European Environment Agency

Fact sheet - Meta-info cover page

ETC/ACC IP2004

Task number	***Task Title***	***ETC task leader***
1.3.	TERM	Liana Kalognomou

Indicator

Indicator title:	EEA31 – Transport emissions of greenhouse gases
ETC/ACC Indicator ID	TERM 2004 02

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Status & Deadlines

	Status *(mark with **X**)*	***Planned deadline (IP2004)*** *(Fill all out at start of drafting process)*	***Date of delivery***
First Draft, for approval by EEA	**X**	7/8.2004	09.08.2004
Final Draft, for approval by EEA	**X**	8/9.2004	09.09.2004
Final Version, Approved by EEA	**X**	11.2004	07/02/2005

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Internal ETC/ACC Review (by ETC-members and data source owners)

Date	***Modificated by***	***Organisation***	***Reason for modification***

Indicator Fact Sheet

TERM 2004 02 EEA31 – Transport emissions of greenhouse gases by mode

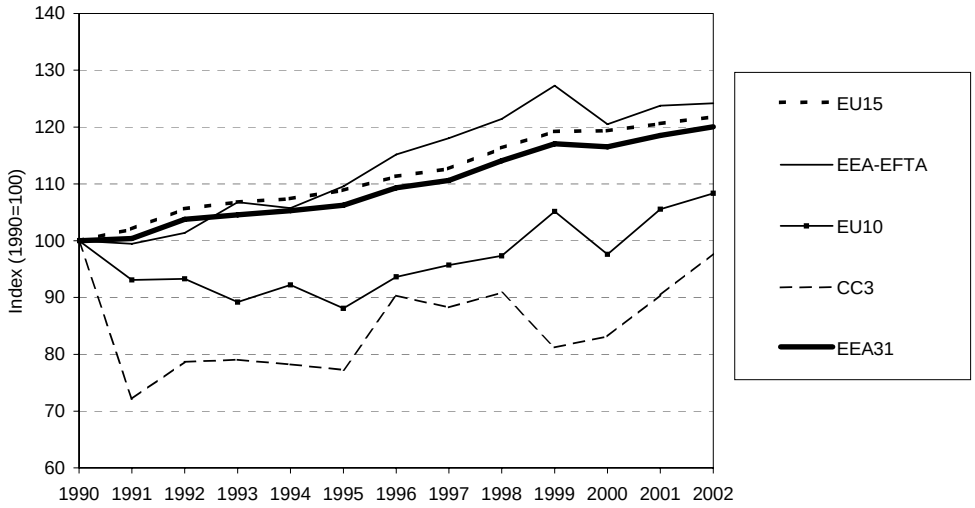
☹ **In the area of EEA31, emissions of greenhouse gases (GHGs) from transport (excluding international air and maritime transport) increased by 20 % between 1990 and 2002. The EU15 Member States make up 89 % of the total EEA31 transport emissions and they increased by 22 % in the period of 1990-2002. In the EEA-EFTA countries the emissions increased by 24 % while in the new EU Member States (EU10) the increase was 8 %. The group EEA-EFTA has the highest increase in emissions, followed by EU15 and EU10. In the Candidate Countries (CC3 – without Turkey) the emissions decreased by 2 %.**

For several EU15 Member States and EEA-EFTA countries rapidly rising greenhouse gas emissions from transport are a serious concern for meeting the Kyoto target.

EU15 is the only country group with data on change in modal split in 1990 and 2002. In the EU15, domestic aviation was the fastest growing transport mode, while rail transport was the fastest decreasing one. Also GHG emissions from international aviation and navigation are increasing rapidly but these emissions are, in accordance with UNFCCC guidelines, not included in the GHG emission totals relevant for the Kyoto targets.

In the EU15, the transport sector was responsible for 21 % of the total GHG emissions in 2002 while in the EU10 the transport sector contributed only by 10 % to the total GHG emissions. In the EEA-EFTA this figure was 26 %.

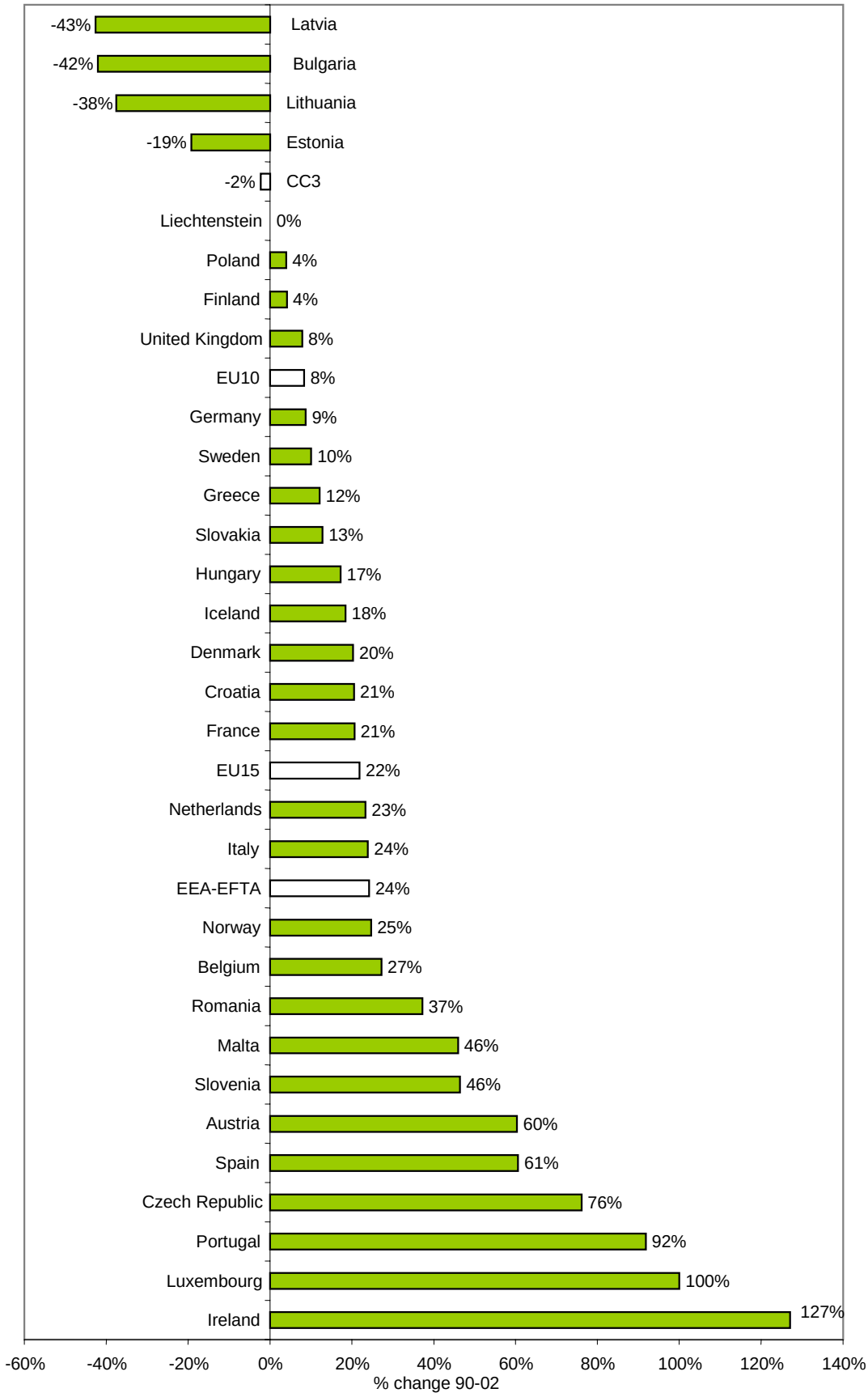
Figure 1: Total EEA31 greenhouse gas emissions from transport



Note: EU15 refers to EU Member States prior to May 2004 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom) EEA-EFTA to the EFTA countries (Iceland, Liechtenstein and Norway), EU10 to new EU Member States as of May 2004 (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia – no data available from Cyprus) and CC3 to Candidate Countries (Bulgaria, Croatia and Romania – no data available from Turkey)

Source: EEA, 2004b.

Figure 2: Change in total GHG emissions from transport



Note: Change 1990-2002 refers to last available year, see table 1.

