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European Union emission inventory report 1990–2009 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)

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Executive summary

This document is the annual European Union emission inventory report under the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (LRTAP) ([1]). The report and its accompanying data are provided as an official submission to the secretariat for the Executive Body of the LRTAP Convention by the European Commission on behalf of the European Union. The report is compiled by the European Environment Agency (EEA).

Under the LRTAP Convention, Parties (including the European Union) are obliged to report emissions data for a large number of air pollutants, including nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), sulphur oxides (SO_X), ammonia (NH_3), carbon monoxide (CO), primary particulate matter ($PM_{2.5}$ and PM_{10}), heavy metals (among which lead (Pb), cadmium (Cd) and mercury (Hg)) and persistent organic pollutants (POPs) (among which polychlorinated dibenzodioxin/ polychlorinated dibenzofurans (PCDD/F), polycyclic aromatic hydrocarbons (PAHs), hexachlorobenzene (HCB), hexachlorocyclohexane (HCH) and polychlorinated biphenyls (PCBs)).

These pollutants each harm human health and the environment, and in addition, certain species also contribute to the formation of ozone and particulate matter in the atmosphere (Box ES.1).

This report describes:

- the institutional arrangements that underpin the European Union's emission inventory (Chapter 1);
- emission trends for the EU-27 as a whole ([2]), and individual Member States, and the contribution made by important individual emission sources to emissions (Chapter 2);
- sector emission trends for key pollutants (Chapter 3);
- information on recalculations and future planned improvements (Chapter 4).

Emissions data presented in this report are included as accompanying annexes and are also available for direct download through the EEA's dataservice ([3]).

([1]) UNECE. 1979.

([2]) The EU-27 comprises Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

([3]) The online dataviewer for the EU LRTAP Convention dataset is available at http://dataservice.eea.europa.eu/PivotApp/pivot.aspx?pivotid=478 (accessed 24 May 2011).

Box ES.1. The main air pollutants and their effects on human health and the environment

Sulphur dioxide (SO_2)
Sulphur dioxide is emitted when fuels containing sulphur are burned. It contributes to acid deposition, the impacts of which can be significant, including adverse effects on aquatic ecosystems in rivers and lakes, and damage to forests.

Nitrogen oxides (NO_X)
Nitrogen oxides are emitted during fuel combustion, such as by industrial facilities and the road transport sector. As with SO_2, NO_X contributes to acid deposition but also to eutrophication. Of the chemical species that comprise NO_X, it is NO_2 that is associated with adverse affects on health, as high concentrations cause inflammation of the airways and reduced lung function. NO_X also contributes to the formation of secondary inorganic particulate matter and tropospheric (ground-level) ozone.

Ammonia (NH_3)
Ammonia, like NO_X, contributes to both eutrophication and acidification. The vast majority of NH_3 emissions — around 94% in Europe — come from the agricultural sector, from activities such as manure storage, slurry spreading and the use of synthetic nitrogenous fertilisers.

Non-methane volatile organic compounds (NMVOCs)
NMVOCs, important O_3 precursors, are emitted from a large number of sources including paint application, road transport, dry-cleaning and other solvent uses. Certain NMVOC species, such as benzene (C_6H_6) and 1,3-butadiene, are directly hazardous to human health. Biogenic NMVOCs are emitted by vegetation, with amounts dependent on the species and on temperature.

Particulate matter (PM)
In terms of potential to harm human health, PM is one of the most important pollutants as it penetrates into sensitive regions of the respiratory system. PM is emitted from many sources and is a complex heterogeneous mixture comprising both primary and secondary PM; primary PM is the fraction of PM that is emitted directly into the atmosphere, whereas secondary PM forms in the atmosphere following the oxidation and transformation of precursor gases (mainly SO_2, NO_X, NH_3 and some volatile organic compounds (VOCs)). References to PM in this report refer to primary PM.

Carbon monoxide (CO)
Carbon monoxide is produced as a result of fuel combustion. The road transport sector, businesses and households, and industry are important sources. Long-term exposure to low concentrations of CO can result in neurological problems and potential harm to unborn babies. Carbon monoxide can react with other pollutants to produce ground level ozone. Elevated levels of ozone can cause respiratory health problems and can lead to premature mortality.

Polycyclic aromatic hydrocarbons (PAHs)/Benzo(a)pyrene (BaP)
Polycyclic aromatic hydrocarbons are a large group of persistent organic pollutants (POPs) which contribute to different harmful effects in the environment and to human health. PAHs are released by combustion processes, as well as being emitted via evaporation from materials treated with creosote, mineral oils, pitch etc. BaP is a specific PAH formed mainly from the burning of organic material such as wood, and from car exhaust fumes especially from diesel vehicles. It is a known cancer-causing agent in humans. In Europe, BaP pollution is mainly a problem in certain areas such as western Poland, the Czech Republic and Austria where domestic coal and wood burning is common.

Dioxins and furans (PCCD/F)
PCDDs and PCDFs are formed by the combustion of fuels and wastes, processing of metals and the production of pulp and paper. Exposure to normal background levels of dioxins and furans is unlikely to cause health problems, although some PCDDs and PCDFs may cause cancer and may affect the unborn child in low concentrations. PCDDs and PCDFs are categorised as POPS, being persistent in the environment. Emissions to air will eventually be deposited on soil and/or waters. Livestock and wildlife can subsequently ingest them from soil and vegetation, with fish susceptible to uptake from aquatic sediments.

Polychlorinated biphenyls (PCBs)
Polychlorinated biphenyls are used mainly as electrical insulating material in capacitors and transformers. They have also been used as flame retardants. The main source of releases have been from their manufacture and use, as well as during disposal of PCB containing equipment. PCBs may cause cancer and can affect the unborn child. PCBs are toxic to wildlife, particularly aquatic organisms. They can cause serious reproductive and developmental problems and damage to the immune system. PCBs are categorised as a persistent organic pollutant (POP).

Hexachlorobenzene (HCB)
Hexachlorobenzene was used as a fungicide on seeds (now banned), and is also used in the manufacture of chlorinated organic solvents. It is released to the environment as a byproduct of the burning of coal, waste incineration and some metal processes. It has also been released through its use as a fungicide. The environment levels of HCB are not typically high enough to cause significant health effects. HCB is however classed as dangerous to the environment. The main concern over environmental releases is related to its persistence and ability to bio-accumulate in the food chain. High levels can build up in fish and marine mammals and also certain plants.

Hexachlorocyclohexane (HCH)
Hexachlorocyclohexane is a family of organic compounds, the most common of which is gamma-HCH (lindane). The main use of lindane has been as a timber insecticicide. Releases of lindane to water damage insects and fish. It also accumulates in fish. Its ability to persist and accumulate in the environment mean that lindane can travel long distances and have effects far from the point of emission. Emissions of HCH occur through its manufacture, use, storage and transport.

Heavy metals
The heavy metals arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg) and nickel (Ni) are emitted mainly as a result of various combustion processes and industrial activities. Both BaP and heavy metals can reside in or be attached to PM. As well as polluting the air, heavy metals can be deposited on terrestrial or water surfaces and subsequently build up in soils or sediments. Heavy metals are persistent in the environment and may bio-accumulate in food-chains.

EU-27 emission trends

Figure ES.1 presents the aggregated EU-27 emission trends of the main pollutants, particulates, heavy metals and POPs for the period 1990–2009 ([4]). Across the EU-27, the largest emission reduction has been achieved for the acidifying pollutant SO_X. Emissions in 2009 were 80 % less than in 1990. The emission reductions across the EU-27 since 1990 have been achieved as a result of a combination of measures, including 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 abatement technology in industrial facilities and the impact of European Union directives relating to the sulphur content of certain liquid fuels.

For the two most recent years, a significant decrease in emissions occurred — a reduction of 21 % between 2008 and 2009, mainly due to reductions in the energy sector (i.e. power plant) emissions reported by Bulgaria, Poland, Romania and Spain which occurred as a result of the economic recession.

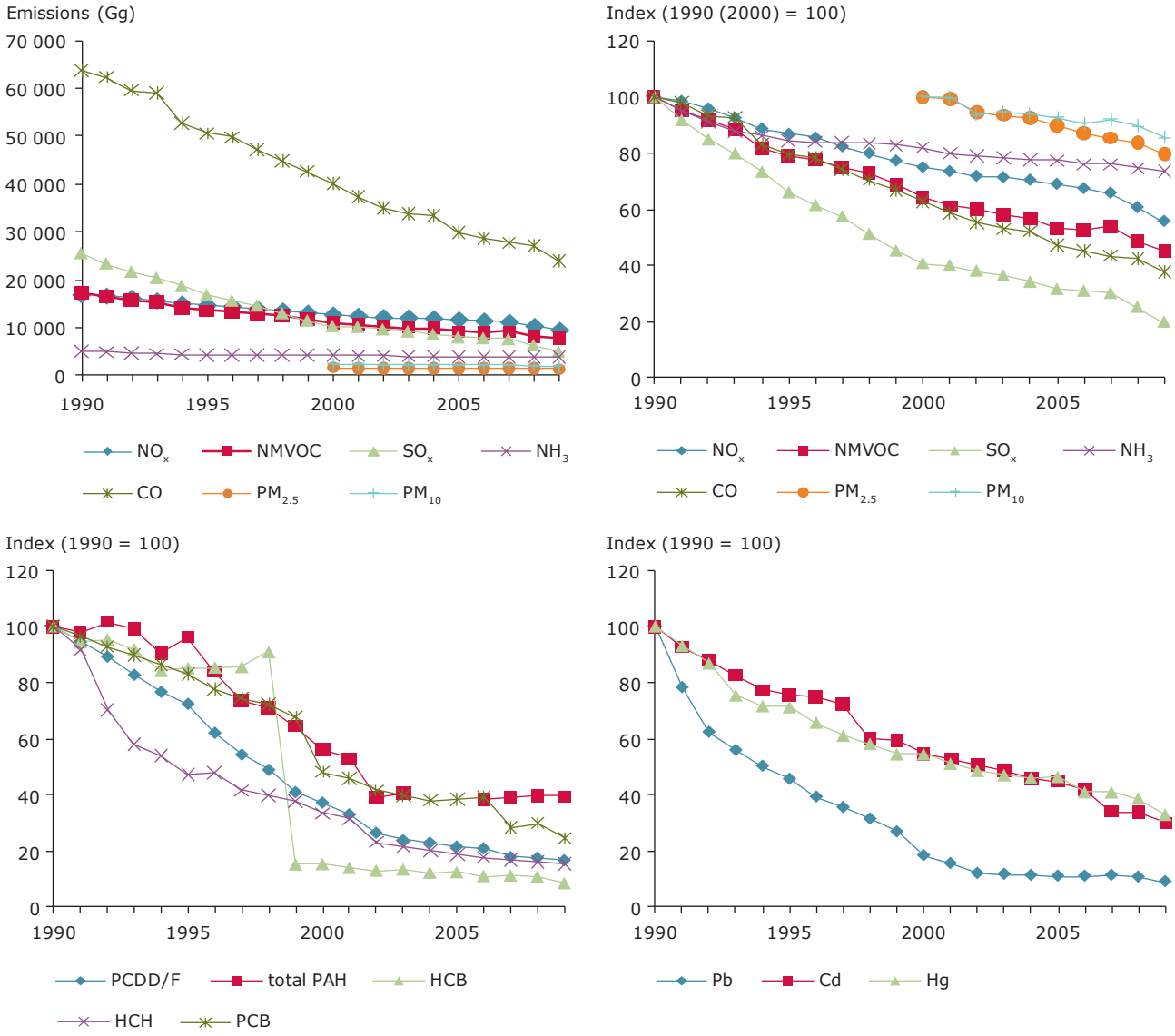
Emissions of other key air pollutants also fell significantly since 1990, including emissions of the three air pollutants primarily responsible for the formation of harmful ground-level ozone in the atmosphere: CO (62 % reduction), NMVOCs (55 % reduction) and NO_X (44 % reduction). Emission reductions have been achieved from the road transport sector for all three pollutants, primarily through legislative measures requiring abatement of vehicle tailpipe emissions. For NO_X, significant

([4]) By 15 February each year, Member States must report emission data for years up until the current year minus two. Thus by 15 February 2011, Member States were obliged to report for years until 2009. Emission inventory data (both for air pollutants and greenhouse gases) can typically only be compiled and reported by countries with around a 12-15 month delay. 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 performing quality assurance/quality control checks.

reductions in the electricity/energy generation sectors have also occurred, in these instances as a result of measures such as the introduction of combustion modification technologies (such as use of low NO_X burners), implementation of flue-gas abatement techniques (e.g. NO_X scrubbers and selective (SCR) and non-selective (SNCR) catalytic reduction techniques) and fuel-switching from coal to gas.

Also for HM and POPs, significant emission reductions have been achieved since 1990 (in the order of 60 % or more). Much progress was been made since the early 1990s in reducing point source emissions of these substances (e.g. emissions from industrial facilities). This has been achieved through improvements in for example abatement technologies for wastewater treatment, incinerators and in metal refining and smelting industries,

Figure ES.1 EU-27 emission trends for the main air pollutants, particulate matter, heavy metals and POPs



Note: Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards. Hence emission trends for these years only are shown.

The drop in HCB emissions between years 1998 and 1999 is due to a significant reduction reported by the United Kingdom. Data are not shown for total PAH (2004–2005) due to inconsistencies in the original data reported by Member States.

and in some countries by the closure of older industrial facilities as a consequence of economic re-structuring. However, the rate of decrease in total emissions of these substances has slowed over the most recent years, particularly for the three heavy metals.

For PM_{10} and $PM_{2.5}$, the aggregated EU-27 emission reduction achieved since 2000 is 20 % and 14 %, respectively. The reductions in total emissions of particulate matter have been mainly due 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 fuels to low-sulphur fuels (which have also contributed to decreased formation of secondary particulate matter in the atmosphere).

Progress of the European Union in meeting its 2010 emission reduction targets under the UNECE LRTAP Convention Gothenburg Protocol

The Gothenburg Protocol to the UNECE LRTAP Convention ([5]) contains emission ceilings for 2010 for the pollutants NO_X, NMVOCs, SO_X and NH_3 that Parties to the protocol must meet. In addition to the ceilings for individual countries, the protocol also specifies ceilings for the European Union, itself a Party to the protocol. The ceilings apply only to the EU-15 grouping of Member States that constituted the European Community at the time the Gothenburg Protocol was agreed.

