least 5 consecutive years showing a clear trend ($r^2 \geq 0.6$) were available. Extrapolation 'backwards' was never allowed to result in negative values.

(c) If fewer than five consecutive years were available as a basis for extrapolation, or if years did not show a clear trend (this is the case when $r^2 < 0.6$), the value of the previous or next year was used to fill the gaps.

(d) If the notation keys 'not applicable' (NA) or 'not occurring' (NO) were used as a basis for gap-filling, they were treated as '0' and were not gap-filled.

(e) Manual changes of gap-filled PM_{10}, $PM_{2.5}$ and BC data were carried out in cases where PM_{10} values were larger than the corresponding TSP values, $PM_{2.5}$ values were larger than PM_{10} values or BC values were larger than $PM_{2.5}$ values.

Moreover, gap-filling was only applied where National Total and sectoral data were unavailable, or where a National Total was available but there were no sectoral data. In the former instance, sectors were first gap-filled and then summed to determine the total. In the latter instance, the sectoral split of the previous or following year was used to fill the gaps. If a National Total was available, but the sectoral data were incomplete, no gap-filling was carried out.

Table 1.7 and Table 1.8 show how gap-filling affects the total emissions at EU level. Generally, the need to gap-fill 2013 data is much lower than it was for 1990 data. It is notable that in 2013, few Member States reported no emission values or the notation key 'not estimated' (NE). On the whole, the contribution of gap-filling is rather low. By contrast, gap-filling of 1990 data can constitute a high percentage of the National Total (e.g. above 44% for $PM_{2.5}$, PM_{10}, Cd, As, Indeno(1,2,3-cd) pyrene; see Table 1.8).

Still, inventories cannot be considered complete for all pollutants: even if the notation keys NE or 0, and in some cases NR, are used for gap-filling, the respective inventory is still considered incomplete at EU level.

Table 1.7 Effect of gap-filling on EU emission data for the year 2013

Pollutant	Reporting of National Totals in 2012								Gap-filling			
	Number of MS reporting emission values	Number of MS reporting 'NE'	Number of MS reporting 'NR'	Number of MS reporting 'NA'	Number of MS reporting 'NO'	Number of MS reporting 'IE'	Number of MS reporting 0	Number of MS not reporting (empty cells)	Number of MS gap-filled with value	Number of MS gap-filled with notation key	Effect on EU National Total	EU-28 inventory complete?
NO_X	27	0	0	0	0	0	0	1	1	0	3%	Yes
NMVOCs	27	0	0	0	0	0	0	1	1	0	2%	Yes
SO_X	27	0	0	0	0	0	0	1	1	0	4%	Yes
NH_3	27	0	0	0	0	0	0	1	1	0	2%	Yes
$PM_{2.5}$	27	0	0	0	0	0	0	1	0	0	0%	No
PM_{10}	27	0	0	0	0	0	0	1	0	0	0%	No
TSP	27	0	0	0	0	0	0	1	0	0	0%	No
BC	19	3	2	0	0	0	1	3	0	0	0%	No
CO	27	0	0	0	0	0	0	1	1	0	2%	Yes
Pb	26	0	0	0	0	0	0	2	0	1	0%	No
Cd	26	0	0	0	0	0	0	2	0	1	0%	No
Hg	26	0	0	0	0	0	0	2	0	1	0%	No
As	24	0	1	0	0	0	0	3	0	2	0%	No
Cr	24	0	1	0	0	0	0	3	0	2	0%	No
Cu	24	0	1	0	0	0	0	3	0	2	0%	No
Ni	24	0	1	0	0	0	0	3	0	2	0%	No
Se	22	2	1	0	0	0	0	3	1	2	0%	No
Zn	24	0	1	0	0	0	0	3	0	2	0%	No
PCDD/Fs	27	0	0	0	0	0	0	1	0	0	0%	No
Benzo(a)-pyrene	22	2	0	0	0	2	0	2	2	2	0%	No
Benzo(b)-fluoranthene	22	2	0	0	0	2	0	2	2	2	0%	No
Benzo(k)-fluoranthene	22	2	0	0	0	2	0	2	2	2	0%	No
Indeno (1,2,3-cd)-pyrene	22	2	0	0	0	2	0	2	2	2	0%	No
Total PAHs	27	0	0	0	0	0	0	1	3	0	0%	No
HCB	27	0	0	0	0	0	0	1	0	0	0%	No
PCBs	24	0	0	0	0	0	2	2	2	1	0%	No

Note: The analysis refers only to the National Total in 2013 for the entire territory.

MS = Member State.

Table 1.8 Effect of gap-filling on EU emission data for the year 1990

Pollutant	Reporting of National Totals in 1990								Gap-filling			
	Number of MS reporting emission values	Number of MS reporting 'NE'	Number of MS reporting 'NR'	Number of MS reporting 'NA'	Number of MS reporting 'NO'	Number of MS reporting 'IE'	Number of MS reporting 0	Number of MS not reporting (empty cells)	Number of MS gap-filled with value	Number of MS gap-filled with notation key	Effect on EU National Total	EU-28 inventory complete?
NO_X	22	0	0	0	0	0	0	6	6	0	17%	Yes
NMVOCs	22	0	0	0	0	0	0	6	6	0	11%	Yes
SO_X	22	0	0	0	0	0	0	6	6	0	27%	Yes
NH_3	22	0	0	0	0	0	0	6	6	0	21%	Yes
$PM_{2.5}$ (*)	12	1	7	1	0	0	1	6	15	0	45%	No
PM_{10} (*)	12	1	7	1	0	0	1	6	15	0	52%	No
TSP	14	1	5	1	0	0	1	6	13	0	36%	No
BC	9	2	7	1	0	0	1	8	9	2	18%	No
CO	22	0	0	0	0	0	0	6	6	0	17%	Yes
Pb	21	0	0	0	0	0	0	7	6	1	10%	No
Cd	21	0	0	0	0	0	0	7	6	1	45%	No
Hg	21	0	0	0	0	0	0	7	6	1	34%	No
As	19	0	1	0	0	0	0	8	6	2	45%	No
Cr	19	0	1	0	0	0	0	8	6	2	24%	No
Cu	19	0	1	0	0	0	0	8	6	2	20%	No
Ni	19	0	1	0	0	0	0	8	6	2	27%	No
Se	18	1	1	0	0	0	0	8	6	3	12%	No
Zn	19	0	1	0	0	0	0	8	6	2	32%	No
PCDD/Fs	22	0	0	0	0	0	0	6	5	0	42%	No
Benzo(a)-pyrene	17	2	0	0	0	2	0	7	5	2	19%	No
Benzo(b)-fluoranthene	17	2	0	0	0	2	0	7	5	2	23%	No
Benzo(k)-fluoranthene	17	2	0	0	0	2	0	7	5	2	36%	No
Indeno-(1,2,3-cd)-pyrene	17	2	0	0	0	2	0	7	5	2	46%	No
Total PAHs	22	0	0	0	0	0	0	6	5	0	44%	No
HCB	22	0	0	0	0	0	0	6	5	0	3%	No
PCBs	20	0	0	0	0	0	1	7	6	1	24%	No

Note: The analysis refers only to the National Total in 1990 for the entire territory.

MS = Member State.

(*) Parties to the LRTAP Convention are formally requested to report emissions of PM for the year 2000 and after.

Table 1.9 and Table 1.10 show how the various officially reported data sets were used to supplement the LRTAP Convention data submissions for those Member States where gap-filling was required. The trend tables in Chapter 2 provide an initial overview, indicating which data have been gap-filled. Annex D offers a more detailed overview, showing for each Member State which data were gap-filled and how this was performed.

Belgium explained that they are aware of the obligation to report emission inventories for all years from the base years in the protocols (1990 for most pollutants) following the revised reporting guidelines in 2014 (UNECE, 2014a). Unfortunately, reporting datasets for 24 years was not possible in 2015. However, a new data warehouse is currently being developed and tested. From the 2016 submission onwards, Belgium will be able to provide emissions data for all inventory years (comment received from Belgium in 2015).

Table 1.9 Data sources of NO_X, NMVOCs, SO_X, NH_3, CO, BC, $PM_{2.5}$, PM_{10} and TSP emissions, used for the 2015 EU-28 inventory compilation (as of 6 May 2015)

Member State	NFR as provided as LRTAP Convention submission via Eionet		CRF as provided under Council Decision 280/2004/EC via Eionet (NO_X, NMVOCs, SO_X, CO)	NFR as provided via NEC Directive (NO_X, NMVOCs, SO_X, NH_3)	Data submitted via LRTAP Convention to EMEP (CEIP database)
	NO_X, NMVOCs, SO_X, NH_3, CO	$PM_{2.5}$, PM_{10}, TSPs and BC			
Austria	1990–2013	1990, 1995, 2000–2013 ($PM_{2.5}$, PM_{10}, TSP)			
Belgium	1990, 1995, 2000, 2005, 2010–2013	2000, 2005, 2010–2013	1990–1994, 1996–1999, 2001–2004, 2006–2009		NH_3: 1990–1994, 1996–1999, 2001–2004, 2006–2009; $PM_{2.5}$, PM_{10}, TSPs: 2001–2004, 2006–2009
Bulgaria	1990–2013	1990–2013			
Croatia	1990–2013	1990–2013			
Cyprus	1990–2013	2000–2013			
Czech Republic	2013	2013 ($PM_{2.5}$, PM_{10}, TSP)	1990–2012	NH_3: 2012	NH_3: 2001–2011; $PM_{2.5}$: 2003–2012; PM_{10}, TSPs: 2001–2012
Denmark	1985–2013, SO_X: 1980–2013	2000–2013			
Estonia	1990–2013	$PM_{2.5}$, PM_{10}: 2000–2013; TSPs: 1990–2013; BC: 2013			
Finland	NO_X, SO_X, NH_3: 1980–2013; NMVOCs: 1987–2013; CO: 1990–2013	$PM_{2.5}$: 1997, 2000–2013; PM_{10}, TSPs, BC: 2000–2013			
France	NO_X, SO_X, NH_3, CO: 1980–2013, NMVOCs: 1988–2013	1990–2013			
Germany	1990–2013	$PM_{2.5}$, PM_{10}: 1995–2013; TSP: 1990–2013			
Greece	n/a	n/a	1990–2012	NO_X, SO_X, NMVOCs: 2013; NH_3: 2012–2013	$PM_{2.5}$, PM_{10}, TSPs: 2009
Hungary	1990–2013	2000–2013			
Ireland	NO_X: 1987, 1990–2013; NMVOCs, SO_X, NH_3, CO: 1990–2013	1990–2013			
Italy	1990–2013	1990–2013			
Latvia	1990–2013	2000–2013			
Lithuania	1990–2013	1990–2013			
Luxembourg	1990–2013	1990–2013 ($PM_{2.5}$, PM_{10}, TSP)			
Malta	2000–2013	2000–2013 ($PM_{2.5}$, PM_{10}, TSP), BC: 2012-2013	1990–2000		
Netherlands	1990–2013	1990–2013			
Poland	1995–2013	1995–2013 ($PM_{2.5}$, PM_{10}, TSP)	NO_X, NMVOCs, SO_X: 1990 –1994; CO: 1990, 1992–1994		
Portugal	1990–2013	1990–2013			
Romania	2005–2013	2005–2013	1990–2005		
Slovakia	2000–2013	2000–2013 ($PM_{2.5}$, PM_{10}, TSP)	1990–1999		
Slovenia	NO_X, SO_X, CO: 1980–2013; NH_3: 1986–2013; NMVOCs: 1990–2013	2000–2013 ($PM_{2.5}$, PM_{10}, TSP)			
Spain	1990–2013	2000–2013 ($PM_{2.5}$, PM_{10}, TSP)			
Sweden	1990–2013	$PM_{2.5}$, PM_{10}, TSPs: 1990–2013; BC: 2000–2013			
United Kingdom	1990–2013	1990–2013			

Table 1.10 Data sources of HM (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) and POP (PCDD/Fs, total PAH, B(a)P, B(b)F, B(k)F, IP, HCB and PCBs) emissions, used for the 2015 EU-28 inventory compilation (as of 6 May 2015)

Member State	NFR as provided as LRTAP Convention submission via Eionet			Data submitted via LRTAP Convention to EMEP (CEIP database)
	Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn	PCDD/Fs, HCB, HCH, PCBs	PAHs: Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, total PAHs	
Austria	1990–2013 (Pb, Cd, Hg)	1990–2013 (PCDD/Fs, HCB)	1990–2013 (Total PAHs)	add. HMs, PCBs, B(a)P, B(b)F, B(k)F, IP: 2013
Belgium	1990, 1995, 2000, 2005, 2010–2013	1990, 1995, 2000, 2005, 2010–2013	1990, 1995, 2000, 2005, 2010–2013 (Total PAHs)	HMs, PCDD/Fs, HCB, PCBs, total PAHs: 1990–1994, 1996–1999, 2001–2004, 2006–2009
Bulgaria	1990–2013	1990–2013	1990–2013	
Croatia	1990–2013	1990–2013	1990–2013	
Cyprus	1990–2013	1990–2013	1990–2013	
Czech Republic	2013	2013	2013	HMs, PCDD/Fs, PCBs, total PAHs: 2001–2012; B(a)P, B(b)F, B(k)F, IP: 2002–2012; HCB: 1990, 2002–2012
Denmark	1990–2013	1990–2013	1990–2013	
Estonia	1990–2013	1990–2013	1990–2013	
Finland	Pb, Cd, Hg, As, Cr, Cu, Ni, Zn: 1990–2013; Se: 2002	1990–2013	1990–2013 (Total PAHs)	
France	1990–2013	1990–2013	1990–2013	
Germany	1990–2013	1990–2013	1990–2013	
Greece	n/a	n/a	n/a	HMs, PCDD/Fs, HCB, PCBs, PAHs: 2009
Hungary	1990–2013	1990–2013	1990–2013	
Ireland	1990–2013	1990–2013	1990–2013	
Italy	1990–2013	1990–2013	1990–2013 (Total PAHs)	
Latvia	1990–2013	1990–2013	1990–2013	
Lithuania	1990–2013	1990–2013	1990–2013	
Luxembourg	n/a	1990–2013	1990–2013	HMs: 2007
Malta	2000–2013	PCDD/Fs: 2005, 2010–2013, HCB: 2010–2013, PCBs: 2010	2010–2013	
Netherlands	1990–2013	PCDD/Fs, HCB: 1990–2013, PCBs: 1995, 1998, 2002, 2004, 2005	1990–2013	
Poland	1995–2013 (Pb, Cd, Hg, As, Cr, Cu, Ni, Zn)	1995–2013	1995–2013	
Portugal	1990–2013	1990–2013	1990–2013	
Romania	2005–2013	2005–2013	2005–2013	PCDD/Fs, HCB, PCBs, PAHs: 2004
Slovakia	2000–2013	2000–2013	2000–2013	
Slovenia	1990–2013 (Pb, Cd, Hg)	1990–2013	1990–2013	
Spain	1990–2013	1990–2013	1990–2013 (Total PAHs)	
Sweden	1990–2013	1990–2013	1990–2013	
United Kingdom	1990–2013	1990–2013	1990–2013	

Poland explained that the main reason for not reporting emission data for the 1990 to 1994 period is the partial lack of activity data. However, Poland is undertaking efforts to overcome these difficulties in the near future (comment received from Poland in 2015).

Slovakia stated that data series from 1990 to 1999 are not available in NFR categories (comment received from Slovakia in 2015).

For PM, some HMs and POPs, some Member States in particular instances lacked data for all years, and gap-filling was thus impossible. In such instances, the EU-28 emission totals for these pollutants are not considered complete (i.e. they are underestimated).

1.4.5 Gridded data

According to the revised reporting guidelines, Parties within the geographical scope of EMEP should report gridded data every 4 years, commencing in 2017. From there on, gridded emissions shall be reported in a new resolution (0.1 x 0.1 long-lat).

Gridded data for the EU were last submitted in 2012 (EEA, 2012) and hence are not reported again this year. However, it should be noted that in 2015, none of the Member States provided gridded data for one or several years (see Table A3.1).

1.4.6 Large point sources (LPS)

Parties within the geographical scope of EMEP were also required to provide data on LPS every 5 years, commencing in 2000, with the revised reporting guidelines this changed to every 4 years reporting starting in 2017 LPS data for the EU were last submitted in 2012 (EEA, 2012) and hence are not reported again this year. Despite this, in 2015, Croatia and Finland provided LPS data (see Table A3.1).

Further information concerning the last submission of EU LPS data is provided in Annex G of the *European Union emission inventory report 1990–2010 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)* (EEA, 2012).

1.5 Key category analyses

1.5.1 EU-28 key category analysis (KCA)

It is good practice to identify key inventory categories in a systematic and objective manner by performing a quantitative analysis, either of the magnitude of emissions (a 'level' assessment) or of the change in emissions from year to year (a 'trend' assessment) relative to total national emissions. A key category is defined as an emission-source category that has significant influence on a country's inventory in terms of the absolute level of emissions, the trend in emissions, or both. In this report, categories jointly responsible for 80% of the national total emissions of a given pollutant are classified as key categories (as per the *EMEP/EEA Guidebook* (EMEP/EEA, 2013)).

EU-28 key categories were determined using a level analysis of 2013 emissions for each pollutant (following any necessary gap-filling). It should be noted that when the notation 'included elsewhere' (IE) was used by a Member State for a particular source/pollutant combination, the KCA is likely to have underestimated the category concerned, and overestimated the one in which emissions were reported instead. In addition, as described earlier, PM, HM and POP data from some Member States could not be gap-filled, as no data were reported for any year. In these instances, emissions were aggregated without including data for all the EU-28 Member States in order to be able to present a provisional KCA for these pollutants. The trend tables in Chapter 2 presenting Member State emissions show the instances where data were not reported.

Chapter 2 provides a summary of the top five EU-28 key categories in 2013, for each pollutant. A complete list of all EU-28 key categories for NO_X, NMVOCs, SO_X, NH_3, $PM_{2.5}$, PM_{10} and CO, HMs (Pb, Cd, Hg) and POPs (PCDD/Fs, total PAHs, B(a)P, HCB and PCBs) emissions is also given in the following subsection.

1.5.2 Main emission sources

Table 1.11 presents the EU-28 key categories, i.e. the individual sources that overall contributed most to 2013 emissions of pollutants, determined by a level assessment for each of the main air pollutants, PM, HMs and POPs. The additional HMs and POPs and TSPs are not considered in this subsection.

A total of 52 different emission inventory source categories were identified as being key categories for at least 1 pollutant. A number of emission categories were identified as being key categories for more than 1 of the 15 pollutants assessed. '1A4bi — Residential: Stationary' and '1A1a — Public electricity and heat production' were identified as being important emission sources for 14 and 11 pollutants, respectively. Similarly, '1A2gviii — Stationary combustion in manufacturing industries and construction: Other' was a key category for 10 pollutants, and the categories '2C1 — Iron and steel production' and '1A3bi — Road transport: Passenger cars' were key categories for 9 and 8 pollutants, respectively.

Table 1.11 EU-28 KCA results for the year 2013: cumulative contribution of emission sources to total emissions of NO_x, NMVOCs, SO_x, CO, NH_3, B(a)P, $PM_{2.5}$ and PM_{10}, the HMs Cd, Pb, Hg and the POPs PCBs, HCB, PCDD/Fs and total PAHs (in descending order)

NO_x key categories	(%)	(%) cumul.
1A1a Public electricity and heat production	18%	18%
1A3biii Road transport: Heavy duty vehicles and buses	17%	35%
1A3bi Road transport: Passenger cars	17%	52%
1A4cii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	6%	58%
1A4bi Residential: Stationary	5%	63%
1A3bii Road transport: Light duty vehicles	5%	68%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	4%	71%
1A3dii National navigation (shipping)	3%	74%
1A2gviii Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	3%	77%
1A4ai Commercial/institutional: Stationary	2%	80%
1A2gvii Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	2%	82%

SO_x key categories	(%)	(%) cumul.
1A1a Public electricity and heat production	46%	46%
1A4bi Residential: Stationary	12%	58%
1A1b Petroleum refining	6%	63%
1A2gviii Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	4%	68%
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	4%	72%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	4%	76%
1B2aiv Fugitive emissions oil: Refining/storage	3%	79%
1A2c Stationary combustion in manufacturing industries and construction: Chemicals	3%	81%

CO key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	40%	40%
1A3bi Road transport: Passenger cars	16%	55%
2C1 Iron and steel production	8%	63%
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	5%	69%
1A3biv Road transport: Mopeds & motorcycles	3%	72%
1A1a Public electricity and heat production	2%	74%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	2%	76%
1A4bii Residential: Household and gardening (mobile)	2%	78%
1A3biii Road transport: Heavy duty vehicles and buses	2%	80%

NMVOC key categories	(%)	(%) cumul.
2D3d Coating applications	15%	15%
1A4bi Residential: Stationary	13%	28%
2D3a Domestic solvent use including fungicides	11%	39%
2D3i Other solvent use (please specify in the IIR)	6%	45%
1A3bi Road transport: Passenger cars	5%	50%
2D3g Chemical products	5%	55%
2H2 Food and beverages industry	4%	59%
2D3h Printing	3%	62%
1B2aiv Fugitive emissions oil: Refining/storage	3%	65%
3B1b Manure management — Non-dairy cattle	3%	67%
1A3bv Road transport: Gasoline evaporation	2%	70%
1A3biv Road transport: Mopeds & motorcycles	2%	72%
3B1a Manure management — Dairy cattle	2%	74%
2D3e Degreasing	2%	76%
1B2av Distribution of oil products	2%	78%
2B10a Chemical industry: Other (please specify in the IIR)	2%	79%
1A3dii National navigation (shipping)	1%	81%

NH_3 key categories	(%)	(%) cumul.
3Da1 Inorganic N-fertilizers (includes also urea application)	21%	21%
3B1a Manure management — Dairy cattle	17%	38%
3B1b Manure management — Non-dairy cattle	16%	54%
3B3 Manure management — Swine	13%	67%
3Da2a Animal manure applied to soils	9%	76%
3B4gi Manure mangement — Laying hens	4%	80%
3Da3 Urine and dung deposited by grazing animals	3%	83%

Benzo(a)pyrene key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	71%	71%
3F Field burning of agricultural residues	13%	84%

Table 1.11 EU-28 KCA results for the year 2013: cumulative contribution of emission sources to total emissions of NO_X, NMVOCs, SO_X, CO, NH_3, B(a)P, $PM_{2.5}$ and PM_{10}, the HMs Cd, Pb, Hg and the POPs PCBs, HCB, PCDD/Fs and total PAHs (in descending order) (cont.)

$PM_{2.5}$ key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	52%	52%
1A3bi Road transport: Passenger cars	4%	56%
1A1a Public electricity and heat production	4%	60%
1A3bvi Road transport: Automobile tyre and brake wear	3%	63%
1A4cii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	3%	66%
1A3biii Road transport: Heavy duty vehicles and buses	2%	68%
1A3bii Road transport: Light duty vehicles	2%	70%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	2%	72%
1A4ci Agriculture/Forestry/Fishing: Stationary	2%	73%
1A2gviii Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	2%	75%
2C1 Iron and steel production	1%	76%
1A3bvii Road transport: Automobile road abrasion	1%	78%
2G Other product use (please specify in the IIR)	1%	79%
1A4ai Commercial/institutional: Stationary	1%	80%

Pb key categories	(%)	(%) cumul.
1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	20%	20%
2C1 Iron and steel production	17%	37%
1A4bi Residential: Stationary	11%	48%
1A3bvi Road transport: Automobile tyre and brake wear	10%	58%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	9%	67%
1A1a Public electricity and heat production	7%	74%
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	5%	78%
1A3bi Road transport: Passenger cars	4%	83%

Hg key categories	(%)	(%) cumul.
1A1a Public electricity and heat production	39%	39%
2C1 Iron and steel production	12%	51%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	8%	59%
1A4bi Residential: Stationary	6%	65%
1A4ai Commercial/institutional: Stationary	5%	69%
2B10a Chemical industry: Other (please specify in the IIR)	4%	73%
1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	3%	76%
1A2gviii Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	3%	80%
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	2%	82%

PM_{10} key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	38%	38%
1A1a Public electricity and heat production	4%	42%
1A3bvi Road transport: Automobile tyre and brake wear	3%	46%
3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products	3%	49%
2L Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	3%	52%
1A3bi Road transport: Passenger cars	3%	55%
3B4gii Manure mangement — Broilers	3%	57%
1A3bvii Road transport: Automobile road abrasion	2%	60%
3B3 Manure management — Swine	2%	62%
2A5a Quarrying and mining of minerals other than coal	2%	64%
1A4cii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	2%	66%
2A5b Construction and demolition	2%	68%
2D3b Road paving with asphalt	2%	70%
1A4ci Agriculture/Forestry/Fishing: Stationary	2%	71%
1A3biii Road transport: Heavy duty vehicles and buses	2%	73%
3B4gi Manure mangement — Laying hens	2%	75%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	1%	76%
2C1 Iron and steel production	1%	77%
1A3bii Road transport: Light duty vehicles	1%	79%
1A2gviii Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	1%	80%

Cd key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	14%	14%
2C1 Iron and steel production	12%	26%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	12%	39%
1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	12%	51%
1A1a Public electricity and heat production	11%	62%
1A4ai Commercial/institutional: Stationary	4%	66%
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	4%	70%
1A1b Petroleum refining	4%	73%
2G Other product use (please specify in the IIR)	3%	76%
1A2c Stationary combustion in manufacturing industries and construction: Chemicals	3%	79%
1A3bi Road transport: Passenger cars	3%	82%

Table 1.11 EU-28 KCA results for the year 2013: cumulative contribution of emission sources to total emissions of NO_X, NMVOCs, SO_X, CO, NH_3, B(a)P, $PM_{2.5}$ and PM_{10}, the HMs Cd, Pb, Hg and the POPs PCBs, HCB, PCDD/Fs and total PAHs (in descending order) (cont.)

Dioxine key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	38%	38%
2C1 Iron and steel production	11%	49%
5C1bi Industrial waste incineration	8%	56%
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	5%	61%
1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals	5%	66%
5C1biii Clinical waste incineration	4%	71%
1A1a Public electricity and heat production	4%	75%
5C2 Open burning of waste	2%	78%
1A3bi Road transport: Passenger cars	2%	80%
1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	2%	82%

HCB key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	21%	21%
1A1a Public electricity and heat production	17%	39%
2C1 Iron and steel production	10%	49%
5C1biv Sewage sludge incineration	7%	56%
3Df Use of pesticides	6%	61%
2B10a Chemical industry: Other (please specify in the IIR)	5%	67%
1A3bi Road transport: Passenger cars	5%	71%
5C1bi Industrial waste incineration	4%	75%
2C7a Copper production	3%	78%
1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	3%	81%

PCB key categories	(%)	(%) cumul.
2K Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	33%	33%
1A4bi Residential: Stationary	17%	51%
5C1bi Industrial waste incineration	13%	64%
2C1 Iron and steel production	12%	76%
1A1a Public electricity and heat production	11%	86%

Total PAH key categories	(%)	(%) cumul.
1A4bi Residential: Stationary	61%	61%
3F Field burning of agricultural residues	18%	79%
1A2gviii Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	3%	82%

Note: The codes and descriptions shown correspond to the UNECE emissions reporting nomenclature — the NFR.

'(%) cumul.' means the cumulative sum of the key categories in percentage quotation.

The KCA of Pb, Hg and Cd do not take into account emissions from Greece, as data were not available. For $PM_{2.5}$, PM_{10}, TSPs, HMs and POPs, the EU-28 inventory for the calculation of the key categories was considered incomplete (see Section 1.4.4 and Section 1.9).

For NO_X and CO, 11 and 10 key categories were identified, respectively; as expected for both these pollutants, all key categories are sectors involving fuel combustion or thermal processes. Eight key categories were identified for SO_X (energy related, again), and seven for NH_3 (all from the 'Agriculture' sector). PM_{10}, $PM_{2.5}$ and NMVOC emission sources are more diverse, and thus larger numbers of source categories make up the key category threshold of 80% of total emissions. For the PM pollutants, more than half of the key categories were energy related, while for NMVOCs, high activity levels associated with solvents and product use were a key aspect.

For the HM Cd, 11 key categories were identified, as were 10 for Hg and 9 for Pb. Emissions from these key categories were all energy or industry related, resulting particularly from processes associated with metal production.

For the POPs, source categories from almost all sectors have been identified as key categories. On the whole, metal production was a key source of POP emissions. However, emissions from 'Residential: Stationary' also contributed considerably to emissions of many of the POPs.

Several factors may influence the determination of key categories at EU-28 level. A Member State's use of the emission inventory notation key IE (see Appendix 1) means that emission estimates for one NFR sector can be included in those of a different sector. Also, the allocation of emissions to the (sub)sector 'Other' is applied differently among Member States, which might lead to inconsistencies. Due to such issues, the EU-28 KCA may not always accurately reflect the share of all main emission sources. It is also crucial to note that the results of a similar analysis of individual Member States will differ from the key sources determined for the EU-28.

1.6 Quality assurance (QA), quality control (QC) and verification methods

Member States are encouraged to use appropriate QA and QC procedures to ensure data quality and to verify and validate their emissions data. These procedures should be consistent with those described in the *EMEP/EEA Guidebook* (EMEP/EEA, 2013).

The main activities improving the quality of the EU inventory are the checks performed by the EEA's ETC/ACM on the status of each Member State's submission. In addition, the internal consistency of data tables submitted by Member States is checked before compiling the EU-28 tables. As with last year, more focus was placed on analysing the plausibility of sectoral trends. Member State data were checked at sectoral level: when outliers were found, the responsible categories were identified. When no explanation for a notable trend was found in the IIRs, Member States were contacted. The focus of the checks was on data that appreciably affect EU-28 trends. External checks are also provided by Member States through an Eionet review before the EU-28 inventory is submitted to the secretariat of the LRTAP Convention.

Further, an important element in improving the quality of national and EU Convention on Long-range Transboundary Air Pollution (CLRTAP) inventories is the annual meeting of the Task Force on Emission Inventories and Projections (TFEIP). In this expert meeting, quality issues concerning the emission reporting of Member States are discussed.

The agreed gap-filling procedures are one of the instruments used to assure and improve the quality of the EU inventory; gaps for sectoral emissions and total emissions for any year are analysed and gap-filled, where possible. This improves the key features of completeness, comparability and consistency over the years, and motivates Member States to report their data in the following reporting cycle (further details on gap-filling are available in Section 1.4.4).

All inventory documents (submissions, inventory master files, inventory reports, status reports and related correspondence) are archived electronically at the EEA ETC/ACM Forum data portal. Revisions of data sets are recorded.

More detailed QA activities are performed by the EEA ETC/ACM and the EMEP CEIP in an annual review process (EMEP CEIP, 2015a). The review of Member State LRTAP Convention emission inventories is performed jointly with the review of those reported under the NEC Directive (EC, 2001). The technical review of inventories is carried out in three stages. Review Stages 1 and 2 include checks on timeliness, formats, consistency, accuracy, completeness and comparability of existing Member State inventory submissions. Test results, provided to Member States, are used to improve the quality of the national emission inventories. Summary results of the review (Stages 1 and 2) are published each year in a joint EMEP/EEA review report ([8]).

In 2008, CEIP, in cooperation with the EEA and Member States, started producing centralised reviews ([9]) of national inventories (Stage 3). In 2014, Belgium, Croatia, Cyprus, Denmark, Greece, Germany, Hungary and Spain were reviewed. The results are published in individual country-specific reports (EMEP CEIP, 2015b). The long-term goal of EMEP is to perform a centralised review of 10 LRTAP Convention Parties every year, so that each party undergoes a detailed review approximately once every 5 years.

1.7 General uncertainty evaluation

Quantifying uncertainty in the EU LRTAP emission inventory calls for Member States to first provide detailed information on emission uncertainties. An analysis of the uncertainty evaluation performed in Member States shows that only 15 Member States (Austria, Belgium, Croatia, Cyprus, Denmark, Finland, France, Germany, Ireland, Latvia, the Netherlands, Poland, Spain, Sweden and the United Kingdom) quantified uncertainty in the emissions inventories of 2013. The pollutants considered and the assumptions behind the uncertainty analysis vary across Member States. Due to the small number of Member States providing an uncertainty estimate, the uncertainty of the EU-28 LRTAP inventory cannot be estimated.

([8]) A summary of the results of the Stage 1 and 2 review performed in 2015 will be published jointly by EMEP/EEA (EMEP/EEA, 2015).
([9]) In cooperation with the EEA and TFEIP, CEIP selects countries to be reviewed and sets up an expert review team (ERT) from inventory experts nominated by countries to the EMEP roster. The ERT performs detailed reviews of submitted inventories and IIRs. The countries voluntarily reviewed for the first time within a Stage 3 review process were France, Norway, Portugal and Sweden.

1.8 General assessment of completeness

Completeness in this context means that estimates are reported for all pollutants, all relevant source categories, all years and all territorial areas. The procedure for gap-filling carried out at Member State level is documented in Section 1.4.4. It also describes the quantitative contribution of gap-filling to emissions reported by Member States. Detailed results for the completeness of Member State submissions are provided in the Stage 1 review (EMEP CEIP, 2015b).

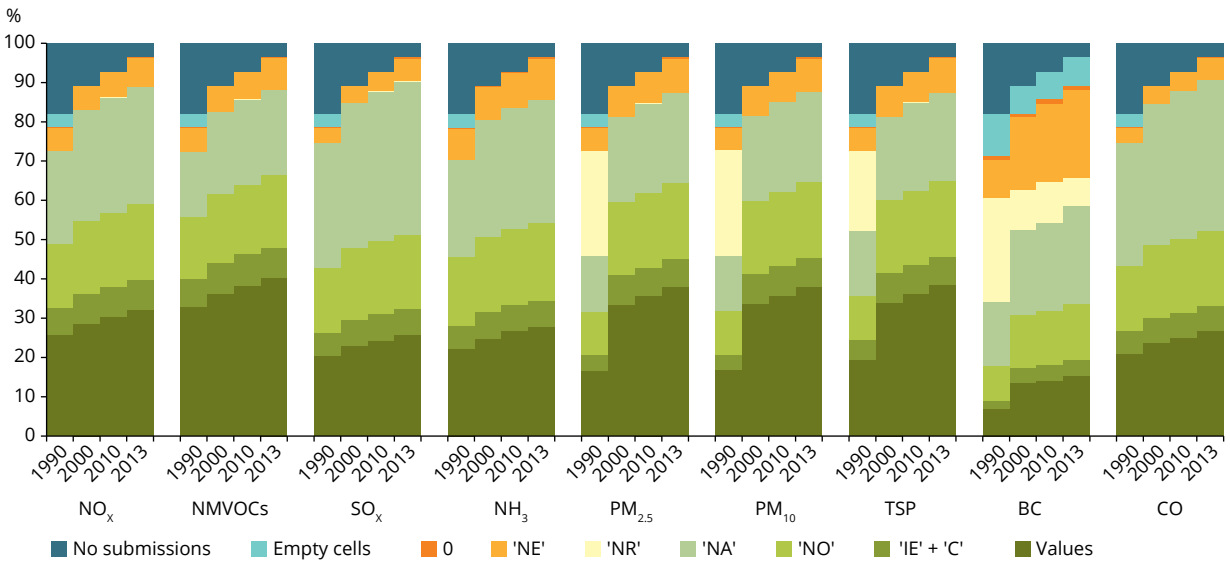
As shown in Appendix 3, only one Member State (Greece) did not submit any data. Luxembourg did not provide any data for heavy metals; Slovenia and Austria submitted no data for additional HMs. Further, Austria reported no data for PCBs. Several Member States did not report data for BC or for B(a)P, B(b)F, B(k)F and/or IP, or they reported incomplete time-series. A total of 19 Member States reported activity data ([10]) for the complete time-series (1990–2013).

Figure 1.3 to Figure 1.5 show a simple compilation indicating completeness of reporting by Member States for the inventory years 1990, 2000, 2010 and 2013, based on the originally submitted NFR templates, i.e. before gap-filling. The number of notation keys or values used for source categories in the NFR templates, shown in percentage values, was accumulated over all Member States. The figures show that for all pollutants, there is better availability of data for more recent years.

EMEP emission reporting guidelines (UNECE, 2014a) require Parties to report data at least for the base year of the relevant protocol, and from the year of entry into force of that protocol, and up to the latest year (current year − 2) (see Table A2.1). So ideally, there should be no difference between the availability of data submissions for 1990 and for 2013. Several Member States use the notation key NR for 1990, as Parties to the LRTAP Convention are formally requested to report PM emissions only for the year 2000 and after.

On average in 2013, Member States used the notation key NA for 36% of the source categories (across all pollutants). The frequent use of this notation key is attributable to the fact that an air pollutant is only relevant for specific emission sources (e.g. NH_3 for agriculture). This makes it necessary to use the notation key NA for other sources. On average, for data of the year 2013, Member States reported an emission value for 21% of the source categories (across all pollutants, maximum 40% for NMVOCs and minimum 11% for HCB and PCBs). The use of the NE notation key, the reporting of empty cells, '0', and in some circumstances the reporting of NR ([11]) are

Figure 1.3 Completeness of reporting of NFR templates submitted by Member States for NO_x, NMVOCs, SO_2, NH_3, PM, TSPs, BC and CO

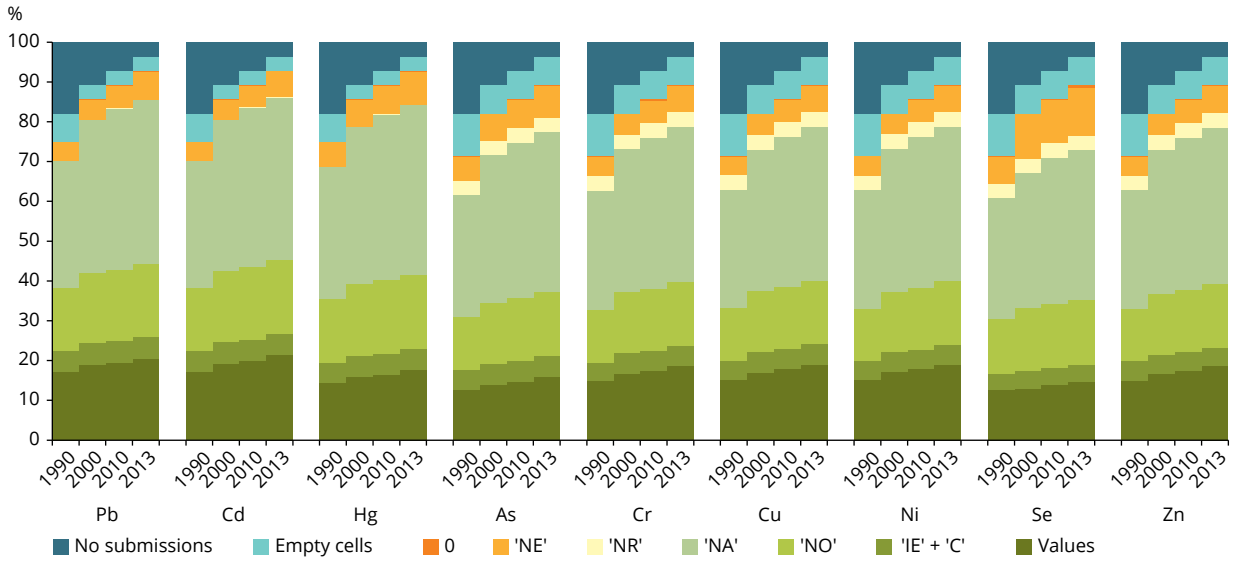


Note: NE — not estimated, NR — not relevant, NA — not applicable, NO — not occurring, IE — included elsewhere, C — confidential. Notation keys are further explained in Appendix 1.

([10]) Reporting of activity data together with emissions is mandatory from 2009 onwards.

([11]) According to paragraph 9 of the Emission Reporting Guidelines, emission inventory reporting should cover all years from 1980 onwards if data are available. However, 'not relevant' (NR) has been added, to ease reporting where emissions are not strictly required by the different protocols. Only in these circumstances can the reporting of NR be considered a correct and appropriate notation key.

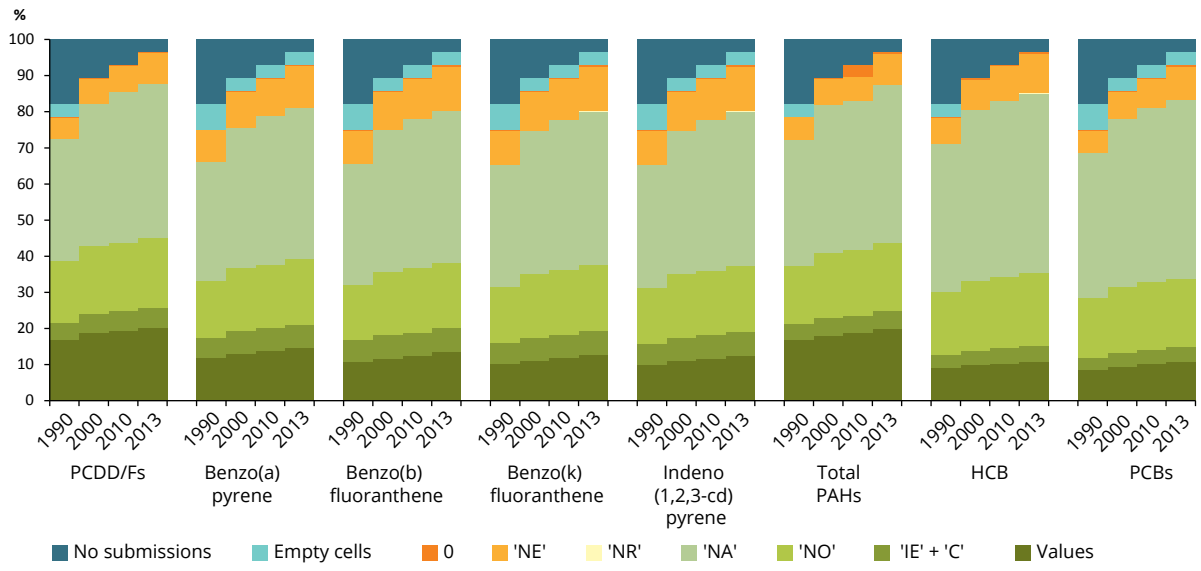
Figure 1.4 Completeness of reporting of NFR templates submitted by Member States for HMs



Note: NE — not estimated, NR — not relevant, NA — not applicable, NO — not occurring, IE — included elsewhere, C — confidential. Notation keys are further explained in Appendix 1.

considered to constitute incomplete reporting. For 2013, 17% of the data were incompletely reported (3% with no submissions, 9% reported as NE, 3% with empty cells, 0.3% as '0' and 1% as NR). For the year 1990, 34% of the data were incompletely reported. Reporting for the year 2013 is therefore much more comprehensive than for 1990.

Figure 1.5 Completeness of reporting of NFR templates submitted by Member States for POPs



Note: NE — not estimated, NR — not relevant, NA — not applicable, NO — not occurring, IE — included elsewhere, C — confidential. Notation keys are further explained in Appendix 1.