Note: EU15 refers to EU Member States prior to May 2004 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom) EEA-EFTA to the EFTA countries (Iceland, Liechtenstein and Norway), EU10 to new EU Member States as of May 2004 (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia – no data available from Cyprus) and CC3 to Candidate Countries (Bulgaria, Croatia and Romania – no data available from Turkey)

Source: EEA, 2004b; UNFCCC, 2004

EEA31 GHG emissions from transport

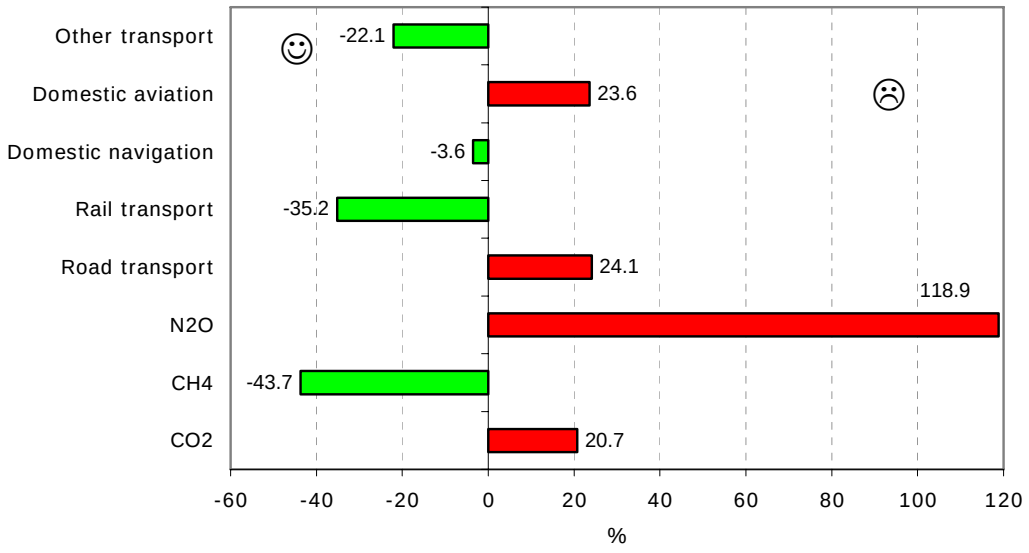
☹ **EU15: Emissions of GHGs from transport have increased by 22 % between 1990 and 2002, contributing to a fifth of the total GHG emissions in 2002 in the EU15. CO_2 is the main contributor to transport GHG emissions (97 %) and road transport is, in turn, the largest contributor to these emissions (93 % in 2002). Road transport and air transport are the fastest growing contributors to transport GHG emissions between 1990 and 2002. Transport is also a small, but rapidly growing source of N_2O emissions. Since transport is not a large source of N_2O, this will not have a major impact on the overall trend of total EU15 GHG emissions.**

☹ **EEA-EFTA: Norway, Iceland and Liechtenstein together account for 2 % of the total GHG emissions from transport in the EEA31 area. The GHG emissions from transport in these three countries were 24 % above the 1990 levels in 2002.**

☹ **EU10: Transport GHG emissions increased by 8 % in the EU10 (no data for Cyprus available) between 1990 and 2002 as a consequence of increased road transport demand in the EU10 area. CO_2 is the most important GHG, with 97 % share on total GHG emissions from the transport sector. These CO_2 emissions increased by 6 % between 1990 and 2002. Road transport is a small, but rapidly growing source of N_2O emissions, due to the penetration of three-way catalysts.**

☺ **The CC3 (without Turkey) make up 2 % of the total GHG emissions from transport in the EEA31 area (no data for Turkey available). The GHG emissions from transport in the CC3 decreased by 2 % between 1990 and 2002.**

Figure 3: Contribution to change in total EU15 GHG transport emissions by mode and pollutant, 1990-2002



Note: The modal split is based on EU15. Modal split excludes emissions from international bunkers. See the note on table 5 for details. 'Other transport' includes pipeline and some off-road transport. For other country groups no modal split for both 1990 and 2002 available. For changes in emissions from transport see table 4.

Source: EEA, 2004b

Results and assessment

Policy relevance

The EU15 Kyoto Protocol target for 2008-2012 is a reduction of 8% from 1990 levels for the basket of six GHGs. In June 1998, EU15 Member States agreed a system of 'burden sharing' or 'target sharing'. These targets for Member States were reaffirmed in Council Decision 2002/358/CE[1].

This indicator analyses the trend in transport GHG emissions from 1990 to 2002. Note that the emission totals relevant under the Kyoto Protocol do not include GHG emissions from international aviation and maritime transport. Therefore, in this fact sheet, all transport related GHG emissions exclude emissions from international aviation and maritime transport. The indicator is aimed to evaluate the trend in transport GHG emissions in the EEA31 region as well as to analyse relative importance of different GHGs and mode.

No overall targets for emissions of GHGs from transport have been agreed in the EU15 or in other country groups.

Policy context EU15

The main frame for policy action at EU level is the European climate change programme (ECCP), which was established in June 2000 to help identify the most cost-effective additional measures (at costs less than EUR 20 per tonne of CO_2 equivalent) to meet the EU target, using a multi-stakeholder consultative process that focused on the energy, transport, industry and agriculture sectors and on the cross-cutting issue of emission trading within the EU. The ECCP is one of the instruments to implement the sixth environmental action programme. ECCP reports (European Commission, 2001a) identified a number of policies and measures, resulting in proposals for directives on emission trading; biofuels; promotion of renewable energy sources, energy performance of buildings, energy-efficient public procurement and proposals on fluorinated gases.

The second ECCP progress report (European Commission, 2003a) gives an overview of the latest results of the ECCP, including the status of implementation of the range of measures investigated since the start of the Programme. It forms the basis for the Commission to prepare further actions in those areas that are most promising and it keeps the focus on cost effective measures.

Furthermore, a directive on the principles and structure of an infrastructure-charging system for road transport (Heavy Duty Vehicles) including a common methodology for setting charging levels and cross financing was proposed by the Commission in 2003 (European Commission, 2003b).

The directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport aims to achieve 20 % substitution of conventional automotive fuels by alternative fuels for road transportation and defines a set of measures to promote the use of biofuels (European Commission, 2003d). The biofuels directive contains two indicative targets of 2 and 5.75% of petrol and diesel to be substituted by biofuels by 2005 and 2010. Security of supply and GHG being the main drivers. Member States have to justify if they do not plan to meet the targets.

A proposal to introduce special tax arrangements for diesel fuel used for commercial purposes and to align the excise duties on petrol and diesel fuel was already proposed by the Commission in 2002 (European Commission, 2002) but has received a negative opinion from the European Parliament and has not so far been adopted by the Council.

[1] OJ L 130, 15.5.2002, p. 1

However, in October 2003 the Council reached agreement on a directive (2003/96/EC) restructuring the Community framework for the taxation of energy products and electricity. The Directive will widen the scope of the Community minimum rate system, currently limited to mineral oils (including motor fuels), to all energy products, chiefly coal, gas and electricity, as well as updating the minimum rates for mineral oils which have not been revised since 1992. Member States will be allowed to differentiate between commercial and non-commercial diesel, which will allow them, for example, to provide for a lower rate of duty on commercial diesel, as long as the minimum levels set by the Directive are observed and as long as the rate for commercial diesel does not fall below the national level of taxation in force on 1 January 2003. This possibility to differentiate will also enable Member States to reduce the gap in excise duty levels between non-commercial diesel used in cars and petrol.

As far as commercial diesel is concerned, the Commission considers that it is necessary for Member States to continue working on the Commission proposal for a directive for the harmonisation of taxation of commercial diesel fuel. The energy tax directive only provides for minimum rates of taxation, and minimum rates do not remedy the problem of distortion of competition on road haulage markets, which stems from the significant differences in the rates of diesel taxation in the Member States.

In December 2003 the Commission proposed a new Directive on energy efficiency and energy services in the Union. The objective is to save an additional fixed amount of energy every year equal to at least 1% of previous consumption in each Member State, leading in 2012 to an annual improvement in energy efficiency of around 6%. Although not the main focus, transport energy consumption is within the scope of the Directive as proposed (European Commission 2003c).

The Communication on transport and CO_2 (European Commission, 1998) identifies a series of measures to reduce CO_2 emissions, such as: improved logistics and more efficient freight operations, technical improvements, promotion of rail, short sea shipping, walking, cycling and public transport, and air traffic management.

The Commission also adopted a strategy to reduce CO_2 emissions from passenger cars and improve fuel economy, which was endorsed by the Council in 1996. It aims at achieving an average CO_2 emission figure for new passenger cars of 120 g CO_2/km by 2005, and 2010 at the latest. An important element in the implementation of this strategy is the voluntary commitments made by the auto manufactures on achieving an average CO_2 emission of 140 g CO_2/km by 2008 for ACEA members (2009 for JAMA and KAMA) [2]. A midterm review was initiated in 2003 to consider the scope for further reductions towards reaching the Commission target of 120 g CO_2/km.The result of the midterm review was that ACEA is on track (ahead of schedule) while JAMA and KAMA are also doing well but still have a long way to go. (see TERM 27 – Overall energy efficiency and specific CO_2 emissions for passenger and freight transport per passenger-km and per tonne-km and by mode).

Policy context EEA-EFTA

According to the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC), the EEA-EFTA countries are committed to emission growth limitations of 1 % (Norway), 10 % (Iceland) and a reduction of 8 % (Liechtenstein) from the base year levels by 2008-2012.