Table ES.1 shows the aggregated emissions for the year 2009 reported by the EU-15 Member States in comparison to the respective 2010 emission ceilings specified for the European Union. NO_X is the only pollutant for which the 2009 emissions exceed the respective ceiling.

The EEA has recently published its annual update of the 'NEC Directive Status Report' ([6]), which analyses the more complete 2010 projections data for the EU Member States reported under the EU National Emission Ceilings (NEC) Directive ([7]). For the EU Member States, the NEC Directive contains national emission ceilings that are either equal to or more ambitious than those in the Gothenburg Protocol.

Main sources of EU-27 air pollutant emissions

Figure ES.2 shows the share of EU-27 emissions per pollutant by sector group. As observed in past years, the road transport and energy production sector groups clearly remain significant sources of air pollutants in the EU-27.

Table ES.1 Comparison of emissions reported for 2009 by the EU-15 Member States with the emission ceilings for the European Union specified in the UNECE Gothenburg Protocol

Pollutant	EU-15 emissions year 2009 (Gg)	European Union (EU-15) Gothenburg Protocol 2010 ceilings (Gg)	Difference (%)	Sum of individual EU-15 ceilings (Gg) ([a])
NO_X	7 443	6 671	12 %	6 648
NMVOC	6 011	6 600	– 9 %	6 600
SO_X	2 588	4 059	– 36 %	4 044
NH_3	3 017	3 129	– 4 %	3 128

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 European Community (EU-15) as a whole.

([5]) UNECE, 1999.
([6]) EEA, 2011a.
([7]) Directive 2001/81/EC.

The energy production and distribution sector remains by far the most important source of SO_X emissions and is also a major source of NO_X, Cd, Hg and PCB emissions, despite some significant reductions of these pollutants in the past. Within the energy sector, the individual source category '1 A 1 a — Public electricity and heat production' ([8]), i.e. emissions arising from fuel combustion in public power and heat generating plants, was identified as a key category ([9]) for 11 of the 15 pollutants assessed in this report. Further, emissions of SO_X from this single source category contributed more than half of the EU-27 total SO_X emissions in 2009.

NO_X emissions from the road transport sector have decreased by 42 % since 1990, mainly as a result of the introduction of three way catalytic converters on passenger cars and stricter regulation of emissions from heavy duty vehicles across Europe. The road transport group is nevertheless a major source of the ozone precursors NO_X and CO in the European Union, in 2009 contributing 42 % and 34 % of total EU-27 emissions respectively. It is also a major source of NMVOC, $PM_{2.5}$ and PM_{10} emissions. Passenger cars and heavy duty vehicles are the principal contributors to NO_X emissions from this sector, whereas for CO passenger cars alone contribute around 73 % of the emissions from the same sector.

In contrast to the road transport sector, emissions of NO_X from aviation have increased significantly since 1990. Emissions from both domestic and international flight activities increased by 79 % between 1990 and 2009 (but decreased by 6 % from 2008 to 2009).

Household fuel combustion for the source category '1 A 4 b i — Residential: Stationary plants' is an important source of air pollution for a number of pollutants. It is the most important key category for NMVOC, CO, $PM_{2.5}$, PM_{10}, Cd, PCDD/F and total PAHs, and the second most important key category for HCB. Energy and process-related emissions from industry contribute significantly to the overall emissions of a number of the heavy metals and POPs.

Recommendations for improved data quality

Last year, for the first time, the EU-27 emission inventory report was prepared using a more complete gap-filling procedure. This has led to significant improvement in the completeness of the European Union emission inventory, especially for the main pollutants where complete emission trends for the EU-27 can be reported. This year, the same gap-filling method has been applied, but improved slightly. Despite clear progress in recent years concerning the completeness of reporting, a number of data gaps remain in the official datasets received from Member States. The completeness of Member State submissions can therefore be further improved, particularly for historic 1990–2001 data and for certain pollutants such as heavy metals and POPs.

This report also contains several recommendations to assist in further improving the quality of the European Union inventory in the future. First, Member States are encouraged to use the data reporting format specified in the recently updated 2009 United Nations Economic Commission for Europe (UNECE) LRTAP Convention emission reporting guidelines ([10]). This allows a comparable aggregation and analysis of the underlying data received from countries, which is necessary for the European Union's own inventory. Second, Member States should submit complete inventories and use proper notation keys for instances where estimated values are not available. Third, Member States should recalculate emissions data for past years when new methods or new scientific knowledge become available. In this context, Member States are encouraged to review and apply the information contained in the updated EMEP/EEA air pollutant emission inventory guidebook ([11]) when compiling their emission inventory datasets.

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 key to ensuring that high quality data are available for the European Union's own inventory.

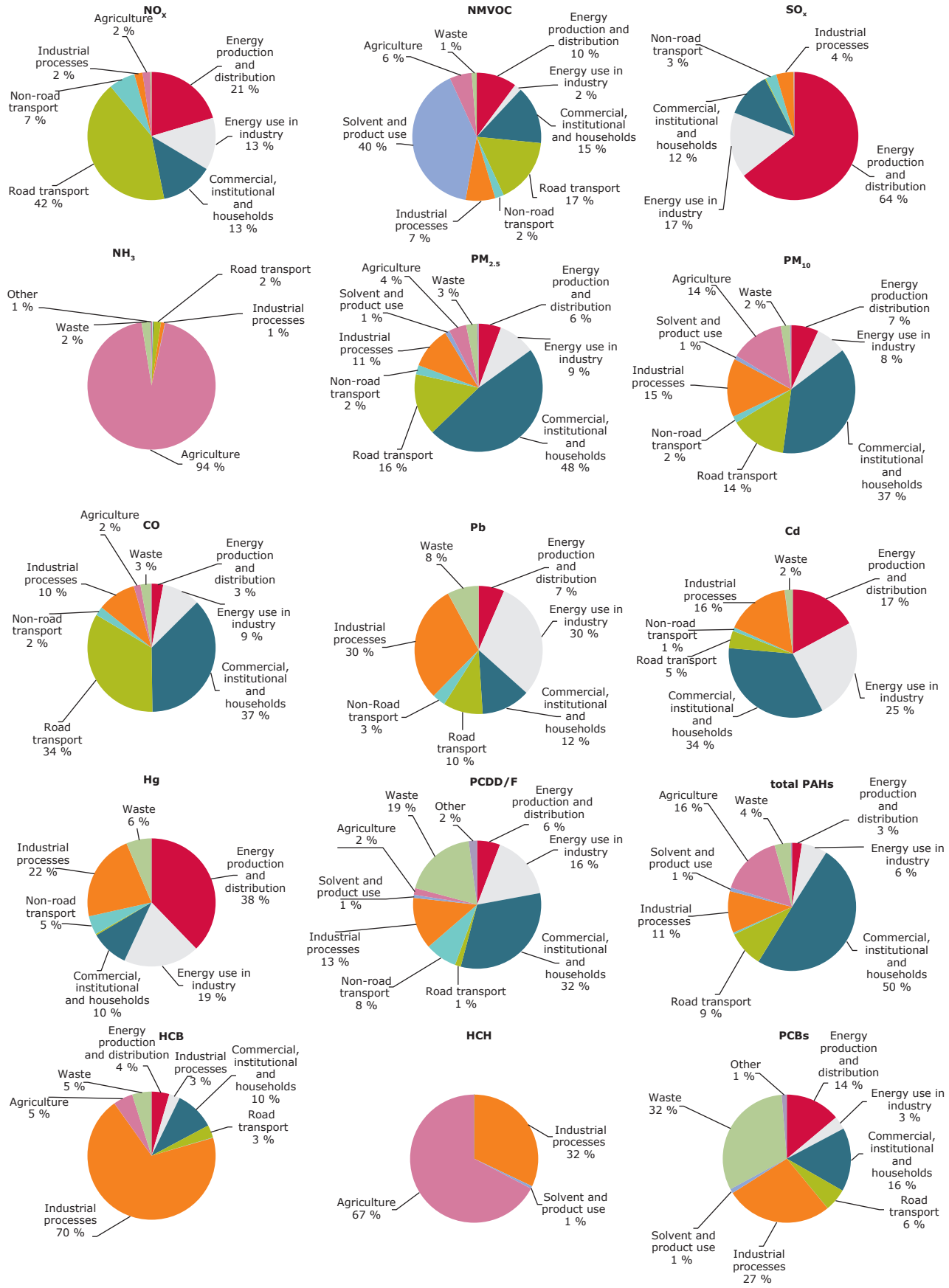
([8]) As defined in EMEP/EEA, 2009.

([9]) For each of the main air pollutants and particulate matter (PM_{10} and $PM_{2.5}$), the priority heavy metals and the POPs, a key category analysis (KCA) was performed to identify the most important sectors that contribute to emissions in 2009. A key category is defined as an emission source that has significant influence on the total inventory in terms of the absolute level of emissions, the trend in emissions, or both. In this report, the categories that are together responsible for 80 % of the total emissions for a given pollutant are classified as key categories (EMEP/EEA, 2009).

([10]) UNECE, 2009.

([11]) EMEP/EEA, 2009.

Figure ES.2. Share of EU-27 emissions per pollutant by sector group



1 Introduction

This report and its accompanying data are provided by the European Commission (on behalf of the European Union) as an official submission to the secretariat for the Executive Body of the LRTAP Convention.

The report provides information on the formal institutional arrangements that underpin the European Union's emission inventory (Chapter 1); emission trends reported by Member States, and the contribution of key categories to total emissions (Chapter 2); sector group emission trends for key pollutants (Chapter 3); and information on recalculations and planned improvements (Chapter 4).

EU-27 emission totals are estimated for the pollutants for which data should be reported under the LRTAP Convention, i.e. emissions of nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), sulphur oxides (SO_X), ammonia (NH_3) and carbon monoxide (CO), of particulate matter emissions ($PM_{2.5}$ and PM_{10}), of the so-called 'priority' heavy metals lead (Pb), cadmium (Cd) and mercury (Hg), and certain persistent organic pollutants (POPs), specifically polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDD/F), total polycyclic aromatic hydrocarbons (total PAHs), hexachlorobenzene (HCB), hexachlorocyclohexane (HCH) and polychlorinated biphenyls (PCBs).

Emission estimates are not always available for all pollutants in each year due to gaps in the data reported by Member States. The more complete gap-filling process that was trialled in 2010 for the compilation of the EU inventory was refined in 2011. Nevertheless, for certain pollutants (i.e. particulate matter, the heavy metals and POPs) some Member States did not report data for any year, which meant that gap-filling techniques could not be applied. For these pollutants, the EU-27 total thus remains incomplete. The details of the gap-filling methodology used are provided in Section 1.4 of this chapter.

A number of annexes accompany this inventory report:

- Annex A provides a copy of the formal LRTAP Convention data submission of the European Union for the years 1990–2009 for the EU-27 in the required UNECE reporting format (NFR09);
- Annex B provides the updated European Union NO_X emissions data for 1987–1989, provided in accordance with the requirements of the 1988 NO_X protocol of the LRTAP Convention;
- Annex C provides results of the key category analysis for the EU-27, showing the main emitting sectors for each pollutant;
- Annex D provides the gap-filled inventory of the EU-27 with colour codes for the different data sources used and the different additional gap-filling methods applied;
- Annex E provides Member States projections for NO_X, NMVOC, SO_X, NH_3 and $PM_{2.5}$ and PM_{10} emissions for the years 2010, 2015, 2020, 2030 and 2050.

1.1 Background

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

The European Union ratified the United Nations Economic Commission for Europe's Convention on Long-range Transboundary Air Pollution (12) 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'.

(12) UNECE, 1979.

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 ([13]), came into force on 17 May 2005. Table 1.1 presents the status of ratification of each protocol by the European Union. The status differs in the individual Member States.

The UNECE LRTAP Convention Executive Body approved revised *Guidelines for reporting emission data under the Convention on Long-range Transboundary Air Pollution* at its 26th session in December 2008 ([23]). These revised 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 to this report.

In 2011, Parties were requested to report emissions data for NO_X, NMVOCs, SO_X, NH_3, CO, HMs, POPs and PM, and also associated activity data. The deadline for individual Parties to submit data to the LRTAP Convention is 15 February each year, with a separate deadline of 15 March for submitting the accompanying inventory reports. The European Union 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-27 inventory data should be submitted by 30 April and the accompanying inventory report by 30 May each year.

The reporting guidelines also request Parties to report emissions inventory data using an updated format — the EMEP nomenclature for reporting (NFR09) format.

Table 1.1 The European Union's status of ratification of the LRTAP Convention and related protocols

LRTAP Convention and its protocols	Status of ratification
Convention on Long-range Transboundary Air Pollution (1979) ([14])	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) ([15])	Signed and ratified (approval)
Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 % (1985) ([16])	Not signed
Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes (1988) ([17])	Ratified (accession)
Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes (1991) ([18])	Signed
Protocol on Further Reduction of Sulphur Emissions (1994) ([19])	Signed and ratified (approval)
Protocol on Persistent Organic Pollutants (1998) ([20])	Signed and ratified (approval)
Protocol on Heavy Metals (1998) ([21])	Signed and ratified (approval)
Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (1999) ([22])	Ratified (accession)

([13]) UNECE, 1999.
([14]) UNECE, 1979.
([15]) UNECE, 1984.
([16]) UNECE, 1985.
([17]) UNECE, 1988.
([18]) UNECE, 1991.
([19]) UNECE, 1994.
([20]) UNECE, 1998a.
([21]) UNECE, 1998b.
([22]) UNECE, 1999.
([23]) UNECE, 2009.

1.1.2 Reporting obligations under the NEC Directive and the EU Monitoring Mechanism

EU Member States also report their emissions of NO_X, NMVOCs, SO_2 and NH_3 under the National Emission Ceilings Directive (NECD) ([24]) and emissions of NO_X, SO_2, NMVOCs and CO under the EU Greenhouse Gas Monitoring Mechanism (EU-MM) ([25]) for the United Nations Framework Convention on Climate Change (UNFCCC) ([26]). This information should also be copied by Member States to the EEA Eionet Reportnet Central Data Repository (CDR) ([27]).