1.9 Underestimations

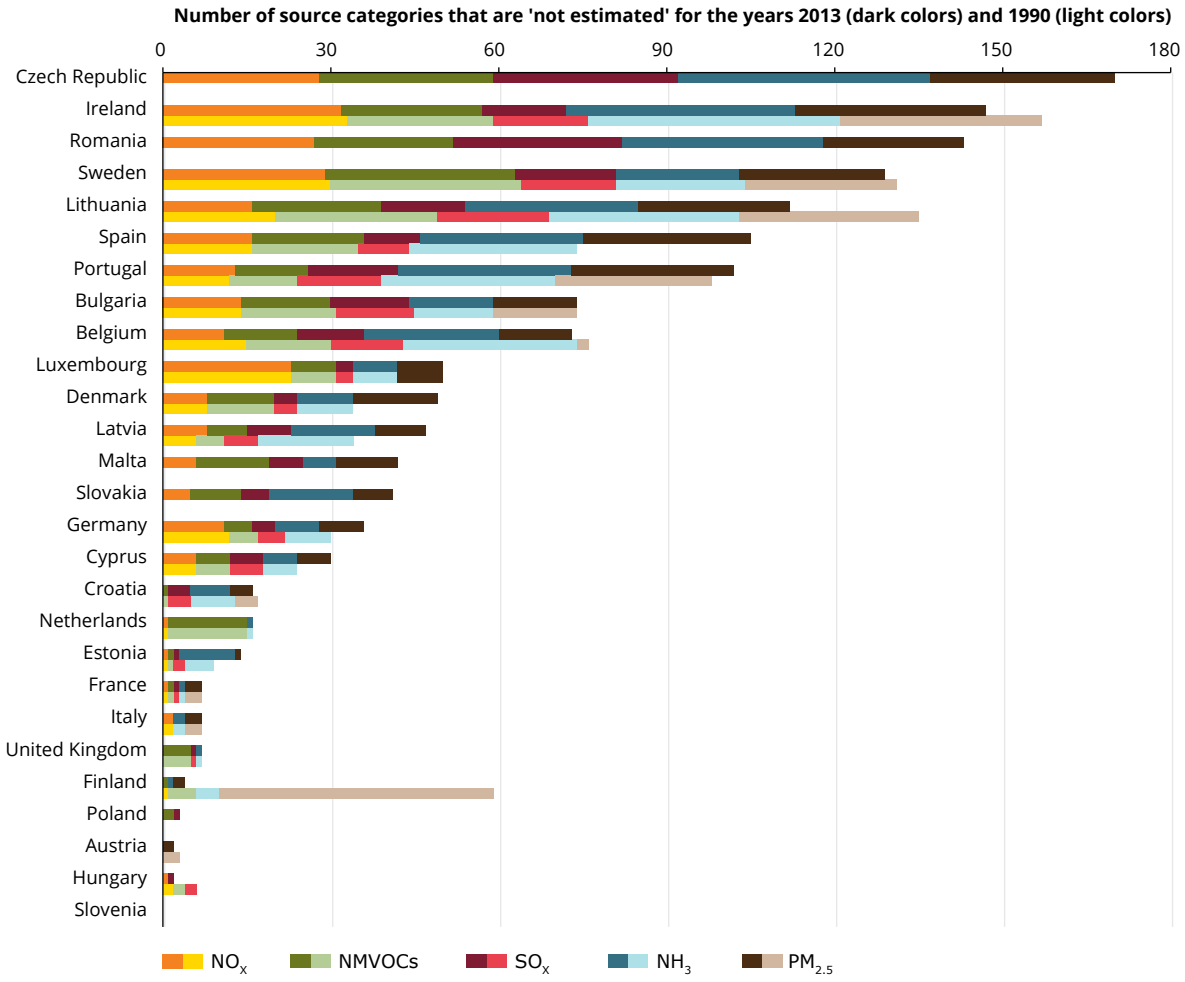
The official reporting guidelines of the LRTAP Convention (UNECE, 2014a) allow countries to report emissions as NE for those sectors where emissions are known to occur, but have not been estimated or reported.

Countries should separately report the reasons explaining why emissions are not estimated. Concerning NE emissions, the *EMEP/EEA Guidebook* (EMEP/EEA, 2013) recommends that the following points be included in an IIR:

- a list of sources not estimated in the inventory;
- a qualitative assessment of their importance, currently and in future;
- a description of intentions to calculate these in future, or an explanation of why no such plans are provided.

Certain Member States used the notation key NE for many source categories (see Figure 1.6). Finland, for example, reported 49 source categories of $PM_{2.5}$ of the year 1990 as NE. A total of 9 Member States used NE for more than 60 source categories in the year 2013 (sum of the pollutants NO_x, NMVOCs, SO_2, NH_3 and $PM_{2.5}$). By contrast, 8 Member States used NE only for up to 10 source categories in the year 2013. Some Member States, like Finland, show a considerably more complete inventory in 2013 compared to the 1990 submission. But in most cases, the use of NE in reporting in 2013 is similar to its use in 1990. The categories '1A3ai(i) — International aviation LTO (civil)', 1A3aii(i) Domestic aviation LTO (civil), '1A3bvii — Road transport: Automobile road abrasion' and '5B1Biological treatment of waste — Composting' show the highest numbers of the use of NE (across all pollutants and Member States). Within these categories, the notation key NE accounts for 23% to 28% of entries.

Figure 1.6 **Number of 'not estimated' source categories for the years 2013 (dark shades) and 1990 (light shades)**



Note: Greece did not report NE.

2 Trends and key categories of EU-28 pollutant emissions

The present EU-28 inventory provides emissions for all the main air pollutants, PM, 'priority' and 'additional' HMs and POPs, and additional reporting of the individual PAHs for which inventory reporting is required or recommended under the LRTAP Convention (UNECE, 1979).

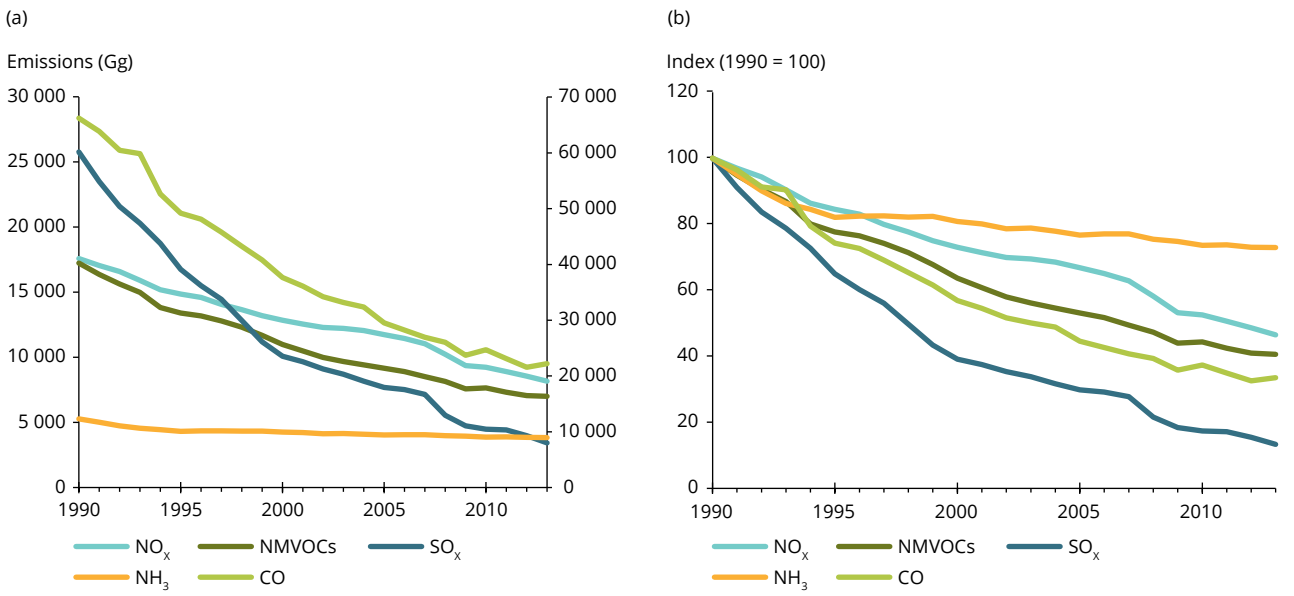
The following sections of Chapter 2 provide a summary of the contributions made by each Member State to the EU-28 total emissions of NO_X, NMVOCs, SO_X, NH_3, CO, $PM_{2.5}$, PM_{10}, TSPs, BC, the HMs Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn and the POPs PCDD/Fs, total PAHs, B(a)P, B(b)F, B(k)F, IP, HCB and PCBs. For the five most important key categories, the past emission trend of the EU-28 is given. Greece did not submit an inventory in 2015. Data for Greece could not be gap-filled — the EU-28 total is therefore underestimated.

2.1 Total EU-28 emission trends and progress in reaching the Gothenburg Protocol 2010 emission ceilings

Emissions of all pollutants were lower in 2012 than in 1990 (or in 2000 for PM). For the main air pollutants, the largest reductions across the EU-28 (in percentage terms) since 1990 have been achieved for SO_X emissions (which decreased by 87%), followed by CO (− 66%), NMVOCs (− 59%), NO_X (− 54%) and NH_3 (− 27%) (Figure 2.1).

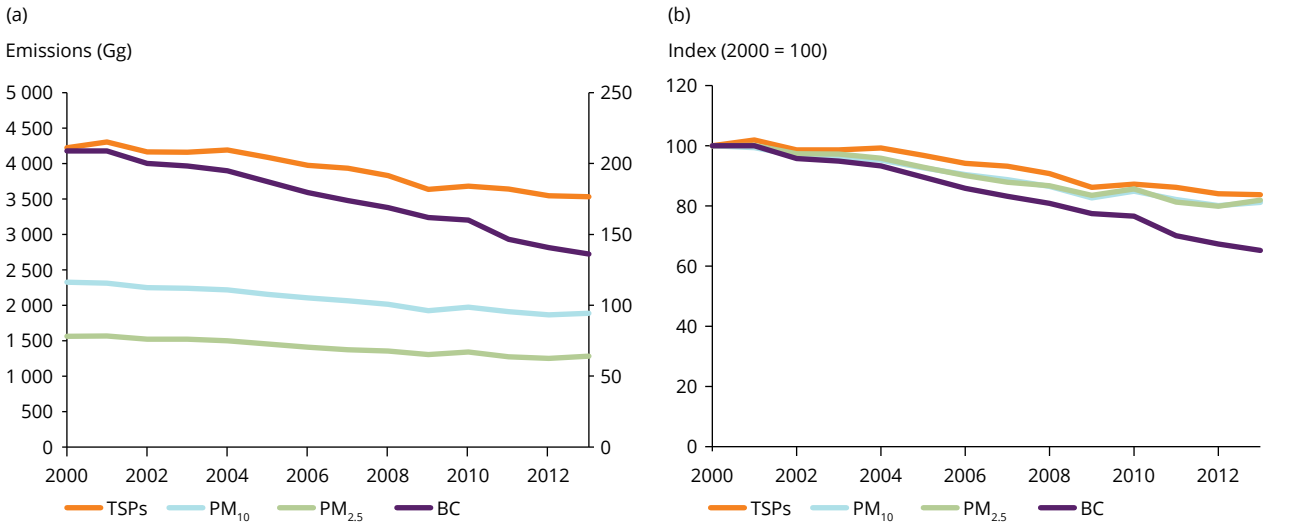
A substantial drop in emissions of HMs and POPs since 1990 has also been recorded (Figure 2.3). Emission changes compiled for the period from 2000 to 2013 indicate that both $PM_{2.5}$ and PM_{10} emissions have fallen by 18% and 19% respectively (Figure 2.2).

Figure 2.1 EU-28 emission trends (a) and indexed emissions (b) for the main air pollutants



Note: Values for CO emissions are provided in the secondary axis.

Figure 2.2 EU-28 emission trends (a) and indexed emissions (b) for the PM and BC



Note: Values for BC emissions are provided in the secondary axis.

Parties to the LRTAP Convention are formally requested to report emissions of PM for the year 2000 and after: emission trends can be shown for these years only. The indexed emissions are based on emissions in the year 2000 (= 100).

For BC, not all Member States reported data.

For various pollutants (e.g. PM, HMs and POPs), some Member States did not report data, or reported the notation keys NE or NR for certain years or the whole time-series. In some cases, the data could not be gap-filled, and thus were not included in the EU-28 total. In such instances, the EU-28 emission totals for these pollutants are not considered complete. Data tables in Chapter 2 (Table 2.4 to Table 2.29 inclusive) show each Member State's reported emissions, thereby indicating instances where emissions of a certain pollutant are missing for all years.

The Gothenburg Protocol to the UNECE LRTAP Convention (UNECE, 1999) contains emission ceilings for the pollutants NO_X, NMVOCs, SO_X and NH_3 that Parties to the protocol must meet by 2010 and after. In their reporting to the LRTAP Convention, some Member States have submitted emission projections for the year 2015, and others up to 2050. Submitted data are available in Annex E of this report. This report does not provide further detailed analysis of projections reported by countries in relation to the emission ceilings for 2010 in the Gothenburg Protocol to the LRTAP Convention. Earlier in June 2015, the EEA published its annual NEC Directive status report, which analyses, for EU Member States, the emission data reported under the EU NEC Directive (EEA, 2015d). The NEC Directive contains EU Member State national emission ceilings that are either equal to or more ambitious than those set out in the Gothenburg Protocol.

The comparison with the EU-15 ceilings of the Gothenburg Protocol in this report is based on reporting on the basis of fuel sold, except for Austria, Belgium, Ireland, Lithuania, Luxembourg, the Netherlands and the United Kingdom. These countries may choose to use the national emissions total calculated on the basis of fuel used in the geographic area of the party as a basis (see Section 1.4.2).

In addition to ceilings for individual countries, the protocol also specifies ceilings for the EU, itself a party to the protocol. Table 2.2 sets out the emissions for the year 2013 reported by the EU-15 Member States, compared to the respective emission ceilings specified for the EU. For all pollutants, emissions in 2013 were below the respective pollutant ceilings.

Figure 2.3 Indexed EU-28 emission trends for the HMs and POPs

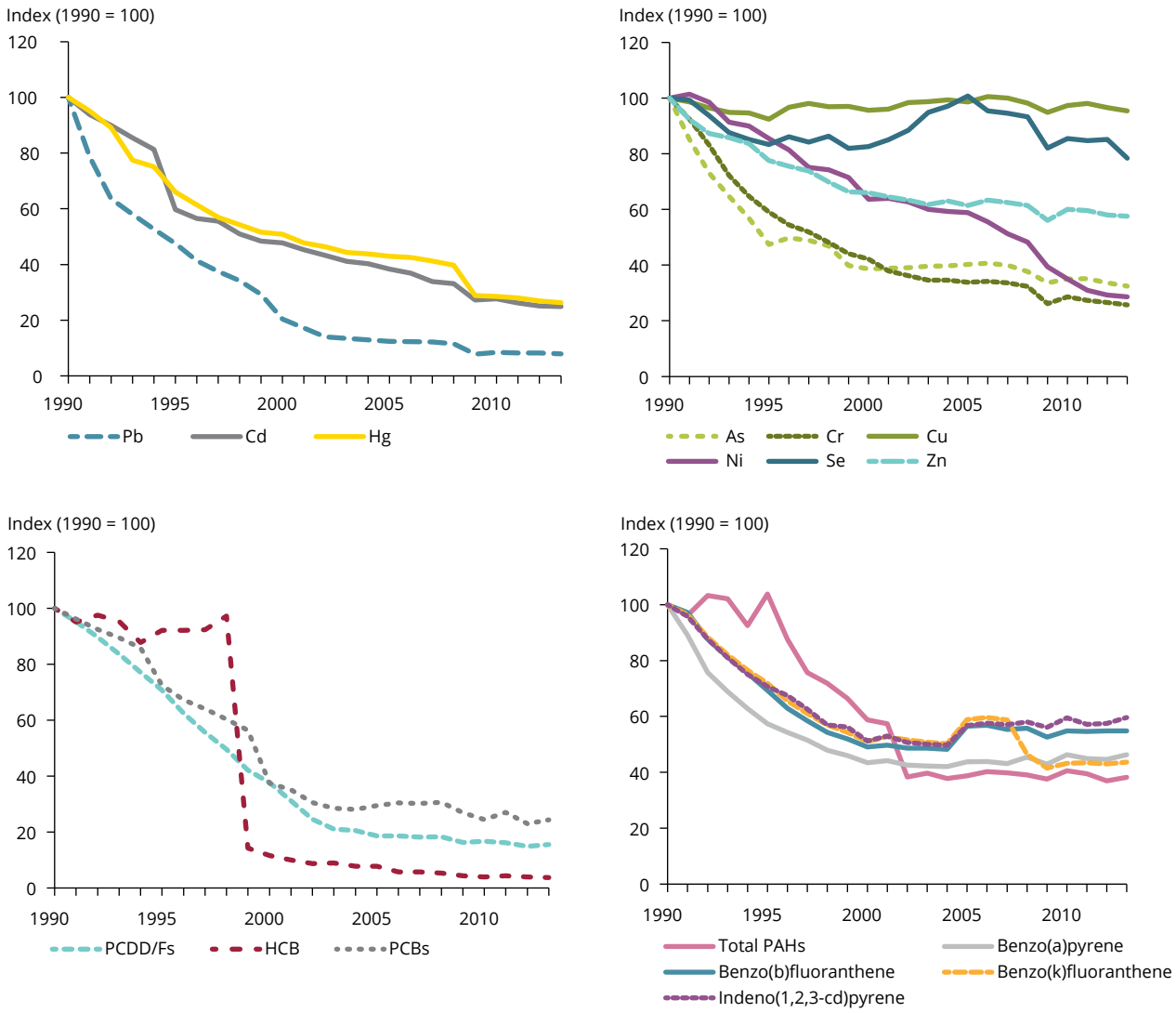


Table 2.1 Total EU-28 emissions of the main air pollutants, HMs, POPs and PM

Pollutant	Unit	1990	1995	2000	2005	2010	2011	2012	2013	Change 1990–2013	Change 2012–2013
NO_X	Gg	17 594	14 870	12 852	11 757	9 245	8 913	8 556	8 176	– 54%	– 4.4%
NO_X (adjusted data (*))	*Gg*	*17 594*	*14 870*	*12 852*	*11 757*	*9 040*	*8 704*	*8 357*	*7 982*		
NMVOCs	Gg	17 253	13 400	10 991	9 164	7 650	7 318	7 072	7 005	– 59%	– 0.9%
SO_X	Gg	25 779	16 758	10 095	7 693	4 485	4 427	3 989	3 430	– 87%	– 14.0%
NH_3	Gg	5 273	4 329	4 265	4 047	3 884	3 890	3 853	3 848	– 27%	– 0.1%
NH_3 (adjusted data (*))	*Gg*	*5 273*	*4 329*	*4 265*	*4 047*	*3 875*	*3 881*	*3 844*	*3 839*		
TSPs	Gg	7 370	4 823	4 220	4 086	3 682	3 638	3 546	3 533	– 52%	– 0.4%
BC	Gg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Benzo(a)pyrene	Mg	419	240	182	183	194	188	187	194	– 54%	3.8%
CO	Gg	66 197	49 188	37 643	29 535	24 724	23 116	21 549	22 199	– 66%	3.0%
Pb	Mg	23 210	11 026	4 723	2 886	1 960	1 896	1 898	1 836	– 92%	– 3.3%
Cd	Mg	253	151	121	97	70	66	63	63	– 75%	– 0.8%
Hg	Mg	230	152	117	99	66	64	62	60	– 74%	– 2.7%
As	Mg	554	263	214	223	194	195	186	180	– 68%	– 3.4%
Cr	Mg	1 306	772	551	441	374	357	347	336	– 74%	– 3.0%
Cu	Mg	3 725	3 441	3 561	3 672	3 625	3 654	3 598	3 555	– 5%	– 1.2%
Ni	Mg	2 434	2 081	1 550	1 433	853	752	711	697	– 71%	– 2.0%
Se	Mg	260	217	215	262	222	220	221	204	– 22%	– 7.9%
Zn	Mg	11 951	9 264	7 893	7 339	7 166	7 118	6 933	6 876	– 42%	– 0.8%
PCDD/Fs	g I-Teq	12 041	8 514	4 540	2 245	2 014	1 948	1 791	1 871	– 84%	4.5%
Benzo(b)fluoranthene	Mg	342	237	168	193	187	187	187	187	– 45%	0.0%
Benzo(k)fluoranthene	Mg	198	142	101	116	86	86	85	86	– 56%	1.5%
Indeno(1,2,3-cd)pyrene	Mg	204	145	105	116	122	117	118	122	– 40%	3.7%
Total PAHs	Mg	2 776	2 881	1 632	1 076	1 125	1 097	1 028	1 063	– 62%	3.4%
HCB	kg	5 321	4 902	617	414	208	231	207	198	– 96%	– 4.7%
PCBs	kg	14 247	10 315	5 334	4 201	3 490	3 851	3 272	3 468	– 76%	6.0%
										Change 2000–2013	**Change 2012–2013**
$PM_{2.5}$	Gg			1 564	1 453	1 339	1 272	1 250	1 281	– 18%	2.5%
PM_{10}	Gg			2 326	2 155	1 975	1 909	1 864	1 889	– 19%	1.3%

Note: Grey shaded cells indicate that data for these pollutants are complete (reported and gap-filled data): Member States have not used NE, NR, 0, or empty cells, or gap-filling without notation keys was possible. Negative percentage values indicate that emissions have decreased.

For BC, not all Member States reported data.

The 1990–2013 changes in emissions in Table 2.1 and subsequent tables (Table 2.2 to Table 2.29 inclusive) are expressed as 100 x (E_{2013} — E_{1990}) / E_{1990} (%), where E_{2013} and E_{1990} are 2013 and 1990 total emissions, respectively. The 2012–2013 changes in emissions are expressed as 100 x (E_{2013} — E_{2012}) / E_{2012} (%), where E_{2013} and E_{2012} are the 2013 and 2012 total emissions, respectively.

The bases for the EU inventory shown in Table 2.1 and subsequent tables (Table 2.2 to Table 2.29 inclusive) are national total data of the entire territory, based on fuel sold. Data of the Netherlands and the United Kingdom are based on fuel used. See Section 1.4.2 for further details.

(*) Adjusted data: Under the Gothenburg Protocol, inventory adjustment applications ([12]) for emissions from Germany (for NO_X) and Denmark (for NH_3) were accepted by the EMEP Steering Board in 2014. This table takes these adjustments for Germany and Denmark into account.

([12]) In 2012, the Executive Body for the LRTAP Convention decided that adjustments to emission reduction commitments, or to inventories for the purposes of comparing total national emissions with them, may be applied in some circumstances (UNECE, 2012b).

Table 2.2 Comparison of emissions reported for 2013 by EU-15 Member States with emission ceilings for the EU specified in the UNECE Gothenburg Protocol

Pollutant	EU-15 emissions year 2013 (Gg)	European Union (EU-15) Gothenburg Protocol 2010 ceilings (Gg)	Difference (%)	Sum of individual EU-15 ceilings (Gg) ([a])
NO_X	6 106	6 671	– 8%	6 519
NMVOCs	5 344	6 600	– 19%	6 510
SO_X	1 848	4 059	– 54%	3 850
NH_3	3 078	3 129	– 2%	3 110

Note: ([a]) Emission ceilings are also specified for individual EU-15 Member States. In some cases, the sum of these ceilings is different to the ceilings specified for the EU-15 as a whole.

For Spain, data for emission comparisons exclude emissions from the Canary Islands.

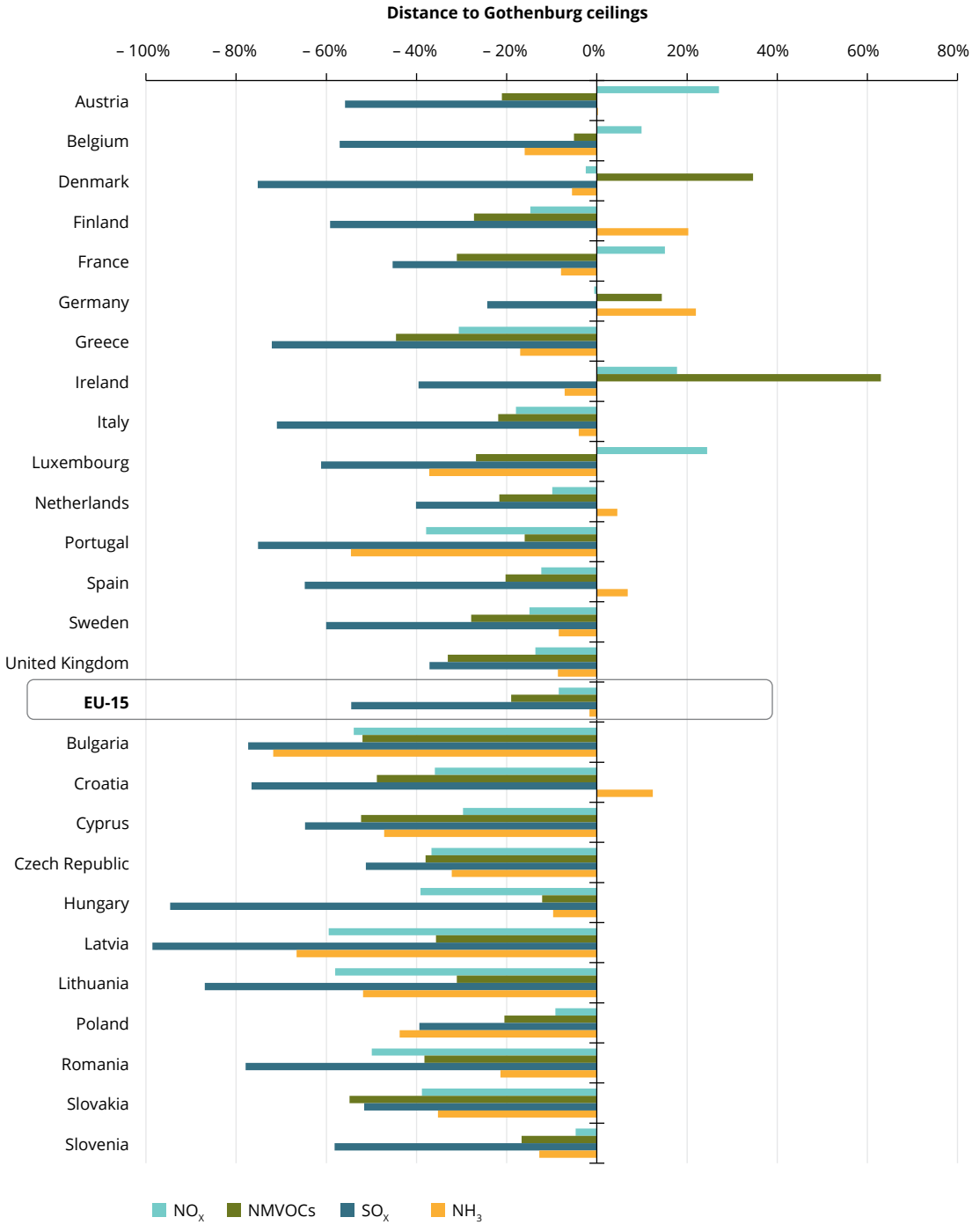
Under the Gothenburg Protocol, inventory adjustment applications for emissions from Germany (for NO_X) and Denmark (for NH_3) were accepted by the EMEP Steering Board in 2014. In this table, these adjusted data for Germany and Denmark are taken into account.

Figure 2.4 shows whether EU Member States met the Gothenburg ceilings in 2013. Five Member States (Austria, Belgium, France, Ireland and Luxembourg) reported NO_X emissions higher than their ceilings in 2010. Six countries exceeded their NH_3 ceiling (Austria, Finland, Germany, the Netherlands, Spain and Croatia). The ceilings for NMVOCs were not met by three Member States (Denmark, Germany and Ireland). SO_X ceilings were met by all Member States. It should also be noted that most new Member States (i.e. the EU-12) have met their emission ceilings for all pollutants, except Croatia for NH_3.

2.2 Progress of non-EU countries in meeting 2010 emission ceilings under the Gothenburg Protocol to the UNECE LRTAP Convention

Three non-EU EEA member countries (Liechtenstein, Norway and Switzerland) have emissions ceilings for-2010 and onwards specified under the Gothenburg Protocol of the LRTAP Convention (UNECE, 1979, 1999, 2012a and 2012b). Data reported by these countries show that Liechtenstein exceeded its NO_X and NH_3 emissions ceilings for all years; although Norway exceeded its NO_X ceiling for 2010 to 2012, it complied in 2013, while its NH_3 emissions ceilings were exceeded in all years. Switzerland complied with all ceilings for all pollutants, except for NH_3 in the year 2010 (see Table 2.3).

Figure 2.4 **Distance of Member State emissions in 2013 to the ceilings set in the Gothenburg Protocol for 2010**



Note: Estonia and Malta do not have a Gothenburg ceiling.

For Spain, data for emission comparisons exclude emissions from the Canary Islands.

Under the Gothenburg Protocol, inventory adjustment applications for emissions from Germany (for NO_x) and Denmark (for NH_3) were accepted by the EMEP Steering Board in 2014. In this figure, these adjusted data for Germany and Denmark are taken into account.

Table 2.3 Progress by other EEA member countries in meeting Gothenburg Protocol UNECE LRTAP Convention emission ceilings

Member State	NO_x					Emission–ceiling comparison				NMVOCs					Emission–ceiling comparison			
	Emission data (Gg)				Ceilings (Annex I)					Emission data (Gg)				Ceilings (Annex I)				
	2010	2011	2012	2013		2 010	2 011	2 012	2 013	2010	2011	2012	2013		2 010	2 011	2 012	2 013
Liechtenstein	0.63	0.65	0.70	0.70	0.37	×	×	×	×	0.41	0.41	0.42	0.42	0.86	✓	✓	✓	✓
Norway	177	170	163	154	156	×	×	×	✓	140	133	135	134	195	✓	✓	✓	✓
Switzerland	73	68	67	66	79	✓	✓	✓	✓	89	86	84	83	144	✓	✓	✓	✓

Member State	SO_x					Emission–ceiling comparison				NH_3					Emission–ceiling comparison			
	Emission data (Gg)				Ceilings (Annex I)					Emission data (Gg)				Ceilings (Annex I)				
	2010	2011	2012	2013		2 010	2 011	2 012	2 013	2010	2011	2012	2013		2 010	2 011	2 012	2 013
Liechtenstein	0.03	0.03	0.03	0.03	0.11	✓	✓	✓	✓	0.17	0.17	0.17	0.17	0.15	×	×	×	×
Norway	20	19	17	17	22	✓	✓	✓	✓	27	27	27	27	23	×	×	×	×
Switzerland	12	10	10	10	26	✓	✓	✓	✓	63	63	62	62	63	×	✓	✓	✓

Note: Emission data for Liechtenstein, Norway and Switzerland are the latest reported data under the LRTAP Convention (2015 submission round), and are compared with the respective emission ceilings of the Gothenburg Protocol. Switzerland's assessment is based on the National Total based on fuel used.

Liechtenstein has signed but not yet ratified the protocol. Neither Iceland nor Turkey has yet signed the Gothenburg Protocol.

2.3 Nitrogen oxides (NO_X) emission trends and key categories

Between 1990 and 2013, NO_X emissions dropped in the EU-28 by 54%. Between 2012 and 2013, the decrease was 4.4%, mainly due to reductions noted for Spain, the United Kingdom and the Czech Republic (Table 2.4). The Member States that contributed most (i.e. more than 10%) to NO_X emissions in 2013 were Germany, the United Kingdom, France and Italy.

For Table 2.4 through Table 2.29, two EU-28 totals are given. The first corresponds to the sum of National Totals officially reported by Member States. The second is the sum of the sectors of all Member States. A difference between these two EU totals arises when only National Totals and no sectoral data are available.

Cyprus explained that the big change in NO_X emissions from 2012 to 2013 was due to the complete restoration of the Vasilikos power station. This plant uses newest technology for combustion, with lower NO_X emissions compared to the temporary installed plants. Another reason for the decrease of the NO_X emissions was the increase of the number of the renewable energy plants (REPs). In 2010, the electricity produced from REP was 61 GWh compared to 311 GWh produced in 2013. This is an increase of 409% (Appendix 5, Cyprus' IIR).

Table 2.4 Member State contributions to EU emissions of NO_X (Gg)

	NO_X (Gg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	215	194	210	235	180	170	165	162	– 25%	– 1.4%	1.2%	2.0%
Belgium	413	384	347	320	252	235	216	208	– 50%	– 3.9%	2.3%	2.5%
Bulgaria	264	165	145	179	139	154	140	123	– 54%	– 12.2%	1.5%	1.5%
Croatia	105	74	84	82	64	60	56	56	– 47%	0.4%	0.6%	0.7%
Cyprus	17	20	22	21	19	21	21	16	– 6%	– 24.2%	0.1%	0.2%
Czech Republic	741	429	396	278	239	225	210	181	– 76%	– 13.8%	4.2%	2.2%
Denmark	299	290	224	202	145	138	128	124	– 59%	– 3.3%	1.7%	1.5%
Estonia	74	39	37	36	36	36	32	30	– 60%	– 7.3%	0.4%	0.4%
Finland	285	254	201	169	167	154	147	145	– 49%	– 1.1%	1.6%	1.8%
France	1 911	1 745	1 610	1 430	1 096	1 036	1 008	990	– 48%	– 1.8%	10.9%	12.1%
Germany	2 882	2 167	1 925	1 573	1 334	1 311	1 270	1 269	– 56%	– 0.1%	16.4%	15.5%
Adjusted data (*)					*1 128*	*1 102*	*1 071*	*1 074*				
Greece	326	329	359	417	319	296	259	239	– 27%	– 7.7%	1.9%	2.9%
Hungary	283	213	206	169	154	140	124	121	– 57%	– 2.8%	1.6%	1.5%
Ireland	134	130	137	136	85	76	78	79	– 41%	0.7%	0.8%	1.0%
Italy	2 047	1 920	1 456	1 244	969	950	863	821	– 60%	– 5.0%	11.6%	10.0%
Latvia	94	52	44	44	38	33	34	34	– 64%	– 0.4%	0.5%	0.4%
Lithuania	128	62	51	54	50	46	48	46	– 64%	– 3.2%	0.7%	0.6%
Luxembourg	42	37	42	59	39	39	35	31	– 24%	– 9.2%	0.2%	0.4%
Malta	8	9	9	9	8	8	9	5	– 35%	– 43.7%	0.0%	0.1%
Netherlands	574	475	395	341	274	258	248	240	– 58%	– 3.2%	3.3%	2.9%
Poland	1 280	1 063	844	851	861	843	819	798	– 38%	– 2.6%	7.3%	9.8%
Portugal	234	265	262	255	177	169	162	161	– 31%	– 0.5%	1.3%	2.0%
Romania	457	341	283	317	232	240	235	219	– 52%	– 6.9%	2.6%	2.7%
Slovakia	226	179	107	102	89	85	81	80	– 65%	– 1.7%	1.3%	1.0%
Slovenia	63	60	52	50	47	47	46	43	– 32%	– 6.5%	0.4%	0.5%
Spain	1 341	1 412	1 398	1 421	960	953	920	812	– 39%	– 11.7%	7.6%	9.9%
Sweden	269	245	207	176	150	139	131	126	– 53%	– 4.2%	1.5%	1.5%
United Kingdom	2 880	2 316	1 798	1 586	1 123	1 051	1 073	1 020	– 65%	– 5.0%	16.4%	12.5%
EU-28 (a)	**17 594**	**14 870**	**12 852**	**11 757**	**9 245**	**8 913**	**8 556**	**8 176**	**– 54%**	**– 4.4%**	**100%**	**100%**
EU-28 (b)	17 594	14 870	12 852	11 757	9 245	8 913	8 556	8 176				
EU-28 (c)	17 594	14 870	12 852	11 757	9 040	8 704	8 357	7 982				

Note: Grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

(*) Adjusted data: Under the Gothenburg Protocol, inventory adjustment applications for emissions from Germany (for NO_X) were accepted by the EMEP Steering Board in 2014. This table takes these adjustments for Germany and Denmark into account.

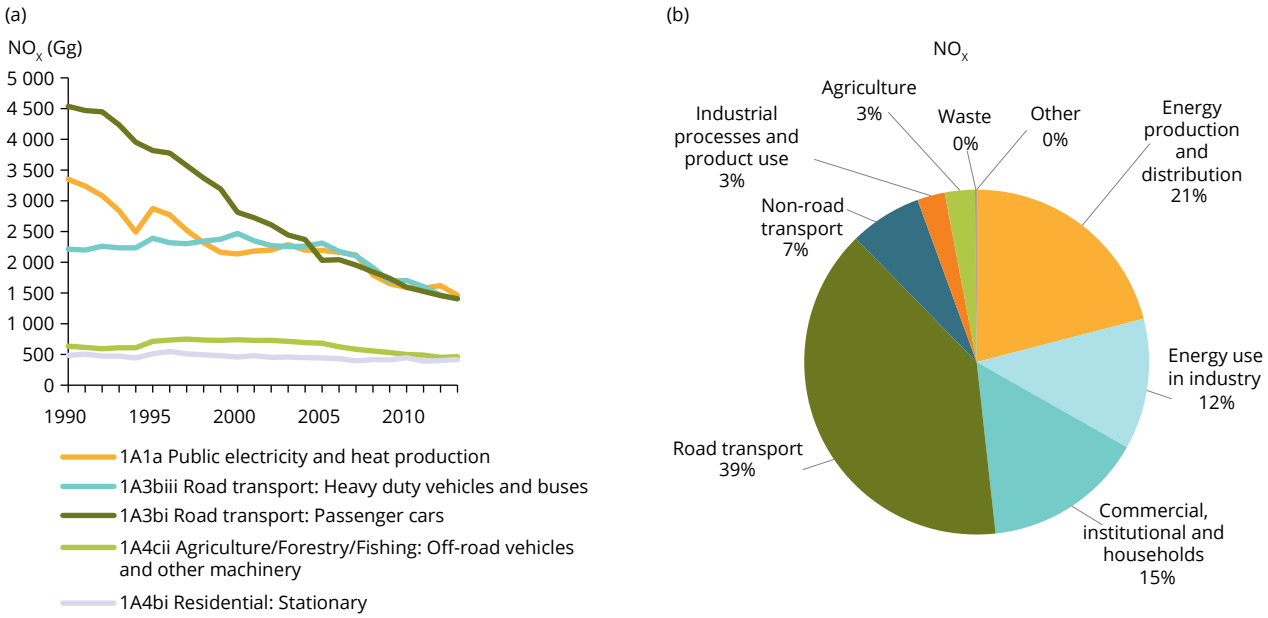
Luxembourg explained that an upward trend for air pollutant emissions recorded from 1999 to 2004 was due to increasing energy consumption and fuel sales in the transport sector. The stabilisation noted for inventory years 2004 to 2006 was largely the result of relatively steady sales of road fuels that peaked in 2005. Finally, the decrease in total emissions from 2006 to 2007 and the period of relative stability that followed was driven by a 'road fuel sales to non-residents'-related emissions reduction, which reached its lower level in 2009 (financial and economic crisis). This was combined with a drop in air pollutant emissions from the power generation sector, the latter being exceptionally significant for the years 2008, 2011 and 2012, when the main power plant of the country experienced maintenance or reduced activities, resulting in several months without substantial production.

In Spain, emissions decreased significantly in the years from 2008 to 2010, driven by technological advances ('Euro' technologies) adopted in vehicle fleets (1A3b), growth in combined-cycle power stations (1A1) with lower NO_x emission ratios and dissemination of NO_x abatement measures, as well as energy efficiency improvements in conventional coal-fired power stations. Further, Spain explained that the change of NO_x emissions between 2012 and 2013 was attributable to the significant drop in 2013; this was due to reductions in electricity production (1A1a) and the change in the energy mix dominated by a decrease in consumption of coal and natural gas. Additionally, there was a continuous decline in emissions from heavy duty vehicles (1A3biii), and an important decrease of emissions from domestic shipping (1A3dii) (Appendix 5, Spain's IIR).

The categories '1A1a — Public electricity and heat production', '1A3bi — Road transport: Passenger cars' and '1A3biii — Road transport: Heavy duty vehicles and buses' were the chief key categories for NO_x emissions, together making up 52% of total emissions (see Figure 2.5). Of the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the third most important key category, '1A3bi — Road transport: Passenger cars' (– 69.1%) (see Figure 2.5(a)).

Figure 2.5(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For NO_x, common key emission sources are the energy and transport sectors. Emission reductions from the 'Road transport' sector are primarily a result of fitting catalysts to vehicles (a move driven by the legislative 'Euro' standards) (EEA, 2015a). Nevertheless, the road transport sectors together represent the largest source of NO_x emissions, accounting for 39% of total EU-28 emissions in 2013. The electricity/energy production sectors have also reduced their emissions, thanks to measures such as the introduction of combustion modification technologies (e.g. the use of low NO_x burners), implementation of flue-gas abatement techniques (e.g. NO_x scrubbers and selective catalytic reduction (SCR) and non-selective catalytic reduction (SNCR) techniques), and fuel-switching from coal to gas (EEA, 2015a).

Figure 2.5 NO_x emissions in the EU-28: (a) trend in NO_x emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



2.4 Non-methane volatile organic compound (NMVOCs) emission trends and key categories

Between 1990 and 2013, NMVOC emissions dropped in the EU-28 by 59%. Between 2012 and 2013, a decrease of 0.9% was reported, and it is attributed mainly to decreased emissions in Romania, Spain and the UK (Table 2.5). In 2013, the Member States that contributed most (i.e. more than 10%) to NMVOC emissions were Germany, Italy, the United Kingdom and France.