Policy context EU10

According to the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1997, the new EU Member States are committed to emission reductions of 6 % (Hungary and Poland) or 8 % (all other countries) by 2008-2012. In accordance with decision 9/CP.2 under the UNFCCC, some EU10 Member States use base years other than 1990: Hungary (average 1985-87), Poland (1988) and Slovenia (1986). Cyprus and Malta have no reduction targets.

[2] The development in the emissions from new passenger cars are monitored in COM(2004)78 final.

Policy context Candidate Countries

According to the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC), Bulgaria and Romania are committed to emission reductions of 8 % from the base years 1988 and 1989 respectively by 2008-2012. Croatia's target is a reduction of 5 % from the base year 1990 by 2009-2012. Turkey has no reduction target.

Environmental context

There is mounting evidence that emissions of GHGs are causing global and European surface air temperature increases, resulting in climate change (IPCC, 2001). The potential consequences at the global level of further increased temperatures include rising sea levels, floods and droughts, changes in biota and food productivity and increase of infectious diseases. These effects will have impacts on socio-economic sectors, such as agriculture and on water resources. Efforts to reduce or limit the effects of climate change are focused on limitation of the emissions of all GHGs.

In the transport sector, CO_2 emissions are the result of burning petrol, diesel and kerosene in internal combustion engines. CO_2 is the most important anthropogenic GHG.

The links between transport, energy use and CO_2 emissions can be characterised by the following equation: CO_2 emissions from transport are equal to the product of transport activity (measured as passenger-kilometres or tonne-kilometres), modal structure (the share of each activity by transport mode), modal energy intensity (energy use per unit of passenger or freight travel by mode), and the emission rate (CO_2 emissions per unit of energy consumed) (IEA, 2000).

Developed countries typically show rising CO_2 emissions from transport, which are mainly due to rising transport activities and an increase in the share of road transport. Fuel efficiency increases have not been able to outweigh this increase.

The transport sector is a small, but rapidly rising source of N_2O as the implementation of the three-way catalysts fitted to petrol-engine motor vehicles increases N_2O emissions. Fluorinated gases are as well a very small part of the total greenhouse gas emissions from the transport sector as they are emitted from automotive air conditioning (European Commission, 2003e). (These emissions have not been quantified separately at EU level.) Methane (CH_4) from transport is a negligible GHG source.

Assessment

GHG emissions from transport increased by 20 % between 1990 and 2002 in the EEA31 countries[3]. Emissions increased faster in the EEA-EFTA and EU15 Member States than in the EU10. For several EU15 Member States and EEA-EFTA countries rapidly rising greenhouse gas emissions from transport are a serious concern for meeting the Kyoto target.

In the EU15 GHG emissions from transport increased by 22 %; they contribute by 89 % to the total EEA31 transport emissions. The transport emissions increased due to continuous increases in road transport volume (both passenger and freight). Since 2000, the increase of transported related GHG emissions slowed down which might be at least partly due to lower economic activity.

Figure 2 shows that between 1990 and 2002, greenhouse gas emissions from transport increased in all EU15 Member States. Finland, Sweden, Germany and the United Kingdom limited their emission increases below 10 %. Austria, Spain, Portugal, Luxembourg and Ireland registered emission increases of more than 60 %. The main reason for the large increase in Ireland is growth in road transport volumes. A second explanation is 'fuel tourism' – passenger car fuels bought in Ireland, where fuel prices are relatively low, but consumed outside Ireland

[3] Note that, in accordance with UNFCCC guidelines, this increase does not include GHG emissions from international aviation and navigation which, in general, increase more rapidly than GHG emissions from domestic transport (see Box 2).

(e.g. in Northern Ireland). 'Fuel tourism' due to comparatively low fuel prices is also an important reason in other EU15 Member States such as Austria and Luxembourg.

Explanations for the relatively small changes in emissions in Finland, Sweden and the UK may be high per capita greenhouse gas emissions from transport in 1990 and high and/or rapidly growing road fuel prices. For the cohesion countries (Greece, Ireland, Portugal and Spain), the opposite is true: low starting points in terms of per capita emissions and low road fuel prices. They have experienced strong growth in transport demand, particularly road, driven by economic growth, and have therefore also experienced large increases in greenhouse gas emissions.

In Germany, which is the largest emitter within EU15, GHG emissions from transport decreased for the third consecutive year. One reason for this might be the annual increases of road fuel taxes since 1999 in the framework of the ecological tax reform. The rising road fuel prices in Germany have a.o. also encouraged cross-border sales of road fuel; as emissions from road transport are calculated on basis of fuel sold in the national territory emissions from fuel sold abroad are not included in the national GHG inventory. However, no information on the magnitude of this effect for Germany is available.

The second largest group is the EU10 with a share of 7 % on total EEA31 transport emissions and an increase of 8 % between 1990 and 2002. There was a slow reduction in emissions until 1995. Since 1995, GHG emissions from transport have been rising again, with a small reduction in 2000. The main reason for the emission reductions in the first half of the decade was the economic downturn after the fall of the iron curtain. In recent years emissions from transport increased mainly due to growing road transport demand which, at least partly, resulted from declining rail transport (modal shift from rail to road).

The CC3 (without Turkey) account for 2 % of total EEA31 transport emissions and decreased their emissions by 2 % between 1990 and 2002. The decrease is due to decline in Bulgarian emissions (-43 %). The reasons for the decline in Bulgaria are the same as in many other East European countries, namely, economic recession during the early nineties. In Croatia and Romania, however, the emissions have increased. Note that the change in Candidate Countries would be different if Turkish emission data were available and included in these comparisons.

The EEA-EFTA countries Norway, Iceland and Liechtenstein together account for 2 % of the total GHG emissions from transport in the EEA31 area. The GHG emissions from transport in these three countries were 24 % above the 1990 levels in 2002. The emissions are dominated by Norway with an increase of 25 %.

With 97 % in the EEA31, CO_2 is by far the most important GHG within the transport sector, followed by N_2O (3 %) and CH_4 (0.3 %). As catalytic converters lead to a decrease in CH_4 emissions, the emissions fell by 41 % between 1990 and 2002. In contrast, the introduction of the catalytic converter has increased N_2O emissions from transport.

Sub-indicator: CO_2 emissions from transport in EEA31

☹ **Emissions of CO_2 from transport (excluding international aviation and maritime transport) increased by 19 % in the EEA31 between 1990 and 2002. In 2002, CO_2 emissions constituted 97 % of total EEA31 GHG emissions from transport. CO_2 emissions from transport increased in all other countries except Latvia, Bulgaria, Lithuania, Estonia, and Liechtenstein.**

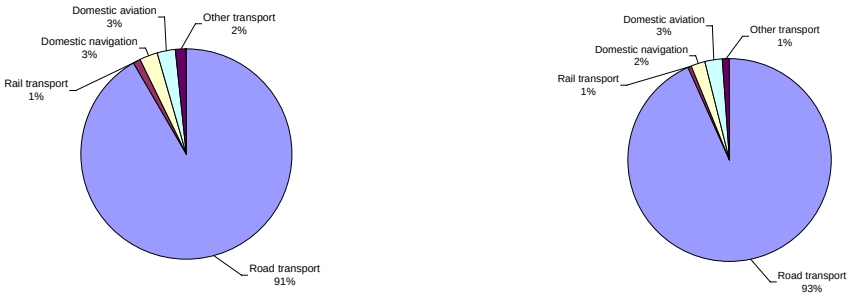
☹ **In the EU15, the CO_2 emissions from transport were 21 % above the 1990 levels in 2002. Similarly, in the EU10, emissions of CO_2 from transport increased by 7 % in the same period. Since 1995, CO_2 emissions from transport have been rising again.**

☺ **The CC3 (without Turkey), CO_2 emissions from transport decreased by 3 % between 1990 and 2002.**

☹ **The emissions from Norway, Iceland and Liechtenstein increased by 20 % in the same period.**