Table 1.2 provides an overview of these different reporting obligations for EU Member States.

The reporting obligations under the LRTAP Convention and NECD have now largely been harmonised since the adoption of the updated reporting guidelines. They differ mainly only with respect to the geographical coverage for France, Portugal and Spain. As compared with the UNFCCC obligation, they differ in terms of inclusion of domestic and international aviation and navigation in the reported 'national total'. 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.

Table 1.2 Overview of air emission reporting obligations in the European Union, 2010–2011

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

Note: (a) 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.
(b) Starting with the 2010 reporting round the list of POPs has been reduced to: PCDD/F, total PAHs, HCB, HCH and PCBs.
(c) Greenhouse gases: methane (CH4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); polyfluorocarbons (PFCs); sulphur hexafluoride (SF_6).

([24]) Directive 2001/81/EC.
([25]) Decision 280/2004/EC.
([26]) UNFCCC, 1992.
([27]) Available at http://cdr.eionet.europa.eu.

Table 1.3 Major differences between the reporting obligations of air pollutants under the LRTAP Convention, NEC Directive and EU Monitoring Mechanism/UNFCCC

	EU NECD	LRTAP Convention —NFR ([a])	EU-MM/UNFCCC —CRF ([b])
Air pollutants	NO_x, NMVOCs, SO_2, NH_3	NO_x, NMVOCs, SO_x, NH_3, CO, HMs, POPs, PM	NO_x, NMVOCs, SO_x, CO
Domestic aviation (landing and take-off)	Included in national total	Included in national total	Included in national total
Domestic aviation (cruise)	*Not included in national total* ([c])	*Not included in national total* ([c])	Included in national total
International aviation (landing and take-off)	Included in national total	Included in national total	*Not included in national total* ([c])
International aviation (cruise)	*Not included in national total* ([c])	*Not included in national total* ([c])	*Not included in national total* ([c])
National navigation (domestic shipping)	Included in national total	Included in national total	Included in national total
International inland shipping	Included in national total	Included in national total	*Not included in national total* ([c])
International maritime navigation	*Not included in national total* ([c])	*Not included in national total* ([c])	*Not included in national total* ([c])
Road transport	Emissions calculated based on fuel sold ([d])	Emissions calculated based on fuel sold ([d])	Emissions calculated based on fuel sold

Note: (a) 'NFR' denotes 'nomenclature for reporting', a sectoral classification system developed by UNECE/EMEP for reporting air emissions.
(b) 'CRF' is the sectoral classification system developed by UNFCCC for reporting of greenhouse gases.
(c) Categories not included in national totals should still be reported by Parties as so-called 'memo items'.
(d) In addition, Parties may also report transport emission estimates (1A3) based on fuel used as an additional 'memo item'.

1.2 Institutional arrangements

1.2.1 Member States

Member States are responsible for choosing activity data, emission factors and other parameters used for their national inventories. Member States should also follow the reporting guidelines ([28]) and use the methodologies contained in the latest version of the EMEP/EEA emission inventory guidebook ([29]). While the latest version of the emission inventory guidebook was formally approved in 2009, not all Member States may yet have fully implemented its recommended methods in their own national emission inventories.

Member States are also responsible for establishing quality assurance and quality control programmes for their inventories. Where Member States compile an inventory report, a description of the quality assurance and quality control activities and recalculations should be included.

In addition to submitting their national LRTAP inventories and inventory reports, Member States through their participation in the Eionet network (see Subsection 1.2.2 below) take part in the annual review and commenting phase of the draft European Union inventory report. The 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 European Environment Agency, the European Commission, Eionet and the European Topic Centre on Air Pollution and Climate Change Mitigation

European Environment Agency

The European Environment Agency assists the European Commission (Environment DG) in compiling the annual European Union LRTAP inventory. The activities of the EEA include:

- overall coordination and management of the inventory compilation process;
- coordinating the activities of the EEA 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;

([28]) UNECE, 2009.
([29]) EMEP/EEA, 2009.

- communication with Member States;
- circulation of the draft European Union emission inventory and inventory report;
- hosting the official inventory database and 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 European Union's emission inventory data and inventory report to EMEP through the Executive Secretary of UNECE.

European Topic Centre on Air Pollution and Climate Change Mitigation

With regard to the European Union's LRTAP Convention emission inventory, the main ETC/ACM ([30]) activities include:

- initial checks, testing and centralised review of Member State submissions in cooperation with EMEP/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 European Union emission inventory and inventory report by 30 April, based on Member State submissions (subsequently submitted by the Commission to UNECE);
- preparing the updated European Union emission inventory and inventory report by 30 May.

Eionet

The work of the EEA and the ETC/ACM is facilitated by the European environmental information and observation network (Eionet) ([31]), which consists of 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 (see http://eionet.europa.eu). Member States are requested to use the CDR of the Eionet Reportnet tools to make their LRTAP Convention submissions available to the EEA.

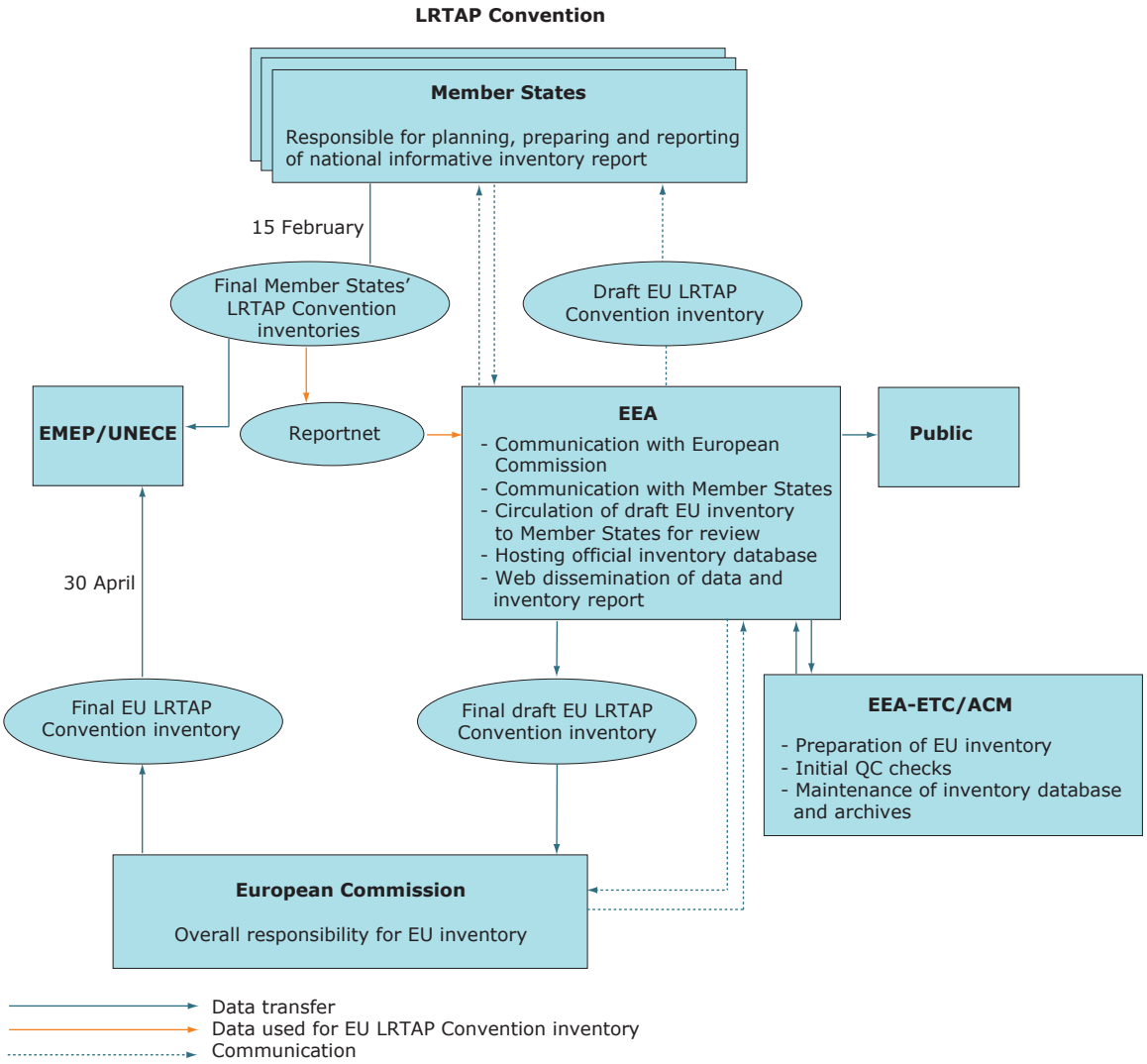
1.3 Inventory preparation process

No specific European Union directive implements the LRTAP Convention's requirements to estimate air emissions and prepare air emission inventories. The basis of reporting for the individual Member States and for the European Union remains the LRTAP Convention ([32]), 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. Within the European Union, Member States are requested each year (under the agreement between Eionet countries and the EEA concerning priority data flows) 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 and compiles the gap-filled European Union LRTAP Convention emission inventory database, producing a European Union LRTAP Convention emission inventory and inventory report.

Within this legal and procedural framework, preparation of the annual LRTAP Convention emission inventory involves the provision of data by Member States, the European Commission and the EEA receiving the data, and finally the EEA and its ETC/ACM compiling the data, gap-filling missing data and preparing the actual inventory. The inventory and accompanying documentation are subsequently made publicly available through the EEA website. Figure 1.1 presents a flowchart diagram illustrating the dataflow that is used to compile the European Union's LRTAP Convention emission inventory.

([30]) The current ETC/ACM was established by a contract between the lead organisation, National Institute for Public Health and the Environment (RIVM, Rijksinstituut voor Volksgezondheid en Mileu), and the EEA in 2010. It involves 10 organisations and institutions in nine European countries.
([31]) Council Regulation (EC) No 933/1999.
([32]) UNECE, 1979.

Figure 1.1 Data flow for compiling the European Union LRTAP Convention emission inventory



1.4 Methods and data sources

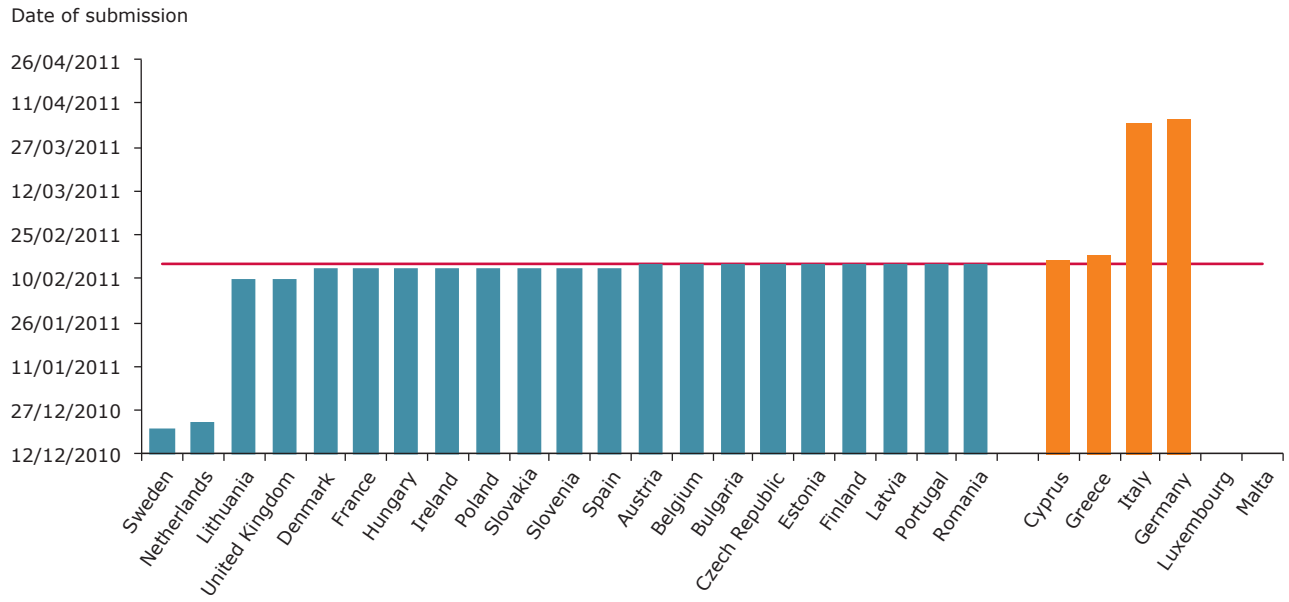
The European Union LRTAP Convention emission inventory is based on an aggregation of data reported by Member States. Member States should have reported inventory data to UNECE and were requested also to provide a copy of this data to the EEA no later than 15 February 2011.

For the inventory prepared in 2011, 25 EU Member States provided data before 12 May 2011. This is a similar level of reporting and timeliness compared to 2010. Cyprus, Greece, Italy and Germany did not submit on time (Figure 1.2). Table 1.4 provides an overview of the data received from Member States' LRTAP Convention submissions in 2011. Of the 25 Member States that submitted inventories twelve Member States posted more than one submission on the CDR, providing additional information and/or revised inventories following their original data submission. Twenty Member States submitted informative inventory reports (IIR) until 12 May.

The updated reporting guidelines ([33]) request that emissions data be provided by Parties to the Convention using the NFR09 format. While most

([33]) UNECE, 2009.

Figure 1.2 Dates of the first data submissions received from Member States (as of 12 May 2011)



Member States used the new NFR09 reporting templates, three States used older formats for part or all of their submission (Finland, Italy and Portugal). Table 1.4 shows the formats used by Member States to report data. In order to compile the EU-27 inventory it was necessary to transfer all submissions into a uniform format (see Appendix 3 for details).

1.4.1 General assessment of completeness

Five Member States provided only 2009 emission data. All other countries also submitted inventories for at least several historical years. As Table 1.5 illustrates, Greece did not report data for emissions of particulate matter, HMs and POPs. Only 15 Member States reported activity data ([34]) for the complete time series (Table 1.4).