Table 2.5 Member State contributions to EU NMVOC emissions (Gg)

	NMVOCs (Gg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	281	204	164	159	131	126	133	126	– 55%	– 4.7%	1.6%	1.8%
Belgium	341	291	227	186	155	143	141	137	– 60%	– 2.3%	2.0%	2.0%
Bulgaria	598	145	99	99	103	101	92	89	– 85%	– 3.7%	3.5%	1.3%
Croatia	129	73	76	69	55	53	49	46	– 64%	– 5.3%	0.7%	0.7%
Cyprus	17	15	13	12	10	8	8	7	– 61%	– 14.0%	0.1%	0.1%
Czech Republic	311	215	244	182	151	140	129	136	– 56%	6.1%	1.8%	1.9%
Denmark	204	204	174	149	125	119	116	114	– 44%	– 1.1%	1.2%	1.6%
Estonia	71	50	45	40	35	34	34	33	– 53%	– 3.5%	0.4%	0.5%
Finland	257	218	166	136	116	106	105	95	– 63%	– 9.7%	1.5%	1.3%
France	2 469	2 062	1 681	1 239	874	807	772	758	– 69%	– 1.8%	14.3%	10.8%
Germany	3 392	2 028	1 600	1 340	1 239	1 169	1 136	1 138	– 66%	0.2%	19.7%	16.2%
Greece	269	260	266	221	185	159	152	145	– 46%	– 4.7%	1.6%	2.1%
Hungary	269	195	176	146	125	118	117	120	– 55%	2.6%	1.6%	1.7%
Ireland	135	128	112	106	91	89	88	90	– 33%	2.0%	0.8%	1.3%
Italy	1 936	1 974	1 524	1 242	942	919	862	906	– 53%	5.0%	11.2%	12.9%
Latvia	141	115	102	100	89	88	89	87	– 38%	– 2.0%	0.8%	1.2%
Lithuania	121	96	72	76	71	69	68	63	– 47%	– 6.9%	0.7%	0.9%
Luxembourg	21	18	14	12	8	8	8	8	– 64%	– 2.9%	0.1%	0.1%
Malta	6	8	3	3	3	3	3	3	– 46%	4.3%	0.0%	0.0%
Netherlands	483	340	239	178	158	156	154	150	– 69%	– 2.6%	2.8%	2.1%
Poland	831	680	575	575	653	638	630	636	– 23%	0.9%	4.8%	9.1%
Portugal	266	263	248	209	180	174	168	170	– 36%	0.9%	1.5%	2.4%
Romania	362	206	266	395	348	344	347	323	– 11%	– 6.9%	2.1%	4.6%
Slovakia	134	91	67	75	64	70	61	63	– 53%	2.8%	0.8%	0.9%
Slovenia	72	65	53	45	38	37	35	33	– 54%	– 5.8%	0.4%	0.5%
Spain	1 055	977	994	829	651	618	571	551	– 48%	– 3.6%	6.1%	7.9%
Sweden	360	278	224	202	192	187	179	174	– 52%	– 3.1%	2.1%	2.5%
United Kingdom	2 721	2 203	1 567	1 136	855	835	824	803	– 70%	– 2.5%	15.8%	11.5%
EU-28 ([a])	**17 253**	**13 400**	**10 991**	**9 164**	**7 650**	**7 318**	**7 072**	**7 005**	**– 59%**	**– 0.9%**	**100%**	**100%**
EU-28 ([b])	17 253	13 400	10 991	9 164	7 650	7 318	7 072	7 005				

Note: Grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

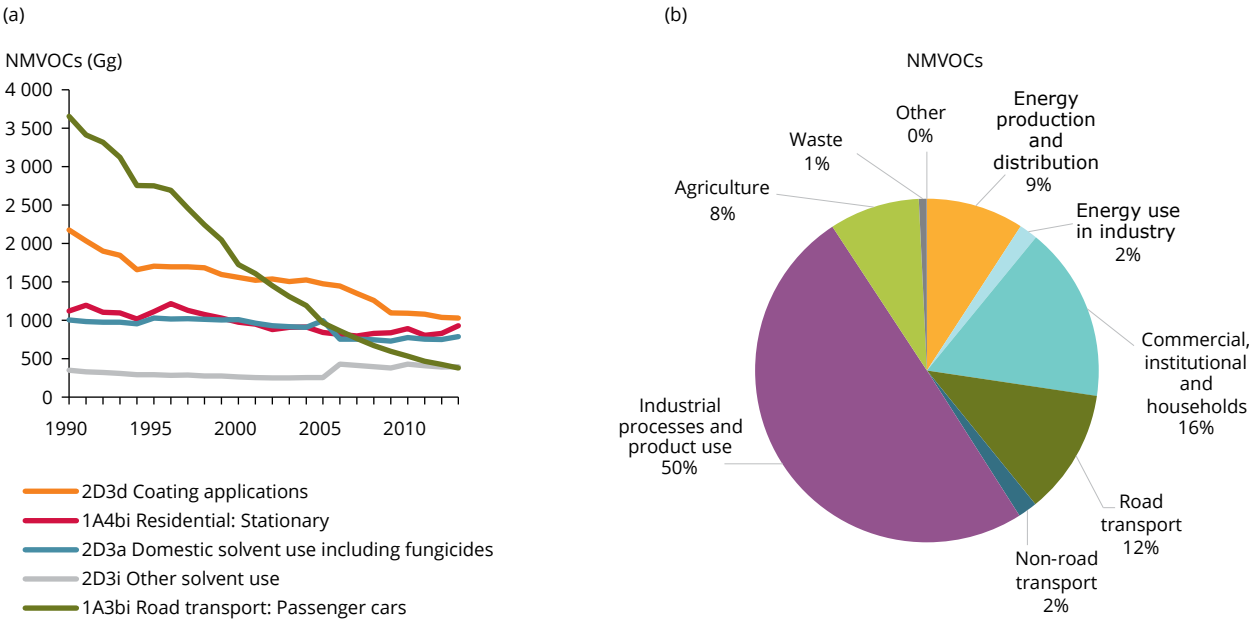
([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors.

The two categories '2D3d— Coating applications' and '1A4bi— Residential: Stationary' were the most important key categories for NMVOC emissions, together making up 28% of total emissions (Figure 2.6(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the fifth most important key category, '1A3bi— Road transport: Passenger cars' (− 89.7%).

Figure 2.6(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For NMVOCs, the chief emission source is 'Industrial processes and product use' (50%), followed by 'Commercial, institutional and households' and 'Road transport'.

Figure 2.6 NMVOC emissions in the EU-28: (a) trend in NMVOC emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



2.5 Sulphur oxides (SO_X) emission trends and key categories

Between 1990 and 2013, SO_X emissions dropped in the EU-28 by 87%. Between 2012 and 2013, emissions decreased by 14%, mainly due to reduced emissions in Bulgaria, Spain, Greece and Romania (see Table 2.6). The Member States that contributed most (i.e. more than 10%) to SO_X emissions in 2013 were Poland, Germany and the United Kingdom.

Spain explained that the change of SO_X emissions between 2012 and 2013 was due to significant decreases driven by changes in the structure of the electricity sector (1A1) with the installation of combined-cycle power stations, and the smaller influence of coal in electricity generation in conventional power plants. Another reason was the increase in consumption of fuels with lower sulphur content, such as a natural gas. Furthermore, the introduction of secondary desulphurisation techniques in the power generation sector (1A1) has resulted in a decrease in SO_X emissions (Appendix 5, Spain's IIR).

Table 2.6 Member State contributions to EU SO_X emissions (Gg)

	SO_X (Gg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	74	47	32	27	19	18	17	17	– 77%	– 0.9%	0.3%	0.5%
Belgium	366	258	174	143	61	53	47	46	– 88%	– 4.0%	1.4%	1.3%
Bulgaria	1 099	1 295	861	776	387	515	329	194	– 82%	– 41.0%	4.3%	5.7%
Croatia	170	77	59	58	35	29	25	16	– 90%	– 34.0%	0.7%	0.5%
Cyprus	33	41	50	38	22	21	16	14	– 58%	– 15.3%	0.1%	0.4%
Czech Republic	1 876	1 095	264	219	170	169	158	138	– 93%	– 12.7%	7.3%	4.0%
Denmark	179	146	32	26	15	15	13	14	– 92%	6.0%	0.7%	0.4%
Estonia	274	116	97	76	83	73	41	36	– 87%	– 10.1%	1.1%	1.1%
Finland	263	99	79	69	67	61	51	47	– 82%	– 7.9%	1.0%	1.4%
France	1 288	966	628	461	285	249	235	219	– 83%	– 7.1%	5.0%	6.4%
Germany	5 307	1 704	645	472	434	431	417	416	– 92%	– 0.1%	20.6%	12.1%
Greece	476	540	496	541	265	262	245	152	– 68%	– 37.8%	1.8%	4.4%
Hungary	825	620	428	41	31	34	31	29	– 96%	– 5.0%	3.2%	0.9%
Ireland	184	163	142	74	28	27	25	25	– 86%	0.8%	0.7%	0.7%
Italy	1 800	1 327	754	407	215	194	175	145	– 92%	– 17.0%	7.0%	4.2%
Latvia	100	48	15	6	3	2	2	2	– 98%	– 24.7%	0.4%	0.0%
Lithuania	169	69	37	31	21	23	20	19	– 89%	– 5.4%	0.7%	0.6%
Luxembourg	15	9	3	2	2	1	1	2	– 90%	6.3%	0.1%	0.0%
Malta	16	27	24	11	8	8	8	5	– 68%	– 35.0%	0.1%	0.1%
Netherlands	192	129	73	65	34	34	34	30	– 84%	– 12.1%	0.7%	0.9%
Poland	3 210	2 255	1 451	1 217	937	885	859	847	– 74%	– 1.4%	12.5%	24.7%
Portugal	315	321	250	177	53	48	43	42	– 87%	– 2.3%	1.2%	1.2%
Romania	871	748	526	601	349	320	258	203	– 77%	– 21.3%	3.4%	5.9%
Slovakia	524	245	127	89	69	68	58	53	– 90%	– 8.8%	2.0%	1.6%
Slovenia	199	122	93	41	10	12	11	11	– 94%	7.4%	0.8%	0.3%
Spain	2 170	1 855	1 496	1 278	421	455	402	287	– 87%	– 28.6%	8.4%	8.4%
Sweden	105	69	42	36	32	29	28	27	– 75%	– 5.3%	0.4%	0.8%
United Kingdom	3 681	2 366	1 217	710	428	391	440	393	– 89%	– 10.6%	14.3%	11.5%
EU-28 ([a])	**25 779**	**16 758**	**10 095**	**7 693**	**4 485**	**4 427**	**3 989**	**3 430**	**– 87%**	**– 14.0%**	**100%**	**100%**
EU-28 ([b])	25 779	16 758	10 095	7 693	4 485	4 427	3 989	3 430				

Note: Grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

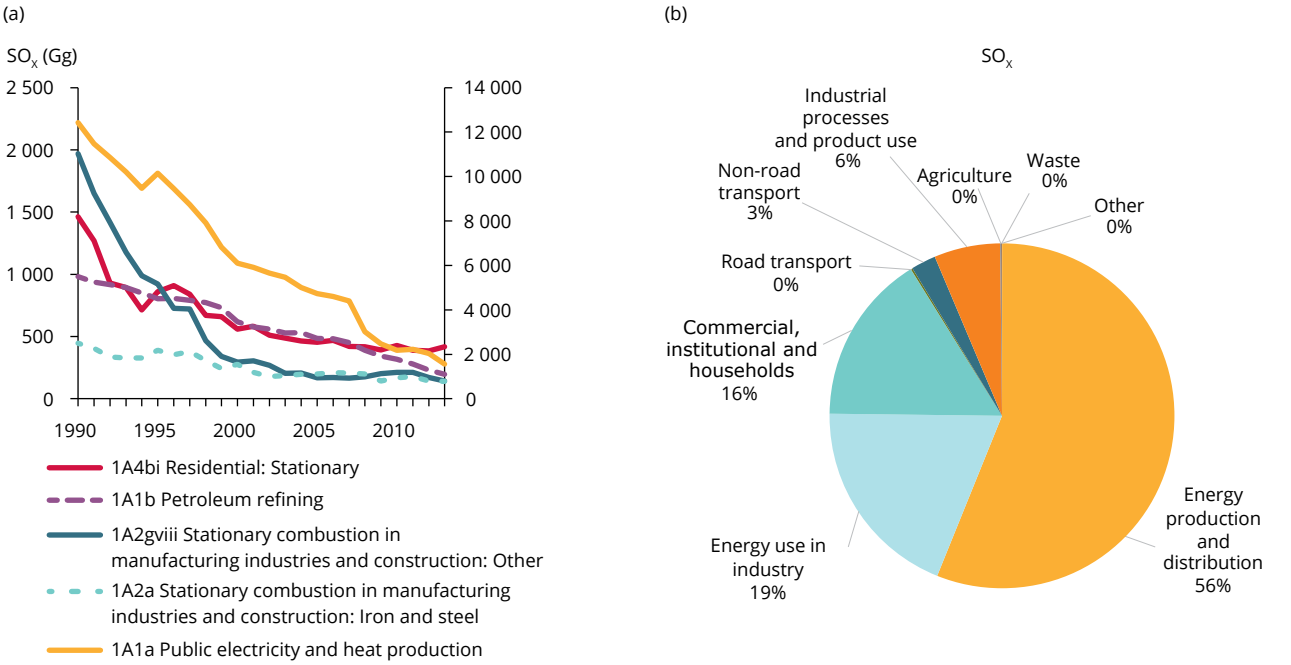
([b]) Sum of sectors.

Category '1A1a — Public electricity and heat production' is the most significant key category for SO_X emissions, making up 46% of total SO_X emissions (Figure 2.7(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the fourth most important key category, '1A2gviii Stationary comb. in manuf. ind. and constr.: Other' (− 92.7%), the most important key category, '1A1a — Public electricity and heat production' (− 87.4%), and the third most important key category, '1A1b — Petroleum refining' (− 79.9%).

For these main emitting sources, the emissions reduction since 1990 has been achieved by combining several measures: switching fuel in energy-related sectors away from high-sulphur solid and liquid fuels to low-sulphur fuels such as natural gas; fitting flue-gas desulphurisation (FGD) abatement technology in industrial facilities; and the impact of EU directives relating to the sulphur content of certain liquid fuels (EEA, 2015a).

Figure 2.7(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For SO_X, common chief emission sources are the energy sectors.

Figure 2.7 SO_X emissions in the EU-28: (a) trend in SO_X emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



Note: In Figure 2.7(a), values for '1A1a — Public electricity and heat production' are provided on the secondary axis.

2.6 Ammonia (NH_3) emission trends and key categories

Between 1990 and 2013, NH_3 emissions dropped in the EU-28 by 27%. Between 2012 and 2013, emissions decreased by 0.1%, mainly due to decreased emissions in Italy, Bulgaria and Croatia (see Table 2.7). The Member States that contributed most (i.e. more than 10%) to NH_3 emissions in 2013 were France, Germany, Italy.

Table 2.7 Member State contributions to EU NH_3 emissions (Gg)

	NH_3 (Gg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	66	70	67	66	68	67	67	66	0%	– 0.6%	1.3%	1.7%
Belgium	117	113	83	69	65	64	63	62	– 47%	– 1.8%	2.2%	1.6%
Bulgaria	113	58	41	47	41	40	38	30	– 73%	– 19.5%	2.1%	0.8%
Croatia	56	41	41	42	39	39	39	34	– 40%	– 12.9%	1.1%	0.9%
Cyprus	5	6	6	6	6	5	5	5	– 11%	– 5.6%	0.1%	0.1%
Czech Republic	156	86	74	68	69	66	67	69	– 56%	2.7%	3.0%	1.8%
Denmark	125	110	98	89	80	79	77	74	– 41%	– 3.6%	2.4%	1.9%
Adjusted data (*)					*71*	*70*	*68*	*65*				
Estonia	26	12	10	10	11	11	11	11	– 56%	– 0.3%	0.5%	0.3%
Finland	38	36	38	39	38	37	37	37	– 1%	– 0.1%	0.7%	1.0%
France	739	717	748	714	729	721	722	718	– 3%	– 0.5%	14.0%	18.7%
Germany	792	678	696	668	643	675	655	671	– 15%	2.4%	15.0%	17.4%
Greece	85	74	71	68	64	62	61	61	– 28%	– 1.1%	1.6%	1.6%
Hungary	157	91	94	89	77	77	77	81	– 48%	5.7%	3.0%	2.1%
Ireland	108	112	115	113	109	105	106	108	0%	1.7%	2.1%	2.8%
Italy	471	452	453	421	388	402	415	402	– 15%	– 3.0%	8.9%	10.5%
Latvia	41	18	14	15	14	14	15	15	– 64%	– 1.8%	0.8%	0.4%
Lithuania	98	48	39	45	43	42	42	40	– 59%	– 2.7%	1.9%	1.1%
Luxembourg	5	5	5	5	5	5	5	5	– 7%	1.2%	0.1%	0.1%
Malta	2	2	2	2	2	1	2	2	– 17%	2.6%	0.0%	0.0%
Netherlands	373	230	182	160	144	140	136	134	– 64%	– 1.3%	7.1%	3.5%
Poland	508	316	284	272	271	271	263	263	– 48%	0.3%	9.6%	6.8%
Portugal	69	64	65	49	46	48	49	49	– 29%	– 0.3%	1.3%	1.3%
Romania	300	217	206	205	168	166	166	165	– 45%	– 0.6%	5.7%	4.3%
Slovakia	65	40	32	29	25	24	25	25	– 61%	– 0.1%	1.2%	0.7%
Slovenia	23	21	21	20	19	18	18	17	– 23%	– 3.6%	0.4%	0.5%
Spain	335	317	400	379	391	381	368	379	13%	3.2%	6.4%	9.9%
Sweden	55	64	59	55	52	52	51	52	– 5%	1.8%	1.0%	1.4%
United Kingdom	344	331	322	304	279	279	275	271	– 21%	– 1.3%	6.5%	7.1%
EU-28 ([a])	**5 273**	**4 329**	**4 265**	**4 047**	**3 884**	**3 890**	**3 853**	**3 848**	**– 27%**	**– 0.1%**	**100%**	**100%**
EU-28 ([b])	5 273	4 329	4 265	4 047	3 884	3 890	3 853	3 848				
EU-28 ([c])	5 273	4 329	4 265	4 047	3 875	3 881	3 844	3 839				

Note: Grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

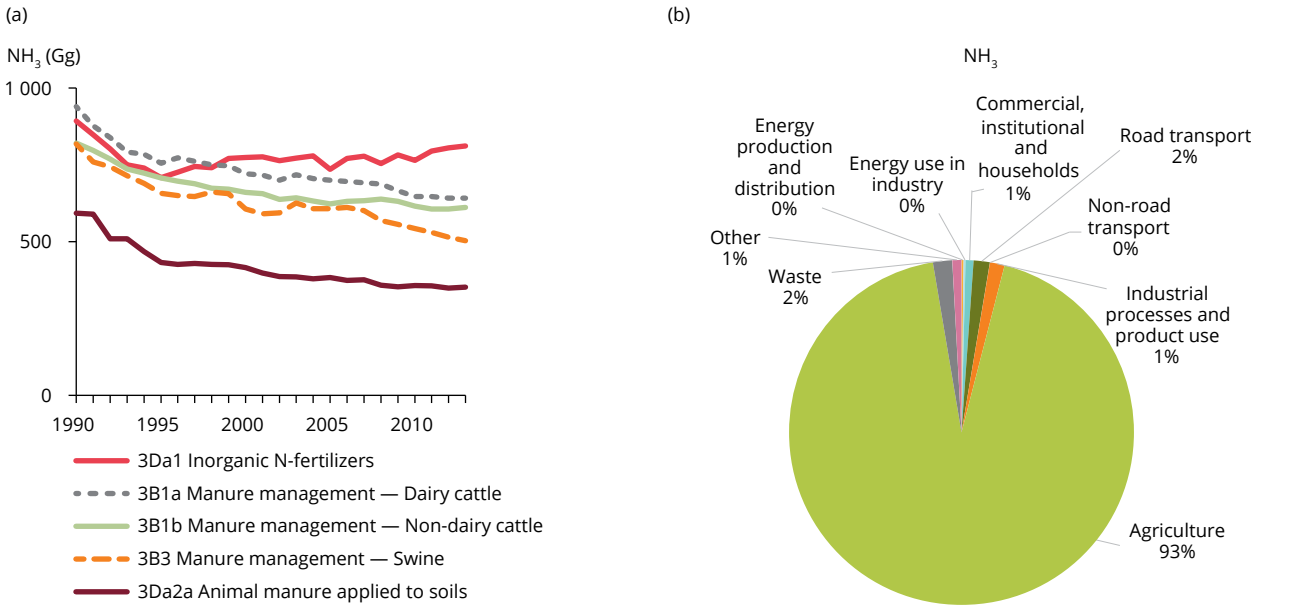
([b]) Sum of sectors.

(*) Adjusted data: Under the Gothenburg Protocol, inventory adjustment applications for emissions from Denmark (for NH_3) were accepted by the EMEP Steering Board in 2014. This table takes these adjustments for Germany and Denmark into account.

Categories '3Da1— Inorganic N-fertilizers', '3B1a — Manure management — Dairy cattle' and '3B1b — Manure management — Non-dairy cattle' are the principal key categories for NH_3 emissions, jointly making up 54% of total NH_3 emissions (see Figure 2.8(a)). Among the top five key categories, the highest relative reduction in emissions between 1990 and 2013 was achieved in the fifth most important key category, '3Da2a — Animal manure applied to soils' (− 40.5%).

Figure 2.8(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. A single sector group, 'Agriculture', is responsible for most (93%) of the NH_3 emissions in the EU-28. The fall in NH_3 emissions in the 'Agricultural' sector is due to the combined effect of reduced livestock numbers across Europe (especially cattle), changes in the handling and management of organic manures and the abated use of nitrogenous fertilisers (EEA, 2015a).

Figure 2.8 **NH_3 emissions in the EU-28: (a) trend in NH_3 emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013**



2.7 Fine particulate matter ($PM_{2.5}$) emission trends and key categories

Between 2000 and 2013, $PM_{2.5}$ emissions dropped in the EU-28 by 18%. Between 2012 and 2013, the increase was 2.5%, mainly due to increased emissions in Italy, Czech Republic and Estonia (see Table 2.8). The Member States that contributed most (i.e. more than 10%) to $PM_{2.5}$ emissions in 2013 were France, Italy and Poland .

Eight countries reported $PM_{2.5}$ values in certain categories higher than the respective PM_{10} values.

Table 2.8 Member State contributions to EU $PM_{2.5}$ emissions (Gg)

	$PM_{2.5}$ (Gg)						Change		Share in EU-28	
Member State	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2000–2013**	**2012–2013**	**2000**	**2013**
Austria	24	23	20	19	19	18	– 23%	– 2.5%	1.5%	1.4%
Belgium	41	36	37	30	32	33	– 19%	3.8%	2.6%	2.6%
Bulgaria	23	28	29	31	31	29	27%	– 5.1%	1.5%	2.3%
Croatia	15	15	15	16	16	15	3%	– 5.9%	1.0%	1.2%
Cyprus	4	3	2	1	1	1	– 73%	– 13.4%	0.3%	0.1%
Czech Republic	25	21	20	20	20	26	3%	28.2%	1.6%	2.0%
Denmark	24	27	27	24	22	21	– 11%	– 5.4%	1.5%	1.7%
Estonia	22	20	24	27	17	20	– 10%	13.8%	1.4%	1.5%
Finland	41	39	40	37	37	35	– 13%	– 6.0%	2.6%	2.7%
France	311	245	206	179	181	181	– 42%	0.1%	19.9%	14.2%
Germany	158	133	125	120	114	113	– 29%	– 1.0%	10.1%	8.8%
Greece										
Hungary	37	27	29	31	30	30	– 20%	– 1.8%	2.4%	2.3%
Ireland	21	19	17	16	15	16	– 23%	3.4%	1.3%	1.2%
Italy	163	140	126	123	121	168	3%	39.1%	10.4%	13.1%
Latvia	25	29	24	25	26	24	– 3%	– 8.7%	1.6%	1.9%
Lithuania	17	19	20	19	19	18	3%	– 5.6%	1.1%	1.4%
Luxembourg	3	3	2	2	2	2	– 18%	1.3%	0.2%	0.2%
Malta	1	1	1	1	1	1	– 22%	– 7.5%	0.1%	0.1%
Netherlands	25	20	15	14	13	13	– 50%	– 3.2%	1.6%	1.0%
Poland	157	167	160	151	145	145	– 8%	– 0.2%	10.0%	11.3%
Portugal	61	56	46	47	46	44	– 27%	– 3.1%	3.9%	3.5%
Romania	88	115	129	117	122	116	31%	– 5.4%	5.6%	9.0%
Slovakia	23	37	27	29	29	29	28%	1.3%	1.5%	2.3%
Slovenia	12	13	12	12	12	12	– 1%	– 2.3%	0.8%	0.9%
Spain	98	94	77	75	72	67	– 32%	– 6.9%	6.3%	5.2%
Sweden	25	26	25	23	23	22	– 13%	– 3.2%	1.6%	1.7%
United Kingdom	121	96	87	81	82	82	– 32%	– 0.8%	7.7%	6.4%
EU-28 ([a])	**1 564**	**1 453**	**1 339**	**1 272**	**1 250**	**1 281**	**– 18%**	**2.5%**	**100%**	**100%**
EU-28 ([b])	1 600	1 453	1 339	1 272	1 250	1 281				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors.

Parties to the LRTAP Convention are formally requested to report emissions of PM for the year 2000 and after.

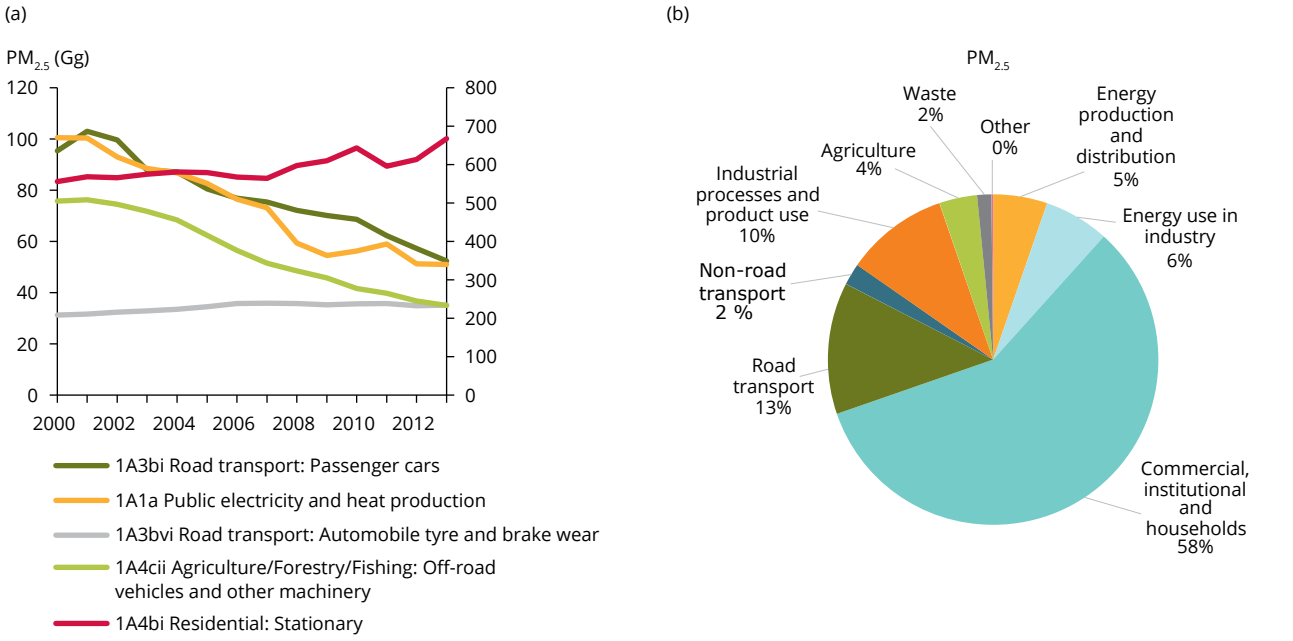
Germany confirmed the inconsistencies found for the categories 1A3bi, 1A3bii and 1A3biii, and stated that these result from problems in their emission database. These problems have now been resolved and all future submissions will reflect these changes (comment received from Germany in 2015).

The Czech Republic explained that inconsistencies in the category 5C1bv originated in the process of data transfer to the final table. Emission values of some pollutants were listed in incorrect order (comment received from the Czech Republic in 2015).

Domestic fuel use in '1A4bi— Residential: Stationary' is the principal key category for $PM_{2.5}$ emissions, making up 52% of total $PM_{2.5}$ emissions (Figure 2.9(a)). Among the top five key categories, the highest relative reductions in emissions between 2000 and 2013 were achieved in the fifth most important key category, '1A4cii — Agriculture/Forestry/Fishing: Off-road vehicles and other machinery' (− 53.7%), there were also high reductions in the third most important key category, '1A1a — Public electricity and heat production' (− 49.3%), and the second most important key category, '1A3bi—Road transport: Passenger cars' (−45.1%). In contrast to the other four top key categories, the chief key category, '1A4bi — Residential: Stationary', increased since 2000 (20.2%), as did the fourth most important key category, '1A3bvi Road transport: Automobile tyre and brake wear' (12.3%).

Figure 2.9(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. The 'Commercial, institutional and households' sector group is a major source of $PM_{2.5}$, and also of PM_{10}, total PAHs, PCDD/Fs and PCBs.

Figure 2.9 $PM_{2.5}$ emissions in the EU-28: (a) trend in $PM_{2.5}$ emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



Note: In Figure 2.9(a) values for '1A4bi Residential: Stationary' are provided in the secondary y-axis.

Parties to the LRTAP Convention are formally requested to report emissions of PM for the year 2000 and after.

2.8 PM_{10} emission trends and key categories

Between 2000 and 2013, PM_{10} emissions in the EU-28 dropped by 19%. Between 2012 and 2013, the increase was 1.3%, mainly due to an increase of emissions in Italy, Czech Republic and Estonia (see Table 2.9). The Member States that contributed most (i.e. more than 10%) to PM_{10} emissions in 2013 were France, Italy, Poland and Germany.

Latvia explained that the change in primary PM_{10} emissions between 2000 and 2013 was due to increased amounts of fuel used. The largest part of PM emissions are produced in the 'Energy' sector, which can be explained by the use of combustion wood fuel in this sector (Appendix 5, Latvia's IIR).

Eleven countries reported PM_{10} values in certain categories higher than the respective TSP values.

Table 2.9 Member State contributions to EU PM_{10} emissions (Gg)

	PM_{10} (Gg)						Change		Share in EU-28	
Member State	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2000–2013**	**2012–2013**	**2000**	**2013**
Austria	39	38	34	34	33	33	– 15%	– 1.5%	1.7%	1.7%
Belgium	56	49	47	39	41	43	– 23%	3.7%	2.4%	2.3%
Bulgaria	36	46	43	46	45	42	17%	– 6.3%	1.6%	2.2%
Croatia	20	22	21	22	22	20	1%	– 7.9%	0.9%	1.1%
Cyprus	6	4	3	3	2	2	– 66%	– 14.2%	0.3%	0.1%
Czech Republic	42	34	37	34	34	39	– 7%	14.3%	1.8%	2.1%
Denmark	36	39	39	36	34	32	– 11%	– 3.9%	1.6%	1.7%
Estonia	38	28	32	42	21	25	– 33%	18.4%	1.6%	1.3%
Finland	57	54	54	51	50	47	– 17%	– 5.3%	2.5%	2.5%
France	419	345	294	268	271	272	– 35%	0.3%	18.0%	14.4%
Germany	276	238	233	234	228	228	– 17%	0.4%	11.9%	12.1%
Greece										
Hungary	72	50	49	50	48	47	– 35%	– 1.5%	3.1%	2.5%
Ireland	31	30	27	25	25	26	– 17%	1.6%	1.3%	1.4%
Italy	196	171	153	150	147	194	– 1%	31.7%	8.4%	10.3%
Latvia	29	35	30	31	33	30	5%	– 9.0%	1.2%	1.6%
Lithuania	16	18	18	18	17	16	0%	– 6.2%	0.7%	0.9%
Luxembourg	5	5	4	4	4	4	– 21%	– 3.6%	0.2%	0.2%
Malta	1	2	1	1	1	1	– 9%	– 7.4%	0.1%	0.1%
Netherlands	40	34	29	28	27	27	– 33%	– 1.0%	1.7%	1.4%
Poland	276	295	276	258	245	246	– 11%	0.4%	11.9%	13.0%
Portugal	85	86	65	64	61	57	– 32%	– 6.5%	3.6%	3.0%
Romania	126	151	165	154	160	153	21%	– 4.5%	5.4%	8.1%
Slovakia	45	42	30	32	32	33	– 27%	1.0%	1.9%	1.7%
Slovenia	17	17	15	16	16	15	– 14%	– 4.4%	0.7%	0.8%
Spain	141	134	107	106	101	95	– 33%	– 6.2%	6.1%	5.0%
Sweden	40	41	40	38	36	36	– 9%	– 1.0%	1.7%	1.9%
United Kingdom	179	147	129	123	125	123	– 31%	– 1.6%	7.7%	6.5%
EU-28 (a)	**2 326**	**2 155**	**1 975**	**1 909**	**1 864**	**1 889**	**– 19%**	**1.3%**	**100%**	**100%**
EU-28 (b)	2 331	2 155	1 975	1 909	1 864	1 889				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

Parties to the LRTAP Convention are formally requested to report emissions of PM for the year 2000 and after.

Croatia is aware of the inconsistencies in the sector 2A1 (PM_{10} > TSP) and explained that all Croatian facilities for cement production have installed electrostatic precipitators (ESPs) on main stacks and smaller fabric filters for moderate control of fugitive sources. For the calculation, the Tier 1 methodology and default emission factors from the *EMEP/EEA Guidebook* (EMEP/EEA, 2013) were used, along with the use of abatement technologies and corresponding default efficiencies. As the recommended value for the efficiency of TSP is greater than for PM_{10}, the resulting emission factor is less, and the emissions are lower. As a result, in the inventory, lower TSP emissions than PM_{10} emissions were calculated (comment received from Croatia in 2015).

Germany confirmed the inconsistencies found for category 3B4gii and stated that these result from problems in their emission database. These problems have now been resolved and all future submissions will reflect these changes (comment received from Germany in 2015).

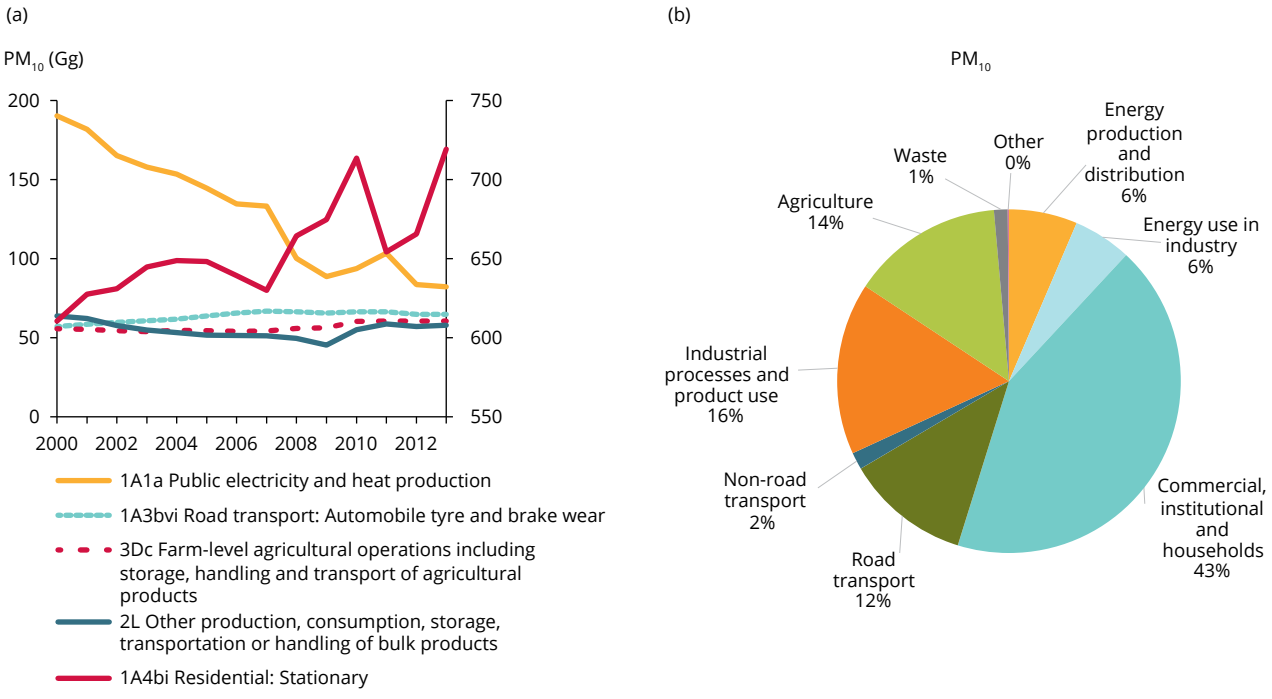
Ireland explained that the emissions of TSP are equal to the emissions of PM_{10}, and that the same emission factors for both PM and TSP are used for the liquid fuels (Comment received from Ireland in 2015).

Slovakia stated that except for one case, all inconsistencies were caused by rounding off during the data handling (comment received from Slovakia in 2015).

As for $PM_{2.5}$, '1A4bi — Residential: Stationary' is the most significant key category for PM_{10} emissions, accounting for 38% of total PM_{10} emissions (see Figure 2.10(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the second most important key category, '1A1a — Public electricity and heat production', (− 56.8%) (Figure 2.10(a)) and the fifth most important key category, '2L — Other production, consump., storage, transp. or handling of bulk products' (− 9.2%). Emissions of the other top five key categories increased.

Figure 2.10(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. The 'Commercial, institutional and households' sector group is a very significant source of PM_{10} and likewise of $PM_{2.5}$, total PAHs, PCDD/Fs and PCBs.

Figure 2.10 PM_{10} emissions in the EU-28: (a) trend in PM_{10} emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



Note: In Figure 2.10(b) values for '1A4bi Residential: Stationary' are provided in the secondary y-axis.

Parties to the LRTAP Convention are formally requested to report emissions of PM for the year 2000 and after.

2.9 Total suspended particulate (TSP) emission trends

Between 1990 and 2013, TSP emissions in the EU-28 dropped by 52%. Between 2012 and 2013, emissions kept stable (– 0.4%). A major increase was reported by Italy, but most other countries reported decreases (Table 2.10). The Member States that contributed most (i.e. more than 10%) to TSP emissions in 2013 were France, Poland and Germany.

Latvia explained that the change in TSP emissions between 2000 and 2013 is due to the increased amounts of fuel used. The largest part of TSP emissions are produced in the 'Energy' sector due to the intense combustion of wood fuel in this sector (Appendix 5, Latvia's IIR).

Latvia explained the peak in TSP emissions in 2004 by the increased activities in the road-paving sector —this particular year saw the construction of the Via Baltica, which connects the capitals of all Baltic states (Appendix 5, Latvia's IIR).

Table 2.10 Member State contributions to EU TSP emissions (Gg)

	TSPs (Gg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	62	62	62	62	58	57	57	57	– 8%	– 0.8%	0.8%	1.6%
Belgium	96	86	79	69	60	52	55	56	– 41%	3.1%	1.3%	1.6%
Bulgaria	83	112	83	129	99	112	98	93	13%	– 5.1%	1.1%	2.6%
Croatia	33	23	27	38	33	35	34	29	– 11%	– 13.2%	0.4%	0.8%
Cyprus	18	14	10	6	5	4	4	3	– 83%	– 15.8%	0.2%	0.1%
Czech Republic	640	202	57	64	61	57	56	49	– 92%	– 12.6%	8.7%	1.4%
Denmark	127	114	100	96	98	94	91	89	– 30%	– 1.9%	1.7%	2.5%
Estonia	279	135	76	39	39	50	27	30	– 89%	8.9%	3.8%	0.8%
Finland	37	38	77	79	79	76	74	70	92%	– 4.6%	0.5%	2.0%
France	1 233	1 143	1 078	983	884	863	877	879	– 29%	0.2%	16.7%	24.9%
Germany	1 932	453	412	356	349	356	346	348	– 82%	0.7%	26.2%	9.8%
Greece												
Hungary	212	203	193	176	170	169	168	168	– 21%	– 0.1%	2.9%	4.8%
Ireland	50	41	37	35	32	30	30	31	– 38%	1.8%	0.7%	0.9%
Italy	279	279	238	212	192	189	186	240	– 14%	29.4%	3.8%	6.8%
Latvia	24	29	34	48	39	46	49	43	77%	– 13.1%	0.3%	1.2%
Lithuania	29	21	21	23	23	23	22	21	– 29%	– 6.1%	0.4%	0.6%
Luxembourg	18	10	6	6	5	5	5	5	– 74%	– 3.1%	0.2%	0.1%
Malta	3	4	5	6	1	2	2	1	– 49%	– 8.9%	0.0%	0.0%
Netherlands	93	70	49	42	36	36	35	35	– 63%	– 1.0%	1.3%	1.0%
Poland	717	581	444	471	449	431	406	407	– 43%	0.2%	9.7%	11.5%
Portugal	122	174	198	236	156	148	135	118	– 3%	– 13.1%	1.7%	3.3%
Romania	271	269	278	294	291	286	279	260	– 4%	– 6.5%	3.7%	7.4%
Slovakia	290	106	57	53	36	38	38	39	– 87%	1.2%	3.9%	1.1%
Slovenia	26	24	22	23	19	20	20	19	– 29%	– 5.9%	0.4%	0.5%
Spain	204	203	203	195	158	158	151	142	– 30%	– 5.9%	2.8%	4.0%
Sweden	60	55	45	47	45	43	42	42	– 30%	– 0.1%	0.8%	1.2%
United Kingdom	432	373	328	299	265	257	259	258	– 40%	– 0.1%	5.9%	7.3%
EU-28 ([a])	**7 370**	**4 823**	**4 220**	**4 086**	**3 682**	**3 638**	**3 546**	**3 533**	**– 52%**	**– 0.4%**	**100%**	**100%**
EU-28 ([b])	7 370	4 823	4 220	4 086	3 682	3 638	3 546	3 533				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors.

2.10 Black carbon (BC) emission trends

Between 1990 and 2013, BC emissions in the EU-28 dropped by 39%. Between 2012 and 2013, emissions decreased by 3.1%, mainly due to emissions reductions in France, the United Kingdom, Romania and Finland (Table 2.11). The Member States that contributed most (i.e. more than 10%) to BC emissions in 2013 were France, Italy and the United Kingdom. Several Member States did not provide data for BC, and in some cases, these gaps could not be filled with data. The EU-28 total is therefore underestimated.

Six countries reported BC values in certain categories higher than the respective $PM_{2,5}$ values. Three of these Member States have sent a resubmission.

Ireland noted the error and explained that the data reported for BC are actually tonnes for the category 1A3ei, and not kilotonnes as recorded in Ireland's submission. This will be corrected in future submissions (comment received from Ireland in 2015).

Table 2.11 Member State contributions to EU BC emissions (Gg)

	BC (Gg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	11	10	9	8	7	6	6	6	– 48%	– 2.5%	4.8%	4.1%
Bulgaria	1	0	1	2	1	1	1	1	83%	– 16.4%	0.3%	0.9%
Croatia	3	2	2	2	2	2	2	2	– 41%	– 6.2%	1.3%	1.2%
Cyprus	0	0	0	0	0	0	0	0	– 43%	7.7%	0.1%	0.1%
Czech Republic	NE	NE	NE	NE	NE	NE	NE	NE				
Denmark	6	6	7	7	6	6	5	5	– 10%	– 0.9%	2.5%	3.7%
Estonia	2	2	3	3	3	3	3	3	26%	2.1%	0.9%	2.0%
Finland	7	7	6	6	6	5	6	6	– 21%	– 10.8%	3.2%	4.1%
France	70	75	64	53	44	40	38	36	– 48%	– 4.3%	31.6%	26.7%
Germany	NR	NR	NR	NR	NR	NR	NR	NR				
Greece												
Hungary	4	4	4	5	5	6	5	5	13%	– 3.5%	2.0%	3.6%
Ireland	4	4	4	4	3	3	2	2	– 38%	0.0%	1.8%	1.8%
Italy	45	45	42	36	28	27	24	27	– 42%	11.6%	20.5%	19.5%
Latvia	2	2	3	4	3	3	3	3	60%	– 7.0%	0.9%	2.3%
Lithuania	1	1	1	2	2	2	2	2	44%	– 2.6%	0.5%	1.1%
Luxembourg												
Malta	0	0	0	0	0	0	0	0	– 32%	– 31.6%	0.0%	0.0%
Netherlands	14	11	9	7	5	4	4	4	– 74%	– 7.7%	6.1%	2.6%
Poland	NE	NE	NE	NE	NE	NE	NE	NE				
Portugal	7	7	8	7	6	6	5	5	– 24%	– 4.9%	3.0%	3.7%
Romania	3	5	7	10	12	11	12	10	219%	– 12.9%	1.5%	7.6%
Slovakia	0	0	0	0	0	0	0	0			0.0%	0.0%
Slovenia	NR	NR	NR	NR	NR	NR	NR	NR				
Spain	NE	NE	NE	NE	NE	NE	NE	NE				
Sweden	5	5	5	5	4	4	4	4	– 33%	– 5.7%	2.5%	2.7%
United Kingdom	37	39	34	29	23	20	18	17	– 54%	– 8.6%	16.7%	12.4%
EU-28 ([a])	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
EU-28 ([b])	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors.