Figure 4: EU15 CO_2 emissions from transport by mode, 1990 and 2002

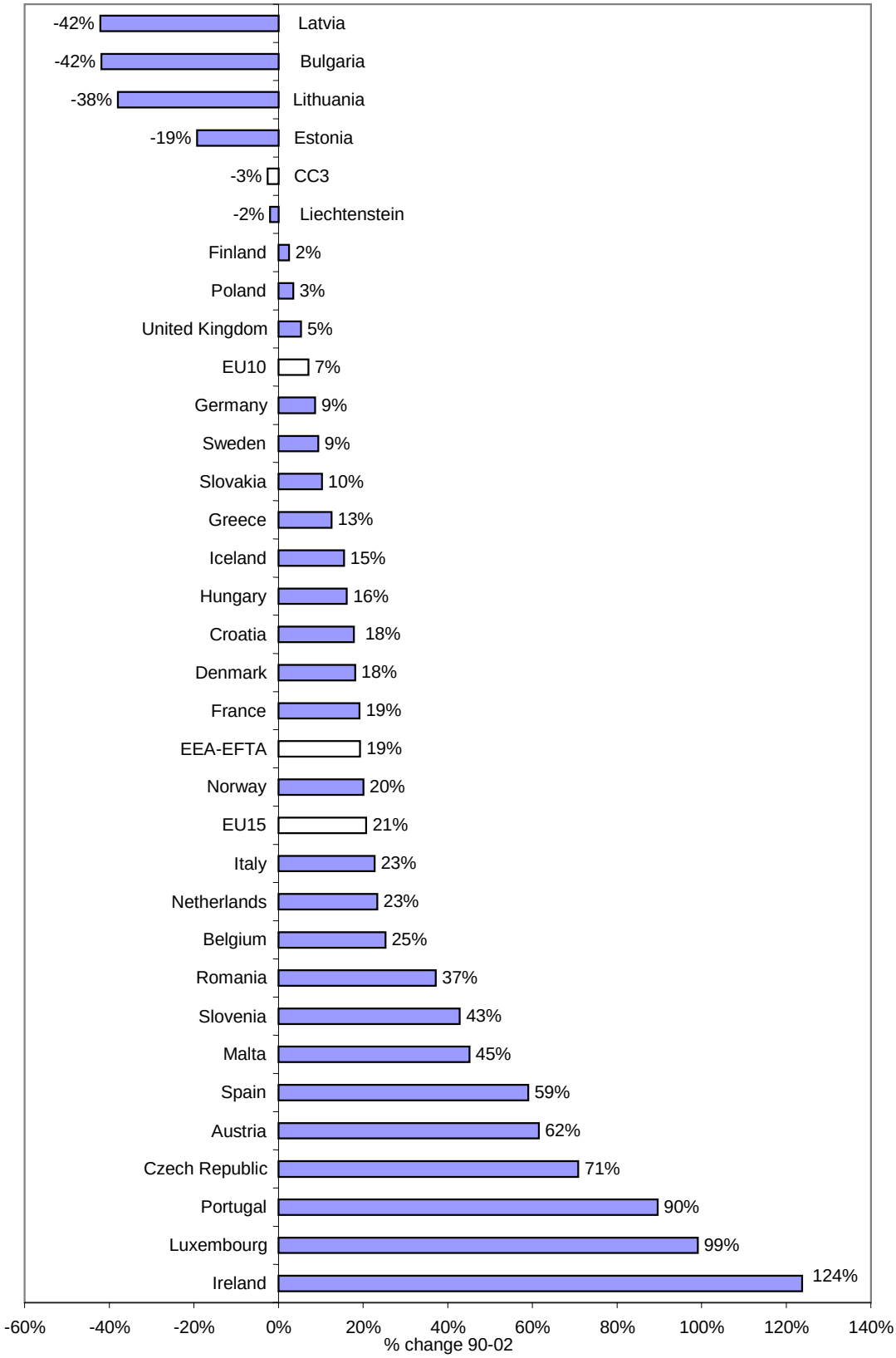
EU15 **1990** **2002**



Note: Modal split excludes emissions from international bunkers. See table 5 for details on other country groups. 'Other transport' includes pipeline and some off-road transport.

Source: EEA, 2004b

Figure 5: Change in CO_2 emissions from transport in the EEA31, 1990-2002 (%)



Note: Change 1990-2002 refers to last available year, see table 7.

Note: EU15 refers to EU Member States prior to May 2004 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom) EEA-EFTA to the EFTA countries (Iceland, Liechtenstein and Norway), EU10 to new EU Member States as of May 2004 (Czech

Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia – no data available from Cyprus) and CC3 to Candidate Countries (Bulgaria, Croatia and Romania – no data available from Turkey)

Source: EEA, 2004b; UNFCCC, 2004

Results and assessment EEA31

EU15: In 2002, road transport was the main source of CO_2 emissions contributing by 93 % to the EU15 transport CO_2 emissions. Domestic air transport is the second main source with 3 %, while inland navigation (2 %), other transportation (1 %) and rail transport (1 %) have a comparatively smaller contribution to the total EU15 transport CO_2 emissions.

The mode with the largest increase in CO_2 emissions between 1990 and 2002 is domestic air transport (24 %). Road transport emissions increased by 23 % in the same period.

The general upward trend in CO_2 emissions from transport is due mainly to growing traffic volumes (see TERM 2004 12 EU – Passenger transport and TERM 2004 13 EU – Freight transport), as there has been relatively little change in average energy use per vehicle-km. In the future, policies such as the voluntary commitments made by ACEA, JAMA and KAMA are expected to result in the decrease in average energy use (see also TERM 2004 27 EU – Energy efficiency and specific CO_2 emissions).

In 2002, the largest emitter of CO_2 from transport in the EU15 was Germany accounting for 21 % of total EU15 CO_2 emissions from transport, followed by France (17 %), and the UK and Italy (15 % each). Although all Member States saw their CO_2 emissions from transport increase between 1990 and 2002, there are significant differences between the Member States. In Finland, Sweden, Germany, and the United Kingdom emissions grew by less than 10 % from 1990 to 2002, whereas Ireland doubled its CO_2 emissions from transport.

EU10: In 2002, road transport was the main source of CO_2 emissions contributing 94 % to total transport related CO_2 emissions. Rail and 'Other transport' (including e.g. pipeline transport) are the second largest sources with 2 % share each. Domestic aviation and domestic navigation (1 % each) have comparatively low shares on total transport CO_2 emissions. Compared with the EU15, the share of road transport is about the same in the EU10, the share of rail is higher, whereas the share of domestic aviation is lower than in the EU15.

The EU10 showed a great variety in change of transport related CO_2 emissions. Large decreases occurred in the Baltic States (Latvia –42 % and Estonia –19 %). In contrast to this, the Czech Republic increased CO_2 emissions from transport by 71 % and Malta by 45%. The largest economy in the region, Poland, showed an increase of 3 % from 1990 levels by 2001 (no 2002 data available).

CC3 and EEA-EFTA: The CC3 (without Turkey) decreased CO_2 emissions by 3 % and in the area of Norway, Iceland and Liechtenstein there was an increase of 20 % between 1990 and 2002. Largest CO_2 emission reductions from transport were achieved in Bulgaria (-42 %) and Liechtenstein (-2 %). All other countries increased their emissions. Note that the change in CC3 countries would be different if Turkish emission data were available and included in these comparisons.

Sub-indicator: Projections of CO_2 from transport

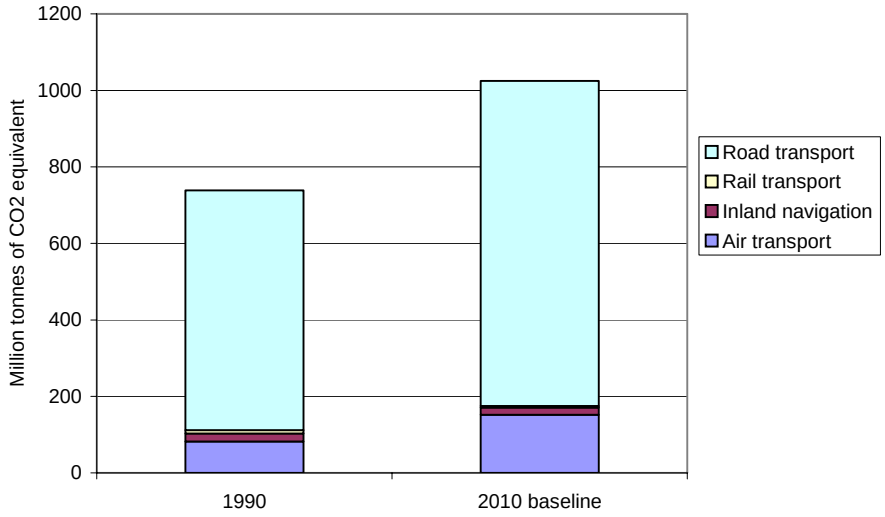
☹ **Projections for EU15 suggest that the transport sector will continue to counteract the attempts to reach the overall GHG emission reduction targets. CO_2 emissions from transport are projected to be 39 % above 1990 levels in 2010.**

☹ **In the EU10, CO_2 emissions from transport will be 62 % above 1990 levels in 2010.**

☹ **Also in the CC3 (including Turkey, without Croatia), the CO_2 emissions from transport will increase substantially by 2010.**

Results and assessment for EU15

Figure 6: CO_2 emissions per transport mode, 1990 and 2010 (projected) in EU15 (PRIMES Baseline Projection)



Source: PRIMES Baseline Projection, 2003

Projections of transport related GHG emissions for the EU15 exist from two sources: (1) projections of CO_2 emissions made with the PRIMES model are available for all EU15 Member States; (2) Member States' own projections on GHG emissions are available for fourteen Member States (EEA, 2004a).