1.4.2 Data gaps and gap-filling

Ideally, there should be no need to gap-fill the reported inventory data, as it is the role of Member States to submit full and accurate inventory datasets. However, as Table 1.6 and Table 1.7 indicate, Member State submissions contain various data gaps for particular pollutants or years in the time series. The most frequent problems observed are as follows:

- Submissions (whole national inventory) are not provided for the most recent year and/or other years.
- Emissions of some pollutants (e.g. PM, the heavy metals, POPs and NH_3) are not provided for either a single year, several years or the entire time series.
- Sectoral emissions are missing and only national totals are provided.

The EMEP reporting guidelines ([35]) require that submitted emission inventories be complete. Before 2010, the inventory for the European Community was already partially gap-filled, whereby official data reported by Member States under other reporting obligations (e.g. the NEC Directive ([36]) and EU-MM ([37])) was used to fill gaps. This process nevertheless still resulted in the Community's inventory being incomplete for certain pollutants and years.

Reflecting the need to submit a more complete dataset, several discussions were held with Member State representatives in both 2008 and

([34]) Reporting of activity data together with emissions is mandatory from 2009 onwards.
([35]) UNECE, 2009.
([36]) Directive 2001/81/EC.
([37]) Decision 280/2004/EC.

Table 1.4 Date on which the EEA received inventory submissions, years covered and information provided by Member States, as of 12 May 2011

	Annual reporting							Minimum 5 year reporting	
Member State	**Submission date [a])**	**Date of resubmission and/or additional information**	**NFR template**	**Other format**	**IIR 2009**	**Activity data [b])**	**Projections**	**Gridded data**	**LPS emissions**
Austria	15.02.2011	15.03.2011	NFR 2009-1		15.03.2011	1980–2009	2010, 2015, 2020, 2030	np	np
Belgium	15.02.2011		NFR 2009-1		15.03.2011	1990, 1995, 2000, 2005–2009	2010	np	np
Bulgaria	15.02.2011		NFR 2009-1		15.03.2011	2009	2010, 2015, 2020	np	np
Cyprus	17.02.2011		NFR 2009-1		01.03.2011	1990–2009	2010, 2015, 2020	2009	2009
Czech Republic	15.02.2011		NFR 2009-1		31.03.2011[c])	2009	np	np	np
Denmark	14.02.2011		NFR 2009-1		14.03.2011	1980–2009	2010, 2015, 2020, 2030	np	np
Estonia	15.02.2011	15.03.2011	NFR 2009-1		15.03.2011, 16.03.2011	1990–2009	2010, 2015	np	np
Finland	15.02.2011	23.02.2011	NFR 2004-1 (1980-2006); NFR 2009-1 (2007-2009)		15.03.2011	2007–2009	2020, 2050	2009	2009
France	14.02.2011		NFR 2009-1		15.03.2011	1980–2009	2010, 2015, 2020	np	np
Germany	06.04.2011		NFR 2009-1		np	1990–2009	2010, 2015, 2020	np	np
Greece	18.02.2011	29.03.2011	NFR 2009-1		np	2009	2010, 2015, 2020	np	np
Hungary	14.02.2011		NFR 2009-1		14.02.2011	2009	np	np	np
Ireland	14.02.2011	25.02.2011	NFR 2009-1		11.04.2011	1987, 1990–2009	np	np	np
Italy	04.04.2011		NFR 2008-1		29.04.2011	1990–2009	np	np	np
Latvia	15.02.2011	15.03.2011	NFR 2009-1		15.03.2011	1990–2009	2010, 2015, 2020	np	np
Lithuania	10.02.2011		NFR 2009-1		14.02.2011	2009	2010, 2015, 2020	np	np
Luxembourg									
Malta									
Netherlands	23.12.2010	15.02.2011	NFR 2009-1		np	1990–2009	2010, 2015, 2020, 2030	np	np
Poland	14.02.2011	13.05.2011	NFR 2009-1		14.02.2011 (polish); 31.03.2011	2008–2009	2010, 2015, 2020, 2030	np	np
Portugal	15.02.2011	15.03.2011	NFR 2008-1		15.03.2011, 16.03.2011	1990–2009	np	np	np
Romania	15.02.2011		NFR 2009-1		np	2008–2009	np	np	np
Slovakia	14.02.2011		NFR 2009-1	Nat. tot. (1990—1999)	14.02.2011	2000–2009	2010, 2015, 2020, 2030, 2050	1990, 1995, 2000, 2005	np
Slovenia	14.02.2011	21.03.2011	NFR 2009-1		21.03.2011, 11.05.2011	1990–2009	2010, 2015, 2020	np	np
Spain	14.02.2011	15.02.2011, 31.03.2011, 10.05.2011	NFR 2009-1	Level 1 (1980—1989)	np	1990–2009	np	1990—2009	1990—2009
Sweden	21.12.2010	14.02.2011, 27.04.2011	NFR 2009-1		21.12.2010	1990–2009	2010, 2015, 2020, 2030	np	np
United Kingdom	10.02.2011		NFR 2009-1		14.03.2011	1980–2009	2010	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 2011.
(c) The Czech Republic submitted its IIR only to CEIP and did not post a copy on the CDR.
'IIR' denotes 'informative inventory report'.
'np' denotes 'not provided'.

Table 1.5 Overview of air pollutants and years reported by Member States in their LRTAP Convention submissions of 2011 (as of 12 May 2011)

Member State	NO_X, NMVOC, SO_X, NH_3, CO	$PM_{2.5}$, PM_{10}	TSP [b])	Pb, Cd, Hg	Additional HMs [a])	POPs (PCDD/F, PAHs, HCB, HCH, PCBs)
Austria	1980–2009	1990, 1995, 2000–2009	1990, 1995, 2000–2009	1985–2009	np	1985–2009
Belgium	1990, 1995, 2000, 2005–2009	2000, 2005–2009	2000, 2005–2009	1990, 1995, 2000, 2005–2009	1990, 1995, 2000, 2005–2009	1990, 1995, 2000, 2005–2009
Bulgaria	2009	2009	2009	2009	2009	2009
Cyprus	1990–2009	2000–2009	2000–2009	1990–2009	1990–2009	1990–2009
Czech Republic	2009	2009	2009	2009	2009	2009
Denmark	1980–2009	2000–2009	2000–2009	1990–2009	1990–2009	1990–2009
Estonia	1990–2009	2000–2009	2000–2009	1990–2009	1990–2009	1990–2009
Finland	1980–2009	2000–2009	2000–2009	1990–2009	1990–2009	1990–2009
France	1980–2009	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009
Germany	1990–2009	1995–2009	1990–2009	1990–2009	1990–2009	1990–2009
Greece	2009	np	np	np	np	np
Hungary	2009	2009	2009	2009	2009	2009
Ireland	1987, 1990–2009	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009
Italy	1980–2009	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009
Latvia	1990–2009	2000–2009	2000–2009	1990–2009	1990–2009	1990–2009
Lithuania	2009	2009	2009	2009	2009	2009
Luxembourg	0	0	0	0	0	0
Malta	0	0	0	0	0	0
Netherlands	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009
Poland	2002, 2003, 2008, 2009	2002, 2003, 2008, 2009	2002, 2003, 2008, 2009	2002, 2003, 2008, 2009	2002, 2003, 2008, 2009	2002, 2003, 2008, 2009
Portugal	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009
Romania	2008–2009	2008–2009	2008–2009	2008–2009	2008–2009	2008–2009
Slovakia	2000–2009	2000–2009	2000–2009	2000–2009	2000–2009	2000–2009
Slovenia	1980–2009	2000–2009	2000–2009	1990–2009	np	1990–2009
Spain	1980–2009	2000–2009	2000–2009	1990–2009	1990–2009	1990–2009
Sweden	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009	1990–2009
United Kingdom	1980–2009	1980–2009	1980–2009	1980–2009	1980–2009	1990–2009

Note: (a) 'TSP' denotes 'total suspended particles'. Reporting of TSP is not required if a Member State reports PM emissions.
(b) 'HMs' denotes 'heavy metals'. Reporting of additional HMs is not mandatory.

2009 concerning possible approaches to achieve more complete gap-filling of the European Union emission inventory. At a meeting in September 2009 ([38]), Member State representatives agreed to trial an improved procedure in 2010. In accordance with this agreement, the gap-filling procedure used during the compilation of the European Union's 2010 and 2011 emissions inventory was performed in accordance with a methodology paper developed by the EEA and ETC/ACC ([39]). These are also consistent with the suggested techniques to fill emission data gaps described in the EMEP/EEA guidebook ([40]).

A stepwise approach was used to fill gaps in the national datasets:

1. Emission trends of all pollutants were compiled from 1990 onward using the Member State LRTAP Convention emission inventories provided to the EEA in 2011.
2. For Member States that did not report complete data, emissions data reported officially by Member States under EU-MM (NO_X, NMVOCs, SO_2, CO) and then NECD (NO_X, NMVOCs, SO_2, NH_3) were used in the first instance to fill gaps. In this step notation keys were not used.

([38]) Meeting of the Air and Fuels Committee under Directive 96/62/EC: Information on the Member States reporting under the National Emission Ceilings Directive (2001/81/EC), 28 September 2009, Brussels
([39]) EEA, 2009.
([40]) EMEP/EEA, 2009.

Table 1.6 Data sources of the main pollutants NO_X, NMVOCs, SO_X, NH_3, CO, $PM_{2.5}$ and PM_{10} emissions used for the 2011 EU-27 inventory compilation (as of 12 May 2011)

Member State	NFR as provided as LRTAP Convention submission via Eionet		CRF as provided under Council Decision 280/2004/EC via Eionet (NO_X, NMVOC, SO_X, CO)	NFR as provided via NEC Directive (NO_X, NMVOC, SO_X, NH_3)	Data submitted via LRTAP Convention to EMEP (CEIP database)
	NO_X, NMVOC, SO_X, NH_3, CO	$PM_{2.5}$ and PM_{10}			
Austria	1990–2009	1990, 1995, 2000–2009			
Belgium	1990, 1995, 2000, 2005–2009	2000, 2005–2009	1991–1994, 1996–1999, 2001–2004		NH_3: 1991–1994, 1996–1999, 2001–2004; $PM_{2.5}$, PM_{10}: 2001–2004
Bulgaria	2009	2009	1990–2008	2008 (NH_3)	NH_3: 2001–2007; $PM_{2.5}$, PM_{10}: 2007–2008
Cyprus	1990–2009	2000–2009			
Czech Republic	2009	2009	1990–2008	2008 (NH_3)	NH_3: 2001–2007; $PM_{2.5}$: 2003–2008; PM_{10}: 2001–2008
Denmark	1990–2009	2000–2009			
Estonia	1990–2009	2000–2009			
Finland	1990–2009	1990–2009			
France	1990–2009	1990–2009			
Germany	1990–2009	1995–2009			
Greece	2009	2009	1990–2008		2007–2008 (NH_3)
Hungary	2009	2009	1990–2008		NH_3: 1990–2008; $PM_{2.5}$, PM_{10}: 2002–2008
Ireland	1990–2009	1990–2009			
Italy	1990–2009	1990–2009			
Latvia	1990–2009	2000–2009			
Lithuania	2009	2009	1990–2008	1990, 1995, 2007–2008 (NH_3)	NH_3: 2002–2006; $PM_{2.5}$, PM_{10}: 2004–2008
Luxembourg			1990–2005; NMVOC: 1990–2009	2008–2009; NH_3: 2009	NO_X, SO_X: 2006–2007; NH_3: 1990–2007
Malta			1990–2009		2000–2008 (NH_3, $PM_{2.5}$, PM_{10})
Netherlands	1990–2009	1990–2009			
Poland	2002–2003, 2008–2009	2002–2003, 2008–2009	1990–2001, 2004–2007	2000–2001, 2004–2007 (NH_3)	2001, 2004–2007 (PM_{10}, $PM_{2.5}$)
Portugal	1990–2009	1990–2009			
Romania	2008–2009	2008–2009	1990–2007		2007 (NH_3, $PM_{2.5}$, PM_{10})
Slovakia	2000–2009	2000–2009	1990–1999		
Slovenia	1990–2009	2000–2009			
Spain	1990–2009	2000–2009			
Sweden	1990–2009	1990–2009			
United Kingdom	1990–2009	1990–2009			

3. In a further step notation keys reported officially by Member States under EU-MM (NO_X, NMVOCs, SO_2, CO) and then NECD (NO_X, NMVOCs, SO_2, NH_3) were used to fill any remaining gaps.
4. In the next step Member State LRTAP Convention emission inventories provided to the EEA in previous years were used to fill still remaining gaps.
5. Older LRTAP Convention data submitted to EMEP/CEIP was the final source of official data used to fill gaps.
6. Finally, for all remaining cases of missing data, further gap-filling procedures were applied in accordance with the procedures described in EEA (2009).

The further gap-filling procedures described in Step 6 are summarised as follows:

(i) Interpolation was performed if one or several years in the middle of a time series were missing.
(ii) 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 five consecutive years showing a clear trend ($r^2 < 0.6$) were available. Extrapolation 'backwards' was never allowed to result in negative values.
(iii) If fewer than five consecutive years were available as a basis for extrapolation, or if years did not show a clear trend, the value of the previous or next year was used to fill the gaps.