2.11 Carbon monoxide (CO) emission trends and key categories

Between 1990 and 2013, CO emissions dropped in the EU-28 by 66%. Between 2012 and 2013, the increase was 3%, and was mainly due to emission increases in Italy, Belgium and Czech Republic (Table 2.12). The Member States that contributed most (i.e. more than 10%) to CO emissions in 2013 were France, Germany, Italy and Poland.

Belgium explained that the sudden increase of CO emissions in 2013 can be explained by the fact that lime production occurred without oxygen in plants (reducing atmosphere) (Appendix 5, Belgium's IIR).

Table 2.12 Member State contributions to EU CO emissions (Gg)

	CO (Gg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	1 287	987	785	699	596	575	582	582	– 55%	0.1%	1.9%	2.6%
Belgium	1 415	1 129	942	766	526	423	374	553	– 61%	47.8%	2.1%	2.5%
Bulgaria	780	630	461	414	332	332	326	302	– 61%	– 7.3%	1.2%	1.4%
Croatia	461	311	345	266	185	179	172	153	– 67%	– 11.0%	0.7%	0.7%
Cyprus	55	48	36	27	19	17	16	15	– 73%	– 5.9%	0.1%	0.1%
Czech Republic	1 030	897	643	511	402	382	342	519	– 50%	51.9%	1.6%	2.3%
Denmark	747	666	491	465	407	370	355	339	– 55%	– 4.5%	1.1%	1.5%
Estonia	227	197	183	158	172	148	162	158	– 30%	– 2.8%	0.3%	0.7%
Finland	723	624	611	530	485	455	453	369	– 49%	– 18.4%	1.1%	1.7%
France	10 523	8 910	6 392	5 164	4 239	3 508	3 133	3 196	– 70%	2.0%	15.9%	14.4%
Germany	12 534	6 413	4 787	3 705	3 529	3 451	3 063	3 089	– 75%	0.8%	18.9%	13.9%
Greece	1 132	953	921	720	525	492	450	405	– 64%	– 10.0%	1.7%	1.8%
Hungary	1 217	762	649	447	383	366	350	326	– 73%	– 6.9%	1.8%	1.5%
Ireland	350	291	247	217	146	135	129	123	– 65%	– 4.6%	0.5%	0.6%
Italy	7 007	7 029	4 672	3 239	2 283	2 229	2 062	2 571	– 63%	24.7%	10.6%	11.6%
Latvia	386	294	236	204	154	158	165	149	– 62%	– 10.2%	0.6%	0.7%
Lithuania	453	275	199	197	182	167	168	146	– 68%	– 13.0%	0.7%	0.7%
Luxembourg	467	225	55	45	32	29	30	30	– 94%	– 0.5%	0.7%	0.1%
Malta	24	30	1	1	11	12	12	12	– 48%	4.6%	0.0%	0.1%
Netherlands	1 141	890	755	727	679	656	636	621	– 46%	– 2.4%	1.7%	2.8%
Poland	7 406	3 466	2 647	2 754	3 019	2 933	2 791	2 876	– 61%	3.1%	11.2%	13.0%
Portugal	793	798	665	466	350	327	298	288	– 64%	– 3.4%	1.2%	1.3%
Romania	1 239	901	1 302	1 026	876	802	823	761	– 39%	– 7.6%	1.9%	3.4%
Slovakia	515	423	300	272	221	227	221	218	– 58%	– 1.3%	0.8%	1.0%
Slovenia	338	301	213	181	153	160	159	155	– 54%	– 2.0%	0.5%	0.7%
Spain	3 661	3 165	2 705	2 142	2 002	1 990	1 753	1 709	– 53%	– 2.5%	5.5%	7.7%
Sweden	1 316	1 162	849	700	632	588	580	562	– 57%	– 3.2%	2.0%	2.5%
United Kingdom	8 969	7 412	5 553	3 493	2 182	2 005	1 942	1 971	– 78%	1.5%	13.5%	8.9%
EU-28 (a)	**66 197**	**49 188**	**37 643**	**29 535**	**24 724**	**23 116**	**21 549**	**22 199**	**– 66%**	**3.0%**	**100%**	**100%**
EU-28 (b)	66 197	49 188	37 643	29 535	24 724	23 116	21 549	22 199				

Note: Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

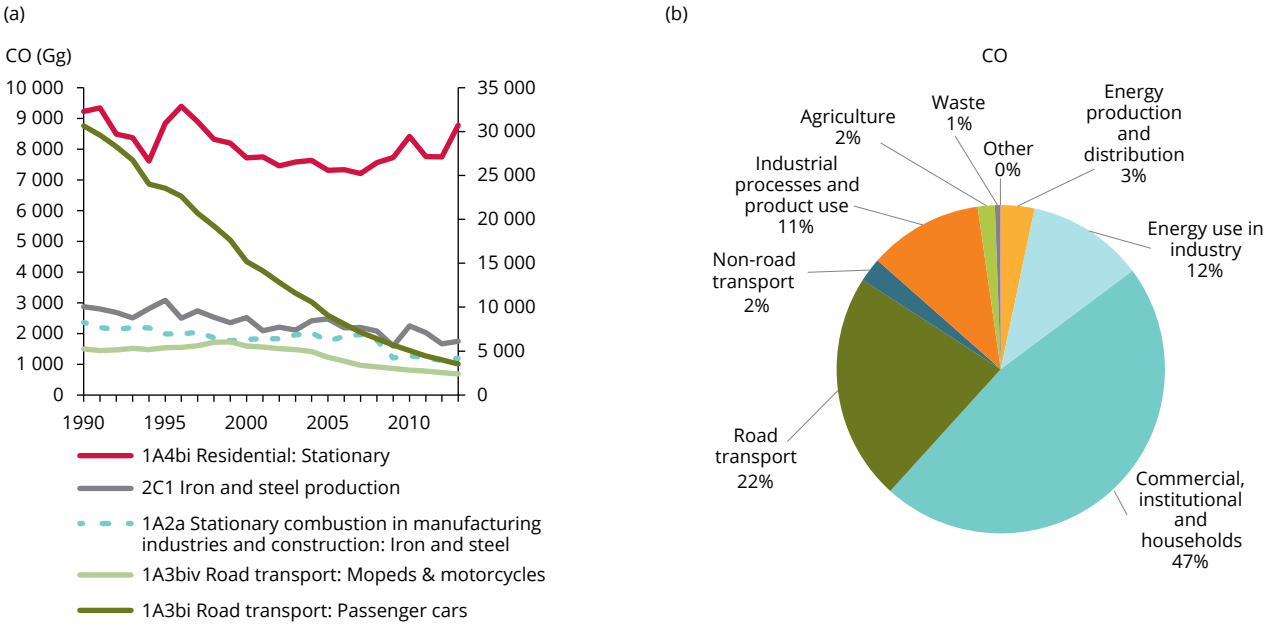
(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

'1A4bi — Residential: Stationary' and '1A3bi — Road transport: Passenger cars' were the most important key categories for CO emissions, jointly accounting for 55% of total CO emissions. Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the second most important key category, '1A3bi — Road transport: Passenger cars' (− 88.5%) (see Figure 2.11a).

Figure 2.11(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For CO, common major emission sources are 'Commercial, institutional and households' and 'Road transport'.

Figure 2.11 CO emissions in the EU-28: (a) trend in CO emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



Note: In Figure 2.11(a), values for '1A3bi — Road transport: Passenger cars' are provided in the secondary axis.

2.12 Lead (Pb) emission trends and key categories

Between 1990 and 2013, Pb emissions dropped in the EU-28 by 92%. Between 2012 and 2013, emissions decreased by 3.3%, mainly due to reduced emissions in Romania, Spain, Italy and the Czech Republic (see Table 2.13). The Member States that contributed most (i.e. more than 10%) to Pb emissions in 2013 were Poland, Italy and Germany. Luxembourg once reported a notation key NR for Pb emissions, which was used to gap-fill all missing years. Therefore, the EU-28 total is underestimated.

Latvia explained that compared with 1990, Pb emissions have decreased by 98%. The most significant decrease in emissions occurred in 1999, when changes in international legislation prohibited use of liquid fuels with high Pb content (Appendix 5, Latvia's IIR).

Table 2.13 Member State contributions to EU Pb emissions (Mg)

	Pb (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	215	16	12	13	15	15	15	16	– 93%	3.8%	0.9%	0.9%
Belgium	254	187	107	75	41	30	30	26	– 90%	– 11.9%	1.1%	1.4%
Bulgaria	321	324	255	126	70	75	75	76	– 76%	2.0%	1.4%	4.2%
Croatia	538	328	276	52	7	7	6	7	– 99%	1.8%	2.3%	0.4%
Cyprus	36	42	44	29	31	30	28	25	– 31%	– 11.3%	0.2%	1.3%
Czech Republic	269	180	108	47	26	17	23	18	– 93%	– 22.2%	1.2%	1.0%
Denmark	128	26	19	17	12	12	12	12	– 91%	0.0%	0.6%	0.6%
Estonia	206	86	37	36	39	38	34	39	– 81%	16.1%	0.9%	2.1%
Finland	338	67	45	22	23	22	19	18	– 95%	– 2.2%	1.5%	1.0%
France	4 591	1 799	296	183	146	135	138	136	– 97%	– 1.4%	19.8%	7.4%
Germany	2 130	739	463	375	220	220	212	210	– 90%	– 1.0%	9.2%	11.4%
Greece	470	470	470	470							2.0%	
Hungary	60	28	23	8	7	8	8	7	– 88%	– 9.5%	0.3%	0.4%
Ireland	124	78	19	21	16	15	14	14	– 89%	– 2.1%	0.5%	0.8%
Italy	4 415	2 029	946	281	260	261	260	254	– 94%	– 2.3%	19.0%	13.9%
Latvia	96	60	6	4	4	4	3	2	– 98%	– 45.6%	0.4%	0.1%
Lithuania	151	92	7	6	5	5	4	4	– 97%	– 6.7%	0.7%	0.2%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	0	1	1	1	3	6	13	8	2071%	– 39.7%	0.0%	0.4%
Netherlands	337	155	28	30	38	23	16	14	– 96%	– 14.0%	1.5%	0.8%
Poland	1 372	642	524	552	573	565	554	561	– 59%	1.4%	5.9%	30.6%
Portugal	549	754	37	36	33	33	33	33	– 94%	– 0.4%	2.4%	1.8%
Romania	161	136	112	82	51	42	67	36	– 78%	– 46.2%	0.7%	2.0%
Slovakia	99	79	89	73	59	59	58	54	– 46%	– 7.6%	0.4%	2.9%
Slovenia	352	200	47	16	17	17	16	16	– 95%	0.2%	1.5%	0.9%
Spain	2 753	942	576	207	185	184	186	175	– 94%	– 5.8%	11.9%	9.5%
Sweden	358	39	28	16	14	13	12	12	– 97%	– 4.3%	1.5%	0.6%
United Kingdom	2 887	1 529	149	107	63	59	61	63	– 98%	3.4%	12.4%	3.4%
EU-28 ([a])	**23 210**	**11 026**	**4 723**	**2 886**	**1 960**	**1 896**	**1 898**	**1 836**	**– 92%**	**– 3.3%**	**100%**	**100%**
EU-28 ([b])	22 740	10 556	4 253	2 416	1 960	1 896	1 898	1 836				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

Portugal stated that the Pb emissions registered from 1990 to 2013 show a decreasing trend, with a reduction of approximately 94%. This is mainly related to the reduction in emissions by road transport, due to the phasing out of leaded petrol within the EU (Appendix 5, Portugal's IIR).

The categories '1A2b — Stationary combustion in manufacturing industries and construction: Non-ferrous metals', '2C1 — Iron and steel production' and '1A4bi — Residential: Stationary' were the leading key categories for Pb emissions, together making up 48% of total Pb emissions (see Figure 2.12(a)).

The largest relative reductions in emissions between 1990 and 2013 were from the second most important key category, '2C1 — Iron and steel production' (− 66.5%), and the fifth most important key category, '1A2f — Stationary combustion in manufacturing industry' (− 61.2%). The fourth most important key category, '1A3bvi — Road transport: Automobile tyre and brake wear', have increased since 1990 by 17.2%.

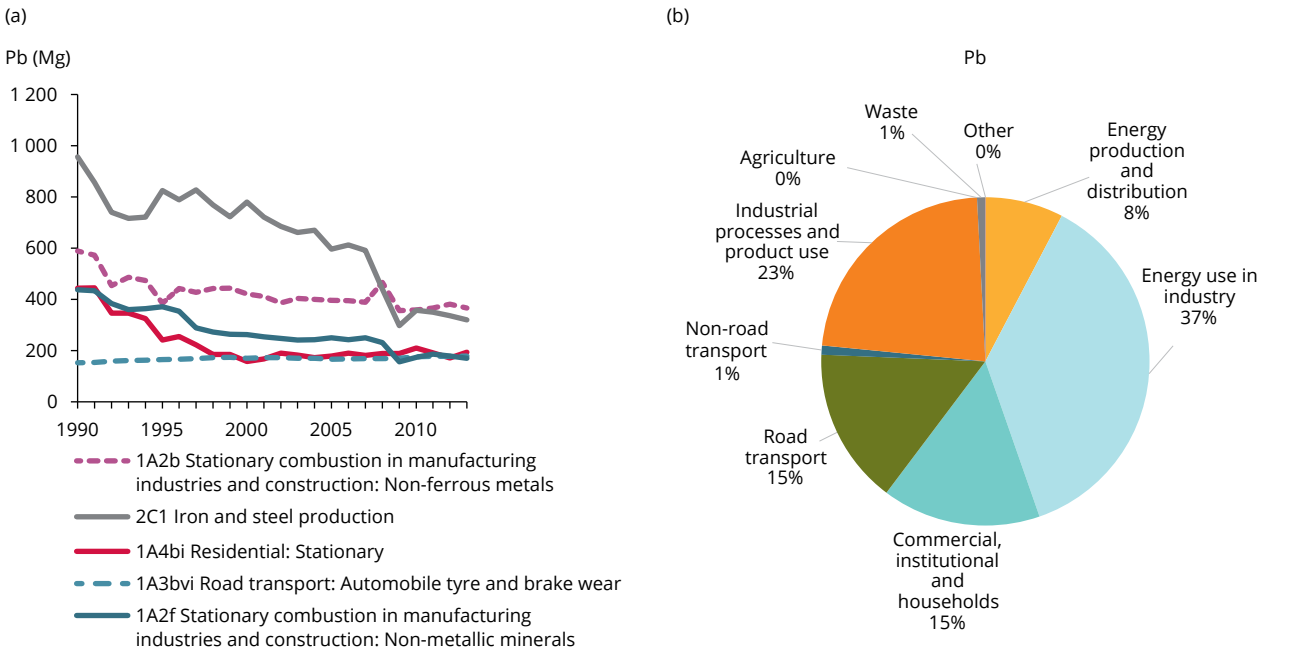
The high increase of Pb emissions of the category '2C1 — Iron and steel production' from 1994 to 1995, and likewise the decrease from 2007 to 2008 is mainly caused by data reported from Germany.

The peak of Pb emissions in the category '1A2b — Stationary combustion in manufacturing industries and construction: Non-ferrous metals' in the year 2008 was mainly due to high emissions reported from Bulgaria for this year.

Emissions of Pb have declined to a tenth of the total emissions in 1990. This is primarily due to reductions made by countries in emissions from the 'Road transport' sector. The promotion of unleaded petrol within the EU through a combination of fiscal and regulatory measures has been a notable success story. EU Member States and other EEA member countries have now phased out the use of leaded petrol, a goal that was regulated in the EU by the Directive on the Quality of Petrol and Diesel Fuels (98/70/EC) (EEA, 2015c).

Figure 2.12(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For Pb, common major emission sources are the sectors 'Energy use in industry', 'Industrial processes' 'Road transport' and 'Commercial, institutional and households'.

Figure 2.12 Pb emissions in the EU-28: (a) trend in Pb emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



2.13 Cadmium (Cd) emission trends and key categories

Between 1990 and 2013, Cd emissions decreased by 75% in the EU-28. Between 2012 and 2013, they decreased by 0.8% (Table 2.14), mainly due to decreased emissions in Italy, Romania and Spain. The Member States that contributed most (i.e. more than 10%) to Cd emissions in 2013 were Portugal, Spain, Germany and Italy. Greece did not submit an inventory in 2015. However, it should be noted that Greece only reported an emission value once (for 1996), which has been used to gap-fill the years up to 2005. Likewise, Luxembourg once reported a notation key NR for Cd emissions, which was used to gap-fill all missing years. Therefore, the EU-28 total is underestimated.

Table 2.14 Member State contributions to EU Cd emissions (Mg)

	Cd (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	2	1	1	1	1	1	1	1	– 23%	0.5%	0.6%	2.0%
Belgium	6	5	3	2	3	2	2	2	– 62%	5.6%	2.4%	3.7%
Bulgaria	5	4	3	3	1	1	1	1	– 78%	2.6%	2.1%	1.8%
Croatia	1	1	1	1	1	1	1	0	– 51%	– 6.5%	0.4%	0.8%
Cyprus	0	0	0	0	0	0	0	0	– 43%	– 34.4%	0.0%	0.1%
Czech Republic	4	4	3	3	1	1	1	1	– 84%	– 26.9%	1.7%	1.1%
Denmark	1	1	1	1	1	1	1	1	– 47%	– 0.3%	0.4%	0.9%
Estonia	5	2	1	1	1	1	1	1	– 79%	21.8%	1.8%	1.5%
Finland	6	2	1	1	1	1	1	1	– 81%	– 8.9%	2.5%	1.9%
France	20	17	13	5	3	3	2	3	– 87%	5.5%	7.9%	4.0%
Germany	20	13	13	10	8	8	7	7	– 63%	– 1.5%	7.8%	11.7%
Greece	3	3	3	3							1.2%	
Hungary	4	3	3	1	1	1	1	1	– 74%	– 4.4%	1.5%	1.6%
Ireland	0	1	1	0	0	0	0	0	– 37%	– 1.1%	0.2%	0.5%
Italy	10	9	9	8	7	7	7	6	– 36%	– 4.1%	4.0%	10.3%
Latvia	0	1	1	1	1	1	1	1	27%	– 6.2%	0.2%	0.9%
Lithuania	1	0	0	1	0	0	0	0	– 23%	– 4.9%	0.2%	0.7%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	0	0	0	1	0	0	0	0	– 92%	6.6%	0.1%	0.0%
Netherlands	2	1	1	2	3	1	1	1	– 70%	– 23.0%	0.8%	1.0%
Poland	92	28	20	16	16	16	16	15	– 83%	– 1.8%	36.2%	24.4%
Portugal	6	6	6	7	4	3	3	4	– 32%	60.0%	2.5%	6.8%
Romania	4	4	4	4	3	3	3	3	– 25%	– 9.0%	1.5%	4.6%
Slovakia	10	10	9	6	1	1	1	1	– 86%	1.7%	3.8%	2.1%
Slovenia	1	0	0	0	0	0	0	0	– 35%	1.6%	0.2%	0.6%
Spain	25	23	19	15	10	9	9	8	– 68%	– 11.0%	9.9%	12.8%
Sweden	2	1	1	1	1	1	1	0	– 79%	– 6.0%	0.9%	0.8%
United Kingdom	23	11	6	4	2	3	2	2	– 90%	6.2%	8.9%	3.5%
EU-28 ([a])	**253**	**151**	**121**	**97**	**70**	**66**	**63**	**63**	**– 75%**	**– 0.8%**	**100%**	**100%**
EU-28 ([b])	250	148	118	94	70	66	63	63				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

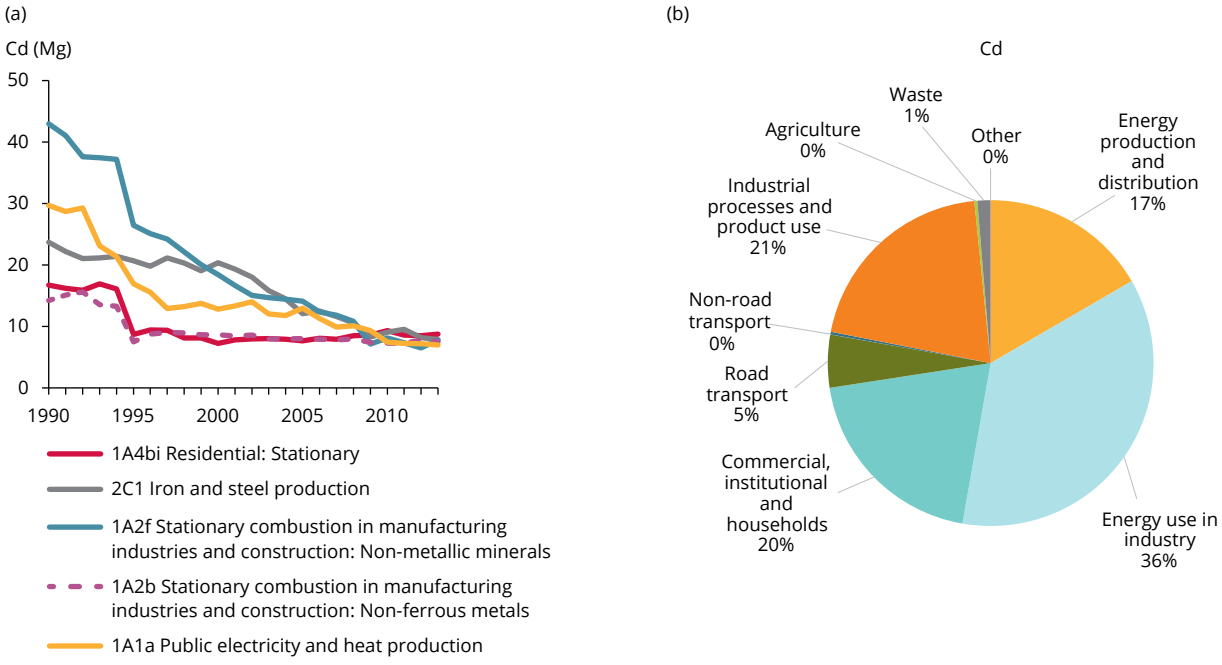
'1A4bi — Residential: Stationary' and '2C1 — Iron and steel production' were the principal key categories for Cd emissions, making up 26% of total Cd emissions (see Figure 2.13(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the third most important key category, '1A2f — Stationary combustion in manufacturing industries and construction: Non-metallic minerals' (− 82%) and the fifth most important key category, '1A1a —Public electricity and heat production' (− 76.5%).

The pronounced emission decreases of Cd in the categories '1A2f — Stationary combustion in manufacturing industry and construction: Non-metallic minerals', '1A4bi — Residential: Stationary' and '1A2b — Stationary combustion in manufacturing industry and construction: Non-ferrous metals' between the years 1994 and 1995 is mainly caused by differences between gap-filled data (until 1994) and emissions reported from Poland (starting from 1995).

As is the case for Pb, industrial sources of Cd emissions have decreased since the early 1990s overall. This is largely due to improvements in abatement technologies for wastewater treatment and incinerators, and in metal refining and smelting facilities (EEA, 2015c).

Figure 2.13(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For Cd, common leading emission sources are the energy sectors and the 'Commercial, institutional and households' sector.

Figure 2.13 Cd emissions in the EU-28: (a) trend in Cd emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



2.14 Mercury (Hg) emission trends and key categories

Between 1990 and 2013, Hg emissions dropped by 74% in the EU-28. Between 2012 and 2013, the decrease was 2.7% (see Table 2.15), mainly due to reduced emissions in Spain, Romania and the Czech Republic. The Member States that contributed most (i.e. more than 10%) to Hg emissions in 2013 were Poland, Germany, Italy and the United Kingdom. Luxembourg once reported a notation key NR for Hg emissions, which was used to gap-fill all missing years. Therefore, the EU-28 total is underestimated.

Table 2.15 Member State contributions to EU Hg emissions (Mg)

	Hg (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	2	1	1	1	1	1	1	1	– 52%	1.1%	0.9%	1.7%
Belgium	6	3	3	2	2	2	1	2	– 71%	11.4%	2.5%	2.7%
Bulgaria	2	2	1	2	1	1	1	1	– 70%	– 5.2%	1.1%	1.2%
Croatia	1	0	0	1	1	1	0	0	– 58%	0.2%	0.5%	0.8%
Cyprus	0	0	0	0	0	0	0	0	– 15%	13.9%	0.0%	0.1%
Czech Republic	8	7	4	4	3	3	3	3	– 64%	– 10.5%	3.3%	4.5%
Denmark	3	2	1	1	0	0	0	0	– 89%	12.3%	1.4%	0.6%
Estonia	1	1	1	1	1	1	1	1	– 41%	19.4%	0.5%	1.1%
Finland	1	1	1	1	1	1	1	1	– 34%	– 8.1%	0.4%	1.1%
France	25	20	12	6	4	5	4	4	– 85%	– 6.0%	10.7%	6.3%
Germany	32	17	16	13	10	10	10	10	– 68%	– 0.7%	14.0%	17.0%
Greece	13	13	13	13							5.7%	
Hungary	3	2	2	2	1	1	1	1	– 72%	– 18.5%	1.3%	1.4%
Ireland	1	1	1	1	1	1	1	1	– 38%	– 1.9%	0.4%	0.9%
Italy	12	10	9	10	9	9	8	8	– 31%	– 2.6%	5.1%	13.4%
Latvia	0	0	0	0	0	0	0	0	– 63%	2.1%	0.1%	0.2%
Lithuania	1	0	0	0	0	0	0	0	– 82%	– 2.1%	0.6%	0.4%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	0	1	1	1	0	0	0	0	– 97%	1561.6%	0.2%	0.0%
Netherlands	4	1	1	1	1	1	1	1	– 85%	– 6.5%	1.5%	0.9%
Poland	33	13	11	10	10	10	10	10	– 69%	0.2%	14.5%	17.2%
Portugal	3	3	3	3	2	2	2	2	– 53%	– 5.5%	1.4%	2.5%
Romania	11	9	8	5	2	2	2	2	– 83%	– 12.3%	4.9%	3.2%
Slovakia	13	4	6	3	1	1	1	1	– 89%	4.3%	5.5%	2.2%
Slovenia	1	0	1	0	0	0	0	0	– 36%	4.8%	0.3%	0.7%
Spain	14	16	13	11	7	7	6	5	– 63%	– 15.2%	6.3%	8.9%
Sweden	1	1	1	1	0	0	0	0	– 70%	2.0%	0.7%	0.8%
United Kingdom	37	20	8	7	6	6	6	6	– 84%	7.3%	16.3%	10.1%
EU-28 (a)	**230**	**152**	**117**	**99**	**66**	**64**	**62**	**60**	**– 74%**	**– 2.7%**	**100%**	**100%**
EU-28 (b)	217	139	104	86	66	64	62	60				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

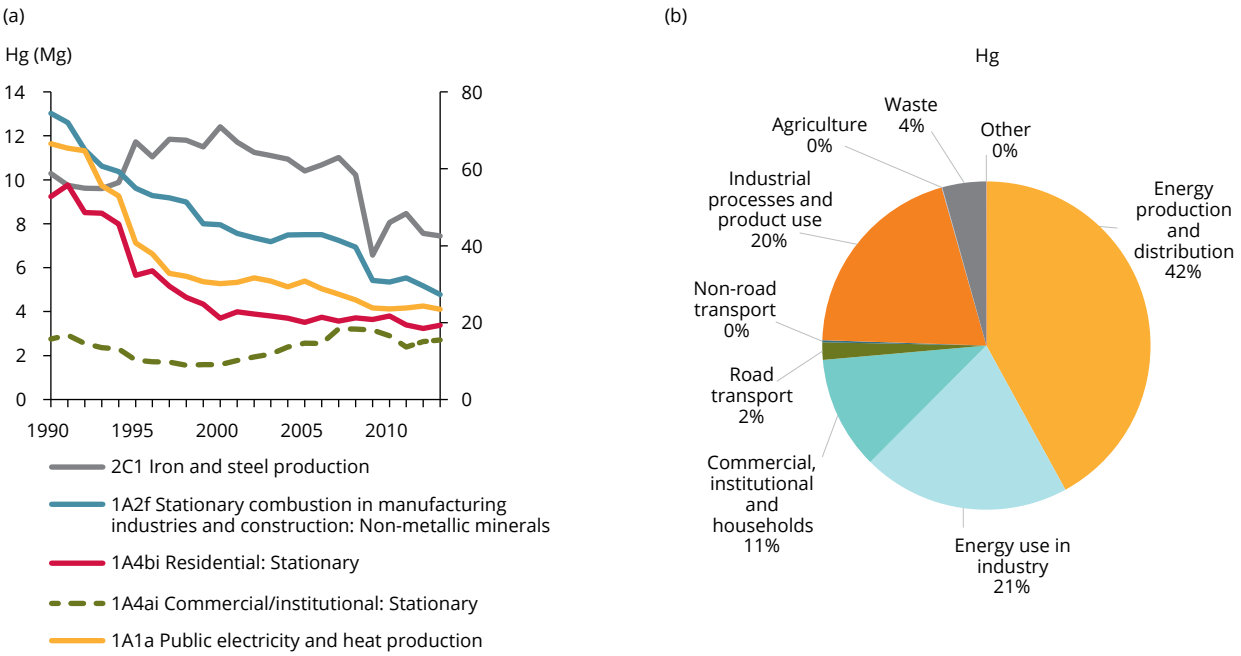
(b) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

'1A1a — Public electricity and heat production' and '2C1 — Iron and steel production' were the chief key categories for Hg emissions, making up 51% of total Hg emissions (see Figure 2.14(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 was achieved by the most important key category, '1A1a — Public electricity and heat production' (− 64.7%). The third most important key category 'Stationary combustion in manufacturing industries' (-63.3%) and the fourth most important key category, '1A4bi — Residential: Stationary' (− 63.5%), also show high emission reductions.

Emissions from categories '1A1a — Public electricity and heat production' and '1A2gviii — Stationary combustion in manufacturing industries and construction: Other' have decreased considerably since 1990. This is attributed chiefly to changes in the industrial sector: improving emission controls on mercury cells and their replacement by diaphragm or membrane cells, fuel-switching from coal to gas and other energy sources in the power and heat generating sectors in many countries (EEA, 2015c).

Figure 2.14(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For Hg, principal emission sources are the energy sectors and the sector 'Industrial processes'.

Figure 2.14 Hg emissions in the EU-28: (a) trend in Hg emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



Note: In Figure 2.14(a), values for '1A1a Public electricity and heat production' are provided in the secondary axis.

2.15 Arsenic (As) emission trends

Between 1990 and 2013, As emissions in the EU-28 dropped by 68%. Between 2012 and 2013, emissions decreased by 3.4%, mainly due to reduced emissions in Slovakia, Spain and Romania (see Table 2.16). The Member States that contributed most (i.e. more than 10%) to As emissions in 2013 were Italy and Poland.

It should be noted that Greece only reported an emission value once (for 1996), which has been used to gap-fill the years up to 2005. Likewise, Luxembourg once reported a notation key NR for As emissions, which was used to gap-fill all missing years. Austria and Slovenia did not provide emission data for As. Therefore, the EU-28 total is underestimated.

Table 2.16 Member State contributions to EU As emissions (Mg)

	As (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	6	6	5	3	2	2	2	2	– 74%	– 5.7%	1.1%	0.9%
Bulgaria	19	15	7	15	3	4	3	3	– 85%	– 3.2%	3.4%	1.6%
Croatia	9	2	1	1	1	1	1	0	– 95%	– 22.2%	1.6%	0.2%
Cyprus	0	0	0	0	0	0	0	0	– 8%	– 35.0%	0.0%	0.1%
Czech Republic	2	2	3	4	3	3	3	3	38%	2.0%	0.4%	1.8%
Denmark	1	1	1	1	0	0	0	0	– 73%	22.9%	0.2%	0.2%
Estonia	19	10	9	9	11	11	10	11	– 40%	17.1%	3.4%	6.3%
Finland	33	3	4	3	4	3	3	3	– 91%	0.9%	6.0%	1.6%
France	17	17	15	11	8	7	6	7	– 62%	5.4%	3.1%	3.7%
Germany	81	7	6	6	5	5	5	5	– 93%	1.9%	14.5%	2.9%
Greece	4	4	4	4							0.7%	
Hungary	4	3	3	2	2	2	2	2	– 54%	– 13.4%	0.7%	1.0%
Ireland	2	2	2	2	1	1	1	1	– 21%	– 6.8%	0.3%	0.7%
Italy	37	27	45	40	45	46	45	44	21%	– 0.9%	6.6%	24.6%
Latvia	0	0	0	0	0	0	0	0	– 65%	30.1%	0.1%	0.1%
Lithuania	1	0	0	0	0	0	0	0	– 66%	– 3.1%	0.1%	0.1%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	0	0	0	0	0	0	0	0	– 67%	0.0%	0.0%	0.0%
Netherlands	1	1	1	2	1	1	1	1	– 36%	– 11.5%	0.3%	0.5%
Poland	82	54	40	47	48	46	44	45	– 45%	2.4%	14.8%	24.9%
Portugal	3	3	3	3	1	1	1	1	– 51%	– 5.0%	0.5%	0.8%
Romania	14	12	10	8	5	6	5	4	– 70%	– 15.2%	2.5%	2.3%
Slovakia	147	39	9	23	22	23	20	14	– 91%	– 29.3%	26.5%	7.7%
Slovenia	NR	NR	NR	NR	NR	NR	NR	NR				
Spain	16	17	20	20	14	15	17	14	– 15%	– 18.0%	2.9%	7.6%
Sweden	6	2	1	1	1	1	1	1	– 85%	– 5.9%	1.0%	0.5%
United Kingdom	51	37	24	18	16	16	17	18	– 64%	7.3%	9.1%	10.0%
EU-28 ([a])	**554**	**263**	**214**	**223**	**194**	**195**	**186**	**180**	**– 68%**	**– 3.4%**	**100%**	**100%**
EU-28 ([b])	550	259	210	219	194	195	186	180				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

2.16 Chromium (Cr) emission trends

Between 1990 and 2013, Cr emissions in the EU-28 dropped by 74%. Between 2012 and 2013, emissions decreased by 3%, mainly due to reduced emissions in Belgium, Italy, Hungary and Spain (see Table 2.17). The Member States that contributed most (i.e. more than 10%) to Cr emissions in 2013 were Germany, Italy and Poland. Greece did not submit an inventory in 2015. However, it should be noted that Greece only reported an emission value once (for 1996), which has been used to gap-fill the years up to 2005. Likewise, Luxembourg once reported a notation key NR for Cr emissions, which was used to gap-fill all missing years. Austria and Slovenia did not provide emission data for Cr. Therefore, the EU-28 total is underestimated.

Table 2.17 Member State contributions to EU Cr emissions (Mg)

	Cr (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	33	28	18	17	13	11	11	6	– 82%	– 45.2%	2.5%	1.8%
Bulgaria	21	11	8	10	5	6	5	5	– 76%	– 4.1%	1.6%	1.5%
Croatia	5	4	3	3	2	2	2	1	– 72%	– 18.5%	0.4%	0.4%
Cyprus	0	0	0	0	0	0	0	0	13%	– 16.3%	0.0%	0.1%
Czech Republic	29	21	12	14	19	13	16	18	– 38%	16.0%	2.2%	5.4%
Denmark	6	3	1	2	2	2	1	1	– 74%	4.6%	0.4%	0.4%
Estonia	18	10	8	9	11	10	9	11	– 42%	15.3%	1.4%	3.1%
Finland	29	22	28	18	22	18	18	18	– 38%	– 1.9%	2.2%	5.3%
France	392	189	103	44	27	24	24	24	– 94%	0.0%	30.1%	7.0%
Germany	133	74	63	57	57	58	57	57	– 57%	– 0.1%	10.2%	16.9%
Greece	10	10	10	10							0.8%	
Hungary	18	12	11	11	11	11	10	7	– 63%	– 31.2%	1.4%	2.0%
Ireland	4	4	4	3	2	2	2	2	– 43%	– 1.2%	0.3%	0.6%
Italy	92	74	51	59	52	52	50	46	– 51%	– 8.8%	7.0%	13.5%
Latvia	1	1	1	1	1	1	1	1	– 10%	– 15.2%	0.1%	0.3%
Lithuania	2	1	1	1	1	1	1	1	– 41%	– 2.8%	0.1%	0.3%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	1	1	1	1	1	1	1	1	108%	0.0%	0.0%	0.4%
Netherlands	12	9	5	4	4	4	4	4	– 70%	– 1.4%	0.9%	1.1%
Poland	155	76	47	44	50	48	46	47	– 70%	1.8%	11.8%	13.8%
Portugal	13	14	15	14	11	10	10	10	– 19%	– 0.1%	1.0%	3.1%
Romania	37	31	26	19	13	12	12	11	– 70%	– 3.4%	2.8%	3.3%
Slovakia	77	12	8	6	4	4	4	4	– 94%	3.5%	5.9%	1.3%
Slovenia	NR	NR	NR	NR	NR	NR	NR	NR				
Spain	34	38	41	42	31	30	29	26	– 24%	– 9.9%	2.6%	7.8%
Sweden	23	12	7	10	5	6	5	5	– 79%	– 2.3%	1.8%	1.4%
United Kingdom	161	115	77	40	31	29	29	30	– 81%	5.2%	12.3%	8.9%
EU-28 ([a])	**1 306**	**772**	**551**	**441**	**374**	**357**	**347**	**336**	**– 74%**	**– 3.0%**	**100%**	**100%**
EU-28 ([b])	1 296	762	541	431	374	357	347	336				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

2.17 Copper (Cu) emission trends

Between 1990 and 2012, Cu emissions in the EU-28 dropped by 4.6%. Between 2012 and 2013, emissions decreased by 1.2%, mainly due to reduced emissions from Spain, Slovakia and the Czech Republic (see Table 2.18). The Member State that contributed most (i.e. more than 10%) to Cu emissions in 2013 was Germany. It should be noted that Greece only reported an emission value once (for 1996), which has been used to gap-fill the years up to 2005. Likewise, Luxembourg once reported a notation key NR for Cu emissions, which was used to gap-fill all missing years. Austria and Slovenia did not provide emission data for Cu. Therefore, the EU-28 total is underestimated.

Table 2.18 Member State contributions to EU Cu emissions (Mg)

	Cu (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	40	40	39	37	35	34	33	31	– 22%	– 4.8%	1.1%	0.9%
Bulgaria	103	74	56	97	19	20	20	19	– 82%	– 3.8%	2.8%	0.5%
Croatia	9	6	7	7	8	7	7	7	– 14%	2.8%	0.2%	0.2%
Cyprus	1	2	2	2	2	2	2	2	47%	– 12.7%	0.0%	0.1%
Czech Republic	24	20	17	20	24	18	17	7	– 71%	– 60.7%	0.6%	0.2%
Denmark	33	37	40	43	44	44	43	43	30%	0.1%	0.9%	1.2%
Estonia	10	5	4	5	5	5	5	5	– 50%	6.1%	0.3%	0.1%
Finland	157	89	78	60	63	58	57	57	– 64%	– 0.1%	4.2%	1.6%
France	249	244	246	248	243	245	242	247	– 1%	2.2%	6.7%	7.0%
Germany	1 747	1 858	2 036	2 055	2 113	2 154	2 138	2 153	23%	0.7%	46.9%	60.6%
Greece	14	14	14	14							0.4%	
Hungary	25	15	14	14	24	23	20	18	– 26%	– 8.8%	0.7%	0.5%
Ireland	10	11	18	21	18	18	17	18	82%	2.1%	0.3%	0.5%
Italy	137	148	144	150	135	138	128	121	– 11%	– 5.4%	3.7%	3.4%
Latvia	5	4	4	5	5	5	5	1	– 86%	– 84.8%	0.1%	0.0%
Lithuania	10	5	4	5	6	6	6	6	– 39%	0.3%	0.3%	0.2%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	1	1	1	1	27	27	27	27	4 598%	0.0%	0.0%	0.8%
Netherlands	37	39	40	42	46	44	43	43	15%	– 1.3%	1.0%	1.2%
Poland	599	385	332	379	369	363	348	351	– 41%	0.9%	16.1%	9.9%
Portugal	22	27	36	37	34	31	30	30	38%	– 1.1%	0.6%	0.8%
Romania	18	21	25	28	26	26	27	20	11%	– 27.2%	0.5%	0.6%
Slovakia	102	49	23	39	47	56	51	39	– 62%	– 24.9%	2.7%	1.1%
Slovenia	NR	NR	NR	NR	NR	NR	NR	NR				
Spain	130	153	222	243	223	215	223	203	56%	– 9.0%	3.5%	5.7%
Sweden	98	83	73	49	51	52	51	50	– 48%	– 0.5%	2.6%	1.4%
United Kingdom	146	112	87	70	59	62	57	57	– 61%	– 0.2%	3.9%	1.6%
EU-28 ([a])	**3 725**	**3 441**	**3 561**	**3 672**	**3 625**	**3 654**	**3 598**	**3 555**	**– 4.6%**	**– 1.2%**	**100%**	**100%**
EU-28 ([b])	3 711	3 427	3 547	3 658	3 625	3 654	3 598	3 555				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

2.18 Nickel (Ni) emission trends

Between 1990 and 2013, Ni emissions in the EU-28 dropped by 71%. Between 2012 and 2013, emissions decreased by 2%, mainly due to reductions reported in Spain, France, Italy, Cyprus and Romania (see Table 2.19). The Member States that contributed most (i.e. more than 10%) to Ni emissions in 2013 were Poland, the United Kingdom, Spain and Germany. It should be noted that Greece only reported an emission value once (for 1996), which that has been used to gap-fill the years up to 2005. Likewise, Luxembourg once reported a notation key NR for Ni emissions, which was used to gap-fill all missing years. Austria and Slovenia did not provide emission data for Ni. Therefore, the EU-28 total is underestimated.

In Bulgaria, Ni emissions in 2000 were much lower than in the years before and after, due to the decrease of Ni emissions from primary Cu production (comment received from Bulgaria in 2012).