PRIMES projections: Under the PRIMES baseline scenario CO_2 emissions from transport are projected to increase in the EU15 by 39 % by 2010 compared to 1990. Road transport CO_2 emissions are expected to increase by 36 % between 1990 and 2010. CO_2 emissions from trains will decrease by 56 % due to increased electrification (and the allocation of these emissions to the electricity generating sector). Aviation CO_2 emissions will increase by 85 %. Note that the PRIMES projections include both emissions from domestic and international aviation. CO_2 emissions from inland navigation are projected to decrease by 10 %.

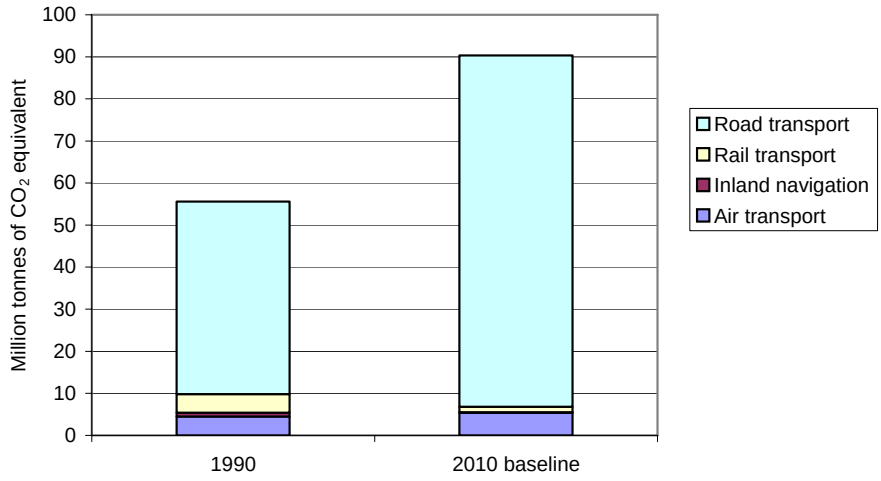
For all EU15 Member States CO_2 emissions from transport are projected to increase under the PRIMES baseline scenario. The largest emission increase are projected for Ireland (+171 %), Luxembourg (+127 %) and Portugal (+119 %). The lowest increases are projected for Denmark (+13 %), Finland (+15 %) and Sweden (+16 %).

Comparison with Member States' own projections: Fourteen EU15 Member States provided emission projections for the transport sector in their third National Communications to the UNFCCC. Based on these data, EU15 transport emissions are projected to increase by 34% compared to 1990 with the existing policies and measures (excluding emissions from international transport). Ireland and Portugal project the strongest growth, both are expecting that emissions will more than double by 2010. Austria, Ireland, Italy, Spain and the UK expect that additional measures will significantly reduce the projected growth in emissions.

One main reason for the difference between the PRIMES baseline scenario and the EU15 Member States' projections is that PRIMES includes international aviation, whereas Member States' projections do not. At EU15 level the difference is rather small (+39 % for PRIMES compared +34 % for the aggregate Member States' projections). At the Member State level, however, larger differences between the projections exist. Largest differences are between the projections for Luxembourg and the Netherlands.

Results and assessment for EU10

Figure 7: CO_2 emissions per transport mode, 1990 and 2010 (projected) in EU10 (PRIMES Baseline Projection)



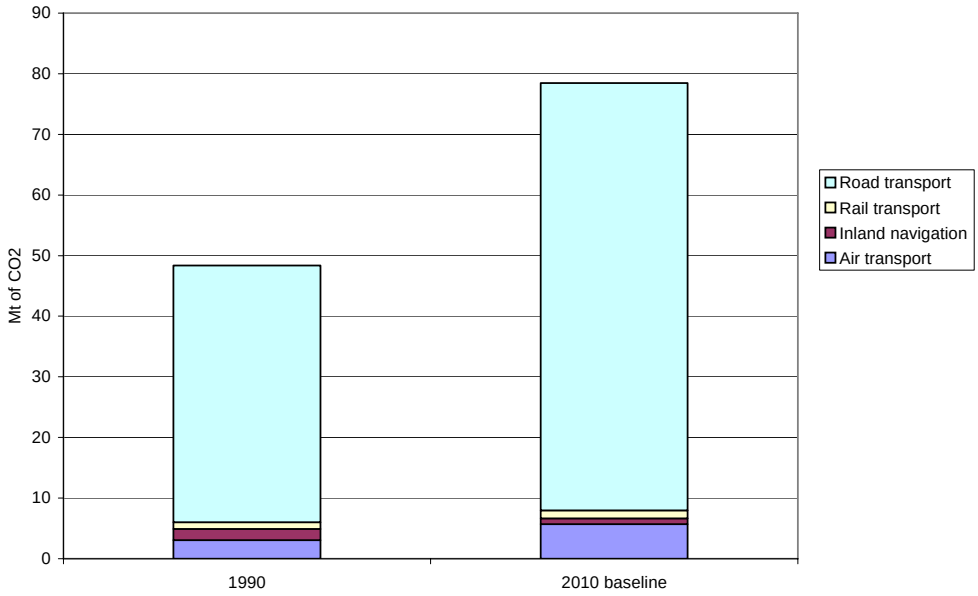
Source: PRIMES Baseline Projection, 2003

Only the projections of CO_2 emissions made with the PRIMES model are available for the EU10 Member States. Under the PRIMES baseline scenario, CO_2 emissions from transport are projected to increase in the EU10 (including Cyprus) by 62 % by 2010 compared to 1990. Road transport CO_2 emissions are expected to increase by 82 % between 1990 and 2010. CO_2 emissions from trains will decrease by 70 % due to increased electrification (and the allocation of these emissions to the electricity generating sector). Aviation CO_2 emissions will increase by 21 %. Note that the PRIMES projections include both emissions from domestic and international aviation. CO_2 emissions from inland navigation are projected to decrease by 91 %.

For all EU10, CO_2 emissions from transport are projected to increase under the PRIMES baseline scenario except for Latvia. The largest emission increase are projected for the Czech Republic (+132 %) and Slovakia (+97 %). For Latvia emission reductions of 12 % are projected under the PRIMES baseline scenario.

Results and assessment for CC3

Figure 8: CO_2 emissions per transport mode, 1990 and 2010 (projected) in CC3 (PRIMES Baseline Projection)



Source: PRIMES Baseline Projection, 2003

Only the projections of CO_2 emissions made with the PRIMES model are available for the CC3 (including Turkey, without Croatia). Under the PRIMES baseline scenario, CO_2 emissions from transport are projected to increase in the CC3 by 63 % by 2010 compared to 1990. Road transport CO_2 emissions are expected to increase by 67 % between 1990 and 2010. CO_2 emissions from trains will decrease by 22 % and aviation CO_2 emissions will increase by 85 %. Note that the PRIMES projections include both emissions from domestic and international aviation. CO_2 emissions from inland navigation are projected to decrease by 48 %.

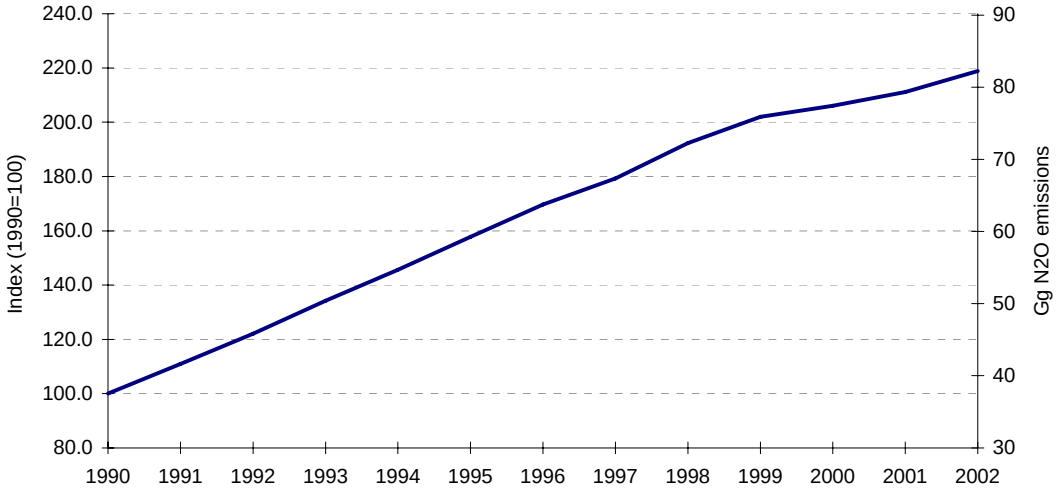
For all CC3, CO_2 emissions from transport are projected to increase under the PRIMES baseline scenario. The largest emission increase are projected for Turkey (+81 %), the second largest increase for Romania (+48 %) and the third largest increase for Bulgaria (+14 %).

Norwegian CO_2 emissions from transport are projected to be 20 % above 1990 levels in 2010. For Iceland and Liechtenstein no projections are available.