Table 1.7. Data sources of heavy metals (Pb, Cd, Hg) and the persistent organic pollutants (PCDD/F, total PAHs, HCB, HCH and PCBs) emissions used for the 2011 EU-27 inventory compilation (as of 12 May 2011)

Member State	NFR as provided as LRTAP Convention submission via Eionet		Data submitted via LRTAP Convention to EMEP (CEIP database)
	Pb, Cd, Hg	PCDD/F, total PAHs, HCB, HCH, PCBs	
Austria	1990–2009	1990–2009; PCBs: 2009	
Belgium	1990, 1995, 2000, 2005–2009	1990, 1995, 2000, 2005–2009; PCBs: 2009	1991–1994, 1996–1999, 2001–2004
Bulgaria	2009	2009	2001–2008
Cyprus	1990–2009	1990–2009; HCH: 2009	
Czech Republic	2009	2009	2001–2008; HCB: 2002–2008
Denmark	1990–2009	1990–2009; HCH, PCBs: 2009	
Estonia	1990–2009	1990–2009; HCH, PCBs: 2009	
Finland	1990–2009	1990–2009; HCH: 2009	
France	1990–2009	1990–2009; HCH: 2009	
Germany	1990–2009	1990–2009	
Greece	2009	2009	1996
Hungary	2009	2009	2002–2008; PCBs: 2002–2003
Ireland	1990–2009	1990–2009; HCH: 2009	
Italy	1990–2009	1990–2009; HCH: 2009	
Latvia	1990–2009	1990–2009; HCH: 2009	
Lithuania	2009	2009	2002–2008; PCBs: 2002–2007
Luxembourg			2007
Malta			2008; Cd, Hg, Pb: 2000–2008
Netherlands	1990–2009	1990–2009; HCb, HCH: 2009; PCBs: 1994, 1998, 2002, 2004–2005	
Poland	2002–2003, 2008–2009	2002–2003, 2008–2009; HCH: 2009	2001, 2004–2007
Portugal	1990–2009	1990–2009; HCH: 2009	
Romania	2008–2009	2008–2009; HCH: 2009	2004–2007; Cd, Hg, Pb: 2007
Slovakia	2000–2009	2000–2009; HCH: 2009	
Slovenia	1990–2009	1990–2009; HCH: 2009	
Spain	1990–2009	1990–2009; PCBs: 2009	
Sweden	1990–2009	1990–2009; HCH: 2009	
United Kingdom	1990–2009	1990–2009	

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

Further, gap-filling was applied only where either national total and sectoral data were not available 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 applied.

Table 1.6 and Table 1.7 show how the various officially reported datasets were used to supplement the LRTAP Convention data submissions for those Member States where gap-filling was required. Annex D provides a detailed overview showing, for each Member State, which data were gap-filled (and how).

The gap-filling procedure used in 2010 and 2011 has resulted in a more accurate determination of EU emission trends and the most significant emission sources of the various pollutants than in previous years. For certain pollutants (PM, HM and POPs), particular Member States in certain cases lacked data for all years and gap-filling was thus impossible. In such instances, the EU-27 emission totals for these pollutants are not considered complete (i.e. they are underestimated).

1.4.3 Comparison of Member State emissions calculated on the basis of fuel sold versus fuel consumed

The reporting guidelines ([41]) specify (Article IV, pararaph 15) how emissions from transport should be reported: 'For emissions from transport, Parties within the EMEP region should calculate and report emissions consistent with national energy balances

([41]) UNECE, 2009.

Table 1.8 Comparison of Member States' total emissions calculated on the basis of fuel sold and fuel consumed, 2009

Member States		NO_x	NMVOC	SO_x	NH_3	PM_{10}	$PM_{2.5}$	CO	Cd	Hg	Pb	PCDD/F	total PAH	HCB	HCH	PCB
		Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg	Mg	Mg	g	Mg	kg	kg	kg
Austria	National Total	187	123	21	64	35	20	649	1	1	13	36	8	38	NR	NR
	National Total (FU)	145	122	21	63	33	19	616	1	1	13	36	7	38	NR	NR
	Difference in %	– 22	– 1	0	0	– 7	– 5	– 5	0	0	0	– 1	– 6	0		
Ireland	National Total	90	52	33	108	14	9	158	0	0	15	16	3	1	NA	18
	National Total (FU)	89	52	33	108	14	9	155	0	0	15	16	3	NA	NA	18
	Difference in %	– 2	0	0	0	– 1	– 1	– 2	– 1	0	– 3	0	0			0
Netherlands	National Total	293	160	38	NE	31	17	611	NE	NE	38	NE	NE	NE	NE	NE
	National Total (FU)	276	154	38	125	30	16	599	2	1	38	29	4	NO	NO	0
	Difference in %	– 6	– 3	0		– 3	– 5	– 2			0					
Sweden	National Total	149	180	30	48	39	27	536	1	1	9	37	13	0	NA	0
	National Total (FU)	102	55	3	1	13	9	290	0	0	1	1	0	0	0	0
	Difference in %	– 32	– 70	– 91	– 97	– 66	– 68	– 46	– 99	– 100	– 92	– 98	– 99	0		0
Estonia	National Total	29	36	55	10	23	19	168	0	0	28	5	15	0	NA	43
	National Total (FU)	29	36	55	10	23	18	168	0	0	28	4	15	0	NA	43
	Difference in %	0	0	0	0	0	0	0	0	0	0	– 12	0	0		0

reported to Eurostat or the International Energy Agency. Emissions from road vehicle transport should therefore be calculated and reported on the basis of the fuel sold in the Party concerned. […] In addition, Parties may report 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 [informative inventory report]'.

The difference between transport emissions estimated using the amount of fuel sold within a country and emissions estimated using the amount of fuel consumed in a country, can be significant for countries where 'tank tourism' occurs, i.e. where fuel purchased within a country is actually used outside the country and vice-versa.

Only Austria, Ireland, the Netherlands, Sweden and Estonia reported emissions based on fuel used that differed from the emissions based on fuel sold. Table 1.8 shows, for these countries, the difference between total emissions for the year 2009 calculated using the two approaches.

1.4.4 Gridded data and large point sources

According to the revised reporting guidelines, Parties within the geographical scope of EMEP should report gridded data every five years, commencing 1990. Gridded data for the EU-27 were last submitted in 2007 and hence are not reported again this year. It is however noted that in 2011 Cyprus, Finland, Slovakia and Spain provided gridded data for one or several years (Table 1.4).

Parties within the geographical scope of EMEP are also required to provide data on large point sources (LPS) every five years, commencing 2000. In 2011 Cyprus, Finland and Spain reported LPS data for 2009. EU-27 LPS data were last submitted in 2007 and hence are not reported in 2011.

Further information concerning the last submission of EU-27 gridded and LPS data is provided in Annexes G and H to the Annual European Community emission inventory report 1990–2005 ([42]).

1.5 Key category analyses

It is good practice to identify key inventory categories in a systematic and objective manner by performing a quantitative analysis of the magnitude of emissions (a 'level' assessment) or 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 total inventory in terms of the absolute level of emissions, the trend in emissions, or both. In this report, the categories that are together responsible for 80 % of the national total emission

([42]) EEA, 2007.

of a given pollutant are classified as key categories (as per the EMEP/EEA guidebook ([43])).

EU-27 key categories were determined using a level analysis of 2009 emissions for each pollutant (after any necessary gap-filling had occurred). It should be noted that when the notation 'IE' (included elsewhere) was used by a Member State for a particular source/pollutant combination the key category analysis is likely to have underestimated the category concerned and overestimated the category in which emissions were instead reported. In addition, as described earlier, particulate matter, heavy metals and POPs data from some Member States could not be gap-filled as no data were reported for any years. To enable presentation of a provisional key category analysis for these pollutants, in these instances emissions were aggregated without including data for all the EU-27 Member States. 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-27 key categories in 2009 for each pollutant. A complete list of all EU-27 key categories for NO_X, NMVOCs, SO_X, NH_3, $PM_{2.5}$, PM_{10} and CO, heavy metals (Pb, Cd and Hg) and POPs (PCDD/F, total PAHs, HCB, HCH and PCBs) emissions is also given in Chapter 2. Detailed key category analysis (KCA) calculations are provided in Annex C to this report.

1.6 Quality assurance, quality control and verification methods

Member States are encouraged to use appropriate quality assurance and quality control 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 emission inventory guidebook ([44]).

There is no formal quality assurance and quality control plan available for the European Union inventory. The main activities to enhance the quality of the inventory are the checks performed by the EEA-ETC/ACM on the status of each Member State's submission. In addition, the internal consistencies of the data tables submitted by Member States are checked before EU-27 tables are compiled. External checks are also provided by Member States through an Eionet review before the EU-27 inventory is submitted to the secretariat of the LRTAP Convention.

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

More detailed quality assurance activities are performed by the EEA-ETC/ACM and the EMEP Centre on Emission Inventories and Projections (CEIP) in an annual review process ([45]). The review of Member State LRTAP Convention emission inventories is performed jointly with the review of those reported under the National Emissions Ceilings Directive ([46]). 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 actual Member State inventory submissions. Test results are provided to Member States and 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 ([47]).

In 2008, CEIP in cooperation with the EEA and Member States started centralised reviews ([48]) of national inventories (stage 3). In 2010, Austria, Cyprus, Germany, Italy, the Netherlands, Romania, the Russian Federation, Slovakia, Switzerland and the United Kingdom were reviewed. The results are published in individual country-specific reports (www.ceip.at/review-process/review-2010). The long-term goal of EMEP is to perform a centralised review every year of ten LRTAP Convention Parties, so that each Party undergoes a detailed review approximately once every five years ([49]).

([43]) EMEP/EEA, 2009.
([44]) EMEP/EEA, 2009.
([45]) More information is available at www.ceip.at/review-process.
([46]) Directive 2001/81/EC.
([47]) A summary of the results of the stage one and two review performed in 2011 will be published jointly by EMEP/EEA.
([48]) 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 voluntary countries which were reviewed for the first time within a stage 3 review process were France, Norway, Portugal, and Sweden.
([49]) The long-term schedule of country reviews is available at http://www.ceip.at/review-process/centralised-review-long-term-plan/.

1.7 General uncertainty evaluation

A quantification of uncertainty in the European Union LRTAP emission inventory first requires Member States to provide detailed information on emission uncertainties. To date, Member States have reported insufficient information to evaluate uncertainty at the overall European Union level.

2 Trends and key categories of EU-27 pollutant emissions

The present EU-27 inventory provides emissions for all the main air pollutants, particulate matter, 'priority' heavy metals and POPs for which inventory reporting is required under the LRTAP Convention ([50]).

The following sections of this chapter provide a summary of the contributions made by each Member State to the EU-27 total emissions of NO_X, NMVOCs, SO_X, NH_3, CO, $PM_{2.5}$ and PM_{10}; the heavy metals Pb, Cd and Hg; and the persistent organic pollutants PCDD/F, total PAHs, HCB, HCH and PCBs. Additionally, for each pollutant the key categories identified, that is, the individual sources which overall contribute most to the 2009 emissions of pollutants. For the five most important key categories the past emission trend of the EU-27 is given.

Table 2.1 Total EU-27 emissions of the main air pollutants, heavy metals, POPs and particulate matter

Pollutant	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Change 1990–2009	Change 2008–2009
NO_x	Gg	16 866	14 630	12 628	12 377	12 097	12 016	11 858	11 613	11 352	11 080	10 212	9 374	– 44 %	– 8,2 %
NMVOC	Gg	17 164	13 553	11 031	10 480	10 309	9 955	9 690	9 176	9 027	9 226	8 301	7 761	– 55 %	– 6,5 %
SO_x	Gg	25 425	16 766	10 348	10 157	9 658	9 217	8 640	7 995	7 831	7 636	6 365	5 015	– 80 %	– 21,2 %
NH_3	Gg	5 131	4 327	4 204	4 101	4 053	4 022	3 985	3 965	3 896	3 896	3 829	3 775	– 26 %	– 1,4 %
CO	Gg	63 785	50 610	40 115	37 313	35 124	33 794	33 299	29 960	28 793	27 708	27 027	24 073	– 62 %	– 10,9 %
Pb	Mg	23 056	10 488	4 197	3 546	2 729	2 661	2 568	2 505	2 504	2 579	2 431	2 054	– 91 %	– 15,5 %
Cd	Mg	312	236	170	165	158	152	143	140	131	106	105	94	– 70 %	– 10,8 %
Hg	Mg	223	159	122	114	108	105	103	104	91	91	86	73	– 67 %	– 15,0 %
PCDD/F	g I-Teq	11 777	8 524	4 385	3 896	3 123	2 811	2 710	2 544	2 470	2 102	2 073	1 968	– 83 %	– 5,0 %
total PAH	Mg	3 694	3 549	2 060	1 956	1 434	1 497	1 266	1 241	1 421	1 439	1 464	1 457	– 61 %	– 0,5 %
HCB	kg	5 858	4 982	893	815	758	782	715	724	644	654	628	494	– 92 %	– 21,3 %
HCH	kg	180 061	84 694	60 019	56 451	41 679	38 864	36 272	34 028	31 837	30 151	28 649	27 309	– 85 %	– 4,7 %
PCB	kg	13 663	11 366	6 581	6 287	5 663	5 398	5 193	5 233	5 356	3 884	4 088	3 364	– 75 %	– 17,7 %
														Change 2000–2009	**Change 2008–2009**
$PM_{2.5}$	Gg			1 621	1 607	1 531	1 513	1 498	1 454	1 412	1 382	1 356	1 293	– 20 %	– 4,6 %
PM_{10}	Gg			2 304	2 297	2 161	2 181	2 164	2 137	2 084	2 118	2 067	1 971	– 14 %	– 4,7 %

Note: Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards. Hence emission trends for these years only are shown.
Negative percentage values indicate that emissions have fallen.
The 1990–2009 changes of emissions in and subsequent tables are expressed as 100 x $(E_{2009}–E_{1990})/E_{1990}$ (%), where E_{2009} and E_{1990} are 2009 and 1990 total emissions, respectively. The 2008–2009 changes of emissions are expressed as 100 x $(E_{2009}–E_{2008})/E_{2008}$ (%), where E_{2009} and E_{2008} are the 2009 and 2008 total emissions, respectively.
Data are not shown for total PAH (2004–2005) due to inconsistencies in the original data reported by a Member State.