Table 2.19 Member State contributions to EU Ni emissions (Mg)

	Ni (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	74	69	35	28	12	11	8	7	– 91%	– 18.9%	3.0%	1.0%
Bulgaria	29	23	8	23	5	6	5	5	– 84%	– 3.3%	1.2%	0.6%
Croatia	30	33	20	22	15	13	11	8	– 75%	– 29.9%	1.2%	1.1%
Cyprus	6	8	11	12	7	9	10	5	– 16%	– 44.8%	0.3%	0.8%
Czech Republic	27	19	16	17	13	11	9	8	– 71%	– 14.6%	1.1%	1.1%
Denmark	21	16	9	8	5	5	4	4	– 80%	– 5.9%	0.9%	0.6%
Estonia	27	10	6	6	7	6	6	6	– 76%	15.2%	1.1%	0.9%
Finland	63	34	34	27	22	20	19	16	– 74%	– 12.8%	2.6%	2.3%
France	287	220	183	144	86	74	61	52	– 82%	– 15.4%	11.8%	7.4%
Germany	282	164	122	136	111	99	96	95	– 66%	– 1.2%	11.6%	13.7%
Greece	101	101	101	101							4.1%	
Hungary	24	35	26	5	4	4	4	3	– 87%	– 10.4%	1.0%	0.5%
Ireland	8	11	16	10	2	1	2	1	– 82%	– 5.6%	0.3%	0.2%
Italy	121	112	103	109	38	37	33	30	– 76%	– 11.1%	5.0%	4.3%
Latvia	9	6	2	1	1	0	0	0	– 97%	– 23.2%	0.4%	0.0%
Lithuania	30	17	9	8	4	4	5	2	– 93%	– 54.0%	1.2%	0.3%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	8	13	17	21	6	1	1	1	– 91%	0.0%	0.3%	0.1%
Netherlands	75	87	19	11	2	2	2	2	– 97%	– 2.3%	3.1%	0.3%
Poland	370	242	166	167	176	162	148	148	– 60%	– 0.3%	15.2%	21.2%
Portugal	106	109	97	90	40	33	28	27	– 75%	– 5.4%	4.4%	3.9%
Romania	67	51	36	21	8	9	8	5	– 93%	– 35.3%	2.7%	0.7%
Slovakia	72	33	23	23	19	18	17	17	– 76%	– 0.1%	3.0%	2.5%
Slovenia	NR	NR	NR	NR	NR	NR	NR	NR				
Spain	264	325	303	288	170	149	138	115	– 56%	– 16.7%	10.8%	16.6%
Sweden	32	33	20	19	18	13	12	10	– 68%	– 12.4%	1.3%	1.5%
United Kingdom	299	311	170	137	81	64	84	129	– 57%	53.8%	12.3%	18.5%
EU-28 ([a])	**2 434**	**2 081**	**1 550**	**1 433**	**853**	**752**	**711**	**697**	**– 71%**	**– 2.0%**	**100%**	**100%**
EU-28 ([b])	2 333	1 980	1 449	1 332	853	752	711	697				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

2.19 Selenium (Se) emission trends

Between 1990 and 2013, Se emissions in the EU-28 dropped by 22%. Between 2012 and 2013, emissions decreased by 7.9%, mainly due to reduced emissions in Romania, Spain and the United Kingdom (see Table 2.20). The Member States that contributed most (i.e. more than 10%) to Se emissions in 2013 were Spain, Portugal and the United Kingdom. It should be noted that Greece only reported an emission value once (for 1996), which has been used to gap-fill the years up to 2005. Likewise, Luxembourg once reported a notation key NR for Se emissions, which was used to gap-fill all missing years. Austria, Slovenia and Poland did not provide emission data for Se. Therefore, the EU-28 total is underestimated.

The high emissions in 2005 of Se in Belgium in the category '1A2f — Stationary combustion in manufacturing industries and construction: Non-metallic minerals' is caused by one glass plant in Wallonia. The plant gives these annual emissions based on measurements, and the concentration of Se was very high in 2005 (comment received from Belgium in 2014). Also, the high emissions in 2010 in Belgium are mainly attributable to operations of a particular company in the glass industry in Wallonia (comment received from Belgium in 2012).

Table 2.20 Member State contributions to EU Se emissions (Mg)

	Se (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	5	6	6	27	11	4	3	4	– 29%	8.0%	1.9%	1.7%
Bulgaria	41	12	5	13	14	16	15	16	– 61%	6.9%	15.8%	7.9%
Croatia	0	0	0	0	0	0	0	0	– 30%	2.8%	0.2%	0.2%
Cyprus	0	0	0	0	0	0	0	0	– 2%	– 42.7%	0.0%	0.0%
Czech Republic	8	8	8	9	8	8	8	7	– 12%	– 11.0%	3.2%	3.6%
Denmark	5	4	3	2	2	1	1	1	– 69%	20.1%	1.9%	0.7%
Estonia	0	0	0	0	0	0	0	0	– 23%	– 5.2%	0.0%	0.0%
Finland	0	0	0	0	1	0	0	0	7 218%	– 46.0%	0.0%	0.0%
France	15	15	15	15	12	12	12	11	– 26%	– 2.6%	5.8%	5.5%
Germany	4	4	4	4	4	4	4	4	1%	– 0.8%	1.3%	1.7%
Greece	0	0	0	0							0.1%	
Hungary	6	6	6	4	3	4	4	3	– 47%	– 2.4%	2.5%	1.7%
Ireland	2	3	2	2	1	1	2	2	– 33%	– 12.8%	0.9%	0.8%
Italy	9	10	11	12	11	11	11	10	7%	– 5.9%	3.6%	4.9%
Latvia	0	0	0	0	0	0	0	0	– 82%	– 11.4%	0.1%	0.0%
Lithuania	0	0	0	0	0	0	0	0	– 53%	– 13.5%	0.1%	0.1%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	0	0	0	0	0	0	2	0	4 958%	– 95.7%	0.0%	0.0%
Netherlands	0	0	0	3	2	1	1	0	28%	– 37.3%	0.1%	0.2%
Poland	NE	NE	NE	NE	NE	NE	NE	NE				
Portugal	12	17	23	27	30	30	32	32	159%	0.3%	4.7%	15.5%
Romania	14	14	14	13	12	14	12	9	– 35%	– 20.6%	5.4%	4.5%
Slovakia	9	9	7	9	11	11	11	9	4%	– 17.1%	3.4%	4.5%
Slovenia	NR	NR	NR	NR	NR	NR	NR	NR				
Spain	50	57	75	84	71	73	71	66	33%	– 7.2%	19.1%	32.5%
Sweden	1	1	1	1	1	1	1	1	13%	– 1.5%	0.2%	0.3%
United Kingdom	77	49	33	37	27	29	33	28	– 64%	– 15.7%	29.6%	13.5%
EU-28 (a)	**260**	**217**	**215**	**262**	**222**	**220**	**221**	**204**	**– 22%**	**– 7.9%**	**100%**	**100%**
EU-28 (b)	260	216	214	262	222	220	221	204				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

2.20 Zinc (Zn) emission trends

Between 1990 and 2013, Zn emissions in the EU-28 dropped by 42%. Between 2012 and 2013, emissions decreased by 0.8%, mainly due to decreased emissions reported in Italy, Czech Republic and Spain (see Table 2.21). The Member States that contributed most (i.e. more than 10%) to Zn emissions in 2013 were Germany, Poland and Italy. It should be noted that Greece only reported an emission value once (for 1996), which has been used to gap-fill the years up to 2005. Likewise, Luxembourg once reported a notation key NR for Zn emissions, which was used to gap-fill all missing years. Austria and Slovenia did not provide emission data for Zn. Therefore, the EU-28 total is underestimated.

Ireland explained the emission decline between the year 2000 and after with the closure of Ireland's only steel plant in 2001. From 1990 to 2001, the main determinant of the trend in Zn emissions was metal production (2C), accounting on average for 52.6% of national total emissions throughout that period (Appendix 5, Ireland's IIR).

Table 2.21 Member State contributions to EU Zn emissions (Mg)

	Zn (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	234	189	183	131	110	104	89	81	– 65%	– 8.9%	2.0%	1.2%
Bulgaria	222	153	292	175	120	134	125	125	– 44%	0.3%	1.9%	1.8%
Croatia	27	15	17	17	18	19	19	18	– 31%	– 2.0%	0.2%	0.3%
Cyprus	4	5	6	7	5	6	6	4	13%	– 25.6%	0.0%	0.1%
Czech Republic	395	283	184	166	114	85	99	62	– 84%	– 36.7%	3.3%	0.9%
Denmark	69	63	54	58	62	59	56	56	– 19%	– 0.3%	0.6%	0.8%
Estonia	107	64	50	53	63	61	55	63	– 41%	13.7%	0.9%	0.9%
Finland	591	342	91	135	161	133	140	134	– 77%	– 4.2%	4.9%	2.0%
France	2 227	1 423	1 014	581	515	505	516	501	– 78%	– 3.0%	18.6%	7.3%
Germany	1 725	1 729	1 894	1 899	1 968	1 995	1 979	1 997	16%	0.9%	14.4%	29.0%
Greece	52	52	52	52							0.4%	
Hungary	85	62	54	37	40	43	45	39	– 54%	– 13.6%	0.7%	0.6%
Ireland	49	49	55	26	21	19	19	20	– 60%	1.7%	0.4%	0.3%
Italy	960	947	910	983	905	973	929	881	– 8%	– 5.2%	8.0%	12.8%
Latvia	25	26	22	27	25	25	28	25	– 2%	– 9.9%	0.2%	0.4%
Lithuania	26	18	17	19	19	19	19	18	– 31%	– 5.3%	0.2%	0.3%
Luxembourg	NR	NR	NR	NR	NR	NR	NR	NR				
Malta	0	1	1	1	10	11	9	10	2 425%	19.1%	0.0%	0.1%
Netherlands	224	146	95	88	110	102	107	99	– 56%	– 7.3%	1.9%	1.4%
Poland	3 092	1 948	1 423	1 543	1 645	1 599	1 545	1 588	– 49%	2.8%	25.9%	23.1%
Portugal	70	76	92	95	90	93	92	91	30%	– 1.6%	0.6%	1.3%
Romania	143	135	134	134	122	115	117	115	– 20%	– 1.8%	1.2%	1.7%
Slovakia	105	68	68	65	57	58	60	63	– 40%	4.0%	0.9%	0.9%
Slovenia	NR	NR	NR	NR	NR	NR	NR	NR				
Spain	260	292	376	413	388	394	342	322	24%	– 5.8%	2.2%	4.7%
Sweden	200	159	120	141	173	157	160	157	– 21%	– 1.8%	1.7%	2.3%
United Kingdom	1 058	1 020	690	493	427	410	377	407	– 62%	7.7%	8.9%	5.9%
EU-28 ([a])	**11 951**	**9 264**	**7 893**	**7 339**	**7 166**	**7 118**	**6 933**	**6 876**	**– 42%**	**– 0.8%**	**100%**	**100%**
EU-28 ([b])	11 899	9 212	7 841	7 287	7 166	7 118	6 933	6 876				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

2.21 Dioxin and furan (PCDD/F) emission trends and key categories

Between 1990 and 2013, PCDD/F emissions dropped in the EU-28 by 84%. Between 2012 and 2013, the increase was4.5% (see Table 2.22), mainly due to increased emissions reported in Italy, Portugal and the United Kingdom. The Member States that contributed most (i.e. more than 10%) to PCDD/F emissions in 2013 were Italy, Poland, the United Kingdom and Romania. Greece did not report PCDD/F emissions for any year, and thus data were not gap-filled. The EU-28 total is therefore underestimated.

The decrease of dioxin emissions in France (1990–2012) is due to regulations limiting emissions, especially in the field of waste incineration, industrial energy processes (steel and metallurgy) and combustion in manufacturing (Appendix 5, France's IIR). The drop in dioxin emissions between 1995 and 2000 is due to improvements in sinter plants (comment received from France in 2013).

Table 2.22 Member State contributions to EU PCDD/F emissions (g I-TEQ)

	PCDD/Fs (g I-TEQ)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	161	58	52	42	40	35	38	38	– 77%	– 0.8%	1.3%	2.0%
Belgium	577	399	117	61	53	44	50	43	– 93%	– 13.9%	4.8%	2.3%
Bulgaria	74	96	112	113	45	53	60	62	– 16%	3.5%	0.6%	3.3%
Croatia	35	22	23	22	19	21	22	21	– 41%	– 6.6%	0.3%	1.1%
Cyprus	2	2	3	0	0	0	0	0	– 83%	– 13.3%	0.0%	0.0%
Czech Republic	1 252	1 135	744	179	129	104	45	25	– 98%	– 43.6%	10.4%	1.4%
Denmark	67	49	32	26	26	24	23	22	– 68%	– 4.1%	0.6%	1.2%
Estonia	9	6	7	6	6	6	5	3	– 60%	– 23.5%	0.1%	0.2%
Finland	34	37	34	12	15	13	14	12	– 64%	– 10.8%	0.3%	0.7%
France	1 776	1 717	551	231	136	128	115	119	– 93%	3.2%	14.7%	6.3%
Germany	750	231	153	70	71	68	65	65	– 91%	– 0.2%	6.2%	3.5%
Greece												
Hungary	113	70	59	44	51	54	52	47	– 59%	– 11.1%	0.9%	2.5%
Ireland	66	49	40	39	31	30	29	30	– 54%	4.0%	0.5%	1.6%
Italy	461	447	366	287	226	233	222	272	– 41%	22.4%	3.8%	14.5%
Latvia	32	33	31	36	26	46	45	51	59%	13.4%	0.3%	2.8%
Lithuania	22	13	14	16	18	18	17	17	– 21%	– 0.2%	0.2%	0.9%
Luxembourg	13	13	5	1	2	2	1	1	– 93%	– 1.8%	0.1%	0.1%
Malta	1	1	1	1	9	1	1	12	1 051%	1 019.4%	0.0%	0.6%
Netherlands	742	66	31	29	31	31	25	25	– 97%	1.2%	6.2%	1.3%
Poland	529	283	190	190	222	219	221	237	– 55%	7.3%	4.4%	12.7%
Portugal	525	524	329	126	202	184	102	132	– 75%	29.2%	4.4%	7.1%
Romania	3 073	2 063	1 053	210	203	212	219	205	– 93%	– 6.7%	25.5%	10.9%
Slovakia	169	150	107	91	63	47	51	47	– 72%	– 8.1%	1.4%	2.5%
Slovenia	16	12	11	10	10	11	11	11	– 32%	0.3%	0.1%	0.6%
Spain	181	157	126	117	119	122	116	115	– 36%	– 0.8%	1.5%	6.2%
Sweden	60	40	33	39	42	38	38	38	– 36%	2.3%	0.5%	2.1%
United Kingdom	1 303	840	316	247	218	203	204	221	– 83%	8.6%	10.8%	11.8%
EU-28 ([a])	**12 041**	**8 514**	**4 540**	**2 245**	**2 014**	**1 948**	**1 791**	**1 871**	**– 84%**	**4.5%**	**100%**	**100%**
EU-28 ([b])	12 041	8 514	4 540	2 244	2 014	1 948	1 791	1 871				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors: differences arise when only National Totals and no sectoral data are available.

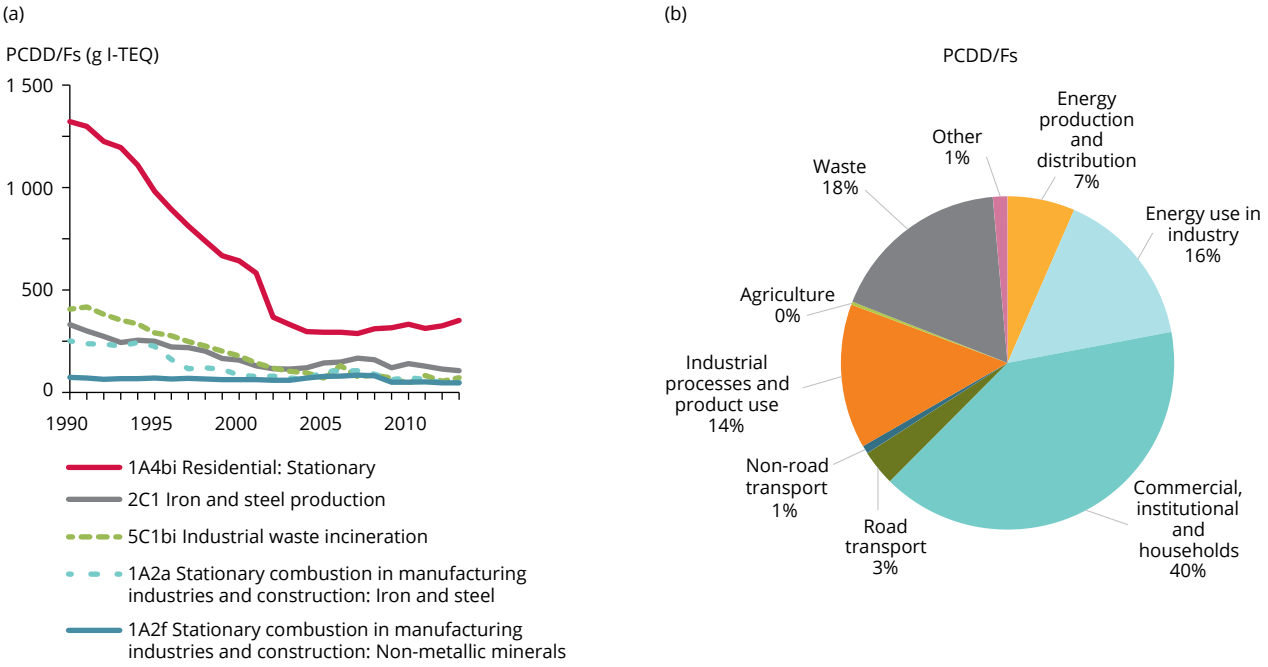
Latvia explained that dioxin emissions increased since 2010, mainly due to high temperatures in winter. The dioxin emissions rise is attributed to the crisis in the national economy and the implemented measures to address the financial problems in the country (Appendix 5, Latvia's IIR).

'1A4bi — Residential: Stationary' and '2C1 — Iron and steel production' were the primary key categories for PCDD/F emissions, together making up 49% of total PCDD/F emissions (see Figure 2.15(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the third most important key category, '5C1bi Industrial waste incineration' (− 82.4%). The fourth most important key category, '1A2a — Stationary comb. in manuf. ind. and constr.: Iron and steel'(− 81%), also saw high reductions.

The steep drop of dioxin in the category '1A4bi — Residential: Stationary' between 2001 and 2002 is caused by data reported from the Czech Republic. In 2002, a new set of emission factors was used, based on the measurements results for the new POP emission inventories. Recalculation of the emission factors is planned (comment received from the Czech Republic in 2013).

Figure 2.15(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. The 'Commercial, institutional and households' sector group is an important source of PCDD/Fs, and also of $PM_{2.5}$, PM_{10}, total PAHs and PCBs.

Figure 2.15 PCDD/F emissions in the EU-28: (a) trend in PCDD/F emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



2.22 Total polycyclic aromatic hydrocarbon (PAH) emission trends and key categories

Between 1990 and 2013, total PAH emissions dropped in the EU-28 by 62%. Between 2012 and 2013, they increased by 3.4%, mainly a result of increased emissions reported in Italy, Poland and the Czech Republic (see Table 2.23). The Member States that contributed most (i.e. more than 10%) to total PAH emissions in 2013 were Germany, Spain, Poland and Portugal. Greece did not report PAH emissions for any year, and thus data were not gap-filled. The EU-28 total is therefore underestimated.

1A4bi — Residential: Stationary' was the principal key category for these emissions, making up 61% of total PAH emissions (see Figure 2.16(a)). Among

Table 2.23 Member State contributions to EU total PAH emissions (Mg)

	Total PAHs (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	17	9	8	9	8	7	8	8	– 56%	– 0.3%	0.6%	0.7%
Belgium	79	66	43	37	32	31	29	28	– 65%	– 3.3%	2.8%	2.6%
Bulgaria	50	66	57	55	29	32	32	30	– 39%	– 5.4%	1.8%	2.8%
Croatia	16	5	6	6	6	7	7	7	– 57%	– 2.4%	0.6%	0.6%
Cyprus	2	2	1	1	1	1	1	1	– 72%	– 7.9%	0.1%	0.1%
Czech Republic	752	1 357	488	24	17	19	19	24	– 97%	21.0%	27.1%	2.2%
Denmark	5	6	6	8	9	8	7	7	38%	– 3.9%	0.2%	0.7%
Estonia	10	10	9	8	8	7	7	7	– 25%	– 0.1%	0.3%	0.7%
Finland	16	17	14	13	18	16	17	16	2%	– 4.3%	0.6%	1.5%
France	43	41	32	25	21	18	19	20	– 54%	3.3%	1.5%	1.9%
Germany	378	165	158	146	208	179	170	172	– 54%	1.7%	13.6%	16.2%
Greece												
Hungary	85	33	19	19	17	19	18	17	– 79%	– 1.7%	3.1%	1.6%
Ireland	54	41	36	39	39	34	32	33	– 39%	3.6%	1.9%	3.1%
Italy	81	86	54	59	60	62	63	86	6%	36.6%	2.9%	8.1%
Latvia	18	17	17	14	12	12	12	11	– 38%	– 9.1%	0.7%	1.1%
Lithuania	19	9	9	10	12	12	11	11	– 41%	– 3.0%	0.7%	1.0%
Luxembourg	5	3	1	1	1	1	0	1	– 89%	12.2%	0.2%	0.0%
Malta	0	0	0	0	0	0	0	0	5 775%	17.1%	0.0%	0.0%
Netherlands	20	10	5	5	5	5	5	5	– 77%	0.5%	0.7%	0.4%
Poland	159	211	148	156	148	143	144	155	– 3%	7.5%	5.7%	14.6%
Portugal	155	147	146	117	111	116	117	120	– 23%	2.4%	5.6%	11.2%
Romania	274	182	91	88	87	84	83	79	– 71%	– 4.6%	9.9%	7.4%
Slovakia	29	15	13	19	18	19	19	20	– 33%	2.4%	1.0%	1.8%
Slovenia	16	15	14	12	12	13	13	13	– 17%	– 0.9%	0.6%	1.2%
Spain	273	258	226	175	223	233	172	171	– 37%	– 0.7%	9.8%	16.1%
Sweden	17	16	14	18	13	12	12	11	– 33%	– 4.4%	0.6%	1.0%
United Kingdom	205	92	15	10	10	9	10	11	– 95%	8.0%	7.4%	1.0%
EU-28 (a)	**2 776**	**2 881**	**1 632**	**1 076**	**1 125**	**1 097**	**1 028**	**1 063**	**– 62%**	**3.4%**	**100%**	**100%**
EU-28 (b)	2 776	2 881	1 632	1 076	1 125	1 097	1 028	1 063				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

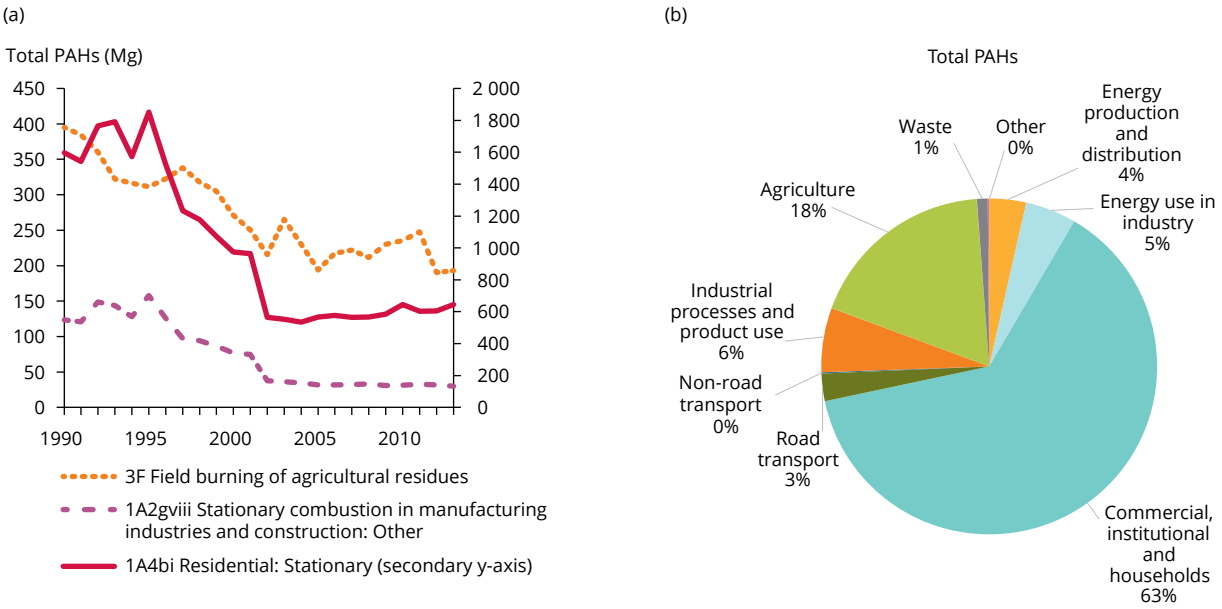
(b) Sum of sectors.

the key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the third most important key category, '1A2gviii — Stationary combustion in manufacturing industries and construction: Other' (− 75.9%).

Emissions from these sources have declined overall since 1990, thanks to less residential use of coal, improvements in abatement technologies for metal refining and smelting, and stricter regulations on emissions from the 'Road transport' sector (EEA, 2015b).

Figure 2.16(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. The 'Commercial, institutional and households' sector group is a very important source of total PAHs, as well as of $PM_{2.5}$, PM_{10}, PCDD/Fs, and PCBs.

Figure 2.16 Total PAH emissions in the EU-28: (a) trend in total PAH emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



Note: In Figure 2.16(a) values for '1A4bi — Residential: Stationary' are given in the secondary axis.

2.23 Benzo(a)pyrene (B(a)P) emission trends and key categories

Between 1990 and 2013, B(a)P emissions in the EU-28 dropped by 54%. Between 2012 and 2013, they increased by 3.8%, mainly due to increased emissions in the Czech Republic, Poland, Germany and Portugal (see Table 2.24). The Member States that contributed most (i.e. more than 10%) to B(a)P emissions in 2013 were Poland, Germany, Portugal and Romania. Several Member States did not provide data for B(a)P, and in several cases, these gaps could not be filled with data. The EU-28 total is therefore underestimated.

Table 2.24 Member State contributions to EU B(a)P emissions (Mg)

	Benzo(a)pyrene (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	NE	NE	NE	NE	NE	NE	NE	NE				
Bulgaria	8	6	7	8	8	9	9	8	6%	– 5.7%	1.9%	4.4%
Croatia	5	2	2	2	2	2	2	2	– 49%	– 0.5%	1.1%	1.3%
Cyprus	0	0	0	0	0	0	0	0	– 67%	– 8.0%	0.1%	0.1%
Czech Republic	11	10	9	8	5	5	6	10	– 9%	79.2%	2.6%	5.1%
Denmark	2	2	2	3	3	3	2	2	42%	– 4.7%	0.4%	1.2%
Estonia	3	3	2	2	2	2	2	2	– 23%	2.4%	0.7%	1.1%
Finland	IE	IE	IE	IE	IE	IE	IE	IE				
France	12	12	9	7	6	5	5	5	– 55%	3.6%	2.9%	2.8%
Germany	139	48	31	23	34	30	28	28	– 80%	2.2%	33.1%	14.6%
Greece												
Hungary	27	10	6	6	5	6	6	6	– 79%	– 2.3%	6.5%	2.9%
Ireland	15	11	9	10	10	8	8	8	– 45%	4.2%	3.6%	4.2%
Italy	NE	NE	NE	NE	NE	NE	NE	NE				
Latvia	6	6	6	5	4	4	4	4	– 38%	– 11.1%	1.5%	1.9%
Lithuania	6	3	3	3	4	4	4	4	– 34%	– 3.0%	1.3%	1.9%
Luxembourg	1	1	0	0	0	0	0	0	– 89%	16.4%	0.3%	0.1%
Malta	0	0	0	0	0	0	0	0	– 23%	0.0%	0.0%	0.0%
Netherlands	12	7	2	2	2	2	2	2	– 87%	0.9%	3.0%	0.8%
Poland	63	49	36	38	45	43	44	46	– 27%	5.9%	15.1%	23.8%
Portugal	26	26	27	22	20	23	23	24	– 8%	5.0%	6.3%	12.5%
Romania	8	11	14	26	27	26	26	24	213%	– 4.8%	1.9%	12.6%
Slovakia	3	3	4	5	5	5	5	6	82%	4.0%	0.7%	2.9%
Slovenia	5	4	4	4	4	4	4	4	– 18%	– 0.9%	1.1%	2.0%
Spain	IE	IE	IE	IE	IE	IE	IE	IE				
Sweden	5	5	4	6	4	4	4	4	– 31%	– 4.4%	1.2%	1.9%
United Kingdom	61	22	5	3	4	3	4	4	– 93%	7.9%	14.7%	2.1%
EU-28 ([a])	**419**	**240**	**182**	**183**	**194**	**188**	**187**	**194**	**– 54%**	**3.8%**	**100%**	**100%**
EU-28 ([b])	419	240	182	183	194	188	187	194				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

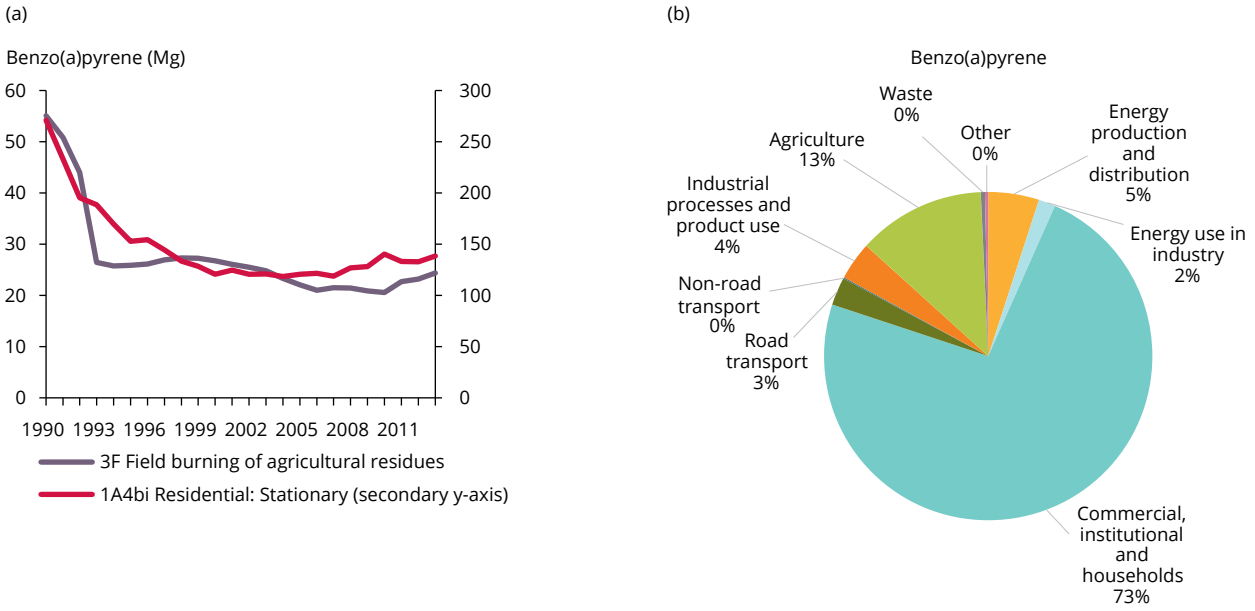
([a]) Sum of National Totals as reported by Member States.

([b]) Sum of sectors.

'1A4bi — Residential: Stationary' was the principal key category for B(a)P emissions, accounting for 71% of total B(a)P emissions. The highest relative reductions in emissions between 1990 and 2013 were achieved in the second most important key category, '3F — Field burning of agricultural residues' (− 55.7%) and the most important key category, '1A4bi — Residential: Stationary' (− 48.9%) (see Figure 2.17(a)).

Figure 2.17(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For B(a)P, the common chief emission source is 'Commercial, institutional and households'.

Figure 2.17 B(a)P emissions in the EU-28: (a) trend in B(a)P emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



Note: In Figure 2.17(a), values for '1A4bi — Residential: Stationary' are provided in the secondary axis.

2.24 Benzo(b)fluoranthene (B(b)F) emission trends

Between 1990 and 2013, B(b)F emissions in the EU-28 decreased by 45%. Between 2012 and 2013, they decreased by 0.03%, mainly due to reduced emissions in the Czech Republic, Bulgaria and Romania (see Table 2.25). The Member States that contributed most (i.e. more than 10%) to B(b)F emissions in 2013 were Poland, Portugal, and Romania. Several Member States did not provide data for B(b)F, and in some cases, these gaps could not be filled with data. The EU-28 total is therefore underestimated.

Sweden explained that the marked decline of B(b)F emissions between 2008 and 2009 was due to a change in aluminium production (2C3). Aluminium production was a key source of PAH emissions in Sweden before 2009. Currently, primary aluminium production takes place in one facility, where historically both the prebaked and the Söderberg processes were used. All pot-lines operating the Söderberg technology were shut down by December 2008. Closing down the Söderberg ovens also ended the need for anode production in late 2008. For this reason, there was a pronounced decrease in PAH (B(b)F) emissions (comment received from Sweden in 2015).

Table 2.25 Member State contributions to EU B(b)F emissions (Mg)

	Benzo(b)fluoranthene (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	NE	NE	NE	NE	NE	NE	NE	NE				
Bulgaria	11	8	8	9	9	10	10	10	– 12%	– 6.8%	3.2%	5.1%
Croatia	6	2	2	2	2	2	2	2	– 61%	– 4.6%	1.6%	1.2%
Cyprus	1	1	1	0	0	0	0	0	– 79%	– 7.8%	0.3%	0.1%
Czech Republic	8	8	8	7	5	7	7	5	– 44%	– 29.8%	2.4%	2.5%
Denmark	2	2	2	3	3	3	3	2	47%	– 3.7%	0.5%	1.3%
Estonia	3	3	3	2	3	2	2	2	– 29%	– 1.7%	0.9%	1.2%
Finland	IE	IE	IE	IE	IE	IE	IE	IE				
France	14	14	10	8	7	6	6	6	– 55%	3.4%	4.2%	3.4%
Germany	3	1	1	1	1	1	1	1	– 60%	2.4%	0.9%	0.7%
Greece												
Hungary	32	12	7	7	6	7	6	6	– 81%	– 1.7%	9.4%	3.3%
Ireland	21	15	12	12	12	11	10	11	– 51%	4.5%	6.3%	5.6%
Italy	NE	NE	NE	NE	NE	NE	NE	NE				
Latvia	6	5	5	5	4	4	4	4	– 44%	– 11.2%	1.9%	1.9%
Lithuania	8	3	3	3	4	4	4	4	– 49%	– 2.6%	2.2%	2.1%
Luxembourg	1	1	0	0	0	0	0	0	– 87%	9.5%	0.4%	0.1%
Malta	0	0	0	0	0	0	0	0	– 31%	– 87.0%	0.0%	0.0%
Netherlands	15	7	2	2	2	2	1	1	– 90%	0.2%	4.5%	0.8%
Poland	66	52	38	40	44	43	44	47	– 29%	6.6%	19.2%	24.9%
Portugal	54	51	49	43	41	42	42	43	– 21%	2.0%	15.9%	22.9%
Romania	0	0	0	29	29	28	28	26	17 689%	– 4.8%	0.0%	14.1%
Slovakia	4	4	4	7	7	7	7	7	70%	1.9%	1.2%	3.8%
Slovenia	6	5	5	5	5	5	5	5	– 19%	– 0.8%	1.8%	2.6%
Spain	IE	IE	IE	IE	IE	IE	IE	IE				
Sweden	3	3	2	4	0	0	0	0	– 88%	– 3.8%	0.8%	0.2%
United Kingdom	76	39	4	3	3	3	4	4	– 95%	12.5%	22.3%	2.1%
EU-28 (a)	**342**	**237**	**168**	**193**	**187**	**187**	**187**	**187**	**– 45%**	**0.0%**	**100%**	**100%**
EU-28 (b)	342	237	168	193	187	187	187	187				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

2.25 Benzo(k)fluoranthene (B(k)F) emission trends

Between 1990 and 2013, B(k)F emissions in the EU-28 decreased by 56%. Between 2012 and 2013, they rose by 1.5%, mainly due to increased emissions in the Czech Republic, Poland and Portugal (see Table 2.26).

The Member States that contributed most (i.e. more than 10%) to B(k)F emissions in 2013 were Portugal, Romania and Poland. Several Member States did not provide data for B(k)F, and in several cases, these gaps could not be filled with data. The EU-28 total is therefore underestimated.

Table 2.26 Member State contributions to EU B(k)F emissions (Mg)

	Benzo(k)fluoranthene (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	NE	NE	NE	NE	NE	NE	NE	NE				
Bulgaria	5	4	4	5	5	5	5	5	12%	– 5.4%	2.3%	6.0%
Croatia	2	1	1	1	1	1	1	1	– 65%	– 4.0%	1.2%	1.0%
Cyprus	0	0	0	0	0	0	0	0	– 70%	– 7.4%	0.2%	0.2%
Czech Republic	3	3	3	3	2	3	3	4	23%	49.1%	1.7%	4.7%
Denmark	1	1	1	1	1	1	1	1	50%	– 4.2%	0.3%	1.1%
Estonia	2	2	2	1	1	1	1	1	– 26%	3.5%	0.9%	1.5%
Finland	IE	IE	IE	IE	IE	IE	IE	IE				
France	9	9	7	5	4	4	4	4	– 54%	2.9%	4.5%	4.7%
Germany	2	1	1	1	1	1	1	1	– 48%	2.4%	0.9%	1.1%
Greece												
Hungary	13	5	3	3	2	3	3	3	– 80%	– 2.0%	6.5%	3.0%
Ireland	9	7	6	7	7	6	5	6	– 36%	3.5%	4.4%	6.5%
Italy	NE	NE	NE	NE	NE	NE	NE	NE				
Latvia	3	2	2	2	1	2	2	1	– 47%	– 11.1%	1.3%	1.6%
Lithuania	3	1	1	1	2	2	2	2	– 49%	– 3.0%	1.5%	1.7%
Luxembourg	1	1	0	0	0	0	0	0	– 93%	10.2%	0.5%	0.1%
Malta	0	0	0	0	0	0	0	0	6%	– 89.5%	0.0%	0.0%
Netherlands	11	6	1	1	1	1	1	1	– 93%	0.6%	5.7%	0.9%
Poland	66	52	38	40	13	12	12	13	– 81%	3.3%	33.3%	14.8%
Portugal	27	25	24	20	20	21	21	22	– 18%	1.7%	13.5%	25.2%
Romania	0	0	0	18	17	17	16	16	16 718%	– 3.8%	0.0%	18.3%
Slovakia	2	2	2	3	3	3	3	3	65%	1.6%	0.9%	3.4%
Slovenia	2	2	2	2	2	2	2	2	– 20%	– 1.1%	1.1%	2.1%
Spain	IE	IE	IE	IE	IE	IE	IE	IE				
Sweden	0	0	0	0	0	0	0	0	– 22%	– 4.1%	0.1%	0.2%
United Kingdom	38	20	3	2	2	1	2	2	– 96%	8.9%	19.1%	2.0%
EU-28 (a)	**198**	**142**	**101**	**116**	**86**	**86**	**85**	**86**	**– 56%**	**1.5%**	**100%**	**100%**
EU-28 (b)	198	142	101	116	86	86	85	86				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

2.26 Indeno(1,2,3-cd)pyrene (IP) emission trends

Between 1990 and 2013, IP emissions in the EU-28 fell by 40%. Between 2012 and 2013, emissions rose by 3.7%, mainly due to increased emissions reported in Poland, Portugal and the Czech Republic (see Table 2.27). The Member States that contributed most (i.e. more than 10%) to IP emissions in 2013 were Poland, Portugal and Romania. Several Member States did not provide data for IP, and in some cases, these gaps could not be filled with data. The EU-28 total is therefore underestimated.

Table 2.27 Member State contributions to EU IP emissions (Mg)

	Indeno(1,2,3-cd)pyrene (Mg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	NE	NE	NE	NE	NE	NE	NE	NE				
Bulgaria	4	3	4	5	5	6	6	5	29%	– 4.7%	2.0%	4.3%
Croatia	2	1	1	1	1	1	1	1	– 44%	– 4.9%	1.1%	1.1%
Cyprus	0	0	0	0	0	0	0	0	– 65%	– 8.3%	0.2%	0.1%
Czech Republic	10	9	7	6	4	4	4	5	– 52%	8.7%	5.0%	4.0%
Denmark	1	1	1	2	2	2	2	1	15%	– 2.8%	0.6%	1.2%
Estonia	2	3	2	2	2	2	2	2	– 19%	– 3.5%	1.0%	1.3%
Finland	IE	IE	IE	IE	IE	IE	IE	IE				
France	8	7	6	5	4	3	4	4	– 52%	3.1%	3.7%	3.0%
Germany	1	1	1	1	1	1	1	1	– 46%	2.9%	0.6%	0.6%
Greece												
Hungary	13	5	3	3	3	3	3	3	– 75%	– 0.7%	6.2%	2.6%
Ireland	9	8	9	10	11	9	8	8	– 4%	2.0%	4.3%	7.0%
Italy	NE	NE	NE	NE	NE	NE	NE	NE				
Latvia	3	3	3	3	2	2	2	2	– 32%	– 12.0%	1.5%	1.7%
Lithuania	3	2	2	2	2	2	2	2	– 27%	– 3.7%	1.4%	1.7%
Luxembourg	1	1	0	0	0	0	0	0	– 90%	13.3%	0.5%	0.1%
Malta	0	0	0	0	0	0	0	0	– 16%	– 93.4%	0.0%	0.0%
Netherlands	10	5	1	1	1	1	1	1	– 92%	0.3%	4.9%	0.7%
Poland	82	59	37	39	47	44	45	50	– 39%	11.0%	40.0%	40.7%
Portugal	19	18	18	15	15	16	16	16	– 16%	2.6%	9.4%	13.3%
Romania	0	0	0	14	14	13	13	12	21 742%	– 5.0%	0.0%	10.2%
Slovakia	3	3	3	4	4	4	4	4	40%	1.4%	1.4%	3.3%
Slovenia	3	3	3	2	2	3	3	3	– 12%	– 0.9%	1.4%	2.1%
Spain	IE	IE	IE	IE	IE	IE	IE	IE				
Sweden	1	1	1	1	0	0	0	0	– 84%	– 3.7%	0.3%	0.1%
United Kingdom	29	12	2	1	1	1	1	1	– 96%	– 6.2%	14.3%	0.9%
EU-28 (a)	**204**	**145**	**105**	**116**	**122**	**117**	**118**	**122**	**– 40%**	**3.7%**	**100%**	**100%**
EU-28 (b)	204	145	105	116	122	117	118	122				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

2.27 Hexachlorobenzene (HCB) emission trends and key categories

Between 1990 and 2013, HCB emissions in the EU-28 fell by 96%. Between 2012 and 2013, the decrease was 4.7%, mainly due to reductions in Belgium, Bulgaria and Poland (see Table 2.28). The Member States that contributed most (i.e. more than 10%) to HCB emissions in 2013 were Austria, Finland, Italy and the United Kingdom. Greece did not report HCB emissions for any year, and thus data were not gap-filled. The EU-28 total is therefore underestimated.

The marked emissions drop in France between 1990 and 1995 is mainly due to a change in the emission factor from the activity of secondary aluminium fusion. Since 1994, this activity has used substitution products that no longer emit HCB. From 1990 to 1992, the emission factor was 5 g/Mg; it decreased by 50% in 1993, and has been null since 1994 (comment received from France in 2013).