Sub-indicator: N_2O emissions from (road) transport

☹ **The transport sector is a small (8 %) but rapidly increasing source of nitrous oxide emissions, a side effect of the use of three-way catalysts fitted to petrol-engined motor vehicles, which caused a more then doubling of emissions between 1990 and 2002.**

Figure 9: EU15 emissions of N_2O from transport, 1990-2002



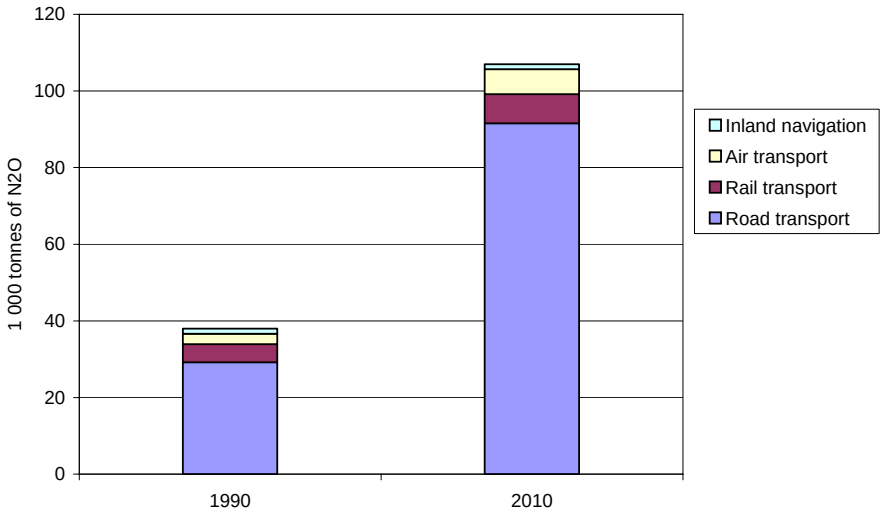
Source: EEA, 2004b

Results and assessment

N_2O emissions from the transport sector, although only responsible for 8% of total N_2O and 0.6 % of total GHG emissions, increased from 37 to 80 Gg between 1990 and 2002, due to the introduction of catalytic converters, which reduce cars' exhaust emissions of certain air pollutants but produce N_2O as a by-product. This occurs mainly during the period when the converter is heating up. The first catalytic converters emitted some 0.05 g N_2O per km while the three-way catalytic converters are estimated to emit some 0.03 g/km. It is likely that the 'light-off' phase – the time needed for the catalytic converter to reach the appropriate temperature it needs to work – of the newer catalytic converters (EURO III and IV) is somewhat shorter, and the emissions will be smaller. There is also some evidence that by lowering the sulphur content of fuels N_2O emissions would be reduced. Thus, the lowering of sulphur content in petrol in the EU might have a positive impact on N_2O emissions (European Commission, 2001b).

Sub-indicator: Projections of N_2O from transport

Figure 10: N_2O emissions in 1990 and 2010 (projected) per transport mode in EU15



Source: European Commission, 2001b

Results and assessment

N_2O emissions from transport are expected to rise substantially between 1990 and 2010 due mainly to the increase in passenger cars equipped with catalytic converters, and their higher N_2O emissions. Emissions from aviation are also expected to increase substantially as a result of the increase in air transport; emissions from rail are projected to increase as well (European Commission, 2000a). However, since N_2O emissions from transport account for less than 1 % of total EU15 GHG emissions, this will not have a major impact on the overall trend of total EU 15 GHG emissions.

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EMISSION OF GREENHOUSE GASES

Table 1: Total GHG emissions from national transport, 1990–2002

Unit: Million tonnes of CO_2 equivalent

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	% change 1990-2002
Austria	13	15	15	15	15	15	17	16	18	17	18	19	21	60%
Belgium	20	21	22	23	22	23	23	23	24	24	25	26	26	27%
Denmark	11	11	11	12	12	12	12	13	13	13	13	13	13	20%
Finland	13	12	12	11	12	12	11	12	13	13	13	13	13	4%
France	122	124	129	129	130	133	134	137	139	142	142	145	147	21%
Germany	167	171	177	182	179	183	183	183	186	192	188	183	181	9%
Greece	19	20	20	20	20	20	21	21	23	24	23	21	21	12%
Ireland	5	5	6	6	6	7	7	8	9	10	11	12	12	127%
Italy	104	107	111	113	113	115	117	118	122	124	124	127	129	24%
Luxembourg	3	3	3	3	4	3	4	4	4	4	5	5	5	100%
Netherlands	30	30	31	32	32	33	33	34	35	36	36	36	37	23%
Portugal	11	11	12	13	13	14	15	15	17	18	19	20	20	92%
Spain	59	60	64	63	66	67	72	72	80	85	87	92	94	61%
Sweden	19	19	20	19	19	20	19	20	20	20	20	20	21	10%
United Kingdom	119	118	120	121	122	121	126	127	127	128	128	128	128	8%
Iceland	1	1	1	1	1	1	1	1	1	1	1	1		18%
Norway	11	11	11	12	12	12	13	13	14	15	14	14	14	25%
Liechtenstein	0									0				0%
Czech Republic	7		8		8		11	12	11	13	12	13	13	76%
Cyprus														
Estonia	3	3	2	2	2	1	1	1	1	1	1	2	2	-19%
Hungary	8	7	7	7	7	7	7	8	8	10	9	9	10	17%
Latvia	5	3	3	2	2	3	2	2	2	2	2	3	3	-43%
Lithuania	6								4				4	-38%
Poland	30	28	31	28	30	26	29	27	29	32	29	31		4%
Slovakia	5	4	4	4	4	5	5	5	5	5	4	5	6	13%
Slovenia	3	3	3	3	3	4	4	4	4	4	4	4	4	46%
Malta	0	0	0	0	0	0	0	0	0	0	0			46%
Bulgaria	11	7	7	8	7	7	6	5	7	6	6	6	6	-42%

Croatia	4	3	3	3	3	3	4	4	4	4	5	5	5	21%
Romania	9	8	9	8	9	8	11	12	11	9	9	11	12	37%
Turkey														
EU15	713	728	753	762	766	776	794	803	829	850	851	860	869	22%
EEA-EFTA	12	12	12	13	13	13	14	14	15	15	15	15	15	24%
EU10	67	62	63	60	62	59	63	64	65	70	65	71	73	8%
CC3	24	17	19	19	19	18	21	21	22	19	20	22	23	-2%
Total	816	819	847	853	859	867	892	903	931	955	951	967	980	20%
Index	100	100	104	105	105	106	109	111	114	117	117	119	120	20%

Note: To derive totals for the country groups, the gaps were filled by using previous year's estimates or interpolation.

The column 'change 1990-2002' refers therefore to the last available year for the above mentioned countries.

Source: EEA 2004b; UNFCCC, 2004

Table 2: Greenhouse gas emissions from national transport split by gas, 2002

Unit: Million tonnes of CO_2 equivalents and %

	EU15		**EU10**		**CC3**		**EEA-EFTA**	
Pollutant	**Mt CO_2 equiv**	**%**	**Mt CO_2 equiv**	**%**	**Mt CO_2 equiv**	**%**	**Mt CO_2 equiv**	**%**
CO_2	841	97%	70	97%	23	99%	14	94%
CH_4	3	0%	0	0%	0	0%	0	0%
N_2O	25	3%	2	3%	0	1%	1	5%
Total	869	100%	72.6	100%	23	100%	15	100%

Note: EU10: Cyprus not included.

CC3: Turkey not included.

EEA-EFTA: Gap filling: Iceland year 2000 was used for 2001-2002; Liechtenstein year 1999 was used for years 2000-2002.

Source: EEA 2004b; UNFCCC, 2004

Table 3: GHG emissions from national transport split by mode, 2002

Unit: Million tonnes CO_2 equivalents and %

	EU15		**EU10**		**CC3**		**EEA-EFTA**	
Mode	**Mt CO_2 equiv**	**%**	**Mt CO_2 equiv**	**%**	**Mt CO_2equiv**	**%**	**Mt CO_2 equiv**	**%**
Road transport	811	93%	68	94%	20	85%	11	73%
Rail transport	6	1%	2	2%	1	4%	0	0%
Domestic navigation	19	2%	1	1%	0	2%	2	15%
Domestic aviation	24	3%	1	1%	0	1%	1	6%
Other transport	9	1%	1	1%	2	7%	1	5%
Total	869	100%	72	100%	23	100%	15	100%

Note: EU10: Cyprus not included.

CC3: Turkey not included.

EEA- EFTA: The modal split is based on Norway (year 2002) and Iceland (year 2000). No data available for Liechtenstein.

Emissions from international aviation and maritime bunkers are excluded.

Source: EEA 2004b; UNFCCC, 2004

Table 4: Contribution to change by pollutant in total GHG emission from national transport between 1990–2002

Unit: Mt CO_2 equivalents and % change

	EU15			EU10			CC3			EEA-EFTA		
Pollutant	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**
CO_2	697	841	21%	65	70	7%	24	23	-3%	12	14	20%
CH_4	5	3	-44%	0	0	-23%	0	0	-20%	0	0	-19%
N_2O	11	25	119%	1	2	85%	0	0	69%	0	1	358%

Note: EU10: without Cyprus.