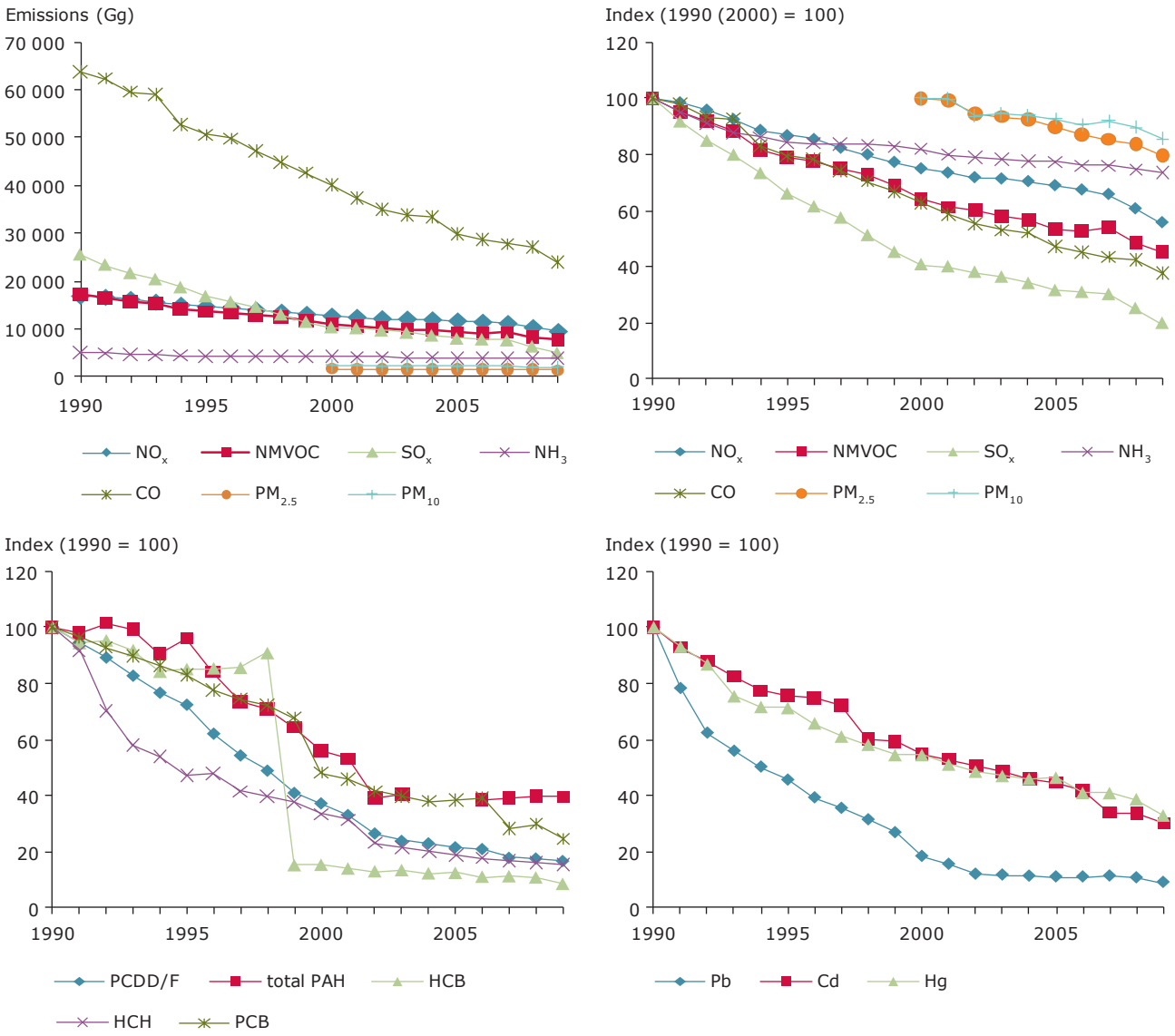
([50]) UNECE, 1979.

2.1 Total EU-27 emission trends

Past trends of the main air pollutants are presented in Figure 2.1 and Table 2.1. . Emissions of all pollutants were lower in 2009 than in 1990 (or 2000 for particulate matter). For the main air pollutants, the largest reductions across the EU-27 (in percentage terms) since 1990 have been achieved for SO_X emissions (which decreased by 80 %), followed by CO (– 62 %), NMVOCs (– 55 %), NO_X (– 44 %) and NH_3 (– 26 %). Substantial decreases in emissions of heavy metals and POPs have also been recorded since 1990. Emission trends compiled for the period 2000–2009 indicate that $PM_{2.5}$ emissions have fallen by 20 % and PM_{10} emissions by 14 %.

For certain pollutants including particulate matter, heavy metals and POPs, some Member States lacked data for all years. That meant that the data could not be gap-filled and thus were not included in the EU-27 total. In such instances, the EU-27 emission totals for these pollutants are not considered

Figure 2.1 EU-27 emission trends for the main air pollutants, particulate matter, heavy metals and POPs



Note: Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards. Hence emission trends for these years only are shown and the indexed emissions are based on emissions in the year 2000 (= 100).
The drop in HCB emissions between years 1998 and 1999 is due to a significant reduction reported by the United Kingdom.
Data are not shown for total PAH (2004–2005) due to inconsistencies in the original data reported by a Member State.

complete. Data tables later in this chapter show the reported emissions by each Member State, therefore indicating instances where emissions of a certain pollutant are missing across all years.

EU-27 projections and progress toward UNECE Gothenburg Protocol 2010 emission ceilings

The Gothenburg Protocol to the UNECE LRTAP Convention ([51]) contains emission ceilings for the pollutants NO_X, NMVOCs, SO_X and NH_3 that Parties to the protocol must meet by 2010. Under the reporting process to the LRTAP Convention, some Member States have submitted emission projections for the year 2010 and up to 2050 in some cases. Submitted data are available in Annex E to this report. As not all Member States have reported projections for all pollutants, this report does not provide further detailed analysis of projections reported by the countries in relation to the emission ceilings for 2010 in the Gothenburg Protocol to the LRTAP Convention.

However, in June 2011, the EEA published its annual 'NEC Directive status report', which analysed, for the EU Member States, the more complete projections data reported under the EU NEC Directive. The NEC Directive contains national emission ceilings that, for the EU Member States, are either equal to or more ambitious than those in the Gothenburg Protocol.

In addition to the ceilings for individual countries, the protocol also specifies ceilings for the European Union which itself is a Party to the protocol. The ceiling applies only to the EU-15 grouping of Member States that constituted the European Community at the time the Gothenburg Protocol was agreed. Table 2.2 shows the emissions for the year 2009 reported by the EU-15 Member States in comparison to the respective emission ceilings specified for the European Union. Only for NO_X are the 2009 emissions above the level of the ceiling, for the remaining pollutants the emissions in 2009 were below the respective pollutant ceilings.

2.2 EU-27 key category analysis — main emission sources

Table 2.3 presents the EU-27 key categories, i.e. the individual sources that overall contributed most to 2009 emissions of pollutants, determined by a level assessment ([52]) for each of the main air pollutants, particulate matter, heavy metals and POPs.

Fifty-three 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 1 of the 15 pollutants assessed. '1 A 4 b i — Residential: Stationary plants' and '1 A 1 a — Public electricity and heat production'

Table 2.2 Comparison of emissions reported for 2009 by the EU-15 Member States with the emission ceilings for the European Union specified in the UNECE Gothenburg Protocol

Pollutant	EU-15 emissions year 2009 (Gg)	European Union (EU-15) Gothenburg Protocol 2010 ceilings (Gg)	Difference (%)	Sum of individual EU-15 ceilings (Gg) ([a])
NO_X	7 443	6 671	12 %	6 648
NMVOC	6 011	6 600	– 9 %	6 600
SO_X	2 588	4 059	– 36 %	4 044
NH_3	3 017	3 129	– 4 %	3 128

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 European Community (EU-15) as a whole.

([51]) UNECE, 1999.

([52]) 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 together responsible for 80 % of the total emission of a given pollutant are classified as key categories (EMEP/EEA, 2009).

were identified as being important emission sources for 13 and 11 pollutants respectively. Similarly, '2 C 1 — Iron and steel production' and '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' were key categories for 9 pollutants, while the categories '1 A 3 b i — Road transport: Passenger cars' and '6 C e Small scale waste burning' were important emission sources for seven and six pollutants, respectively.

For NO_X and CO, nine key categories respectively were identified and, as would be expected for both these pollutants, all key categories are sectors in which fuel combustion or thermal process are involved. Five key categories were identified for SO_X (again all energy related) and NH_3 (five, all from the sector 'agriculture'). 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 particulate matter pollutants, more than half of the key categories were energy related, while for NMVOCs a high amount of the key categories are from activities associated with solvents and product use.

Eight key categories were identified for the heavy metal Cd, nine for Hg and 10 for Pb. Emissions from these key categories were all energy or industry related, particularly from processes associated with metal production.

For the persistent organic pollutants, key categories fell across a range of activities, including energy production and energy use, industrial processes, waste and agricultural activities. Generally, metal production was an important source of POPs emissions. However, emissions from residential households also contributed significantly to emissions of many of the POPs.

Several factors may influence the determination of key categories at the EU-27 level. A Member State's use of the emission inventory notation 'IE' ('included elsewhere' — see Appendix 1) means that emission estimates for one NFR sector can be included in those of a different sector. Also the transfer of emission inventories submitted in NFR04 into the NFR09 format might lead to an over- or underestimation of a category affected by the mapping. Due to such issues, the EU-27 key category analysis may not always accurately reflect the share of all main emission sources. It is also important to note that the results of a similar analysis of individual Member States will differ from the key sources determined for the EU-27.

Table 2.3 Results of key category analysis for the EU-27 for the year 2009 — cumulative contribution of emission sources to total emissions of NO_x, NMVOCs, SO_x, NH_3, CO, $PM_{2.5}$ and PM_{10}, the heavy metals Cd, Pb, Hg, and the persistent organic pollutants PCBs, HCB, total PAHs, PCDD/F, HCH (in descending order)

NO_x key categories	(%)	(%) cumul.
1 A 3 b iii Road transport: Heavy duty vehicles	20 %	20 %
1 A 1 a Public Electricity and Heat Production	17 %	38 %
1 A 3 b i Road transport: Passenger cars	17 %	55 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	7 %	62 %
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	5 %	67 %
1 A 4 b i Residential: Stationary plants	4 %	72 %
1 A 3 b ii Road transport: Light duty vehicles	4 %	76 %
1 A 3 d ii National navigation (Shipping)	4 %	80 %
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	3 %	82 %

SO_x key categories	(%)	(%) cumul.
1 A 1 a Public Electricity and Heat Production	52 %	52 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	10 %	63 %
1 A 4 b i Residential: Stationary plants	8 %	71 %
1 A 1 b Petroleum refining	7 %	78 %
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	3 %	81 %

NMVOC key categories	(%)	(%) cumul.
1 A 4 b i Residential: Stationary plants	11 %	11 %
3 D 2 Domestic solvent use including fungicides	9 %	20 %
1 A 3 b i Road transport: Passenger cars	8 %	29 %
3 A 2 Industrial coating application	7 %	36 %
3 A 1 Decorative coating application	7 %	42 %
3 D 3 Other product use	6 %	49 %
3 C Chemical products	5 %	53 %
1 A 3 b iv Road transport: Mopeds & motorcycles	4 %	57 %
2 D 2 Food and drink	3 %	60 %
1 B 2 a iv Refining/storage	3 %	63 %
3 D 1 Printing	3 %	66 %
1 B 2 a v Distribution of oil products	2 %	68 %
1 A 3 b v Road transport: Gasoline evaporation	2 %	70 %
1 A 3 b iii Road transport: Heavy duty vehicles	2 %	72 %
1 A 3 d ii National navigation (Shipping)	2 %	74 %
3 B 1 Degreasing	2 %	76 %
1 B 2 a i Exploration, production, transport	2 %	78 %
2 B 5 a Other chemical industry	2 %	79 %
4 B 8 Swine	1 %	81 %

CO key categories	(%)	(%) cumul.
1 A 4 b i Residential: Stationary plants	30 %	30 %
1 A 3 b i Road transport: Passenger cars	25 %	55 %
2 C 1 Iron and steel production	8 %	63 %
1 A 3 b iv Road transport: Mopeds & motorcycles	4 %	67 %
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	4 %	71 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	3 %	75 %
1 A 3 b iii Road transport: Heavy duty vehicles	3 %	77 %
6 C e Small scale waste burning	3 %	80 %
1 A 1 a Public Electricity and Heat Production	2 %	82 %

$PM_{2.5}$ key categories	(%)	(%) cumul.
1 A 4 b i Residential: Stationary plants	41 %	41 %
1 A 3 b i Road transport: Passenger cars	5 %	46 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	4 %	50 %
1 A 3 b iii Road transport: Heavy duty vehicles	4 %	54 %
1 A 1 a Public Electricity and Heat Production	4 %	58 %
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	4 %	62 %
2 A 7 a Quarrying and mining of minerals other than coal	3 %	65 %
1 A 3 b ii Road transport: Light duty vehicles	3 %	67 %
6 C e Small scale waste burning	2 %	70 %
1 A 3 b vi Road transport: Automobile tyre and brake wear	2 %	72 %
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	2 %	74 %
4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	2 %	76 %
1 A 3 b vii Road transport: Automobile road abrasion	2 %	78 %
2 C 1 Iron and steel production	2 %	79 %
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	2 %	81 %

Cd key categories	(%)	(%) cumul.
1 A 4 b i Residential: Stationary plants	24 %	24 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	14 %	38 %
1 A 1 a Public Electricity and Heat Production	11 %	49 %
2 C 1 Iron and steel production	10 %	59 %
1 A 2 b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	7 %	66 %
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	6 %	71 %
1 A 1 b Petroleum refining	5 %	76 %
1 A 4 a i Commercial/institutional: Stationary	5 %	80 %

Hg key categories	(%)	(%) cumul.
1 A 1 a Public Electricity and Heat Production	32 %	32 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	12 %	44 %
2 C 1 Iron and steel production	12 %	56 %
1 A 4 b i Residential: Stationary plants	5 %	61 %
2 A 1 Cement production	5 %	66 %
1 A 4 a i Commercial/institutional: Stationary	4 %	70 %
1 A 1 b Petroleum refining	3 %	74 %
1 A 3 d ii National navigation (Shipping)	3 %	77 %
2 B 5 a Other chemical industry	3 %	80 %

NH_3 key categories	(%)	(%) cumul.
4 B 1 b Cattle non-dairy	20 %	20 %
4 B 1 a Cattle dairy	20 %	40 %
4 D 1 a Synthetic N-fertilizers	19 %	60 %
4 B 8 Swine	16 %	76 %
4 B 9 a Laying hens	4 %	80 %