Belgium stated that the jump in HCB emissions from 1990 to 1995 can be explained by (much) higher amounts of burned sludge. From 1999 to 2000, the

Table 2.28 Member State contributions to EU HCB emissions (kg)

	HCB (kg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	92	53	44	45	43	38	42	41	– 55%	– 0.8%	1.7%	20.9%
Belgium	98	218	73	28	27	40	29	14	– 86%	– 51.8%	1.8%	7.1%
Bulgaria	23	25	20	21	19	22	17	14	– 40%	– 16.6%	0.4%	7.0%
Croatia	0	0	0	0	0	0	0	0	– 18%	– 5.7%	0.0%	0.1%
Cyprus	0	0	0	0	0	0	0	0	– 86%	14.0%	0.0%	0.0%
Czech Republic	5	5	5	5	3	2	3	4	– 4%	50.7%	0.1%	2.2%
Denmark	27	8	6	4	3	3	3	3	– 90%	8.4%	0.5%	1.4%
Estonia	0	0	0	0	0	0	0	0	54%	1.6%	0.0%	0.1%
Finland	41	41	44	39	16	33	17	25	– 40%	45.4%	0.8%	12.5%
France	1 200	76	51	19	16	16	16	17	– 99%	2.7%	22.6%	8.5%
Germany	5	5	5	3	4	3	3	3	– 35%	1.8%	0.1%	1.8%
Greece												
Hungary	3	3	3	2	2	2	1	1	– 57%	– 13.2%	0.0%	0.6%
Ireland	41	41	1	2	2	2	2	2	– 96%	– 2.9%	0.8%	0.8%
Italy	43	38	24	21	14	16	22	22	– 49%	0.8%	0.8%	11.0%
Latvia	0	0	0	0	0	0	0	0	86%	11.2%	0.0%	0.2%
Lithuania	0	0	0	0	0	0	0	0	– 21%	– 50.3%	0.0%	0.1%
Luxembourg	0	0	1	1	1	1	0	0	– 7%	– 5.3%	0.0%	0.2%
Malta	0	0	0	0	0	0	0	0	3%	0.0%	0.0%	0.0%
Netherlands	45	1	2	2	2	2	3	3	– 94%	1.5%	0.9%	1.4%
Poland	62	10	9	10	13	13	14	13	– 79%	– 4.6%	1.2%	6.6%
Portugal	4	5	4	3	2	3	3	3	– 16%	7.6%	0.1%	1.6%
Romania	99	64	29	4	3	4	3	3	– 97%	– 11.2%	1.9%	1.5%
Slovakia	3	3	1	2	1	1	1	1	– 67%	– 10.7%	0.1%	0.5%
Slovenia	46	37	38	0	1	1	1	1	– 99%	0.3%	0.9%	0.3%
Spain	326	150	180	135	4	4	4	4	– 99%	– 3.4%	6.1%	1.9%
Sweden	0	0	0	0	0	0	0	0	– 39%	1.5%	0.0%	0.0%
United Kingdom	3 156	4 120	77	69	33	24	23	23	– 99%	– 0.9%	59.3%	11.7%
EU-28 (a)	**5 321**	**4 902**	**617**	**414**	**208**	**231**	**207**	**198**	**– 96%**	**– 4.7%**	**100%**	**100%**
EU-28 (b)	5 321	4 902	617	414	208	231	207	198				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

dip originates in a much lower emission factor (from 0.5 g/t to 0.002 g/t). Due to the introduction of a new methodology to estimate HCB emissions in 2013, values were only available for some years (1990, 1995, 2000 and all years from 2005 on). The methodology will be refined to estimate emissions in the intervening years; the increase during the period from 1995 to 1999 will remain, but will be less steep (comment received from Belgium in 2014).

France reported a pronounced decrease of HCB emissions between the years 1992 and 1994. This decrease is mainly due to the aluminium industry, where chlorine was used to refine aluminium by eliminating magnesium traces. Until the early 90s, hexachloroethane (HCE) was used as a core source, which resulted in HCB emissions. HCE was banned in 1993 for secondary aluminium refining. In the early 90s, this was the main HCB source within the national inventory. Since 1993, following this ban, the secondary aluminium industry no longer emits HCB (comment received from France in 2015).

Ireland reported a marked decrease of HCB emissions between the years 1996 and 1997. The only source of HCB is the secondary manufacturing of aluminium, for which the *EMEP/EEA Guidebook* indicates a factor of 5 g/t of aluminium. This factor has been used to estimate HCB emissions across the time series until use of the HCE-based cover gas was banned in 1996; emissions are reported as not occurring for the years following 1996 (Appendix 5, Ireland's IIR).

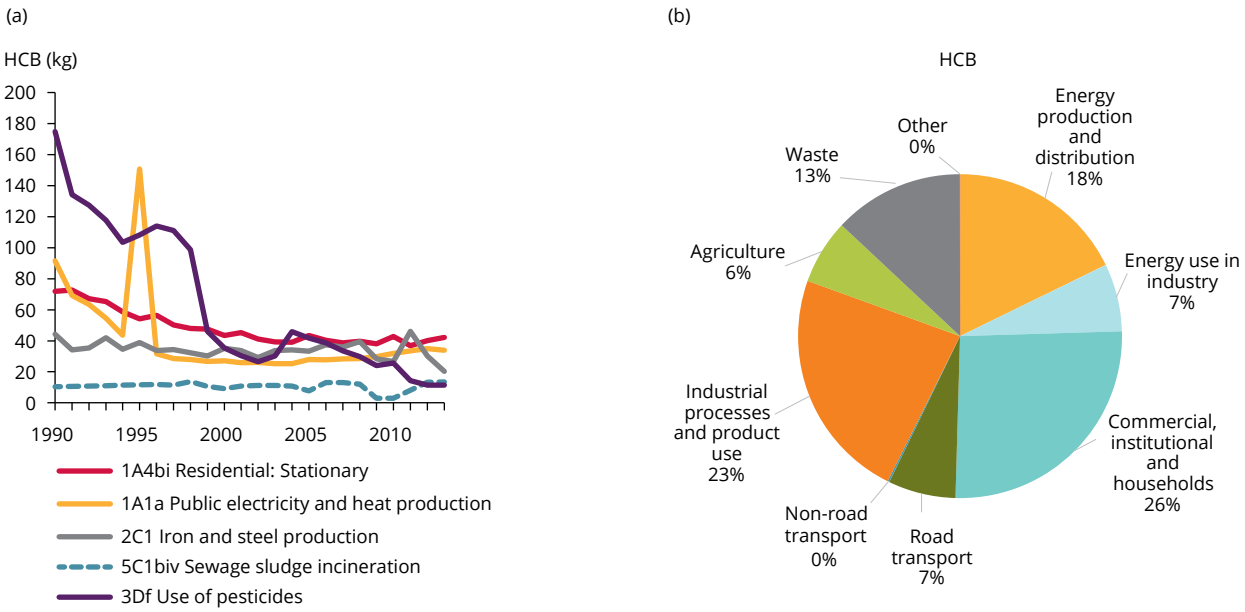
'1A4bi — Residential: Stationary', '1A1a — Public electricity and heat production' and '2C1 — Iron and steel production' were the chief key categories for HCB emissions, accounting for 49% of total HCB emissions (see Figure 2.18(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the fifth most important key category, '3Df — Use of pesticides' (− 93.4%), and in the second most important key category, '1A1a Public electricity and heat production' (− 62.8%).

The enormous emission peak from 1996 to 1999 in the category '5C1bi — Industrial waste incineration' and the peak in the category '1A1a — Public electricity and heat production' was caused by high emissions levels reported from Belgium.

Data reported from the United Kingdom are responsible for the emission decreases from 1998 to 2000 in the category '3Df — Use of pesticides'.

Figure 2.18(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For HCB, primary emission sources are the 'Commercial, institutional and households' and 'Industrial processes and product use' sector groups.

Figure 2.18 HCB emissions in the EU-28: (a) trend in HCB emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



2.28 Polychlorinated biphenyl (PCB) emission trends and key categories

Between 1990 and 2013, PCB emissions dropped in the EU-28 by 76%. Between 2012 and 2013, they increased by 6%, mainly due to increased emissions reported in Portugal and Poland (see Table 2.29). The Member States that contributed most (i.e. with a share higher than 10%) to the emissions of PCBs in 2012 were Poland, the United Kingdom, Croatia and Portugal. Austria reported the whole time-series of its PCB emissions as NA, and Greece did not report emissions for any year. The EU-28 total is therefore underestimated.

In Portugal, PCBs trends are related to category '5C1bi — Industrial waste incineration', which represents the main source of the national total emissions for this pollutant (99.9% in 2013). Pronounced increases in the years from 2003 through 2008 and low emissions values in 2010 and 2012 are related to the quantities of combusted industrial waste (Appendix 5, Portugal's IIR).

Table 2.29 Member State contributions to EU PCB emissions (kg)

	PCBs (kg)								Change		Share in EU-28	
Member State	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**1990–2013**	**2012–2013**	**1990**	**2013**
Austria	NA	NA	NA	NA	NA	NA	NA	NA				
Belgium	105	88	93	71	95	57	9	5	– 96%	– 48.3%	0.7%	0.1%
Bulgaria	6	5	4	4	4	5	5	5	– 25%	– 7.2%	0.0%	0.1%
Croatia	483	468	441	436	434	433	431	430	– 11%	– 0.1%	3.4%	12.4%
Cyprus	0	0	0	0	0	0	0	0	– 9%	27.7%	0.0%	0.0%
Czech Republic	773	623	474	82	24	26	34	3	– 100%	– 92.0%	5.4%	0.1%
Denmark	111	40	39	43	41	41	40	40	– 64%	– 0.7%	0.8%	1.2%
Estonia	8	4	3	4	4	4	3	4	– 53%	13.2%	0.1%	0.1%
Finland	321	293	228	181	156	157	154	152	– 53%	– 1.0%	2.3%	4.4%
France	184	160	107	76	61	55	58	57	– 69%	– 0.7%	1.3%	1.7%
Germany	1 680	1 484	948	194	233	243	232	233	– 86%	0.3%	11.8%	6.7%
Greece												
Hungary	36	19	16	15	12	13	12	7	– 79%	– 35.3%	0.3%	0.2%
Ireland	42	36	36	39	14	14	14	14	– 66%	4.0%	0.3%	0.4%
Italy	286	298	262	274	201	214	218	204	– 29%	– 6.1%	2.0%	5.9%
Latvia	4	1	0	1	1	1	1	0	– 89%	– 20.2%	0.0%	0.0%
Lithuania	374	365	351	333	311	304	300	297	– 21%	– 1.0%	2.6%	8.6%
Luxembourg	36	9	4	2	1	2	1	2	– 93%	79.9%	0.3%	0.1%
Malta	0	0	0	0	0	0	0	0	0%	0.0%	0.0%	0.0%
Netherlands	0	0	0	0	0	0	0	0	– 100%	0.0%	0.0%	0.0%
Poland	2 425	928	582	617	748	714	709	755	– 69%	6.5%	17.0%	21.8%
Portugal	63	69	83	374	172	644	178	411	555%	130.3%	0.4%	11.9%
Romania	135	87	39	182	52	42	31	29	– 79%	– 7.9%	0.9%	0.8%
Slovakia	67	40	31	33	33	32	34	33	– 51%	– 1.5%	0.5%	1.0%
Slovenia	416	290	213	136	77	59	56	53	– 87%	– 4.9%	2.9%	1.5%
Spain	24	36	33	37	33	31	27	27	11%	– 1.1%	0.2%	0.8%
Sweden	0	0	0	0	0	0	0	0	– 40%	1.7%	0.0%	0.0%
United Kingdom	6 667	4 971	1 345	1 067	781	760	726	706	– 89%	– 2.8%	46.8%	20.3%
EU-28 (a)	**14 247**	**10 315**	**5 334**	**4 201**	**3 490**	**3 851**	**3 272**	**3 468**	**– 76%**	**6.0%**	**100%**	**100%**
EU-28 (b)	14 247	10 315	5 334	4 201	3 490	3 851	3 272	3 468				

Note: Dark-grey shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by Member States.

Light-grey shaded cells denote gap-filled data. For more detailed information, see Annex D.

(a) Sum of National Totals as reported by Member States.

(b) Sum of sectors.

Ireland reported high PCB emissions for the year 2003 from the 'Waste' sector, due to an estimated increase in the quantity of household waste that remains unaccounted for in national statistics and which is assumed to be burned (Appendix 5, Ireland's IIR).

The much higher emission data of Belgium in the years 2010 and 2011 is explained by very high emissions for the sector '2A1 — Cement production' in 2010 and 2011, due to one operator in Wallonia. The emissions are directly calculated by the operators on the basis of PCB measurement at the stack (4 measurement/year). In 2010 and at the beginning of 2011, the PCB stack measurement in one plant were very high due to the use of an alternative raw material containing high concentrations of PCB. When the source of PCB was found at the end of 2011, the raw material was withdrawn and the PCB concentration at the stack returned to normal. (comment received from Belgium in 2014).

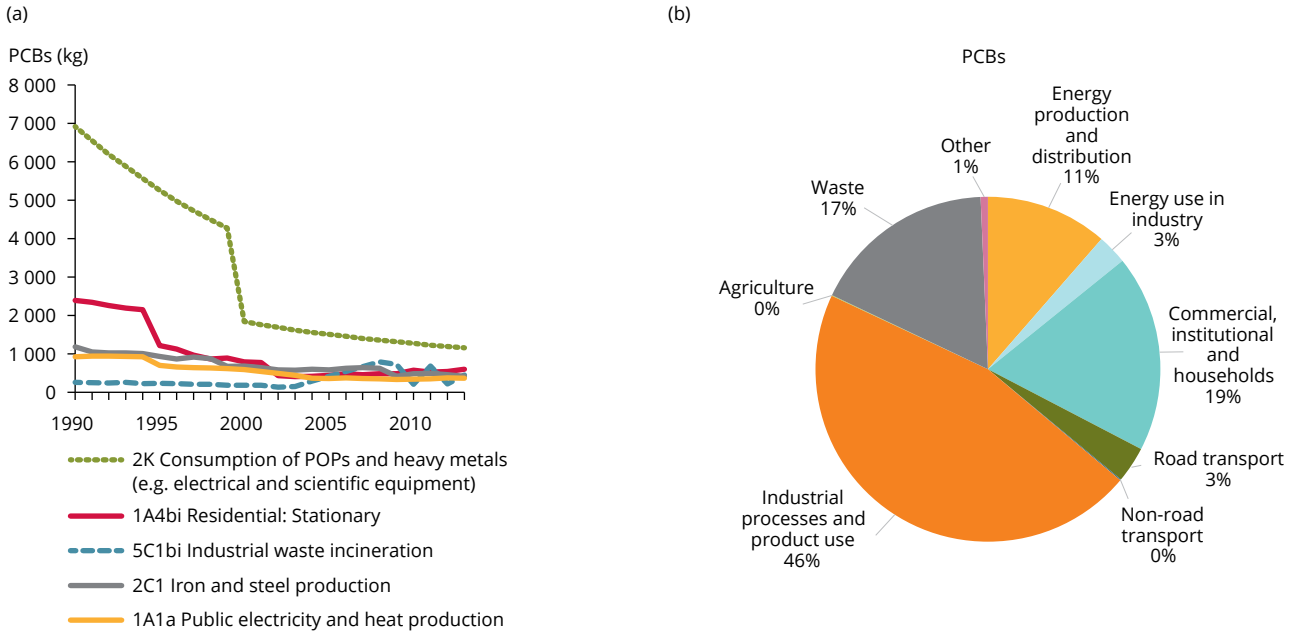
'2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' and '1A4bi — Residential: Stationary' were the chief key categories for PCB emissions, together making up 51% of total PCB emissions (see Figure 2.19(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2013 were achieved in the principal key category, '2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' (− 83.2%) (see Figure 2.19(a)).

The large decrease in emissions from '2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' between 1999 and 2000 is due to reductions reported by the United Kingdom. For this country, the key emission source for PCBs has historically been the use of PCBs as a heat-transfer fluid in dielectric equipment. Older equipment was subject to leakage during 'in-use' lifetime, and these leaks are where the United Kingdom provides estimates for emissions to air. The original estimates were based on assumed stockpiles of in-use equipment around 1990 (usage in new equipment was banned around 1986), after which the in-use equipment reached end of life, and was replaced by non-PCB alternatives. In terms of the year 2000 milestone, the EU set a target in 1996 (Directive 96/59/EC (EC, 1996)) to remove all dielectric equipment containing PCBs with a fill size > 5 kg to hazardous waste facilities. This accounts for a 90% decline in the stockpile and emissions. There is high uncertainty attached to these estimates (comment received from the United Kingdom in 2013).

The steep drop in emissions in the category '1A4bi — Residential: Stationary' from 1994 to 1995 is caused by differences between data reported from Poland in 2015 and gap-filled data.

Figure 2.19(b) shows the contribution to total EU-28 emissions made by the aggregated sector groups. For PCBs, common important emission sources are 'Industrial processes and product use', 'Waste' and the 'Commercial, institutional and households' sector group — as is the case for $PM_{2.5}$, PM_{10}, total PAHs, and PCDD/Fs.

Figure 2.19 PCB emissions from key categories in the EU-28: (a) trend in PCB emissions from the five most important key categories, 1990–2013; (b) share of emissions by sector group, 2013



3 Sectoral analysis and emission trends for key pollutants

Chapter 3 sets out emission trends and detailed methodologies of the key pollutants, aggregated into the following main sector groups:

- Energy production and distribution
- Energy use in industry
- Industrial processes and product use
- Commercial, institutional and households
- Road transport
- Non-road transport
- Agriculture
- Waste.

A conversion chart showing how each of the individual NFR source categories was included in each of the aggregated sector groups is provided in Appendix 4 of this report (see Table A4.1). Box 3.1 gives some general explanations relevant for the figures and tables shown in this chapter.

Box 3.1 Explanations with respect to figures and tables included in this chapter

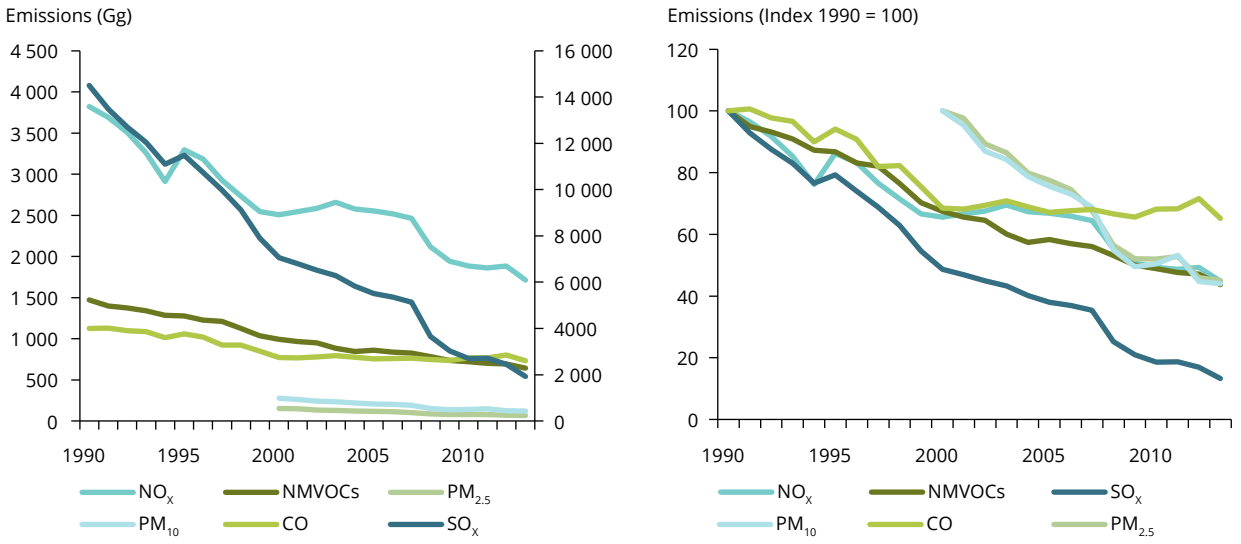
- Parties to the LRTAP Convention are formally requested to report emissions of PM for the year 2000 and after. Only data from year 2000 onwards are shown in the figures included in this chapter.
- The figures showing indexed values (in %) use 1990 as index year (1990 = 100%), with the exception of PM_{10} and $PM_{2.5}$ where the index year is 2000 (2000 = 100%).
- The abbreviations used in Tables 3.2 to 3.8 are defined as follows: CS = country specific; D = default value; PS = plant specific; T = tier method.
- Tables 3.2 to 3.8 only provide an indication of the methods used at the aggregated sector level; for details, the respective IIRs should be consulted. The level of detail in information on methods used varies widely across Member States.
- Member States that did not provide an IIR are not included in Tables 3.2 to 3.8.
- Grey font in the tables denotes IIRs submitted in years previous to 2013 (latest IIRs available included in the tables).

3.1 Sectoral analysis and emission trends for 'Energy production and distribution'

The 'Energy production and distribution' sector grouping comprises emissions from a number of activities that employ fuel combustion to produce energy products and electricity, for instance. It is a primary source of many pollutants, especially SO_X. Despite considerable past reductions, this sector group still contributes 56% of the total EU-28 emissions of this pollutant.

The sector is an important source of SO_X, Hg and NO_X. Poland, Germany and the United Kingdom contributed most (in absolute terms) to the emissions of SO_X in

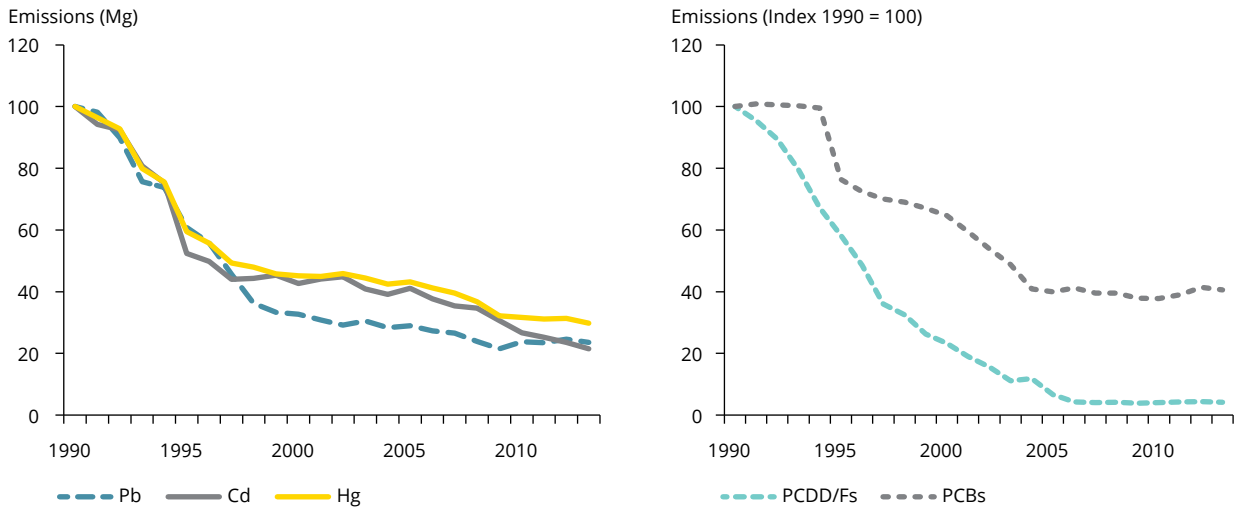
Figure 3.1 EU-28 emission trends in the sector 'Energy production and distribution' for NO_X, NMVOCs, SO_X and CO (in Gg) between 1990 (2000) and 2013



Note: In Figure 3.1 left, values for SO_X are given in the secondary axis.

For PM, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from this country.

Figure 3.2 EU-28 emission trends in the sector group 'Energy production and distribution' for the HMs Pb, Cd and Hg, and for POPs (PCDD/Fs and PCBs) between 1990 and 2013



Notes: For the HMs, no data for Luxembourg and no sectoral data for Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including emission data for these Member States.

For PCDD/Fs and total PAHs, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from this country.

this sector in the year 2013. For Hg, Germany, Poland and Spain reported the highest emissions. The United Kingdom, Germany and Poland contributed most to NO_X emissions.

For emissions of the main pollutants (see Figure 3.1), the highest absolute and relative reduction within this sector group was for SO_X (− 87%) between 1990 and 2013. For $PM_{2.5}$ and PM_{10}, a notable relative decrease of 55% and 56%, respectively, has occurred within this sector group since 2000.

The low emission data of NO_X in 1994 is mainly caused by gap-filled data from the Czech Republic, and emission data from Poland starting in 1995.

Of the three main HMs, Cd shows the highest emission reduction in absolute and relative terms (− 79%) (see Figure 3.2 (a)). For emissions of POPs, the highest relative reduction was seen in PCDD/Fs (− 96%) (see Figure 3.2 (b)).

The emission decrease of PCBs from 1994 to 1995 is caused by differences of gap-filled (up to 1994) and submitted (from 1995 onwards) data of Poland.

Table 3.1 Overview of methods and data used by Member States to calculate emissions from 'Energy production and distribution'

Member State	Activity data	Emission factor	Method
Austria	Energy balance, ETS data, steam boiler database, direct information from industry or associations of industry	PS, CS, D	T1, T2, T3
Belgium	Regional energy balances, annual industrial reports, plant data	D, PS	T1, T2
Bulgaria	Plant data, energy balance, national statistics	D/CS	T1, T2
Croatia	National energy balance, plant data	PS, D	T1, T2
Cyprus	Energy balance, plant data	D	T1, T2, T3
Denmark	Danish energy statistics, plant data	CS, PS, D	T2, T3
Estonia	Plant data, energy balance, Statistics Estonia	PS, CS, D	T1, T3
Finland	Plant data, ETS data, national energy statistics	CS, PS, D	T2, T3
France	Plant data, national statistics, energy balance	CS, PS, D	T3
Germany	National statistics (energy balance)	CS	T2
Greece	Energy balance, ETS data, public power corporation	PS	T2, T3
Hungary	National energy balance, national statistics, plant data	D, CS, PS	T1, T2, T3
Ireland	National energy balance, ETS data, plant data	D, PS	T3
Italy	Energy balance, national electricity producers, national industry corporation, national statistics, ETS data	D, CS	T1, T2
Latvia	National energy balance	D	T1
Lithuania	National energy statistics, plant data (annual emission questionnaires)	D/CS	T1, T2
Luxembourg	National statistics, plant data, country-specific data, specific questionnaires/surveys/annual reports	CS, PS, D	T1, T2, T3
Malta	Plant data, energy statistics	D	T1, T2
Netherlands	Annual environmental reports, national statistics	PS	T2, T3
Poland	Energy statistics, statistical yearbook, energy balance for Poland	D, PS	T1, T3
Portugal	LPS survey, LCP survey, national reports, energy balance, national statistics	D, CS, PS	T2
Romania	Energy balance, LCP inventory	D	T1
Slovakia	Energy statistics, database of stationary sources	PS, D	T1, T3
Slovenia	Annual energy statistics, energy balances, joint questionnaires, ETS data	CS, D	T2
Spain	Eurostat data, national and international statistics, individualised questionnaires	D, CS	T1, T2, T3
Sweden	Quarterly fuel statistics, ETS data, industrial statistics	CS	T2, T3
United Kingdom	Plant data, energy statistics, ETS data	CS, D	T1, T3

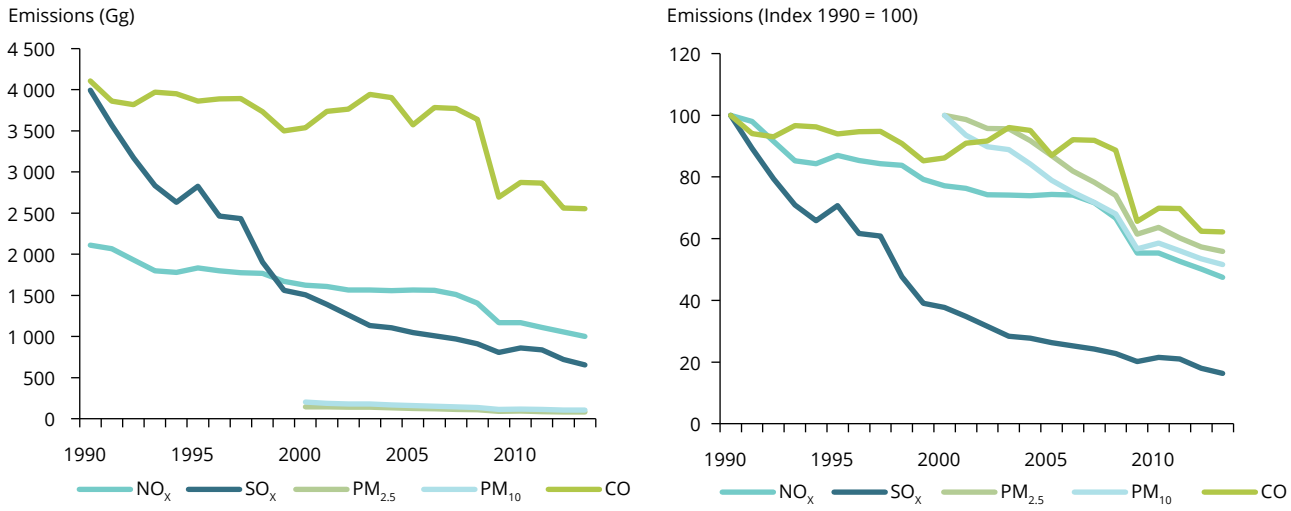
3.2 Sectoral analysis and emission trends for 'Energy use in industry'

The 'Energy use in industry' sector is a primary source for Pb and Cd. Poland, Spain and Italy contributed most (in absolute terms) to the emissions of Pb in this sector in the year 2013. For Cd, Poland, Spain and Portugal reported the highest emissions.

Energy use (fuel combustion) in industry is an important source of many pollutants. For the main pollutants, the highest absolute and relative reduction (− 84%) between 1990 and 2013 occurred for SO_x (see Figure 3.3).

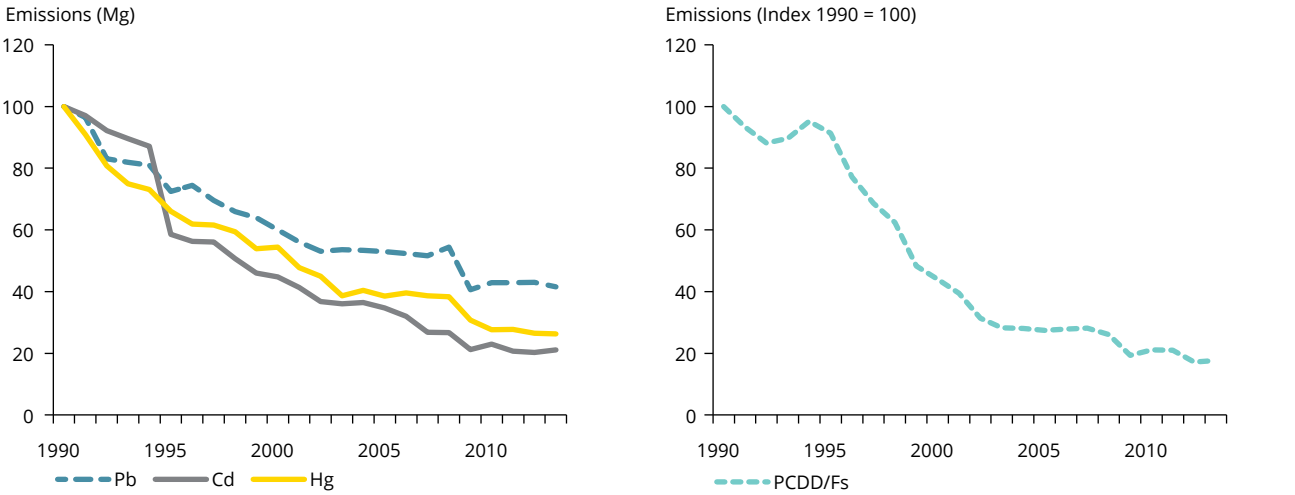
For the three HMs, Cd shows the highest emission reduction in relative terms (− 79%) (see Figure 3.4(a)). Hg and Pb decreased similarly to Cd in relative terms

Figure 3.3 EU-28 emission trends in the sector group 'Energy use in industry' for NO_x, SO_x and CO (in Gg) between 1990 (2000) and 2013



Notes: For PM, data from Greece could not be gap-filled, as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, emissions have been aggregated without including data from this Member State.

Figure 3.4 EU-28 emission trends in the sector group 'Energy use in industry' for the HMs Pb, Cd and Hg, and for PCDD/Fs between 1990 and 2013



Notes: For the HMs, no data for Luxembourg and no sectoral data for Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including emission data for these Member States.

For PCDD/Fs, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from this country.

(− 74% and − 58%, respectively). The emissions peak of Pb in 2008 is mainly caused by data of the category '1A2b — Stationary combustion in manufacturing industries and construction: Non-ferrous metals' reported from Bulgaria.

For POPs, only the PCDD/Fs are key pollutants in the sector group 'Energy use in industry'. Trends of these pollutants are presented in Figure 3.4(b).

The PCDD/F emissions peak from 1994 to 1995 is attributable to data from France. Category '1A2b — Stationary Combustion in manufacturing industries and construction: Non-ferrous metals' was affected by the set-up of a new Zn production plant (second fusion) during the year 1993. Since 1998, however, this plant has used emission reduction equipment (comment received from France in 2013).

Table 3.2 Overview of methods and data used by Member States to calculate emissions from 'Energy use in industry'

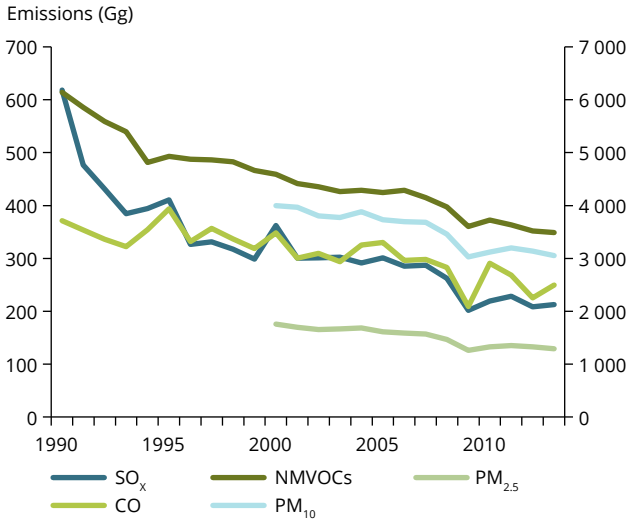
Member State	Activity data	Emission factor	Method
Austria	Energy balance, ETS data, steam boiler database, direct information from industry or associations of industry	PS, CS	T2, T3
Belgium	Regional energy balances, plant data	CS, D, PS	T1, T2
Bulgaria	Plant operator data, energy balance	D/CS	T2
Croatia	National energy balance, plant data	PS/D	T1, T2
Cyprus	National statistics (questionnaires), plant data	D	T1, T2
Denmark	Danish energy statistics	CS, PS, D	T2, T3
Estonia	Plant data, energy balance	PS, CS, D	T1, T3
Finland	Plant data, national energy statistics	CS, PS, D	T2, T3
France	Energy balance, survey, plant data	CS	T2, T3
Germany	National statistics, energy balance	CS	T2
Greece	Energy balance, ETS data	D	T1
Hungary	National energy statistics, plant data (EPRTR, IPPC)	D, CS	T1, T2, T3
Ireland	National energy balance, ETS data	CS, D, PS	T2, T3
Italy	Energy balance, ETS data	D, CS	T1, T2
Latvia	National energy balance	D	T1
Lithuania	National energy statistics, plant data (annual emission questionnaires)	D/CS	T1
Luxembourg	National statistics, plant data, country-specific data, specific questionnaires/surveys/annual reports	D, PS, CS	T1, T2, T3
Malta	Energy statistics	D	T1
Netherlands	Estimated industrial sources, annual environmental reports	CS, PS	T3
Poland	Energy statistics, statistical yearbook, energy balance for Poland	D, CS	T1, T3
Portugal	LPS, LCP, EPER/IPCC energy balances	D, CS	T2
Romania	Energy balance, LCP inventory	PS, D	T1, T2
Slovakia	Energy statistics, database of stationary sources	PS	T1, T3
Slovenia	Annual energy statistics, joint questionnaires, energy balances	D	T1
Spain	Plant data, national fuel balance	D, CS	T1, T2
Sweden	Quarterly fuel statistics, industrial energy statistics, ETS data	CS	T1, T2
United Kingdom	Plant data, energy statistics, ETS data	CS, PS, D	T1, T3

3.3 Sectoral analysis and emission trends for 'Industrial processes and product use'

The 'Industrial processes and product use' sector grouping refers to emissions from industrial sources other than those arising from fuel combustion within the industrial sector. This is the primary sector group for NMVOCs and PCB emissions, and makes important contributions to emissions of HCB, CO, PM, HMs and POPs. Of all the countries that reported data, Germany, the United Kingdom and Italy contributed most to NMVOC emissions, and the United Kingdom, Lithuania and Italy contributed most to PCB emissions in the 'Industrial processes and product use' sector in the year 2013. Past emission trends of the relevant main pollutants are shown in Figure 3.5.

The peak in CO emissions in 1995 is attributable to data from category '2C1 — Iron and steel production', reported by France. These emissions of CO from category 2C1 fluctuate over the years, depending on the amount of blast furnace gas that is produced, reused or flared. These amounts depend on the operating conditions and the feasibility for iron and steel or collieries plants of reusing blast furnace gas that is continuously produced. This may fluctuate a great deal from one year to another, resulting in different peaks (1995, 2004 and 2010) or decreases (1992, 2001 and 2009) (comment received from France in 2013).

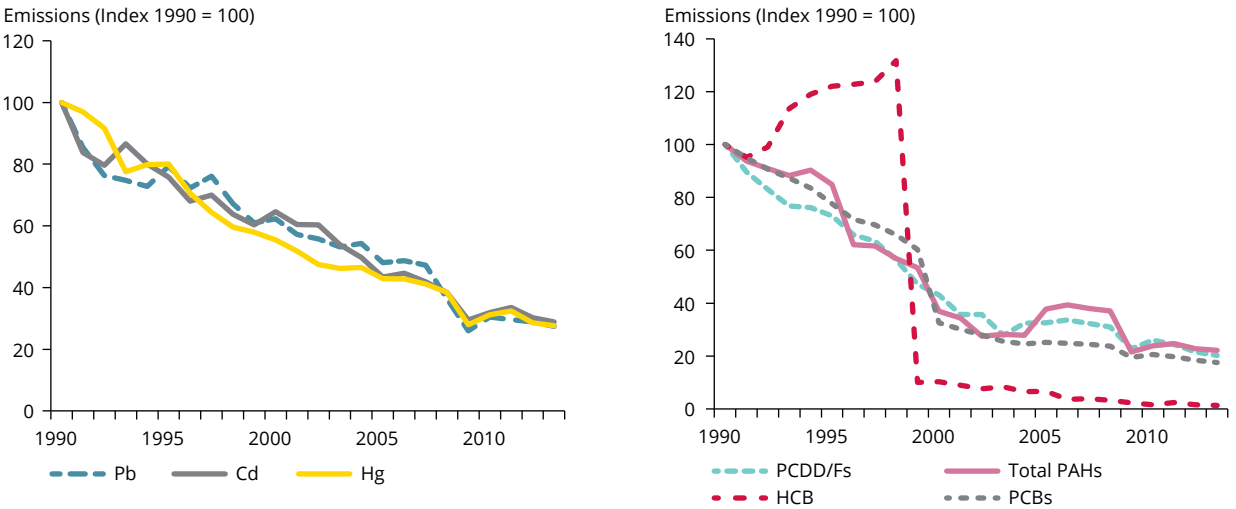
Figure 3.5 EU-28 emission trends in the sector group 'Industrial processes' for NMVOCs, SO_x and CO (in Gg) between 1990 (2000) and 2013



Notes: Values for CO and NMVOCs are given in the secondary axis.

For PM, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data for this Member State.

Figure 3.6 EU-28 emission trends in the sector group 'Industrial processes and product use' for the HMs Pb, Cd, Hg, and for the POPs (PCDD/Fs, total PAHs, HCB and PCBs) between 1990 and 2013



Notes: For the HMs, no data for Luxembourg and no sectoral data for Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including emission data for these Member States.

For PCDD/Fs, total PAHs and HCB, data from Greece could not be gap-filled as values were not reported for any year. For PCBs, no data for Austria and Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from these countries.

'Industrial processes and product use' make a considerable contribution to the total EU-28 emissions of HMs, despite seeing considerable reductions since 1990. Past emission trends for these pollutants are shown in Figure 3.6(a). Pb shows the highest relative and absolute emission reduction between 1990 and 2013 (− 73%).

For POPs, the highest relative reduction between 1990 and 2012 occurred for HCB (− 99%) (Figure 3.6(b)).

The considerable change in HCB emissions is mainly caused by an increase in '2C3 — Aluminium production' in the United Kingdom until 1998. Historically within the United Kingdom, HCE has been used as a cover gas within the secondary aluminium industry. When HCE was manufactured, it was contaminated with HCB and pentachlorobenzene. Van der Most et al. (1992) quote the emission factor for HCB within HCE as 5 g/t of HCE used. In 1999, the use of HCE for this application was banned in the United Kingdom, and the emissions ceased (comment received from the United Kingdom in 2011).

The steep drop in PCBs from 1999 to 2000 is caused by emission data of the category '2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' reported from the United Kingdom.

The decrease of total PAHs from 1994 to 1996 is also caused by data reported from the United Kingdom. The increase of total PAH emissions from 2004 to 2005 is caused by differences of gap-filled data of Romania.

Table 3.3 Overview of methods and data used by Member States to calculate emissions from 'Industrial processes and product use'

Member State	Activity data	Emission factor	Method
Austria	National production statistics, Austrian foreign trade statistics, ETS data, direct information from industry and associations	CS, PS	T1, T3
Belgium	Production figures, mainly directly originating from the industrial plant	PS, CS, D	T2, T3
Bulgaria	National production statistics, national registers (E-PRTR and ETS, national studies), VOCS database	D, CS	T1, T2
Croatia	National statistics, plant data, VOCS database	D, PS	T1, T2
Cyprus	National statistics (production and fuel), plant data	D	T1, T2
Denmark	Plant data, Statistics Denmark	PS, D	T1, T3
Estonia	National statistics, web-based air emission data system for point sources	PS, D	T3, T2, T1
Finland	National and plant-specific data, national statistics, statistics from industry	CS, PS, D	T2, T3
France	National production data, plant data	CS	T2, T3
Germany	German Statistical Office (DESTATIS) (a), branch association publications, plant data	CS	T1, T2
Greece	National statistics, industrial production data, ETS data	D, PS	T1
Hungary	National energy statistics	D, PS	T1, T2, T3
Ireland	ETS data, plant data, European Asphalt Pavement Association (EAPA), national statistics	PS, CS, D	T2
Italy	National statistics, UN statistics, industrial associations, plant data (ETS, EPRTR)	D, CS, PS	T2
Latvia	National statistics, plant data	D, PS, CS	T1, T2, T3
Lithuania	National production data, plant data	D	T1
Luxembourg	National statistics, plant data, specific questionnaires/surveys/annual reports	PS, D	T3
Malta	Trade data, production data	D, CS	T1
Netherlands	National statistics, environmental reports from plants	PS, CS	T3
Poland	Statistical Yearbook of Industry, Statistical Yearbook of Poland, production of industrial goods, import/export data	D, CS	T1, T3
Portugal	Production data, plant data (LPS, LCP), energy balance	S	T1, T3
Romania	Production data, energy balance, local emission inventory data	D, CS	T1, T2
Slovakia	Production data	D, CS, PS	T1
Slovenia	National statistics, plant data	D, CS, PS	T2
Spain	Data from main business associations, individualised questionnaires	D, PS, CS	T1, T2
Sweden	Production statistics, environmental reports	PS, CS, D	T2
United Kingdom	National statistics, production data, trade associations	D, CS, PS	T2

Note: (a) See https://www.destatis.de/EN/Homepage.html.