CC3: without Turkey.

EEA-EFTA: Gap filling; Iceland year 2000 was used for 2001-2002; Liechtenstein year 1990 was used for years 2000-2002.

Source: EEA 2004b; UNFCCC, 2004

Table 5: Contribution to change by mode in total GHG emission from national transport between 1990–2002

Unit: Mt CO_2 equivalents and % change

	EU15			EU10			CC3			EEA-EFTA		
Mode	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**
Road transport	653	811	24%	-	68	-	-	20	-	-	11	-
Rail transport	9	6	-35%	-	2	-	-	1	-	-	0	-
Domestic navigation	20	19	-4%	-	1	-	-	0	-	-	2	-
Domestic aviation	19	24	24%	-	1	-	-	0	-	-	1	-
Other transport	12	9	-22%	-	1	-	-	2	-	-	1	-

Note: Emissions from international aviation and maritime bunkers are excluded.

EU10: Cyprus not included.

CC3: without Turkey.

EEA- EFTA: The modal split is based on Norway (year 2002) and Iceland (year 2000). No data available for Liechtenstein.

Source: EEA 2004b; UNFCCC, 2004

Table 6: GHG emissions from international transport

Unit: Mt CO_2 equivalents and % change

	EU15			EU10			CC2			EEA-EFTA		
Mode	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**
Aviation	62	103	67%	-	3	-	-	0	-	1	1	-12%
Maritime shipping	105	141	34%	-	3	-	-	0	-	2	2	39%

Note: EU10: No data from Cyprus.

EEA-EFTA 1990 refers to Norway only, 2001 to Norway and Iceland (for Iceland year 2000 was used), no data for Liechtenstein available.

CC2: only data from Bulgaria and Croatia available.

Source: EEA 2004b; UNFCCC, 2004

EMISSION OF CO_2

Table 7: Total CO_2 emissions from national transport, 1990–2002

Unit: Million tonnes of CO_2 equivalent

														% change
Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**1990-2002**
Austria	13	14	14	14	14	14	16	15	17	17	17	19	21	62%
Belgium	20	20	22	22	22	22	22	22	23	24	24	25	25	25%

Denmark	10	11	11	11	12	12	12	12	12	12	12	12	12	18%
Finland	12	12	12	11	11	11	11	12	12	13	12	13	13	2%
France	119	122	126	126	127	129	131	133	135	138	138	141	142	19%
Germany	162	166	172	177	173	177	177	177	180	186	182	178	176	9%
Greece	18	19	19	19	19	19	20	21	22	23	22	20	20	13%
Ireland	5	5	6	6	6	6	7	8	9	10	10	11	11	124%
Italy	102	104	109	110	110	112	113	115	119	120	120	123	125	23%
Luxembourg	3	3	3	3	4	3	4	4	4	4	5	5	5	99%
Netherlands	29	29	31	31	31	32	33	33	34	35	35	36	36	23%
Portugal	10	11	12	12	13	14	14	15	16	17	19	19	20	90%
Spain	57	59	63	62	65	66	70	71	78	83	85	89	91	59%
Sweden	18	18	19	18	19	19	19	19	19	19	19	20	20	9%
United Kingdom	117	116	118	119	119	118	122	124	123	123	123	123	123	5%
Iceland	1	1	1	1	1	1	1	1	1	1	1	1	1	15%
Norway	11	11	11	12	12	12	13	13	13	14	13	13	13	20%
Liechtenstein	0									0				-2%
Czech Republic	7		7		8		10	11	11	12	11	12	12	71%
Cyprus														
Estonia	3	3	1	2	2	1	1	1	1	1	1	2	2	-19%
Hungary	8	7	7	7	7	7	7	8	8	10	9	9	9	16%
Latvia	5	3	3	2	2	3	2	2	2	2	2	3	3	-42%
Lithuania	6								4				4	-38%
Poland	29	28	30	28	30	25	28	27	28	31	28	30	30	3%
Slovakia	5	4	4	4	4	4	4	5	5	5	4	5	6	10%
Slovenia	3	3	3	3	3	4	4	4	4	4	4	4	4	43%
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	45%
Bulgaria	11	7	6	7	7	7	6	5	6	6	6	6	6	-42%
Croatia	4	3	3	3	3	3	4	4	4	4	4	4	5	18%
Romania	9	8	9	8	9	8	11	11	11	9	9	11	12	37%
Turkey														
EU15	697	711	735	742	745	754	771	779	804	824	825	833	841	21%
EEA-EFTA	12	12	12	13	12	13	13	14	14	15	14	14	14	19%
EU10	65	61	61	59	61	58	61	62	64	69	63	68	70	7%
CC3	24	17	19	19	18	18	21	21	21	19	20	21	23	-3%
Total	798	801	827	832	837	843	867	876	903	926	921	937	948	19%
Index	100	100	104	104	105	106	109	110	113	116	115	117	119	19%

Note: To derive totals for the country groups, the gaps were filled by using previous year's estimates and interpolation.

The column 'change 1990-2002' refers therefore to the last available year for the above mentioned countries.

Source: EEA 2004b; UNFCCC, 2004

Table 8: CO_2 emissions from national transport split by mode, 2002

Unit: Million tonnes CO_2 and %

	EU15		**EU10**		**CC3**		**EEA-EFTA**	
Mode	**Mt CO_2**	**%**	**Mt CO_2**	**%**	**Mt CO_2**	**%**	**Mt CO_2**	**%**
Road transport	785	93%	66	94%	20	85%	10	72%
Rail transport	5	1%	2	2%	1	4%	0	0%
Domestic navigation	19	2%	0	1%	0	2%	2	16%
Domestic aviation	23	3%	1	1%	0	1%	1	7%
Other transport	9	1%	1	2%	2	7%	1	5%

Total	841	100%	70	100%	23	100%	14	100%				

Note: EU10: without Cyprus.

CC3: without Turkey.

EEA- EFTA: The modal split is based on Norway (year 2002) and Iceland (year 2000). No data available for Liechtenstein.

Emissions from international aviation and maritime bunkers are excluded.

Source: EEA 2004b; UNFCCC, 2004

Table 9: Contribution to change by mode in total CO_2 emission from national transport between 1990–2002

Unit: Mt CO_2 and % change

	EU15			**EU10**			**CC3**			**EEA-EFTA**		
Mode	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**	**1990**	**2002**	**%**
Road transport	639	785	23%	-	66	-	-	20	-	-	10	-
Rail transport	8	5	-35%	-	2	-	-	1	-	-	0	-
Domestic navigation	19	19	-4%	-	0	-	-	0	-	-	2	-
Domestic aviation	19	23	24%	-	1	-	-	0	-	-	1	-
Other transport	11	9	-20%	-	1	-	-	2	-	-	1	-

Note: EU10 : without Cyprus.

CC3 : without Turkey.

EEA-EFTA: The modal split is based on Norway (year 2002) and Iceland (year 2000). No data available for Liechtenstein.

Emissions from international aviation and maritime bunkers are excluded.

Source: EEA 2004b; UNFCCC, 2004

EMISSION OF N_2O

Table 10: EU15 emissions from N_2O from transport, 1990-2002

Unit: Gg

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Index	100	111	122	134	146	158	170	179	192	202	206	211	219
Emissions	37	41	45	49	53	58	62	66	70	74	75	77	80

Source: EEA, 2004b

Table 11: EU10 emissions from N_2O from transport, 1990-2002

Unit: Gg

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Index	100.0	61.4	64.0	60.1	64.7	86.5	107.1	110.3	108.6	120.7	160.3	174.6	185.5
Emissions	3.9	2.4	2.5	2.3	2.5	3.4	4.2	4.3	4.2	4.7	6.3	6.8	7.2

Note : EU10 without emissions from Cyprus.

Source: EEA, 2004a

Table 12: CC3 emissions from N_2O from transport, 1990-2002

Unit: Gg

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Index	100.0	65.9	67.6	71.1	65.2	65.4	78.1	87.9	103.0	112.1	130.4	150.6	169.4
Emissions	0.4	0.2	0.3	0.3	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6

Note : CC3 without emissions from Turkey.

Source: EEA, 2004a

PROJECTIONS

Table 13: Projections of CO_2 emissions from transport, 1990 and 2010

Unit: Mt and % change

	EU15			EU10			CC3			EEA-EFTA		
Mode	**1990**	**2010**	**%**	**1990**	**2010**	**%**	**1990**	**2010**	**%**	**1990**	**2010**	**%**
Air transport	82	152	85%	4	5	21%	3	6	85%	-	-	-
Inland navigation	21	19	-10%	1	0	-91%	2	1	-48%	-	-	-
Rail transport	9	4	-56%	4	1	-70%	1	1	22%	-	-	-
Road transport	627	850	36%	46	84	82%	42	71	67%	-	-	-
Total	739	1025	39%	56	90	62%	48	78	62%	-	-	-

Note: 2010 refers to the PRIMES baseline scenario. Data on international maritime transport are not included. The aviation figure includes domestic and international aviation.