PM_{10} key categories	(%)	(%) cumul.
1 A 4 b i Residential: Stationary plants	31 %	31 %
4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	7 %	38 %
1 A 1 a Public Electricity and Heat Production	4 %	43 %
1 A 3 b i Road transport: Passenger cars	4 %	46 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	4 %	50 %
2 A 7 a Quarrying and mining of minerals other than coal	3 %	53 %
1 A 3 b vi Road transport: Automobile tyre and brake wear	3 %	57 %
1 A 3 b iii Road transport: Heavy duty vehicles	3 %	60 %
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	3 %	63 %
2 G Other production, consumption, storage, transportation or handling of bulk products	2 %	65 %
4 B 8 Swine	2 %	67 %
1 A 3 b vii Road transport: Automobile road abrasion	2 %	69 %
2 A 6 Road paving with asphalt	2 %	71 %
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	2 %	73 %
1 A 3 b ii Road transport: Light duty vehicles	2 %	75 %
6 C e Small scale waste burning	2 %	76 %
2 A 7 b Construction and demolition	2 %	78 %
2 C 1 Iron and steel production	2 %	80 %
4 B 9 b Broilers	2 %	82 %

Pb key categories	(%)	(%) cumul.
2 C 1 Iron and steel production	15 %	15 %
1 A 2 b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	13 %	28 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	12 %	40 %
2 C 5 b Lead production	8 %	48 %
1 A 4 b i Residential: Stationary plants	8 %	56 %
6 C b Industrial waste incineration	7 %	63 %
1 A 3 b vi Road transport: Automobile tyre and brake wear	6 %	69 %
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	5 %	74 %
1 A 1 a Public Electricity and Heat Production	5 %	78 %
1 A 3 b i Road transport: Passenger cars	4 %	82 %

PCB key categories	(%)	(%) cumul.
6 C b Industrial waste incineration	24 %	24 %
2 F Consumption of POPs and heavy metals (e.g. electricial and scientific equipment)	15 %	39 %
1 A 4 b i Residential: Stationary plants	15 %	54 %
1 A 1 a Public Electricity and Heat Production	13 %	66 %
2 C 1 Iron and steel production	11 %	78 %
6 C e Small scale waste burning	5 %	82 %

HCB key categories	(%)	(%) cumul.
2 C 1 Iron and steel production	63 %	63 %
1 A 4 b i Residential: Stationary plants	8 %	70 %
4 G Agriculture other	5 %	75 %
1 A 1 a Public Electricity and Heat Production	4 %	80 %
2 B 5 a Other chemical industry	4 %	84 %

Total PAH key categories	(%)	(%) cumul.
1 A 4 b i Residential: Stationary plants	46 %	46 %
4 F Field burning of agricultural wastes	16 %	62 %
1 A 3 b i Road transport: Passenger cars	8 %	70 %
2 C 3 Aluminum production	4 %	74 %
2 A 6 Road paving with asphalt	3 %	77 %
6 C e Small scale waste burning	3 %	80 %

PCDD/F key categories	(%)	(%) cumul.
1 A 4 b i Residential: Stationary plants	29 %	29 %
2 C 1 Iron and steel production	11 %	40 %
1 A 3 c Railways	8 %	48 %
6 D Other waste	7 %	55 %
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	7 %	61 %
6 C e Small scale waste burning	6 %	67 %
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	6 %	73 %
1 A 1 a Public Electricity and Heat Production	5 %	78 %
6 C b Industrial waste incineration	4 %	82 %

HCH key categories	(%)	(%) cumul.
4 G Agriculture other	67 %	67 %
2 F Consumption of POPs and heavy metals (e.g. electricial and scientific equipment)	32 %	99 %

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

Table 2.4 Member States' contributions to European Union emissions of NO_X (Gg)

Member State	NO_x (Gg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	195	181	206	216	223	233	231	237	223	217	205	187	– 4	– 8.5	1.2	2.0
Belgium	400	390	334	311	295	293	296	290	268	263	241	213	– 47	– 11.6	2.4	2.3
Bulgaria	289	216	171	186	179	201	201	207	214	222	218	165	– 43	– 24.5	1.7	1.8
Cyprus	17	19	22	21	21	21	21	21	21	21	20	19	17	– 1.6	0.1	0.2
Czech Republic	741	429	396	332	318	324	332	278	282	284	261	251	– 66	– 3.7	4.4	2.7
Denmark	278	268	201	201	198	206	190	182	183	169	151	132	– 53	– 12.8	1.6	1.4
Estonia	72	38	37	39	40	41	38	36	34	38	34	29	– 60	– 15.7	0.4	0.3
Finland	300	259	210	220	208	219	205	177	193	184	166	153	– 49	– 8.0	1.8	1.6
France	1 834	1 704	1 575	1 544	1 522	1 484	1 452	1 424	1 356	1 295	1 202	1 117	– 39	– 7.1	10.9	11.9
Germany	2 940	2 209	1 911	1 830	1 737	1 676	1 645	1 583	1 586	1 523	1 468	1 370	– 53	– 6.7	17.4	14.6
Greece	331	333	363	386	387	396	402	419	415	417	395	375	14	– 5.0	2.0	4.0
Hungary	8	185	185	183	183	210	185	203	202	185	169	167	1 960	– 1.1	0.05	1.8
Ireland	126	127	138	140	130	126	126	127	122	121	112	90	– 28	– 19.6	0.7	1.0
Italy	2 015	1 895	1 431	1 405	1 349	1 330	1 294	1 215	1 163	1 132	1 061	981	– 51	– 7.5	11.9	10.5
Latvia	65	39	36	39	39	39	39	37	37	38	34	29	– 56	– 16.1	0.4	0.3
Lithuania	164	63	50	48	51	54	56	57	65	71	68	65	– 60	– 4.1	1.0	0.7
Luxembourg	0,2	0,5	1	1	1	1	0,4	0,4	14	14	15	19	11 772	28.7	0.001	0.2
Malta	8	9	8	9	9	9	9	9	9	9	9	8	7	– 4.7	0.05	0.1
Netherlands	563	468	395	389	375	368	354	341	327	310	300	276	– 51	– 8.0	3.3	2.9
Poland	1 280	1 120	838	805	796	808	804	873	865	885	832	820	– 36	– 1.5	7.6	8.7
Portugal	235	268	293	295	305	285	288	292	270	259	246	239	2	– 3.2	1.4	2.5
Romania	459	386	304	328	342	353	367	332	344	348	280	247	– 46	– 11.8	2.7	2.6
Slovakia	222	178	107	108	100	96	100	104	98	96	94	86	– 61	– 9.3	1.3	0.9
Slovenia	60	58	50	51	51	50	48	47	46	48	53	45	– 25	– 14.7	0.4	0.5
Spain	1 283	1 343	1 367	1 339	1 378	1 367	1 407	1 396	1 349	1 355	1 173	1 056	– 18	– 10.0	7.6	11.3
Sweden	301	266	210	201	195	189	180	174	168	163	153	149	– 50	– 2.6	1.8	1.6
United Kingdom	2 683	2 180	1 789	1 753	1 664	1 635	1 587	1 553	1 495	1 414	1 252	1 086	– 60	– 13.2	15.9	11.6
EU-27 (a)	16 866	14 630	12 628	12 377	12 097	12 016	11 858	11 613	11 352	11 080	10 212	9 374	**– 44**	**– 8.2**	**100**	**100**
EU-27 (b)	16 866	14 630	12 628	12 376	12 096	12 015	11 857	11 613	11 353	11 080	10 212	9 374				

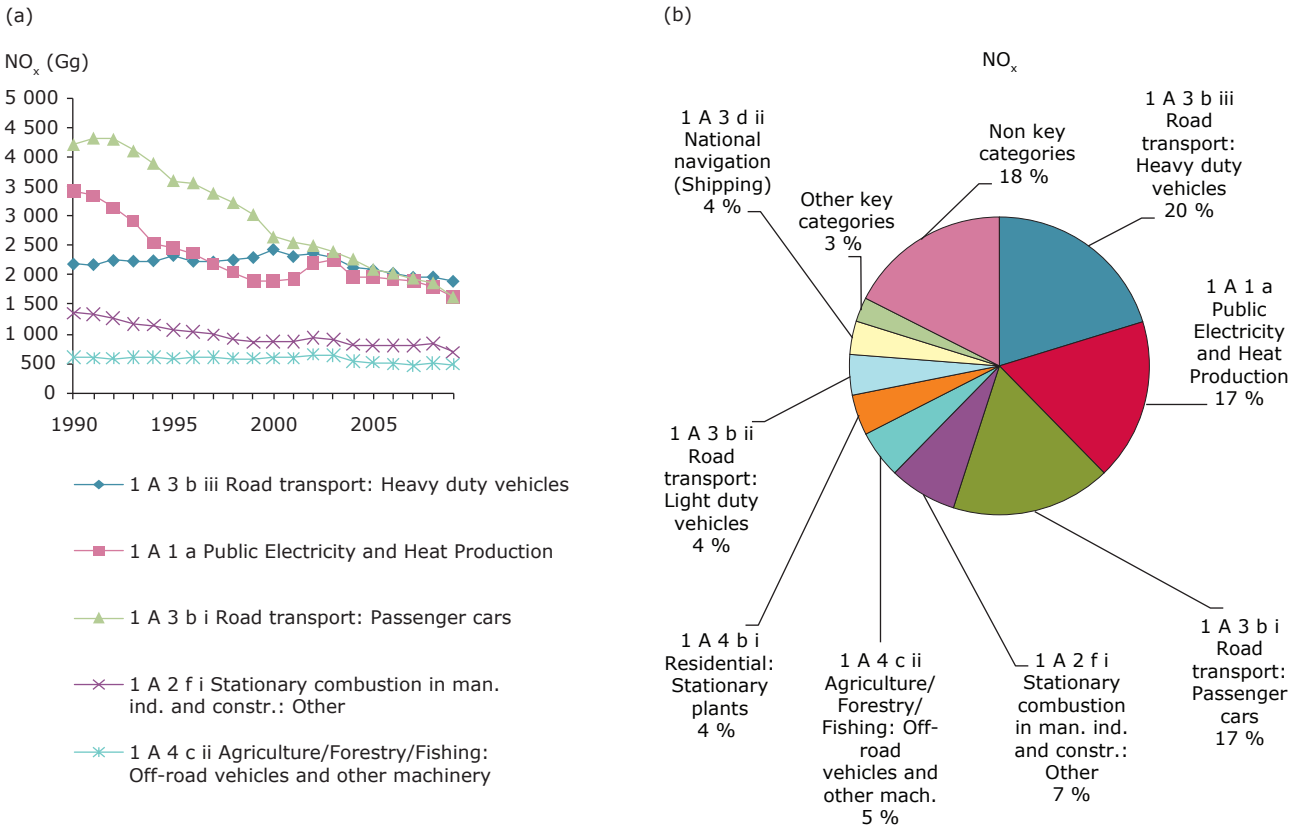
Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([54]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.

2.3 Nitrogen oxides (NO_x) emission trends

Between 1990 and 2009, NO_x emissions decreased in the EU-27 by 44 %. Between 2008 and 2009 the decrease was 8.2 %, mainly caused by reductions reported in the United Kingdom, Spain and Germany (Table 2.4). The five Member States that contributed most to the emissions of NO_x in 2009 were Germany, France, the United Kingdom, Spain and Italy.

The categories '1 A 3 b iii — Road transport: Heavy duty vehicles', '1 A 1 a — Public electricity and heat production' and '1 A 3 b i — Road transport: Passenger cars' were the most important key categories for NO_x emissions (Figure 2.2). Of the top five key categories, the highest relative reductions in emissions between 1990 and 2009 were achieved in the third most important key category '1 A 3 b i — Road transport: Passenger cars' (– 61.5 %) (Figure 2.2).

Figure 2.2 NO_x emissions from key categories in the EU-27: (a) trend in NO_x emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1. Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

([53]) For this and the following tables, two EU-27 totals are given. The first corresponds to the sum of national totals officially reported by Member States. The second is a recalculated EU-27 total following the mapping of emissions reported in the older NFR formats to NFR09. As described earlier, the national totals in these respective reporting formats differ slightly due to the inclusion of different 'memo items' in the required total (see e.g. Appendix 3). Hence following a conversion of inventories in the NFR02 format to NFR09 and subsequent aggregation, the EU-27 total can also change. A further difference between these two EU totals arises when Member States only provide national totals and no sectoral data.

([54]) UNECE, 2009.

Reduced emissions from the road transport sector have mainly resulted from the introduction of three way catalytic converters on cars and stricter regulation of emissions from heavy duty vehicles across Europe ([55]). Nevertheless, the road transport sectors together represent the largest source of NO_X emissions, accounting for 42 % of total EU-27 emissions in 2009. In the electricity/energy production sectors reductions have also occurred, in these instances as a result of measures such as the introduction of combustion modification technologies (such as use of low NO_X burners), implementation of flue-gas abatement techniques (e.g. NO_X scrubbers and selective (SCR) and selective non-catalytic reduction (SNCR) techniques) and fuel-switching from coal to gas ([56]).

2.4 Non-methane volatile organic compounds (NMVOCs) emission trends

Between 1990 and 2009, NMVOC emissions decreased in the EU-27 by 55 %. Between 2008 and 2009 the decrease was 6.5 %, mainly caused by reductions in the United Kingdom, France and Spain (Table 2.5). The three Member States that contributed most to emissions of NMVOCs in 2009 were Germany, Italy and France.