3.4 Sectoral analysis and emission trends for 'Commercial, institutional and households'

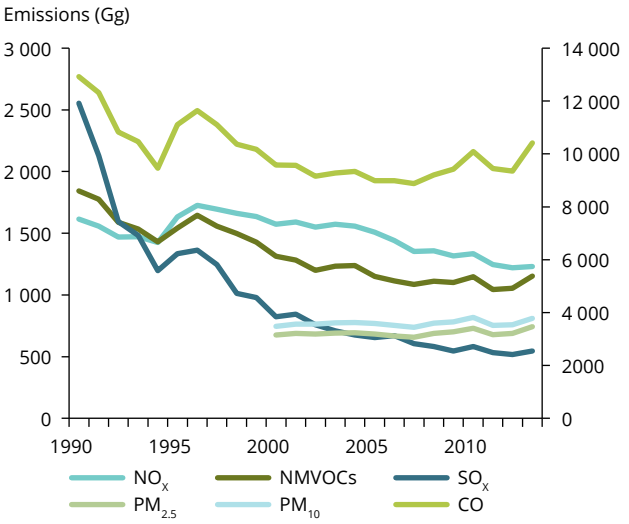
As indicated earlier in Chapter 2, emissions arising from fuel combustion by commercial and institutional facilities and households make an important contribution to total emissions of many pollutants.

The 'Commercial, institutional and households' sector is an important source for B(a)P, CO, $PM_{2.5}$, PM_{10}, Cd, dioxins and furans, total PAHs and HCB. Poland, Romania and Ireland contributed most (in absolute terms) to the emissions of B(a)P, and Germany, Poland and Italy contributed most to the emissions of total PAHs in this sector in the year 2013. For $PM_{2.5}$ and for PM_{10}, Italy, Poland, Romania and France reported the highest emissions. Poland, Italy and France contributed most to CO emissions, and Poland to Cd emissions.

For the main pollutants, the highest relative reduction between 1990 and 2013 for the sector grouping was again seen in SO_X (− 79%). By contrast, PM emissions have changed little since 2000 (see Figure 3.7).

The emission increase of CO, NO_X, SO_X and NMVOCs from 1994 to 1995 is mainly caused by differences of gap-filled (up to 1994) and submitted (from 1995 onwards) data of Poland.

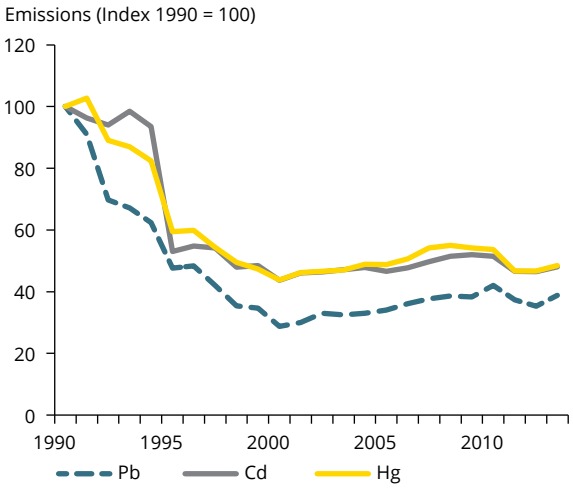
Figure 3.7 EU-28 emission trends in the sector group 'Commercial, institutional and households' for NO_X, NMVOCs, SO_X, and CO (in Gg) between 1990 (2000) and 2013

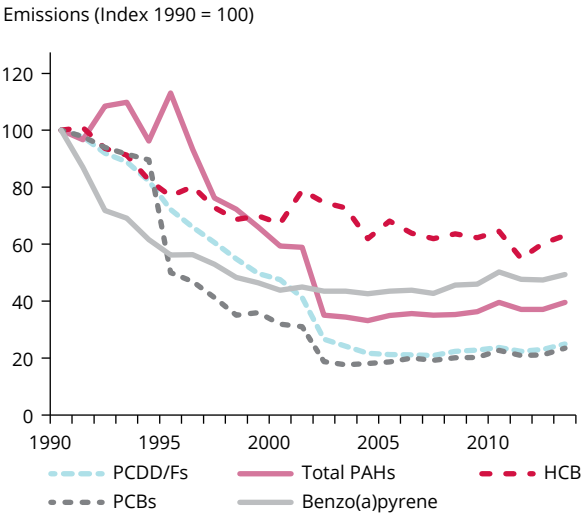


Notes: Values for CO are given in the secondary axis.

For PM, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data for this Member State.

Figure 3.8 EU-28 emission trends in the sector group 'Commercial, institutional and households' for the HMs Pb, Cd and Hg, for POPs (PCDD/Fs, total PAHs, B(a)P, HCB and PCBs) between 1990 and 2013





Notes: For the HMs, no data for Luxembourg and no sectoral data for Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including emission data for these Member States.

For PCDD/Fs, total PAHs and HCB, data from Greece could not be gap-filled as values were not reported for any year. For PCBs, no data for Austria and Greece were available. For B(a)P, several Member States did not provide emission data. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from these countries.

Of the three HMs in the sector 'Commercial, institutional and households', Pb shows the highest emission reduction in absolute and relative terms (− 61%) (see Figure 3.8(a)).

The decrease of Cd in the years 1994 to 1995 is mainly caused by differences of gap-filled and reported data of the category '1A4bi — Residential: Stationary' from Poland.

For POPs relevant to the 'Commercial, institutional and households' sector, the highest relative reduction occurred for PCBs (− 77%) (see Figure 3.8(b)).

The emission decrease of PCBs from 1994 to 1995 is caused by differences of gap-filled data (up to 1994) and submitted data (from 1995 onwards) of Poland.

Table 3.4 Overview of methods and data used by Member States to calculate emissions from commercial, institutional and household combustion

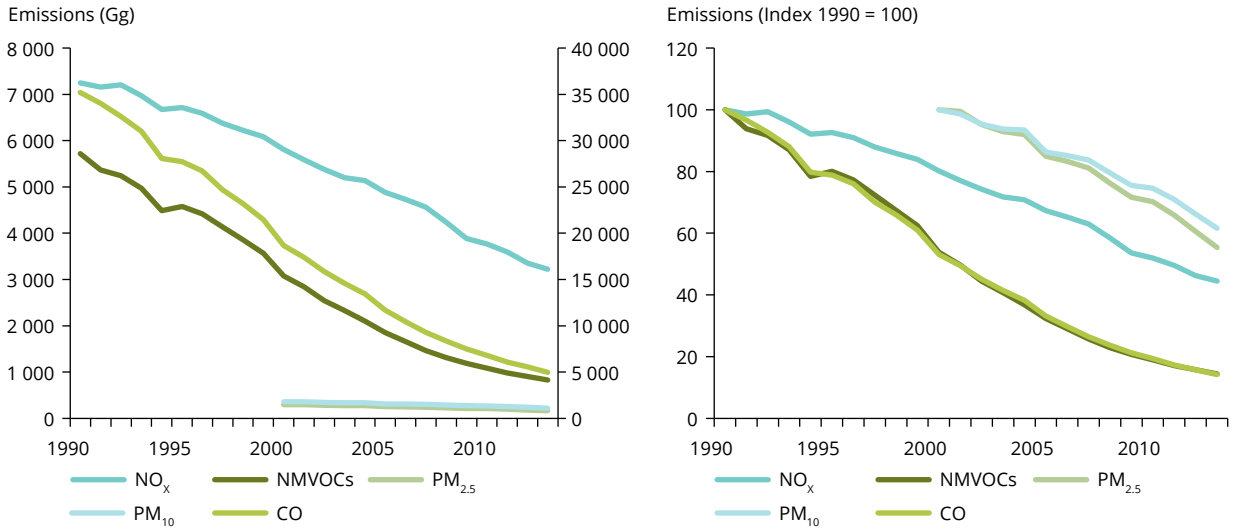
Member State	Activity data	Emission factor	Method
Austria	Energy balance, ETS data, steam boiler database, plant data	CS, D	T2
Belgium	Regional energy balances	D, CS	T2
Bulgaria	National statistics	D, CS	T1
Croatia	National energy balance, national fuel producer	D	T1, T2
Cyprus	Energy balance	D	T1
Denmark	National energy statistics	CS, D	T2
Estonia	National energy balance, emission data from plants	PS, CS, D	T1, T3
Finland	National energy statistics	CS	T2
France	National statistics, energy balance	D, CS	T2
Germany	National statistics	CS, D	T1, T2, T3
Greece	Energy balance, Public Gas Corporation	D	T1
Hungary	National statistics, national energy balance	CS	T1, T2
Ireland	Energy balance	CS, D	T2, T3
Italy	National energy balance	D, PS	T2
Latvia	National energy balance	D	T1
Lithuania	National energy statistics	D, CS	T1
Luxembourg	National statistics, country-specific data	CS, D, PS	T1, T2, T3
Malta	Energy statistics	D	T1
Netherlands	National statistics	CS	T2, T3
Poland	Energy statistics, emission data from plants	D, CS	T1, T3
Portugal	Energy balances	D, CS	T2
Romania	National statistics	D	T1
Slovakia	Energy balances, consumption of fuel	PS	T1, T3
Slovenia	National energy statistics	D	T1
Spain	National and international statistics	D, CS	T1, T2
Sweden	Official statistical reports	CS	T1, T2, T3
United Kingdom	Energy statistics	D, CS	T1, T3

3.5 Sectoral analysis and emission trends for 'Road transport'

As noted earlier, the individual NFR sources that make up the 'Road transport' sector group together contribute considerably to emissions of a number of pollutants, including NO_X, NMVOCs, CO, $PM_{2.5}$, PM_{10}, Pb and certain POPs. Figure 3.9 shows the past emission trends for these pollutants in this sector.

France, Germany and Italy contributed most (in absolute terms) to NO_X emissions in the 'Road transport' sector in the year 2013. For CO, Germany, Italy and Poland reported the highest emissions.

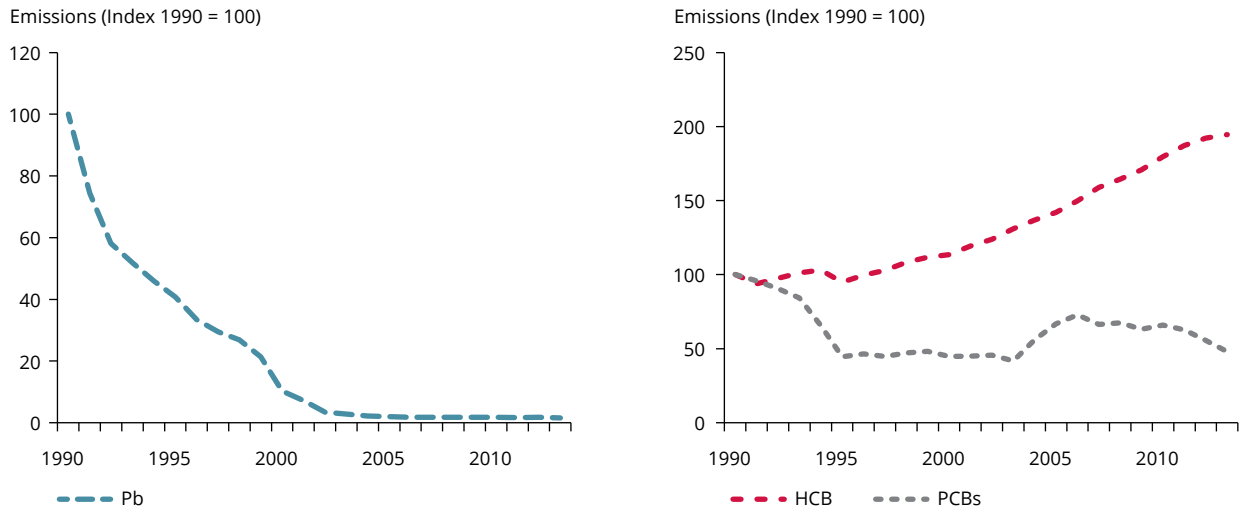
Figure 3.9 EU-28 emission trends in the sector group 'Road transport' for NO_X, NMVOCs and CO (in Gg) between 1990 (2000) and 2013



Notes: In figure 3.9 left, values for CO are given in the secondary axis.

For PM, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data for this Member State.

Figure 3.10 EU-28 emission trends in the sector group 'Road transport' for the priority HM Pb, and for HCB and PCBs between 1990 and 2013



Notes: For Pb, no data for Luxembourg and no sectoral data for Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including emission data for these Member States.

For HCB, data from Greece could not be gap-filled as values were not reported for any year. For PCBs, no data for Austria and Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from these countries.

For the 'Road transport' sector, the main HM is Pb, showing a high relative emission reduction (− 98%) between 1990 and 2013 (see Figure 3.10(a)). However, over the past years, little progress has been made in reducing emissions further; total emissions of Pb have remained largely constant. The promotion of unleaded petrol within the EU and in other EEA member countries through a combination of fiscal and regulatory measures has been a success story. For example, EU Member States have completely phased out the use of leaded petrol, a goal regulated by Directive 98/70/EC relating to the quality of petrol and diesel fuels (EC, 1998). Nevertheless, the 'Road transport' sector remains a key source of Pb, contributing around 15% of total Pb emissions in the EU-28.

Of the POPs, HCB and PCBs are the most important in the 'Road transport' sector group. Trends of past emissions for these pollutants are shown in Figure 3.10(b). Only a few countries (the Czech Republic, Denmark, Finland, France, Luxembourg, Poland and Slovakia) provided PCB emission values for the 'Road transport' sector. The emissions drop from 1993 to 1994 is due to data reported from Denmark, and the decrease from 1994 to 1995 is due to the gap-filling of data before the year 1995 from Poland. Subsequent emission increases from 2003 to 2006 are reported mainly by Poland and the Czech Republic. The rise in HCB emissions is mainly caused by increasing emissions of the 'Road transport' sector as reported by France.

Table 3.5 Overview of methods and data used by Member States to calculate emissions from 'Road transport'

Member State	Activity data	Method
Austria	Energy balance	GLOBEMI ([a])
Belgium	Regional energy balances	COPERT IV, v11.1bis ([b]) (Tier 3 methodology)
Bulgaria	Energy balance, statistics vehicle fleet	COPERT IV, v10.0 (Tier 2 methodology)
Croatia	National energy balance, vehicle database, national fuel producer	COPERT IV (Tier 2/3 method)
Cyprus	National statistics	COPERT IV (Tier 3 methodology)
Denmark	National Statistics	COPERT IV
Estonia	Estonian Road Administration, Statistics Estonia	COPERT IV, v9.1 (Tier 3 methodology)
Finland	National statistics	LIISA ([c]) (sub-model of LIPASTO ([d])) (Tier 3 methodology)
France	National statistics	COPERT IV, v11
Germany	Energy balance	TREMOD, v5.4 ([e])
Greece	Energy balance, national statistics	COPERT IV, v7.1
Hungary	National statistics, fuel statistics	COPERT IV, v9.1
Ireland	Energy balance, statistics from the National Road Authority, vehicle and driver statistics	COPERT IV, v11.0 (Tier 3 methodology)
Italy	National statistics, energy balance	COPERT IV, v10.0
Latvia	National statistics	COPERT IV (Tier 2 methodology)
Lithuania	National statistics	COPERT IV, v10.0
Luxembourg	National statistics, country-specific data, specific questionnaires/surveys/annual reports, expert judgement	NEMO ([f])
Malta	National statistics	Customised model (basic Tier 3 methodology)
Netherlands	National statistics	VERSIT+ ([g])
Poland	Motor Transport Institute with estimations based on energy statistics, Eurostat database	Country-specific model
Portugal	Energy balances, road statistics	COPERT IV, v11
Romania	Romanian Auto Registry, fuel statistics	COPERT IV, v11
Slovakia	National statistics	COPERT IV, v9.0
Slovenia	National statistics	COPERT IV, v9.0
Spain	National and international statistics	COPERT IV (Tier 3 methodology)
Sweden	National statistics	HBEFA 3.1 ([h])
United Kingdom	National statistics	Country-specific model, NO_x: COPERT IV, v10.0

Note:
([a]) GLOBEMI: global emission model (Hausberger, 1998).
([b]) COPERT: Computer Programme to calculate Emissions from Road Transportation, based on the *EMEP/EEA Guidebook* methodology (EMEP/EEA, 2013).
([c]) LIISA: Calculation model for the road transport sector emissions at VTT Technical Research Centre of Finland (Mäkelä et al., 2002, VTT, 2015a).
([d]) LIPASTO: Calculation system for traffic exhaust emissions and energy consumption at VTT Technical Research Centre of Finland (VTT, 2015b).
([e]) TREMOD: Transport Emission Estimation Model (Knörr et al., 2013).
([f]) NEMO: Network Emission Model (Dippold et al., 2012).
([g]) VERSIT+: TNO state-of-the art road traffic emission model. 'Verkeerssituatie' means 'traffic situation' in Dutch (Smit et al., 2006, 2007).
([h]) HBEFA 3.1: The Handbook of Emission Factors for Road Transport (INFRAS, 2014).

3.6 Sectoral analysis and emission trends for 'Non-road transport'

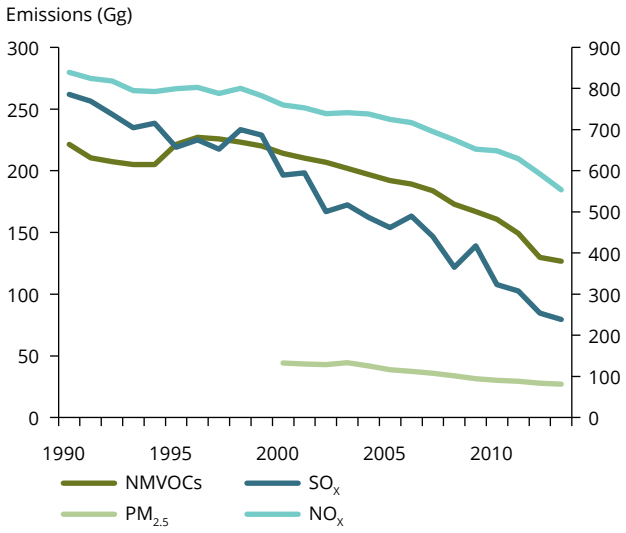
NO_X is an important pollutant in the 'Non-road transport' sector group. The United Kingdom, Italy and Spain contributed most (in absolute terms) to NO_X emissions in 2013.

Little progress has been made since 1990 in reducing emissions from NO_X (see Figure 3.11). For the main pollutants, the highest relative reduction between 1990 and 2013 occurred for SO_X (− 70%).

The 'Non-road transport' sector group does not contribute a great deal to HM and POP emissions. Trends of pollutants from these two groups of substances are therefore not shown.

Emissions from international/domestic aviation and shipping are reported as a simple sum of the emissions from each of the Member States. Accordingly, emissions from international/domestic aviation and shipping are not divided into those occurring within the EU and those that cross the geographical boundary of the EU. However, the guidelines (UNECE, 2014a) define international emissions as those which start in one country and finish in another. Thus the reporting is in consensus with the guidelines.

Figure 3.11 EU-28 emission trends in the sector group 'Non-road transport' for NO_X, NMVOCs and SO_X (in Gg) between 1990 (2000) and 2013



Notes: Values for NO_X are given in the secondary axis.

For PM, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data for this Member State.

Table 3.6 Overview of methods and data used by Member States to calculate emissions from 'Non-road transport'

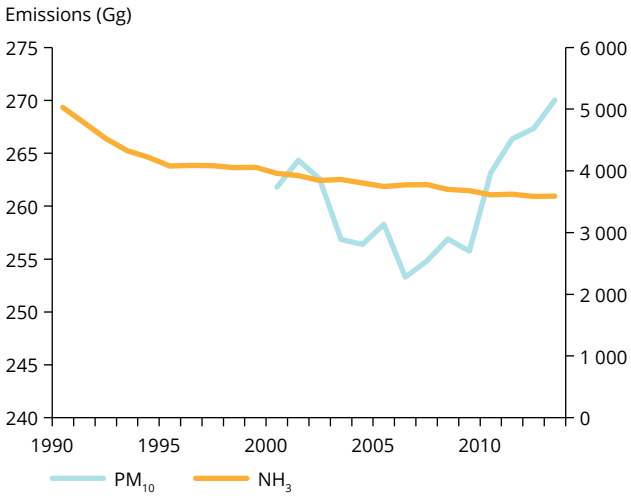
Member State	Activity data	Emission factor	Method
Austria	Energy balance	CS	T2, T3
Belgium	Regional energy balances, airport statistics	D, CS	T3
Bulgaria	Eurostat energy balance	CS, D	T1
Croatia	National energy balance, statistical yearbooks	D	T1
Cyprus	National statistics	D	T2
Denmark	Danish Civil Aviation Agency, statistics Denmark	D, CS	T1, T2
Estonia	Estonian aircraft movement statistics, energy statistics	D	T1, T2
Finland	National statistics	CS	T3
France	French Civil Aviation Authority	D, CS	T3
Germany	National statistics, Eurocontrol	D, CS	T1, T2, T3
Greece	Civil Aviation Organization, national statistics, energy balance	D	IPCC Tier 2a
Hungary	National statistics	CS	T1, T2, T3
Ireland	Irish Aviation Authority, fuel consumption data	D, CS	T3a
Italy	Statistical yearbooks, national energy balance	D	T1, T3
Latvia	National statistics	D	T1, T2
Lithuania	National statistics	D, CS	T1, T2
Luxembourg	National statistics	D	T1
Malta	Aviation statistics	D	T1
Netherlands	National statistics	CS	T2 (railways), T3 (aviation, navigation)
Poland	Eurostat database, energy statistics, Statistical Yearbook	CS	T2
Portugal	Energy balances, road statistics	CS	T1, T2b, T3
Romania	National statistics, Eurocontrol	D	T1
Slovakia	Transport statistics, fuel consumption	D	T1
Slovenia	National statistics	D	T1
Spain	National energy statistics, association data, national statistics, individualised questionnaires	D, CS	T1, T2
Sweden	National statistics	D, CS	T1, T2, T3a
United Kingdom	Transport statistics	CS, D	T2, T3

3.7 Sectoral analysis and emission trends for 'Agriculture'

As noted earlier, the 'Agriculture' sector group is responsible for the vast majority of NH_3 emissions in the EU-28. France, Germany and Italy contributed most (in absolute terms) to emissions of NH_3 in the year 2013.

Agricultural emissions of NH_3 have decreased by 29% since 1990 (see Figure 3.12). The sector also contributes around 14% of PM_{10} emissions; these emissions increased by 3% between 2000 and 2013.

Figure 3.12 EU-28 emission trends in the sector group 'Agriculture' for NH_3 (in Gg) between 1990 (2000) and 2013



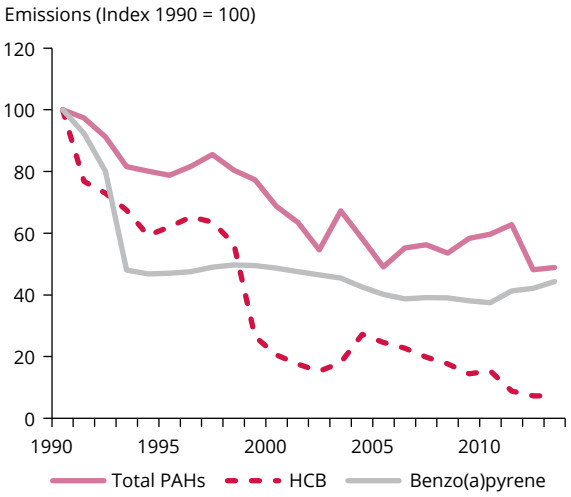
Notes: Values for NH_3 are given in the secondary axis.

For PM_{10}, data from Greece could not be gap-filled as values were not reported for any year. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data for this Member State.

For the POPs, this sector contributes considerably to emissions of total PAHs, B(a)P and HCB. Trends of past emissions for these pollutants are shown in Figure 3.13.

The drop in HCB emissions from 1990 to 1991 and from 1998 to 1999 is mainly caused by emission data reported from the United Kingdom. The emission trend of total PAHs is largely influenced by data of the category '3F — Field burning of agricultural residues', reported by Spain.

Figure 3.13 EU-28 emission trends in the sector group 'Agriculture' for POPs (total PAHs, B(a)P and HCB) between 1990 and 2013



Note: For total PAHs and HCB, data from Greece could not be gap-filled as values were not reported for any year.
For B(a)P, several Member States did not provide emission data. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from these countries.

Table 3.7 Overview of methods and data used by Member States to calculate emissions from 'Agriculture'

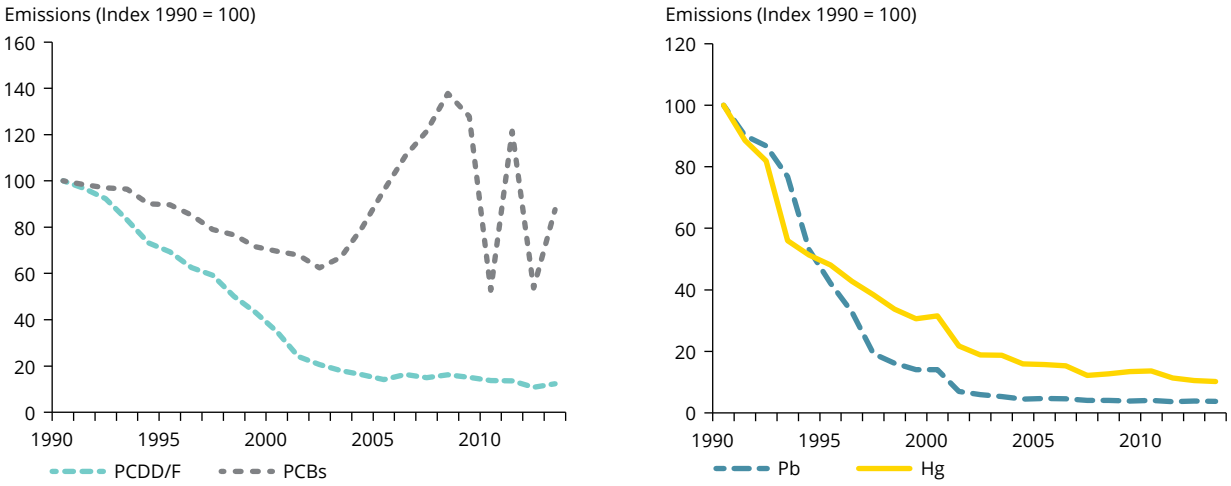
Member State	Activity data	Emission factor	Method
Austria	National agricultural statistics, national studies	CS, D	T1, T2, T3
Belgium	Statistics Belgium, livestock figures	CS, D	T2, T3
Bulgaria	National agriculture statistics	D, CS	T1
Croatia	National statistics	D	T1, T2
Cyprus	National statistics	D	T1
Denmark	National agricultural statistics	CS, D	T2
Estonia	National statistics	D	T1, T2, T3
Finland	National agricultural statistics, Yearbook of Farm Statistics	CS, D	T3
France	Agricultural statistics	D	T2
Germany	National and regional agricultural statistics	D, CS	T1, T2, T3
Greece	National statistics, fertiliser production data	D	T1
Hungary	National statistics	D, CS	T1, T2, T3
Ireland	National studies, national agricultural statistics, housing survey	D, CS	T1, T2
Italy	National statistics, agriculture association statistics	D	T1, T2
Latvia	National statistics	D, CS	T1, T2
Lithuania	National statistics	D	T1
Luxembourg	National statistics, country-specific data, expert judgement	D	T1, T2
Malta	National statistics, trade statistics	D	T1, T2 (for 4D)
Netherlands	National agricultural statistics	D, CS	T3
Poland	Statistical yearbook of Poland, Agriculture Yearbook	D, CS	T1
Portugal	Agricultural statistics, agriculture survey	D, CS	T1, T2
Romania	National production statistics, Statistical yearbook of Romania	D	T1
Slovakia	National statistics	D	T1
Slovenia	National statistics	D, CS	T2, T1
Spain	National agricultural and environmental statistics	D, CS	T1, T2
Sweden	Official statistical reports	D, CS	T2
United Kingdom	Agricultural survey statistics	CS	T2, T3

3.8 Sectoral analysis and emission trends for 'Waste'

The 'Waste' sector group is an important source of certain pollutants, including PCBs and PCDD/Fs. Figure 3.14 shows the past emission trends for PCBs and dioxin.

The marked PCB emission increases starting in 2003, and the dips and jumps in the time series from 2003 to 2013 are due to reported data from Portugal for category '5C1bi — Industrial waste incineration'. Portugal explained that the emission trends for industrial incineration follow the trends of the activity data. The final disposal of industrial waste includes waste landfilling, incineration, export (e.g. dangerous waste) and recycling. The striking differences across years for the amounts of industrial waste incinerated can be explained, at least partially, by the variation in annual market demand for residues (comment received from Portugal in 2013).

Figure 3.14 EU-28 emission trends in the sector group 'Waste' for POPs (PCDD/Fs and PCBs), and the HMs Pb and Hg between 1990 and 2013



Notes: For Pb and Hg, no data for Luxembourg and no sectoral data for Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including emission data for these Member States.

For PCDD/Fs, data from Greece could not be gap-filled as values were not reported for any year. For PCBs, no data for Austria and Greece were available. To enable presentation of provisional EU-28 emission trends, the emissions have been aggregated without including data from these countries.

Table 3.8 Overview of methods and data used by Member States to calculate emissions from 'Waste'

Member State	Activity data	Emission factor	Method
Austria	Federal waste management plan	CS	T2
Belgium	Plant data, national statistics	CS, D	T1, T2
Bulgaria	National statistics, national studies	D, CS	T1
Croatia	National statistics	D	T1, T2
Cyprus	National statistics	D	T1, T2
Denmark	National statistics	D, CS	T1, T2
Estonia	Plant data, Statistics Estonia, Estonian Rescue Service	PS, D	T1, T2, T3
Finland	National statistics, plant data	CS	T2
France	National waste statistics, plant data	D, CS	T1, T2
Germany	National statistics — German Statistical Office (DESTATIS)	D, CS	T1
Greece	National statistics	D	T1
Hungary	National statistics	D, CS	T1, T2, T3
Ireland	National waste reports, plant data	CS, D	T1, T2
Italy	National waste statistics	D	T2
Latvia	National statistics, waste database	D	T1, T2
Lithuania	National statistics (data available from 1991)	D	T1
Luxembourg	National Statistics, plant data		
Malta	Plant data	D	T1, T2
Netherlands	National statistics, branch reports, plant data	CS	T2
Poland	Environment and statistical yearbook, municipal infrastructure	D, CS	T1
Portugal	Waste statistics	D	T2
Romania	National waste database, national statistics	D	T1, T2
Slovakia	National database of waste	D, CS	T1
Slovenia	National statistics, plant data	D	T1
Spain	National statistics, individualised questionnaires	D, CS	T1, T2
Sweden	Annual environmental reports	D, CS	T1, T2
United Kingdom	Annual statistics on waste incineration facilities, periodic studies	CS, PS	T1, T3

4 Recalculations, and implemented or planned improvements

4.1 Recalculations

4.1.1 Recalculations

Recalculations are changes made to past emission estimates (for one or more years) in order to eliminate errors or to incorporate additional factors or data. The *EMEP/EEA Guidebook* (EMEP/EEA, 2009) stipulates that from a country perspective, it is considered good practice to change or refine data and/or methods when:

- available data have changed;
- the previously used method is not consistent with good practice for a certain category;
- an emissions source category has become a key category;
- the previously used method is inadequate to reflect mitigation activities in a transparent manner;

Table 4.1 Comparison of data submitted in 2014 and 2015 by Member States (relative data, EU-28 National Total)

Pollutant	Unit	1990	1995	2000	2005	2010	2011	2012
NO_X	Gg	1%	1%	1%	1%	1%	2%	1%
NMVOCs	Gg	2%	2%	3%	4%	6%	6%	5%
SO_X	Gg	0%	0%	0%	– 1%	0%	0%	0%
NH_3	Gg	3%	4%	4%	4%	5%	4%	5%
TSPs	Gg	– 2%	1%	5%	5%	5%	5%	4%
BC	Gg							
Benzo(a)pyrene	Mg	14%	22%	29%	8%	5%	7%	4%
CO	Gg	0%	– 1%	– 1%	– 1%	– 1%	0%	– 4%
Pb	Mg	– 1%	– 1%	0%	– 1%	– 26%	– 26%	– 25%
Cd	Mg	1%	– 16%	– 10%	– 15%	– 27%	– 24%	– 27%
Hg	Mg	– 2%	0%	0%	– 2%	– 19%	– 19%	– 20%
As	Mg	– 2%	– 3%	– 3%	– 1%	– 7%	– 7%	– 8%
Cr	Mg	– 7%	– 9%	– 13%	– 14%	– 2%	– 2%	– 3%
Cu	Mg	1%	1%	1%	1%	– 1%	– 2%	– 1%
Ni	Mg	– 6%	– 5%	– 6%	– 4%	– 16%	– 17%	– 17%
Se	Mg	– 2%	– 2%	– 3%	– 1%	– 1%	– 2%	– 2%
Zn	Mg	0%	1%	1%	3%	1%	1%	0%
PCDD/Fs	g I-Teq	4%	5%	4%	3%	9%	7%	1%
Benzo(b)fluoranthene	Mg	30%	38%	52%	24%	20%	21%	20%
Benzo(k)fluoranthene	Mg	26%	29%	38%	14%	16%	18%	16%
Indeno(1,2,3-cd)pyrene	Mg	17%	23%	30%	15%	11%	12%	10%
Total PAHs	Mg	7%	6%	11%	9%	6%	7%	– 1%
HCB	kg	1%	1%	5%	1%	2%	3%	6%
PCBs	kg	2%	2%	3%	7%	– 15%	0%	– 12%
				2000	**2005**	**2010**	**2011**	**2012**
$PM_{2.5}$	Gg			1%	3%	2%	2%	1%
PM_{10}	Gg			3%	4%	3%	3%	2%

- the capacity (resources) for inventory preparation has increased;
- new inventory methods become available;
- the correction of errors is necessary.

It is important and necessary to identify inventory recalculations and to understand their origin, in order to evaluate officially reported emissions data properly. The reasons for Member States reporting different numbers in one year compared to an earlier year are often not documented.

Table 4.1 shows a comparison of EU-28 total emissions submitted in 2014 against those submitted in 2015. It should be noted that for some Member States, recalculations might reflect changes in compilation methods (gap-filling) rather than 'true' recalculations performed by the countries themselves.

The highest recalculations occur for the Pb, Cd and Hg. These are ascribable to differences between submitted data of the 2015 inventory compared with submitted data from the 2014 inventory from Portugal for Pb, Poland for Cd and Hg for Romania. Further, high recalculations occur for the PAHs B(k)F and B(b)F due to high recalculations of Romania and Ireland.

Under the revised reporting guidelines (UNECE, 2014a), all countries should submit explanatory IIRs which should include details of any recalculations made. Information on the Member States' IIRs is listed in Appendix 5. Some Member States provide very detailed explanations for their recalculations of parts or the whole time-series (e.g. methodological improvements,

Table 4.2 Overview of Member State recalculations contributing most to EU recalculations

Pollutant	Countries contributing most to recalculations at EU level
NO_X	BE: 1990–2011; FR: 1990–2011; HU: 1990; IT: 2000–2005, 2011
NMVOCs	BE: 1990–2012; HR: 2005; DK: 1990–2012; FR: 1990–2000, 2010–2012; DE: 1990–2012; IE: 1990–2012; IT: 2005; LV: 1990–2012; PT: 1990; RO: 2005; ES: 2012; UK: 1990–2000
SO_X	LT: 1990; RO: 2005; UK: 1990
NH_3	FR: 1990–1995, 2005–2010, 2012; DE: 1990–2012
$PM_{2.5}$	PL: 2005
PM_{10}	RO: 2000–2012
TSPs	DK: 1990–2012; DE: 1990–2012; LU: 1990–1995; PL: 1990–1995, 2005; RO: 1995–2012; UK: 1990–2012
CO	AT: 1990–2005; BE: 1990–1995; BG: 1995–2010; HR: 1990–2012; FR: 1990–2005, 2012; DE: 1990–2000, 2010–2012; IE: 1990; IT: 1995, 2005, 2012; LU: 1995; NL: 1995, 2010–2012; PL: 2010–2011; RO: 2005–2012; ES: 2012; SE: 2010; UK: 1990–2000
Pb	BG: 2010–2012; FR: 1995; DE: 1990–2012; PT: 2005–2012; RO: 1990–2000; UK: 1990–1995
Cd	PL: 1995, 2010
Hg	BE: 1990
As	BG: 2010–2012; RO: 1990–2000
Cr	DE: 1990–2005; RO: 1990
Cu	BG: 2010–2012; DE: 1990–2012
Ni	HU: 1990–1995; IE: 1990–2012; RO: 1900–2005; UK: 1990
Se	BG: 2010–2012; HU: 2005–2013; RO: 2005, 2011
Zn	BG: 2010–2012; DE: 1990, 2012; PL: 2005–2011; RO: 1990, 2005–2012
PCDD/Fs	BE: 1990, 1995; HR: 1990–2012; FR: 1990–2012; IE: 1990; LU: 1990; PL: 1995–2012; PT: 1990–2012; RO: 2005–2012; SK: 2005
Total PAHs	DE: 2012; IE: 1990–2012; PT: 1990–2012; RO: 2005–2012; ES: 2012
B(a)P	IE: 1990–2012; NL: 1990–1995; RO: 1995–2012
B(b)F	HU: 1990–1995, 2011–2012; IE: 1990–2012; NL: 1990–1995; RO: 2005–2012
B(k)F	HU: 1990; IE: 1990–2012; NL: 1990–1995; RO: 2005–2012
IP	IE: 1990–2012; NL: 1990–1995; RO: 2005–2012
HCB	BE: 1990–2000
PCBs	DE: 1995–2000; IE: 1990–1995; LT: 1990–2012; LU: 1990–2000; PL: 2012; PT: 2010–2012; RO: 2005

revisions of emission factors, reallocations, revisions of activity data and corrections of errors). Others, however, do not explain the rationale behind recalculations, despite having submitted IIRs.

Austria provided detailed information on its recalculations: they were carried out due to updates of activity data and improvements of methodologies and emission factors (Appendix 5, Austria's IIR).

Belgium provided detailed information on its recalculations. There are several notable differences from the last submission. The notation keys for the NEC pollutants (NO_X, NMVOCs, SO_X and NH_3) and the other LRTAP pollutants (CO, PM, HMs, POPs) were revised. Reducing the use of the IE notation key was the subject of special attention. For the 'Road transport' sector, much effort was put into harmonising the modelling between the three regions (Flanders, Wallonia and Brussels). Concerning emissions of NOX and NMVOCs from the agricultural sectors, manure management and agricultural soils have been implemented in the emission inventory since this submission. Several suggestions from the 2014 in-depth review were taken into account (Appendix 5, Belgium's IIR).

Bulgaria reported that a recalculation for the sector 1A2 (for HMs and TSPs) and the sector 1A3b (the entire time-series for road transport) had been prepared.

Croatia provided detailed information on its recalculations for almost all pollutants since 1990. The main reason for recalculations is methodology improvement. Table ES4-1 in Croatia's IIR offers an overview of the recalculations (Appendix 5, Croatia's IIR).

Cyprus stated that some methodological improvements were made to the national emissions inventory. This resulted in recalculations of the time series from 1990 through 2012, in order to improve emission data accuracy. The main reason for the recalculations was the implementation of the new *EMEP/EEA Guidebook* (Appendix 5, Cyprus' IIR).

Denmark provided detailed information on its recalculations. Considerable work was put into improving the inventory. The submission includes recalculated inventories for the whole time-series. The reasons for the recalculation are updated activity data, new data, correction of errors and updated emission factors (Appendix 5, Denmark's IIR).

Estonia provided detailed information on its recalculations from 1990 to 2012. The reasons for recalculating are new emission factors (the *EMEP/EEA Guidebook*), correction of emissions, additional emissions, update of activity data, correction of errors, correction of emission factors and correction of calculations (Appendix 5, Estonia's IIR).

Finland provided detailed information on recalculations. The time series has been recalculated for several subcategories, not including the 'Energy' sector. Once this sector has been recalculated, the entire time-series (1990–2011) will be reported. At present, ad hoc checking of basic data, methods and underlying assumptions is being carried out, and remains to be checked systematically once recalculations are complete. The reallocation of emissions will be carried out as well. No actual recalculations were made in Finland's IIR; some emission figures of previous years were corrected in the NFR tables to reflect changes in activity data, changes in data reported by the plants or errors found in previous years. The altered figures are coloured red in the NFR tables. (Appendix 5, Finland's IIR).

France noted that several recalculations of methodology and statistics were applied (Appendix 5, France's IIR).

Germany provided detailed information. Recalculations were undertaken in Germany for several reasons: revision of activity, revision of the entire model, newly implemented emission factors, revision of emission factors and reallocation of activity data and emissions (Appendix 5, Germany's IIR).

Ireland provided detailed information on its recalculations. The reasons for recalculating are revised activity data, revised emission factors, methodological changes and revised proxy data (Appendix 5, Ireland's IIR).

Italy provided detailed information on its recalculations. The main reasons for recalculations are revised activity data, methodological changes and updated emission factors (Appendix 5, Italy's IIR).

Latvia provided detailed information on recalculations. Recalculations were carried out due to improved activity data, updated methodology and emission factors in the *EMEP/EEA Guidebook* and new guidelines (Appendix 5, Latvia's IIR).

Lithuania applied some renewals in its calculations, based on an in-depth review of emission inventories submitted under the UNECE LRTAP Convention and the NEC Directive. Activity data and sulphur/lead content in fuels were corrected for the years 1990 to 2013. Emission factors were reviewed and corrected. Most of the activity data within all sectors were corrected according to the national greenhouse gas

(GHG) emission inventory reports — the CRF. NMVOC emissions were evaluated based on Tier 1 (Appendix 5, Lithuania's IIR).

Luxembourg reported recalculations due to updates of AD, methodology and EFs for several source categories (Appendix 5, Luxembourg's IIR).

The **Netherlands** stated that compared to the 2014 inventory report, several methodological changes were implemented in the Pollutant Release and Transfer (PRTR) system: fuel emissions in the 'Road transport' sector were recalculated on the basis of new research (VERSIT+ LD model); minor errors in PM inventory were corrected; new emission factors were used to calculate the nitrogen flows in agriculture; and HCB emissions were finalised for several sectors (Appendix 5, Netherlands' IIR).