CC3 with Turkey, without Croatia.

Source: PRIMES baseline scenario.

Table 14: Projections of N_2O emissions from transport, 1990 and 2010

Unit: Mt and % change

	EU15			EU10			CC3			EEA-EFTA		
Mode	**1990**	**2010**	**%**	**1990**	**2010**	**%**	**1990**	**2010**	**%**	**1990**	**2010**	**%**
Air transport	3	6	140	-	-	-	-	-	-	-	-	-
Inland navigation	1	1	-7	-	-	-	-	-	-	-	-	-
Rail transport	5	8	60	-	-	-	-	-	-	-	-	-
Road transport	29	92	214	-	-	-	-	-	-	-	-	-
Total	38	107	181	-	-	-	-	-	-	-	-	-

Source: European Commission, 2001b

File: TERM 2004 02 EEA31 – Transport emissions of greenhouse gases.xls

Meta data EEA31

Technical information

1. *Data source*: Official data reported national total and sectoral emissions to UNFCCC and under the EU Monitoring Mechanism and EIONET. For the EU15, the data are compiled by EEA in the European greenhouse gas inventory report (and related database) (EEA, 2004b). Sources for the EEA-EFTA countries, EU10 and CC3, submissions to UNFCCC secretariat, Malta IPCC Tables downloaded from the address provided by the country (http://www.phys.um.edu.mt/climate/downloads/ghg/ghg_inventory.zip). Emission projections are taken from the official submissions under the EU Monitoring Mechanism and from the third national communications and from PRIMES baseline scenario.
2. *Description of data*: Annual emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 in UNFCCC reporting format (in million tonnes) converted to their global warming potential where necessary (100 year time horizon) for addition and comparison with the Kyoto Protocol targets.

3. *Geographical coverage:* EEA31.
4. *Temporal coverage:* Historical data: 1990-2002. Data gaps exist for a few countries. Cyprus and Turkey did not provide any data. Projected data: 2010.
5. *Methodology and frequency of data collection:* Annual official data submission to UNFCCC and EU Monitoring mechanism.
6. *Methodology of data manipulation, including making 'early estimates':* This data was multiplied by GWP weights (CO_2 1, CH_4 21, N_2O 310, SF_6 23900) to give total GWP emissions in million tonnes CO_2 equivalent.
   Data gap filling: to calculate country group totals, data gaps were filled either by interpolation, in case that data was missing in between reported data, or by using the first (or last) reported emission value.

   Quality information
7. Strength and weakness (at data level). Strength: officially reported data following agreed procedures, e.g. regarding source sector split. The GWP weighting is the agreed UNFCCC and EU Monitoring Mechanism procedure. Weakness: Data is not available in full detail for all countries or country groups.
8. Reliability, accuracy, robustness, uncertainty (at data level): The IPCC suggests that the uncertainty in GWP weighted emission estimates, in Europe, is likely to be better than ±20 %. While uncertainties in the estimates of some of the gases are much larger than this, the dominance of CO_2 in the GWP emissions results in a lower uncertainty. For EU10, however, data gaps increase the uncertainties (especially of N_2O emissions).
9. Overall scoring (give 1 to 3 points: 1=no major problems, 3=major reservations): 2

   Relevancy: 1 (Greenhouse gas emissions from transport are a relevant overall indicator for the impact of transport on the environment. However, a further modal split of road transport into passenger and freight transport emissions would be helpful for further analysis of trends.)

   Accuracy: 2 (some data gaps exist)

   Comparability over time: 2 (Parties to the UNFCCC are required to recalculate their emission data if methodologies have been changed. Therefore, the time series provided should be consistent. However, not all Parties recalculate the time series every year.)

   Comparability over space: 1 (Methodologies used should be comparable between countries because of the reporting guidelines of the international conventions. However, missing data or existing data gaps affect this comparability.)

Further work required

The EEA31 countries should improve the completeness of the time series of their estimates (filling gaps). Further validation and checking is the responsibility of the country and needs especially to lead to improved detailed sectoral time series of emissions. There is also a need for further validation and checking within the framework of UNFCCC and EU Monitoring Mechanism, as recommended by the IPCC Good Practice Guide.

Box 1: Aviation and the global atmosphere

Aircraft emit gases and particles directly into the upper troposphere and lower stratosphere where they have an impact on atmospheric composition. These gases and particles alter the concentration of atmospheric GHGs, including carbon dioxide, ozone, and methane. They trigger formation of condensation trails (contrails) and may increase cirrus cloudiness. All these contribute to climate change.

Global passenger air travel, as measured in passenger-km, is projected to grow by about 5 % per year between 1990 and 2015 (although this estimate is expected to be influenced by the events of 9-11, SARS and the Iraq war), whereas total aviation fuel use is projected to increase

by 3 % per year, over the same period, the difference being due mainly to improved aircraft efficiency. All scenarios assume that technological improvements leading to reduced emissions per revenue passenger-km will continue and that optimal use of airspace availability is achieved by 2050. Emissions of carbon dioxide by aircraft were 0.14 Gt C/year in 1992. This is about 2 % of total anthropogenic carbon dioxide emissions in 1992 or about 13 % of carbon dioxide emissions from all transportation sources. The range of scenarios considered by IPCC projects that aircraft emissions of carbon dioxide will continue to grow and by 2050 will be 0.23 to 1.45 Gt C/year.

The climate impacts of emissions can be compared using the concept of radiative forcing. The radiative forcing in 1992 by aircraft was 0.05 Wm^{-2} or about 3.5 % of the total radiative forcing by all anthropogenic activities. For the reference scenario, the radiative forcing by aircraft in 2050 is 0.19 Wm^{-2} or 5 % of the total radiative forcing in the mid-range IPCC scenario. This equates to aircraft contributing about 0.05 ^{0}C to global warming in 2050, compared to a total of 1.5 to 6 ^{0}C projected by 2100 due to all sources of GHG emissions (IPCC, 2001).

There is a range of options to reduce the impact of aviation emissions, including changes in aircraft and engine technology, fuel, operational practices, and regulatory and economic measures. Substantial aircraft and engine technology advances and the air traffic management improvements are already incorporated in the aircraft emissions scenarios used for IPCC climate change calculations. Other operational measures, which have the potential to reduce emissions, and alternative fuels, were not assumed in the scenarios. Further technology advances have the potential to provide additional fuel and emissions reductions. In practice, some of the improvements are expected to take place for commercial reasons. The timing and scope of regulatory, economic, and other options may affect the introduction of improvements and may affect demand for air transport.

CO_2 emissions from international aviation (not included in the Member States' emission totals), represented 3 % of the total CO_2 EU15 emissions in 2002, which is an increase compared to the share of 2 % in 1990.

Source: IPCC, 1999

Box 2: EU15 Greenhouse gas emissions from international transport

GHG emissions from EU15 Member States reported as emissions from international transport (so-called 'international bunkers') represented 4 % of the total EU GHG emissions in 1990 and 6 % in 2002. There was therefore, a 46 % increase in EU emissions reported as originating from this source between 1990 and 2002. (The shares on total GHG emissions were for marine transport 3 % and 3 % and for aviation 1 % and 2 % in 1990 and 2002.)

According to the UNFCCC reporting guidelines, 'inventories should include greenhouse gas emissions and removals taking place within national (including administered) territories and offshore areas over which the country has jurisdiction'.

One of the qualifications of the national territory principle in the guidelines is: 'Emissions based upon fuel sold to ships or aircraft engaged in international transport should not be included in national totals but reported separately.'

International marine and aviation bunkers are reported separately. However, it is not known whether all EU15 Member States apply the guidelines correctly. In addition, it is not clear from the guidelines whether for the EU15, as the sole instance of a regional economic integration organisation, maritime and air traffic between EU15 Member States, EU15 Member States and the overseas countries and territories, and the overseas countries and territories themselves should be considered as 'belonging' to the EU15. It is assumed that at least each Member State applies its own definitions consistently.

Emissions from international flights and shipping are excluded from the emission reduction targets of the Kyoto Protocol, although emissions from domestic transport are not. The UNFCCC Subsidiary Body on Scientific and Technical Advice is currently considering the issue of emissions from international flights. Annex 1 Parties to the UNFCCC are required by the Kyoto Protocol to act to limit or reduce emissions from international flights, working through the International Civil Aviation Organisation (ICAO). The ICAO has asked its Committee on Aviation

Environmental Protection (CAEP), to study policy options to limit or reduce GHG emissions from civil aviation, but ICAO has so far only been able to agree on a template for voluntary agreements and to publish a catalogue of operational opportunities to minimize fuel use and reduce emissions. For international shipping, the Kyoto Protocol requires developed countries to pursue action through the International Maritime Organisation.