Poland reported that comprehensive recalculations of data from 1995 were carried out in 2014, which changed the inventory data for combustion processes for the entire period from 1995 to 2012. Reported emissions under the NEC Directive in December 2014 differ slightly from data submitted to the LRTAP Convention in February 2015, due to corrections of statistical activity data. Following the recommendations of the in-depth review in 2013, some methodological changes have been introduced (Appendix 5, Poland's IIR).

Portugal provided detailed information on its recalculations. Since the last submission, recalculations were made were mainly due to updates of background information and methodological revisions according to the *EMEP/EEA Guidebook* and the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006), and in line with recommendations issued during the CLRTAP inventory reviews and other inventory review processes under the UNFCCC and the EC (Appendix 5, Portugal's IIR).

Romania noted that emissions from road transportation were recalculated for the year 2005 to 2013 using COPERT 4 software. The entire 2005–2012 time series was also recalculated following the *EMEP/EEA Guidebook* (Appendix 5, Romania's IIR).

Slovakia provided detailed information on its recalculations. The reasons are new methodology, changes in the legislation, corrections, emission factors in compliance with the *EMEP/EEA Guidebook* and reallocations, as well as updated activity data (Appendix 5, Slovakia's IIR).

Slovenia provided detailed information on its recalculations. The most important recalculations were made in the small combustion sector. Recalculations were carried out due to calculations errors, reallocation of emissions, availability of better data, new estimations, revised guidelines and emission factors from the *EMEP/EEA Guidebook* (Appendix 5, Slovenia's IIR).

Spain provided detailed information on its recalculations. The main reasons for recalculation are changes in estimation methods, updated activity data and error correction (Appendix 5, Spain's IIR).

Sweden provided detailed information on its recalculations. The reasons are reallocation of emissions, revisions and updates of activity data, corrected emissions, correction of the calculation model and updates of methodology (Appendix 5, Sweden's IIR).

The **United Kingdom** provided detailed information on recalculations made since its last CLRTAP submission. Reasons for the recalculations are improved emission estimates and new or additional sources (Appendix 5, the United Kingdom's IIR).

A summary of the individual recalculations reported by Member States is presented in the annual joint EMEP/EEA inventory review report (EMEP/EEA, 2015). This report is available from the CEIP website in July of each year (EMEP CEIP, 2015b).

4.1.2 Member States' emission changes due to review improvements

EMEP CEIP has also been assigned the task of reviewing the submitted emissions, in order to assist Parties in improving the quality of national inventories. These yearly reviews should help Member States to prepare and improve their inventories. Member States compile their individual emission estimates and submit their inventories together with their IIRs.

The Stage 1 review — an automated test — is carried out every year to assess timeliness, completeness and format. The Stage 2 review assesses recalculations, KCA, inventory comparison, trends and time series. Stage 3 is an in-depth review carried out by experts nominated by the Parties. Each year, a review of 10 Parties' inventories is anticipated.

In 2014, the following countries were reviewed: Belgium, Greece, Cyprus, Croatia, Denmark, Germany, Hungary and Spain. In their IIRs, some Member States refer explicitly to improvements made as a consequence of these reviews.

4.2 Planned and implemented improvements

The EEA and ETC/ACM have noted that the main future challenge for EU Member States remains one of improving the quality of data submissions, in order to obtain more complete and timely UNECE LRTAP Convention emission inventories. Improvements cannot be implemented at EU level alone; the development and prioritisation of reliable and timely inventory reporting systems in the Member States themselves is also needed.

Improvements to the quality of Member States' inventories are facilitated through the joint EMEP/EEA annual review of inventory data. The review of data reported under the LRTAP Convention is performed jointly with the review of data reported by Member States under the NEC Directive. Since 2009, a centralised Stage 3 review process has been in. The reviews are performed by two teams of emission experts. Member States are encouraged to nominate reviewers for the EMEP roster of emission review experts; nomination process details are available on the CEIP website. In 2012, the EU emission inventory report (1990–2010) under the UNECE LRTAP Convention was reviewed (EEA, 2012).

4.2.1 Improvements at EU level

Planned improvements

- Further progress concerning **completeness of reporting**: despite clear progress having been made in recent years in terms of the completeness of reporting, a complete set of emission inventory data for air pollutants is still not available for all Member States, as noted earlier in this report. Further, for certain pollutants (including PM, HMs and POPs), data could not be fully gap-filled, because emission values for some Member States had not been not reported in any years.

- **Updating of emission data** by Member States, for past years too: a further issue identified by the ETC/ACM concerns the use of data submitted several years ago in the gap-filling procedure. In a number of cases, because countries have not since resubmitted corrected or updated data sets, inconsistencies are unavoidably introduced into the EU-28 inventory. The quality of the EU's inventory will thus be enhanced if the consistency and completeness of Member States' submissions improves. Such improvements would facilitate reliable trend analysis to inform policy.

- **Review current gap-filling procedures** to ensure that gap-filling procedures use the best approach, reflecting real emissions: the improved inventory gap-filling procedure performed in 2011 has helped develop a more complete EU emission inventory, but there is room for improvement (e.g. by including manual changes into the procedure).

- **Reducing the need for gap-filling**: this can be achieved if Member States report complete time-series as far as possible, and also if the data have been already provided in earlier submissions under the LRTAP. Current gap-filling procedures first use submissions received in the actual reporting years under various reporting mechanisms, and then use older LRTAP submissions.

- **More explanatory information** on trends and recalculations could be provided if such information is contained in the IIRs received.

- Further research on **outliers in Member States' emission data** will help ensure that real emissions are reflected: a comparison of Member States' shares in the EU-28 total reveals extraordinarily high shares in some instances, e.g. for TSPs in France (25%), for BC in France (33%), for Pb in Poland (30%), for Cu in Germany (59%), for Se in Spain (31%), for Zn in Germany (29%), for B(b)F in Poland (25%), for B(k)F in Portugal (25%) and for IP in Poland (41%). Future investigation could determine whether these high shares reflect true emissions, or whether they are ascribable to incomplete reporting (or underestimates) of other Member States.

- More attention to **data quality**: in several submissions from Member States and due to the gap-filling procedure, values of BC exceed $PM_{2.5}$ values, values of $PM_{2.5}$ exceed PM_{10} values, or values of PM_{10} exceed TSP values — which should be impossible. Changes in the gap-filling results and improved Member State emission data should resolve these problems.

Improvements undertaken in 2015

- Information on Member States' adjustments is included in Chapter 1.1.1.

- According to the new NFR14 reporting template, BC was included and HCH excluded from the report.

- Compared to previous years, more focus was placed on B(a)P in this year's report.

- Figures on the completeness of reporting (Figure 1.3, Figure 1.4, Figure 1.5) now include

information for the years 1990, 2000, 2010 and 2013.

- A new sector aggregation has been made according to the new NFR14 reporting template.
- A section on the EEA-5 countries was included (Section 2.2).
- The gap-filled inventory was improved by manual corrections for BC, $PM_{2.5}$ and PM_{10}.
- Early data checks on submitted Member State inventories were performed.

Improvement in reporting at Member State Level

- Basis of emissions from transport: according to the reporting guidelines (UNECE, 2014a), all Member States should calculate and report emissions from road vehicle transport on the basis of the fuel sold. Only for the purpose of comparison with the ceilings, Austria, Belgium, Ireland, Lithuania, Luxembourg, the Netherlands and the United Kingdom may choose to use the national emission total calculated on the basis of fuel used. This year again, the United Kingdom and the Netherlands only submitted data based on fuel used, but for the first time, Belgium submitted data based on fuel sold.
- The updated reporting guidelines (UNECE, 2014a) request that emissions data be provided by Parties to the convention using the new NFR14 format. All 27 EU Member States that submitted data used the new template.

4.2.2 Improvements at Member State level

Improvements at Member State level also automatically improve the EU inventory. For this reason, it is a point of interest to note which countries have improvements planned. An overview of these is provided in Table 4.3. However, that is not easy to gain a systematic overview of the situation overall, as Member States provide varying degrees of information.

Table 4.3 Overview of improvements planned at Member State level

Member State	Improvements planned
Austria	Required methodological changes and planned improvements are described in the corresponding sector analysis chapters (Austria's IIR, p. 21).
Belgium	Planned improvements are listed in Belgium's IIR in Chapters 9.1 through 9.4 and are also described in the relevant sectoral chapters (Belgium's IIR, Chapter 9, pp. 1–5).
Bulgaria	Planned improvements: application of higher tier method for estimation of emissions; incorporation of ETS and E-PRTR databases into emission inventory in NFR sector 1 'Energy' and NFR sector 2 'Industrial processes and other solvents and product use'; incorporation of data provided by branch business associations; revision of activity data in NFR sector 3 'Agriculture', in line with agrostatistic data of the Ministry of Agriculture and Food; improving the accuracy of the estimates; improving transparency, completeness, consistency, including recalculations and time series and comparability of national emission inventory (Bulgaria's IIR, p. 101).
Cyprus	In the 2015 IIR, there are no planned improvements reported.
Czech Republic	*No IIR available.*
Denmark	The inventories are still being improved through work to increase the number of LPS, e.g. power plants, included in the databases as individual point sources. Such an inclusion makes it possible to use plant-specific data for available emissions, e.g. in annual environmental reports from the plants in question (Denmark's IIR, p. 365). Sector-specific planned improvements are described in the relevant sectoral chapters.
Estonia	Source-specific planned improvements are listed in Estonia's IIR: they include recalculations, uncertainty analysis, and improvement of data quality and of QA/QC procedures (Estonia's IIR, p. 75).
Finland	Sector-specific improvement needs are set out in Table 14.3 of Finland's IIR (Finland's IIR, p. 390). Further, the source-specific planned improvements are described in the sectoral chapters.
France	In general, an emission inventory is always improvable. This is especially the case for the underlying approach used in the inventory compilation for substances included in the LRTAP Convention. Diverse investigations have been launched and are planned within this context. Conducting research to improve accuracy, especially for key categories. Establishing measures to determine uncertainties. Reducing the number of non-considered or poorly determined pollutants. There are still plans to improve the estimation from heating boilers in the residential sector, which could strongly influence NO_x emissions. Introducing further splits for energy consumption in the industry sector. Adopting the recent developments of EMEP/EEA. Strengthening all activities, for a better QA and QC of the system, especially towards the implementation of procedures and tools, cooperation with experts from different fields and the maintenance of the ISO 9001 certification system (France's IIR, p. 101).

Table 4.3 Overview of improvements planned at Member State level (cont.)

Member State	Improvements planned
Germany	Planned improvements for the overall inventory include updating projections (data and text), and working on completing the POP inventory. Improvements listed for individual source categories for stationary combustion are improvements/ revision of emission factors (EFs), new calculations and correction of activity data. For mobile combustion, these include new estimates and revision of models.
Greece	*No IIR available.*
Hungary (Information from IIR 2013)	- Further improvement of coordination with E-PRTR reporting and within the Air Quality Protection Information System (LAIR) reporting process. - Quantitative uncertainty analyses. - Submission of entire time-series from 1990. - Improvement of QA/QC actions, application of the same processes as for the UNFCCC annual emission inventory reporting. - Use of CollectER software. - Application of the updated *EMEP/EEA Guidebook.*
Ireland	The source-specific planned improvements are described in the sectoral chapters of Ireland´s IIR.
Italy	For the 'Energy' sector, significant progress is planned in management of the information system. Here, data collected under different obligations (Large Combustion Plants Directive, E-PRTR and Emissions Trading Scheme), are collated to highlight major discrepancies and to detect potential errors. For the sectors 'Agriculture' and 'Waste' improvements related to the availability of new information on emission factors, activity data etc. are planned. Further work is planned to update/change emission factors for the $PM_{2.5}$, BC, PAH, dioxin and HMs (Italy's IIR, p. 146).
Latvia	Planned improvements are listed in the IIR (Latvia's IIR, p. 149) and mainly concern activity data for the sectors 'Energy' and 'Waste'.
Lithuania	Source-specific planned improvements are listed in the sectoral chapters. The reported improvements comprise uncertainty analyses for the transport sector (railway transport, gas transport).
Luxembourg	Planned improvements are listed in the IIR (Luxembourg's IIR, p. 324) and mainly concern the update of methodology to calculate emissions, correction of errors and notation keys, reallocation of emissions and completeness.
Malta (Information from IIR 2013)	The time series may be updated with respect to HM emissions (Malta's IIR, p. 20).
Netherlands	During the compilation process of inventory reports, activities are initiated for future improvement. At this moment, there is no finalised improvement plan available (Netherland's IIR, p. 137) There are some source-specific improvements planned, which are described in the sectoral chapters of Netherland´s IIR.
Poland	The planned programme of improvement is focused on the following tasks: verification of NMVOC emissions from solvents use; gathering additional activity data to include new emission sources (e.g. venting and flaring); and further methodology development by applying higher tiers of estimation methodology (especially for key categories). Emission data for LPS, reported in 2012 in an aggregated form due to statistical confidentiality, will be prepared on an individual basis for the next submission, based on data reported to the national emission inventory database (Poland's IIR, p. 122).
Portugal	A detailed explanation of the planned sectoral improvements is presented in each source-specific section. The main development priorities are focus on country-specific emissions factors for combustion in energy industries, continued work addressing emission factor revision based on the *EMEP/EEA Guidebook*, improvement of the completeness of the inventory by considering the latest methodological guidance available and development of the uncertainty analysis (Portugal's IIR, p. 13).
Romania	Improvements are planned in the 'Energy' sector. 1A3c (Railways): collecting fleet data by locomotive type for applying Tier 2 emissions estimations. 1A4ai and 1A4bi (Commercial/Institutional/Residential): collecting specific fuel consumption data by fuel type and sector at county level detail, for applying Tier 2 emissions estimations. 1A4cii (Agriculture/Forestry/Fishing): collecting specific data for machinery and internal combustion equipment from economic operators/institutions, for applying Tier 2 emissions estimations. 1B2a (Oil): petrol distribution data are being collected at county level. After validation using an energy balance approach, these could be used for a better estimation of NMVOC emissions arising from this source. 1B2b (Natural gas): natural gas extraction data are being collected at county level. After validation using an energy balance approach, these could be used for a better estimation of NMVOC emissions.
Slovakia	No information on planned improvements.
Slovenia	Planned improvements relate to Sectors 1, 3 and 5. The main aim is to use methodology and emission factors from the *EMEP/EEA Guidebook*. A detailed list of the planned improvements can be found within the Slovenia's IIR (Slovenia's IIR, pp. 200–201).
Spain	The principal areas of improvement are: harmonising the inventory with other registries (e.g. PRTR); continuing to update emission factors and methodologies based on guidance given in the *EMEP/EEA Guidebook*; calculation of BC; carrying out quantitative estimations of uncertainty and improvements in the methodology for identifying key categories; implementing a QA programme based on external audits; continuing to revise the inventory of persistent organic compounds; integrating the Expert Review Team (ERT) recommendations from the 2014 in-depth review. Improvements at sectoral level are also listed in Chapters 8.3.1 through 8.3.4 (Spain's IIR, Chapter 8, pp. 10–13)

Table 4.3 Overview of improvements planned at Member State level (cont.)

Member State	Improvements planned
Sweden	Experts at the Swedish Environmental Protection Agency (EPA) review the inventory estimates, methodologies and emissions factors used. The experts also identify areas of improvement which constitute part of the basis for improvements in coming submissions. Besides this information, there is no information on planned improvements.
United Kingdom	A number of improvements to the inventory are planned, although it is anticipated that not all improvements will be incorporated into the next version of the inventory. Planned improvements are relevant for the sectors 'Energy', 'Industrial Processes' and 'Waste', and include methodological changes, as well as orientation on the new *EMEP/EEA Guidebook* (United Kingdom's IIR, pp. 199–210).

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Appendix 1 Notation keys

Where methodological or data gaps in inventories exist, information on these gaps should be presented in a transparent manner. Parties should clearly indicate the sources not considered in their inventories, albeit included in the *EMEP/EEA Guidebook* (EMEP/EEA, 2013), and explain the reason for the exclusion. Similarly, each party should indicate if part of its territory has been excluded, and explain the reason for this. In addition, each party should use the notations presented below to fill the blanks in all the tables of the NFR inventory. This approach facilitates assessment of the completeness of emission data reports. The notations are as follows ([13]).

NO 'Not occurring' is used where an emissions source or process does not exist within a country.

NE **'**Not estimated' is used where emissions occur, but have not been estimated or reported. Where 'NE' is used in an inventory, the party should indicate why emissions could not be estimated.

NA 'Not applicable' is used where a source exists, but relevant emissions are considered never to occur.

IE 'Included elsewhere' is used for emissions that are estimated and included in the inventory, but are not presented separately for the respective source. Where IE is used, the party should indicate where in the inventory the emissions from the displaced source category have been included, and should give the reasons for deviating from the expected category.

C 'Confidential' is used for emissions that are aggregated and included elsewhere in the inventory, because reporting at a disaggregated level could lead to the disclosure of confidential information. Where 'C' is used in an inventory, reference should be made to the protocol provision that authorises such practice.

NR 'Not relevant'. According to Article III, paragraph 9 in the emission reporting guidelines, emission inventory reporting should cover all years from 1980 onwards if data are available. However, 'NR' has been introduced to ease the reporting where emissions are not strictly required by the different protocols, e.g. for some Parties, this includes emissions of NMVOCs prior to 1988.

If a party estimates emissions from country-specific sources, it should explicitly describe which source categories these are, as well as which methodologies, emission factors and activity data have been used for their estimation.

([13]) Further explanation and guidance concerning the use of these notation codes may be found in the EMEP emission reporting guidelines (UNECE, 2014a).

Appendix 2 LRTAP Convention emission reporting programme for 2015

Emission data should be submitted to EMEP CEIP by **15 February 2015**. IIRs should reach the centre no later than **15 March 2015**. Table A2.1 below summarises information contained in the revised emission reporting guidelines (UNECE, 2014a).

Table A2.1 Summary of the information requested in the EMEP emission reporting guidelines

Description of contents	Pollutant(s)	Reporting years [a]
Yearly: minimum (and **additional**)		
A. National total emissions		
1. Main pollutants	NO_x, NMVOCs, SO_x, NH_3, CO	1980–2013
2. Particulate matter	$PM_{2.5}$, PM_{10}, TSPs, (BC)	2000–2013
3. Heavy metals [c]	Pb, Cd, Hg / (As, Cr, Cu, Ni, Se, Zn)	1990–2013
4. Persistent organic pollutants	[b]	1990–2013
B. Emissions by NFR source category		
1. Main pollutants	NO_x, NMVOCs, SO_x, NH_3, CO	1990–2013
2. Particulate matter	$PM_{2.5}$, PM_{10}, TSPs, (BC)	2000–2013
3. Heavy metals [c]	Pb, Cd, Hg / (As, Cr, Cu, Ni, Se, Zn)	1990–2013
4. Persistent organic pollutants	[b]	1990–2013
C. Activity data	Liquid fuels, solid fuels, gaseous fuels, biomass, other fuels, other activity	1990–2013
4-yearly: minimum reporting (from 2017 onwards)		
D. Gridded data in the EMEP 0.1° x 0.1° long/lat grid — Sector emissions (GNFR14) and National Totals (optional)	SO_x, NO_x, NH_3, NMVOCs, CO, PM_{10}, $PM_{2.5}$, Pb, Cd, Hg, PCDD/F, PAHs, HCB, PCBs	2000 (optional), 2005, 2010, 2015 and every 4 years
E. Emissions from LPS	SO_x, NO_x, NH_3, NMVOCs, CO, PM_{10}, $PM_{2.5}$, Pb, Cd, Hg, PCDD/F, PAHs, HCB, PCBs	2000 (optional), 2005, 2010, 2015 and every 4 years
F. Projected emissions and projected activity data		
1. National total emission projections	SO_x, NO_x, NH_3, NMVOCs, $PM_{2.5}$ and BC	2020, 2025, 2030, where available 2040 and 2050
2. Emission projections by NFR14	SO_x, NO_x, NH_3, NMVOCs, $PM_{2.5}$ and BC	2020, 2025, 2030, where available 2040 and 2050
3. Projected activity data by NFR14		2020, 2025, 2030, where available 2040 and 2050
5-yearly: additional reporting for review and assessment purposes		
VOCS speciation/Height distribution/Temporal distribution		Parties are encouraged to review the information used for modelling at http://www.ceip.at/ms/ceip_home1/ceip_home/webdab_emepdatabase/emissions_emepmodels/ online (accessed 20 March 2015)
Land-use data/Mercury breakdown		
Percentage of toxic congeners of PCDD/F emissions		
Pre 1990 emissions of PAHs, HCB, PCDD/Fs and PCBs		
Information on natural emissions		

Note: [a] As a minimum, data for the base year of the relevant protocol and from the year of entry into force of that protocol and up to the latest year (current year − 2) should be reported.

[b] HCB, PCBs, dioxins/furans (PCDD/Fs), PAHs: B(a)P, B(b)F, B(k)F, IP, Total 1-4 (see revised emission reporting guidelines).

[c] The pollutants listed in brackets are voluntary reported pollutants.

Reporting format

Each party should use the reporting format set out in Annex IV of the reporting guidelines (UNECE, 2014a) for its annual submissions. The information should be formally submitted to the CEIP, with notification to the UNECE secretariat, preferably in electronic form. The reporting format, including the NFR, is a standardised format for reporting estimates of emissions — i.e. the NFR format — including activity data, projected activity data, projected emissions and other relevant information. The reporting format aims to facilitate electronic submissions, so as to simplify the processing of emissions information and the preparation of useful technical analyses and synthesis documentation.

The new NFR14 format covers:

- national annual emissions and national annual sector emissions (Annex I);
- total and aggregated sector emissions for reporting emissions of NO_x, NMVOCs, sulphur, NH_3, PM, BC, CO, Pb, Cd, Hg, PCDD/Fs, PAHs, HCB and PCBs, for the EMEP 0.1° x 0.1° grid cell and from LPS (Annexes V and VI);
- for the years 2020, 2025, 2030, 2040 and 2050, projected activity data and projected national total emissions of NO_x, NMVOCs, sulphur and NH_3 to be reported for the source categories listed in Annex IV (A-WM, BWM, A-WaM, BWaM).

Table A2.2 European Union — country grouping

EU-9	refers to the nine Member States, up to 31 December 1980: Belgium (BE), Denmark (DK), France (FR), Germany (DE), Ireland (IE), Italy (IT), Luxembourg (LU), the Netherlands (NL) and the United Kingdom (UK)
EU-12	refers to the 12 Member States, up to 31 December 1994: EU-9 Member States plus Greece (GR), Portugal (PT) and Spain (ES)
EU-15	refers to the 15 Member States, up to 30 April 2003: EU-12 Member States plus Austria (AT), Finland (FI), and Sweden (SE)
EU-27	refers to the 27 Member States up to 30 June 2013: EU-15 Member States plus Bulgaria (BG), Cyprus (CY), the Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Malta (MT), Poland (PL), Romania (RO) Slovakia (SK) and Slovenia (SI)
EU-28	refers to the 28 Member States, from 1 July 2013: EU-27 Member States plus Croatia (HR)

Appendix 3 Status of reporting

Table A3.1 Member State inventory submissions 2015: date received by the EEA, years covered and information provided (as of 6 May 2015)

Member State	Annual reporting						Minimum 5-year reporting		
	Submission date [a]	Date of resubmission and/or additional information	NFR template	Other format	IIR 2015	Activity data [b]	Projections	Gridded data	LPS emissions
Austria	12.02.2015	15.04.2015	2014-1		13.03.2015, 15.04.2015	1990–2013	np	np	np
Belgium	13.02.2015	14.03.2015	2014-1		14.03.2015	1990, 1995, 2000, 2005, 2010–2013	2020, 2025, 2030	np	np
Bulgaria	13.02.2015	15.03.2015, 30.04.2015	2014-1		15.03.2015	1990–2013	2020, 2025, 2030	np	np
Croatia	11.02.2015		2014-1		14.03.2015	1990–2013	2020	np	2013
Cyprus	13.02.2015	17.03.2015, 30.04.2015	2014-1		17.03.2015	1990–2013	2020, 2025, 2030	np	np
Czech Republic	15.02.2015	30.03.2015, 04.05.2015	2014-1		np	2013	2020, 2025, 2030	np	np
Denmark	13.02.2015		2014-1		13.03.2015	1980–2013	2020, 2025, 2030	np	np
Estonia	12.02.2015	13.03.2015, 27.03.2015	2014-1		13.03.2015	1990–2013	2020, 2025, 2030	np	np
Finland	13.02.2015	27.02.2015, 10.03.2015, 13.03.2015, 29.04.2015	2014-1		13.03.2015	2008–2013	2020, 2025, 2030, NH_3: 2050	np	2013
France	12.02.2015		2014-1		13.03.2015	1980–2013	2020	np	np
Germany	04.02.2015	29.04.2015	2014-1		04.02.2015	1990–2013	2020, 2025, 2030	np	np
Greece									
Hungary	20.02.2015		2014-1		07.04.2015	1990–2013	np	np	np
Ireland	13.02.2015		2014-1		16.03.2015	1990–2013	np	np	np
Italy	01.04.2015		2014-1		01.04.2015	1990–2013	np	np	np
Latvia	14.02.2015	15.03.2015, 23.03.2015, 30.04.2015	2014-1		15.03.2015	1990–2013	2020, 2025, 2030	np	np
Lithuania	13.02.2015	10.03.2015, 23.04.2015	2014-1		10.03.2015	1990–2013	2020, 2025, 2030	np	np
Luxembourg	16.02.2015	05.05.2015	2014-1		15.03.2015, 05.05.2015	1990–2013	np	np	np
Malta	25.03.2015		2014-1		np	2000–2013	np	np	np
Netherlands	15.02.2015	30.04.2015	2014-1		15.03.2015	np	2020, 2025, 2030	np	np
Poland	06.02.2015		2014-1		06.02.2015 10.3.2015	1995–2013	np	np	np
Portugal	13.02.2015	13.03.2015, 24.03.2015	2014-1		13.03.2015, 24.03.2015	1990–2013	np	np	np
Romania	13.02.2015	13.03.2015, 30.04.2015	2014-1		13.03.2015	2005–2013	2025	np	np
Slovakia	16.02.2015	16.03.2015, 02.04.2015	2014-1		16.03.2015	2000–2013	np	np	np
Slovenia	12.02.2015		2014-1		13.03.2015	1990–2013	2020, 2025, 2030	np	np
Spain	13.02.2015	23.02.2015, 13.03.2015	2014-1		13.03.2015	1990–2013	2020, 2025, 2030	np	np
Sweden	10.02.2015	11.03.2015	2014-1		10.02.2015	1990–2013	2020, 2025, 2030	np	np
United Kingdom	13.02.2015	13.03.2015	2014-1		13.03.2015	1990–2013	2020, 2025, 2030	np	np

Note: [a] Refers to the first submission of inventory data to the CDR; submission of other data is possible at later dates.
[b] Activity data reported in 2015.
IIR: informative inventory report; np: not provided.
Red-coloured dates indicate that data were submitted after the formal deadline for submissions (15 February; IIR: 15 March).

Table A3.2 Member States' LRTAP Convention submissions of 2015 (as of 6 May 2015)

Member State	NO_x, NMVOC, SO_x, NH_3, CO	$PM_{2.5}$, PM_{10}, TSP (a), BC	Pb, Cd, Hg	Additional HMs (b)	POPs (PCDD/F, PAHs, HCB, PCBs)
Austria	1990–2013	1990, 1995, 2000–2013	1990–2013	np	1990–2013
Belgium	1990, 1995, 2000, 2005, 2010–2013	2000, 2005, 2010–2013	1990, 1995, 2000, 2005, 2010–2013	1990, 1995, 2000, 2005, 2010–2013	1990, 1995, 2000, 2005, 2010–2013
Bulgaria	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Croatia	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Cyprus	1990–2013	2000–2013	1990–2013	1990–2013	1990–2013
Czech Republic	2013	2013	2013	2013	2013
Denmark	1980–2013	2000–2013	1990–2013	1990–2013	1990–2013
Estonia	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Finland	1980–2013	2000–2013	1990–2013	1990–2013	1990–2013
France	1980–2013	1990–2013	1990–2013	1990–2013	1990–2013
Germany	1990–2013	1995–2013	1990–2013	1990–2013	1990–2013
Greece	np	np	np	np	np
Hungary	1990–2013	2000–2013	1990–2013	1990–2013	1990–2013
Ireland	1987, 1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Italy	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Latvia	1990–2013	2000–2013	1990–2013	1990–2013	1990–2013
Lithuania	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Luxembourg	1990–2013	1990–2013	np	np	1990–2013
Malta	2000–2013	2000–2013	2000–2013	2000–2013	2005, 2010–2013
Netherlands	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Poland	1995–2013	1995–2013	1995–2013	1995–2013	1995–2013
Portugal	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
Romania	2005–2013	2005–2013	2005–2013	2005–2013	2005–2013
Slovakia	1990–2013	2000–2013	1990, 1992, 1994–2013	1990, 1992, 1994–2013	2000–2013
Slovenia	1980–2013	2000–2013	1990–2013	np	1990–2013
Spain	1990–2013	2000–2013	1990–2013	1990–2013	1990–2013
Sweden	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013
United Kingdom	1990–2013	1990–2013	1990–2013	1990–2013	1990–2013

Note: (a) Reporting of TSPs is not required if a Member State reports PM emissions.
(b) Reporting of additional HMs is not mandatory.
'np': not provided.

Appendix 4 Conversion chart for aggregated sector groups

To enable the presentation of sectoral emission trends (Chapter 3), individual NFR source categories for the EU-28 inventory were aggregated into the following main sector groups:

- Energy production and distribution
- Energy use in industry
- Industrial processes and product use
- Commercial, institutional and households
- Road transport
- Non-road transport
- Agriculture
- Waste.

A conversion chart showing which of the individual NFR source categories was included in each of the aggregated sector groups is provided in Table A4.1.

Table A4.1 Conversion chart for aggregated sector groups

NFR code	Full name	EEA aggregated sector name
1A1a	Public electricity and heat production	Energy production and distribution
1A1b	Petroleum refining	Energy production and distribution
1A1c	Manufacture of solid fuels and other energy industries	Energy production and distribution
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Energy use in industry
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Energy use in industry
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Energy use in industry
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Energy use in industry
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Energy use in industry
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Energy use in industry
1A2gvii	Mobile Combustion in manufacturing industries and construction	Energy use in industry
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Energy use in industry
1A3ai(i)	International aviation LTO (civil)	Non-road transport
1A3aii(i)	Domestic aviation LTO (civil)	Non-road transport
1A3bi	Road transport: Passenger cars	Road transport
1A3bii	Road transport: Light duty vehicles	Road transport
1A3biii	Road transport: Heavy duty vehicles and buses	Road transport
1A3biv	Road transport: Mopeds & motorcycles	Road transport
1A3bv	Road transport: Gasoline evaporation	Road transport
1A3bvi	Road transport: Automobile tyre and brake wear	Road transport
1A3bvii	Road transport: Automobile road abrasion	Road transport
1A3c	Railways	Non-road transport
1A3di(ii)	International inland waterways	Non-road transport
1A3dii	National navigation (shipping)	Non-road transport

Table A4.1 Conversion chart for aggregated sector groups (cont.)

NFR code	Full name	EEA aggregated sector name
1A3ei	Pipeline transport	Non-road transport
1A3eii	Other	Non-road transport
1A4ai	Commercial/institutional: Stationary	Commercial, institutional and households
1A4aii	Commercial/institutional: Mobile	Commercial, institutional and households
1A4bi	Residential: Stationary	Commercial, institutional and households
1A4bii	Residential: Household and gardening (mobile)	Commercial, institutional and households
1A4ci	Agriculture/Forestry/Fishing: Stationary	Commercial, institutional and households
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Commercial, institutional and households
1A4ciii	Agriculture/Forestry/Fishing: National fishing	Non-road transport
1A5a	Other stationary (including military)	Commercial, institutional and households
1A5b	Other, Mobile (including military, land-based and recreational boats)	Commercial, institutional and households
1B1a	Fugitive emission from solid fuels: Coal mining and handling	Energy production and distribution
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	Energy production and distribution
1B1c	Other fugitive emissions from solid fuels	Energy production and distribution
1B2ai	Fugitive emissions oil: Exploration, production, transport	Energy production and distribution
1B2aiv	Fugitive emissions oil: Refining/storage	Energy production and distribution
1B2av	Distribution of oil products	Energy production and distribution
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	Energy production and distribution
1B2c	Venting and flaring (oil, gas, combined oil and gas)	Energy production and distribution
1B2d	Other fugitive emissions from energy production	Energy production and distribution
2A1	Cement production	Industrial processes and product use
2A2	Lime production	Industrial processes and product use
2A3	Glass production	Industrial processes and product use
2A5a	Quarrying and mining of minerals other than coal	Industrial processes and product use
2A5b	Construction and demolition	Industrial processes and product use
2A5c	Storage, handling and transport of mineral products	Industrial processes and product use
2A6	Other mineral products	Industrial processes and product use
2B1	Ammonia production	Industrial processes and product use
2B2	Nitric acid production	Industrial processes and product use
2B3	Adipic acid production	Industrial processes and product use
2B5	Carbide production	Industrial processes and product use
2B6	Titanium dioxide production	Industrial processes and product use
2B7	Soda ash production	Industrial processes and product use
2B10a	Chemical industry: Other	Industrial processes and product use
2B10b	Storage, handling and transport of chemical products	Industrial processes and product use
2C1	Iron and steel production	Industrial processes and product use
2C2	Ferroalloys production	Industrial processes and product use
2C3	Aluminium production	Industrial processes and product use
2C4	Magnesium production	Industrial processes and product use
2C5	Lead production	Industrial processes and product use
2C6	Zinc production	Industrial processes and product use
2C7a	Copper production	Industrial processes and product use
2C7b	Nickel production	Industrial processes and product use
2C7c	Other metal production	Industrial processes and product use
2C7d	Storage, handling and transport of metal products	Industrial processes and product use
2D3a	Domestic solvent use including fungicides	Industrial processes and product use
2D3b	Road paving with asphalt	Industrial processes and product use
2D3c	Asphalt roofing	Industrial processes and product use
2D3d	Coating applications	Industrial processes and product use

Table A4.1 Conversion chart for aggregated sector groups (cont.)

NFR code	Full name	EEA aggregated sector name
2D3e	Degreasing	Industrial processes and product use
2D3f	Dry cleaning	Industrial processes and product use
2D3g	Chemical products	Industrial processes and product use
2D3h	Printing	Industrial processes and product use
2D3i	Other solvent use	Industrial processes and product use
2G	Other product use	Industrial processes and product use
2H1	Pulp and paper industry	Industrial processes and product use
2H2	Food and beverages industry	Industrial processes and product use
2H3	Other industrial processes	Industrial processes and product use
2I	Wood processing	Industrial processes and product use
2J	Production of POPs	Industrial processes and product use
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	Industrial processes and product use
2L	Other production, consumption, storage, transportation or handling of bulk products	Industrial processes and product use
3B1a	Manure management — Dairy cattle	Agriculture
3B1b	Manure management — Non-dairy cattle	Agriculture
3B2	Manure management — Sheep	Agriculture
3B3	Manure management — Swine	Agriculture
3B4a	Manure management — Buffalo	Agriculture
3B4d	Manure management — Goats	Agriculture
3B4e	Manure management — Horses	Agriculture
3B4f	Manure management — Mules and asses	Agriculture
3B4gi	Manure management — Laying hens	Agriculture
3B4gii	Manure management — Broilers	Agriculture
3B4giii	Manure management — Turkeys	Agriculture
3B4giv	Manure management — Other poultry	Agriculture
3B4h	Manure management — Other animals	Agriculture
3Da1	Inorganic N-fertilizers (includes also urea application)	Agriculture
3Da2a	Animal manure applied to soils	Agriculture
3Da2b	Sewage sludge applied to soils	Agriculture
3Da2c	Other organic fertilisers applied to soils (including compost)	Agriculture
3Da3	Urine and dung deposited by grazing animals	Agriculture
3Da4	Crop residues applied to soils	Agriculture
3Db	Indirect emissions from managed soils	Agriculture
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	Agriculture
3Dd	Off-farm storage, handling and transport of bulk agricultural products	Agriculture
3De	Cultivated crops	Agriculture
3Df	Use of pesticides	Agriculture
3F	Field burning of agricultural residues	Agriculture
3I	Agriculture other	Agriculture
5A	Biological treatment of waste — Solid waste disposal on land	Waste
5B1	Biological treatment of waste — Composting	Waste
5B2	Biological treatment of waste — Anaerobic digestion at biogas facilities	Waste
5C1a	Municipal waste incineration	Waste
5C1bi	Industrial waste incineration	Waste
5C1bii	Hazardous waste incineration	Waste
5C1biii	Clinical waste incineration	Waste

Table A4.1 Conversion chart for aggregated sector groups (cont.)

NFR code	Full name	EEA aggregated sector name
5C1biv	Sewage sludge incineration	Waste
5C1bv	Cremation	Waste
5C1bvi	Other waste incineration	Waste
5C2	Open burning of waste	Waste
5D1	Domestic wastewater handling	Waste
5D2	Industrial wastewater handling	Waste
5D3	Other wastewater handling	Waste
5E	Other waste	Waste
6A	Other (included in National Total for entire territory)	Other

Note: LTO: Landing/Take-off.

Appendix 5 Member State informative inventory reports (IIRs)

Table A5.1 List of submitted IIRs including source and date of submission (cut-off date 6 May 2015)

Country code	Title of informative inventory report	Source	Date of submission
AT	Austria's Informative Inventory Report (IIR) 2015. Submission under the UNECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/at/un/CLRTAP_AT/envvqhc_a	13.3.2015
	Austria's Informative Inventory Report (IIR) 2015. Submission under the UNECE Convention on Long-range Transboundary Air Pollution (Resubmission)	http://cdr.eionet.europa.eu/at/un/CLRTAP_AT/envvs49xa/index_html?&page=2	15.03.2015
BE	Informative Inventory Report. About Belgium's annual submission of air emission data reported in February 2015 under the Convention on Long-range Transboundary Air Pollution (CLRTAP)	http://cdr.eionet.europa.eu/be/un/UNECE_CLRTAP_BE/envvqrtpg	14.3.2015
BG	Bulgaria's Informative Inventory Report 2015 (IIR). Submission under the UNECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/bg/un/copy_of_UNECE_CLRTAP_BG/envvqwnfq	15.3.2015
CY	Cyprus Informative Inventory. Report 2013	http://cdr.eionet.europa.eu/cy/un/UNECE_CLRTAP_CY/envvqgjug	17.3.2015
CZ	No IIR available		
DE	German Informative Inventory Report	http://iir-de.wikidot.com/start	04.2.2015
DK	Annual Danish Informative Inventory Report to UNECE. Emission inventories from the base year of the protocols to year 2013	http://cdr.eionet.europa.eu/dk/Air_Emission_Inventories/Submission_EMEP_UNECE/envvqkh8q	13.3.2015
EE	Estonian Informative Inventory Report 1990–2013. Submitted under the Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/ee/un/UNECE_CLRTAP_EE/envvqlzzw	13.3.2015
ES	Spain. Informative Inventory Report. 1990–2013	http://cdr.eionet.europa.eu/es/un/UNECE_CLRTAP_ES/envvqmiua	13.3.2015
FI	Air Pollutant Emissions in Finland 1990–2013. Informative Inventory Report to the UNECE CLRTAP	http://cdr.eionet.europa.eu/fi/un/UNECE_CLRTAP_FI/envvqld1w	13.3.2015
FR	Inventaire des émissions de polluants atmosphériques en France au titre de la convention sur la pollution atmosphérique transfrontalière à longue distance et de la directive Européenne relative aux plafonds d'émissions nationaux (NEC)	http://cdr.eionet.europa.eu/fr/eu/colqhxdtq/envvqkrdq	13.3.2015
GB	UK Informative Inventory Report (1990–2013)	http://cdr.eionet.europa.eu/gb/un/cols3f2jg/envvqfeaw	13.3.2015
GR	No IIR available	n/a	n/a
HR	Republic of Croatia 2015. Informative Inventory Report (1990–2013)	http://cdr.eionet.europa.eu/hr/un/UNECE_CLRTAP_HR/envvqrcuq	14.3.2015
HU	No IIR available		
IE	Ireland. Informative Inventory Report 2015. Air Pollutant Emissions in Ireland 1990-2013 reported to the Secretariat of the UN/ECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/ie/un/colvnzbnq/envvqcdvq	16.3.2015
IT	Italian Emission Inventory 1990–2013 Informative Inventory Report 2015	http://groupware.sinanet.isprambiente.it/reportnet/library/ae1sclrtapsandsnecsdata/ae-1-clrtap-data-2015/informative-inventory-report-2015	03.05.2015
LT	Lithuania's Informative Inventory Report 2013	http://cdr.eionet.europa.eu/lt/un/UNECE_CLRTAP_LT/envvp7qzw	10.3.2015

Table A5.1 List of submitted IIRs including source and date of submission (cut-off date 6 May 2015) (cont.)

Country code	Title of informative inventory report	Source	Date of submission
LU	Luxembourg's Informative Inventory Report 1990–2013. Submission under the UNECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/lu/un/UNECE_CLRTAP_LU/envvqxomq	15.3.2015
	Luxembourg's Informative Inventory Report 1990–2013. Submission under the UNECE Convention on Long-range Transboundary Air Pollution — Version 2 (Resubmission)	http://cdr.eionet.europa.eu/lu/un/UNECE_CLRTAP_LU/envvqxomq/	05.05.2015
LV	Latvian Informative Inventory Report 1990–2013	http://cdr.eionet.europa.eu/lv/un/copy_of_colqhgwdg/envvqxk4g	15.3.2015
MT	No IIR available		
NL	Emissions of transboundary air pollutants in the Netherlands 1990–2013. Informative Inventory Report 2015	http://cdr.eionet.europa.eu/nl/eu/colqt3lza/envvqw9kg	15.3.2015
PL	Poland's Informative Inventory Report 2015. Submission under UN ECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/pl/un/EMEP%20emissions%20data/envvp7w9q	10.3.2015
PT	Portuguese Informative Inventory Report 1990–2013. Submitted under the UNECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/pt/un/UNECE_CLRTAP_PT/envvqmjmw	13.3.2015
	Portuguese Informative Inventory Report 1990–2013. Submitted under the UNECE Convention on Long-range Transboundary Air Pollution — Version 2	http://cdr.eionet.europa.eu/pt/un/UNECE_CLRTAP_PT/envvrffa/	24.03.2015
RO	Romania's Informative Inventory Report 2015. Submission under UNECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/ro/un/UNECE_CLRTAP_RO/envvqltiw	13.3.2015
SE	Informative Inventory Report Sweden 2015. Submitted under the Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/se/eu/colp93lqa/envvnnqjw	10.2.2015
SI	2015. Informative Inventory Report for Slovenia. Submission under the UNECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/si/un/UNECE_CLRTAP_SI/colvnywhw/envvqktrq	13.3.2015
SK	Informative Inventory Report 2015. Slovak Republic. Under the Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/sk/un/UNECE_CLRTAP_SK/envvqyojg	16.3.2015

European Environment Agency

European Union emission inventory report 1990–2013 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)

2015 — 125 pp. — 21 x 29.7 cm

ISBN 978-92-9213-655-0
doi:10.2800/031449

TH-AK-15-008-EN-N
doi:10.2800/031449

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