Table 2.5 Member State contributions to European Union NMVOC emissions (Gg)

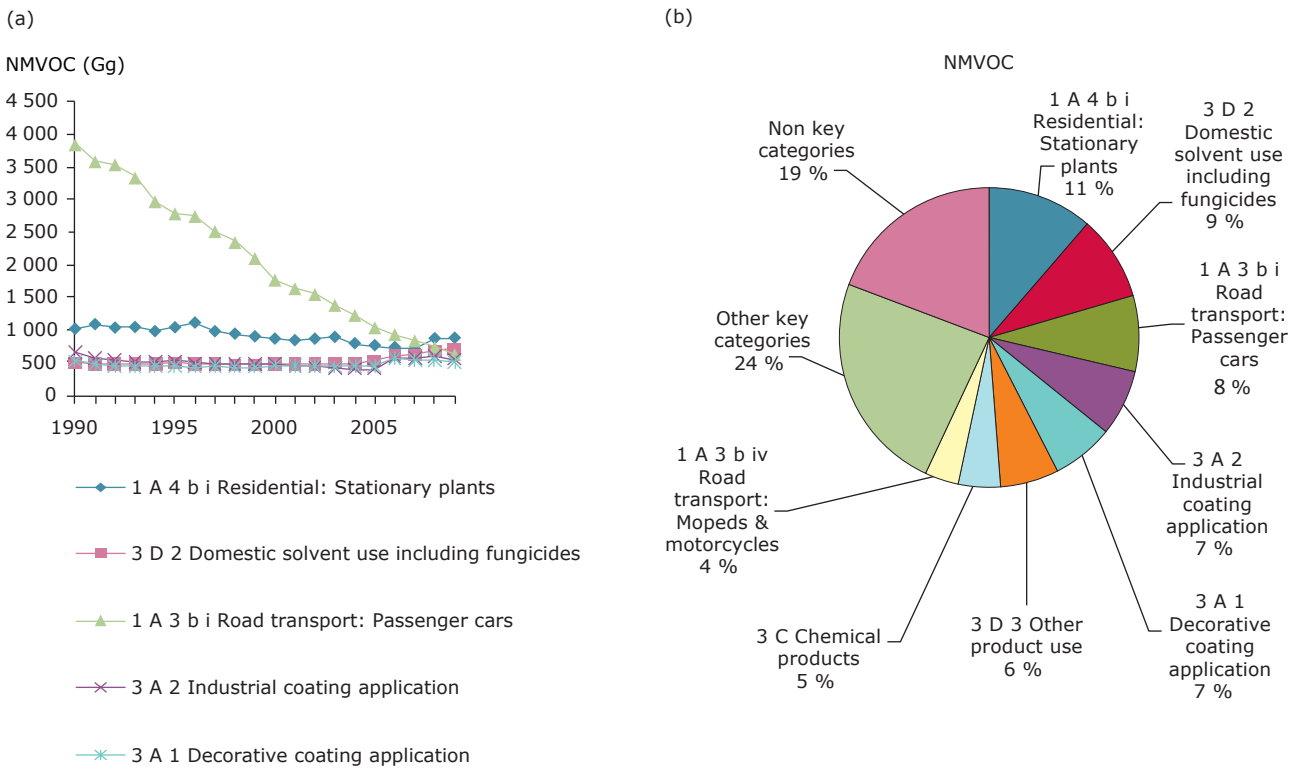
Member State	NMVOC (Gg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	276	226	179	177	177	174	155	164	173	160	150	123	– 55	– 18.2	1.6	1.6
Belgium	316	269	206	184	170	161	149	154	146	126	118	108	– 66	– 8.3	1.8	1.4
Bulgaria	541	146	103	92	97	104	100	106	114	111	113	146	– 73	29.7	3.2	1.9
Cyprus	17	16	14	14	14	15	14	14	13	13	12	11	– 34	– 7.2	0.1	0.1
Czech Republic	311	215	244	220	203	203	198	182	179	174	166	151	– 51	– 8.8	1.8	1.9
Denmark	189	168	139	132	128	123	120	117	113	107	103	95	– 50	– 7.2	1.1	1.2
Estonia	70	50	46	46	45	44	44	41	40	41	38	36	– 48	– 5.3	0.4	0.5
Finland	226	185	160	155	154	145	140	131	133	129	118	111	– 51	– 5.6	1.3	1.4
France	2 551	2 143	1 707	1 620	1 487	1 400	1 319	1 226	1 122	1 039	963	878	– 66	– 8.8	14.9	11.3
Germany	3 751	2 157	1 663	1 570	1 501	1 431	1 437	1 415	1 403	1 348	1 298	1 285	– 66	– 1.0	21.9	16.6
Greece	279	269	274	271	268	256	256	222	232	221	228	212	– 24	– 7.4	1.6	2.7
Hungary	63	170	166	162	160	169	157	176	187	168	168	128	104	– 23.9	0.4	1.7
Ireland	88	81	73	71	67	64	61	60	58	57	55	52	– 41	– 5.4	0.5	0.7
Italy	2 021	2 094	1 620	1 536	1 465	1 399	1 349	1 273	1 245	1 219	1 161	1 107	– 45	– 4.7	11.8	14.3
Latvia	102	67	65	69	65	65	110	73	75	84	74	61	– 40	– 18.0	0.6	0.8
Lithuania	116	75	71	67	67	81	76	91	85	84	73	70	– 40	– 4.4	0.7	0.9
Luxembourg	6	6	5	5	5	5	6	6	5	5	5	5	– 22	– 7.2	0.0	0.1
Malta	6	7	3	3	3	3	3	3	3	3	3	2	– 63	– 12.9	0.0	0.03
Netherlands	464	328	232	208	196	183	172	176	167	165	164	154	– 67	– 6.1	2.7	2.0
Poland	831	769	599	576	898	892	597	566	567	596	641	615	– 26	– 4.0	4.8	7.9
Portugal	306	265	241	230	226	214	211	205	201	198	193	179	– 41	– 7.0	1.8	2.3
Romania	335	281	336	316	332	363	665	539	601	1 056	466	432	29	– 7.3	2.0	5.6
Slovakia	141	101	69	73	72	73	73	76	71	69	69	65	– 54	– 5.1	0.8	0.8
Slovenia	55	54	44	43	42	40	40	37	36	35	33	31	– 44	– 6.2	0.3	0.4
Spain	1 043	976	1 009	988	908	914	897	858	842	832	780	696	– 33	– 10.8	6.1	9.0
Sweden	353	247	200	188	186	188	186	184	181	182	181	180	– 49	– 0.5	2.1	2.3
United Kingdom	2 706	2 186	1 563	1 463	1 373	1 248	1 155	1 080	1 034	1 004	929	826	– 69	– 11.1	15.8	10.6
EU-27 ([a])	17 164	13 553	11 031	10 480	10 309	9 955	9 690	9 176	9 027	9 226	8 301	7 761	**– 55**	**– 6.5**	**100**	**100**
EU-27 ([b])	17 164	13 553	11 032	10 480	10 309	9 969	9 691	9 176	9 027	9 226	8 301	7 761				

Note ([53]): ([a]) Sum of national totals as reported by Member States.
([b]) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.

([55]) EEA, 2011b.
([56]) EEA, 2010c.

The three categories, '1 A 4 b i — Residential: Stationary plants', '3 D 2 — Domestic solvent use including fungicides' and '1 A 3 b i — Road transport: Passenger cars' were the most important key categories for NMVOC emissions, together comprising 29 % of total emissions (Figure 2.3). Among the top five key categories the highest relative reductions in emissions between 1990 and 2009 were achieved in the third most important key category '1 A 3 b i — Road transport: Passenger cars' (– 83.5 %) and, as was the case for NO_X, this largely reflects successful implementation of vehicle emission standards and use of vehicle exhaust catalytic converters ([57]).

Figure 2.3 NMVOC emissions from key categories in the EU-27: (a) trend in NMVOC emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 NMVOC emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1. Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

([57]) EEA, 2011b.

2.5 Sulphur oxides (SO_X) emission trends

Between 1990 and 2009, SO_X emissions decreased in the EU-27 by 80 %. Between 2008 and 2009 the decrease was 21.2 %, mainly caused by reductions in Bulgaria, Poland, Romania, Spain and the United Kingdom (Table 2.6). The two Member States that contributed most to the emissions of SO_X in 2009 were Poland and Bulgaria.

Inspection of the time series trends for some Member States shows some significant changes in emission reductions since 1990. For example, emissions of SO_X in Slovenia fell considerably in 2001 and again in 2006 due to the introduction of flue gas desulphurisation abatement equipment in thermal power plants.

The category'1 A 1 a — Public electricity and heat production' is the most important key category for SO_X emissions, comprising 52 % of total SO_X emissions (Figure 2.4).

Among the top five key categories the highest relative reduction in emissions between 1990 and 2009 were achieved in the second most important key category '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' (– 83.2 %), the most important key category '1 A 1

Table 2.6 Member State contributions to European Union SO_x emissions (Gg)

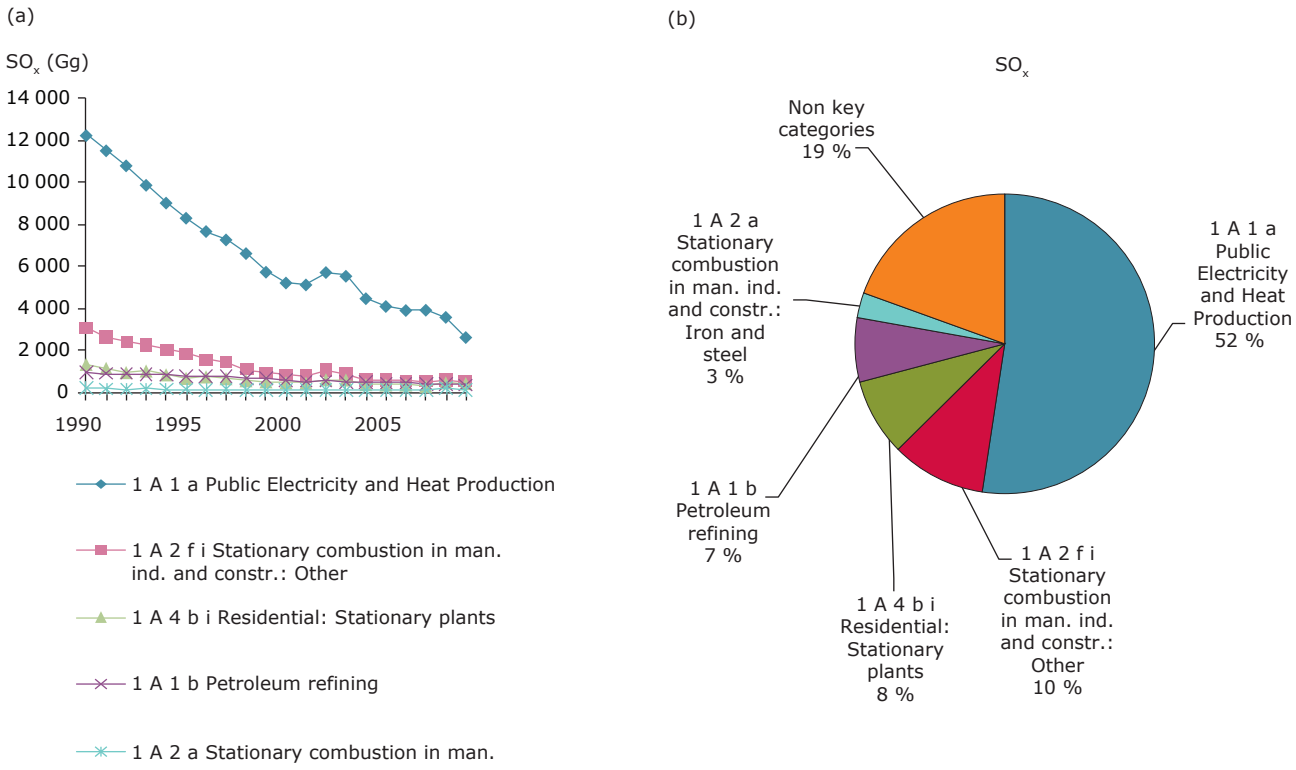
Member State	SO_x (Gg)												Change (%)		Share in EU-27 in %	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	74	47	32	33	31	32	27	27	28	25	22	21	– 72	– 8.4	0.3	0.4
Belgium	362	261	172	166	156	154	157	145	135	125	97	76	– 79	– 21.5	1.4	1.5
Bulgaria	1 767	1 350	1 080	1 198	1 113	1 234	1 195	1 143	1 147	1 278	1 238	658	– 63	– 46.9	7.0	13.1
Cyprus	30	37	46	43	44	45	38	36	29	27	22	17	– 42	– 21.0	0.1	0.3
Czech Republic	1 876	1 095	264	251	237	232	227	219	211	217	174	173	– 91	– 0.5	7.4	3.5
Denmark	179	139	29	28	26	33	26	23	27	24	19	15	– 92	– 22.0	0.7	0.3
Estonia	274	116	97	91	87	100	88	76	70	88	69	55	– 80	– 21.0	1.1	1.1
Finland	259	95	79	85	79	99	84	69	85	83	70	59	– 77	– 15.5	1.0	1.2
France	1 326	977	632	566	520	500	485	462	422	415	354	303	– 77	– 14.6	5.2	6.0
Germany	5 312	1 725	656	651	601	586	571	539	544	517	507	448	– 92	– 11.5	20.9	8.9
Greece	477	541	497	505	516	555	549	528	534	539	446	427	– 10	– 4.3	1.9	8.5
Hungary	10	707	489	404	365	348	249	147	123	99	106	80	727	– 24.5	0.0	1.6
Ireland	183	161	140	134	101	79	72	71	61	55	45	33	– 82	– 27.7	0.7	0.7
Italy	1 794	1 320	749	697	617	519	481	402	380	337	282	231	– 87	– 18.2	7.1	4.6
Latvia	105	49	16	12	11	9	7	7	6	6	5	4	– 96	– 13.7	0.4	0.1
Lithuania	215	86	42	39	38	38	41	42	42	34	29	36	– 83	26.5	0.8	0.7
Luxembourg	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	1	1	2	3	1 846	50.2	0.0	0.1
Malta	16	27	24	26	25	27	11	11	11	12	11	7	– 52	– 30.7	0.1	0.1
Netherlands	192	130	73	75	68	64	66	65	64	61	51	38	– 80	– 25.2	0.8	0.8
Poland	3 210	2 376	1 511	1 564	1 455	1 375	1 241	1 145	1 237	1 131	995	861	– 73	– 13.4	12.6	17.2
Portugal	295	304	284	265	262	177	178	179	158	152	111	76	– 74	– 31.0	1.2	1.5
Romania	755	636	457	505	539	530	512	522	542	537	566	460	– 39	– 18.8	3.0	9.2
Slovakia	526	246	127	131	103	106	96	89	88	71	69	64	– 88	– 7.7	2.1	1.3
Slovenia	198	122	92	63	63	61	49	40	16	14	13	12	– 94	– 9.6	0.8	0.2
Spain	2 176	1 791	1 463	1 439	1 541	1 277	1 321	1 275	1 170	1 170	533	430	– 80	– 19.3	8.6	8.6
Sweden	105	69	42	41	40	41	37	36	36	33	30	30	– 72	– 1.6	0.4	0.6
United Kingdom	3 711	2 357	1 253	1 146	1 018	997	831	697	663	586	498	397	– 89	– 20.2	14.6	7.9
EU-27 (a)	25 425	16 766	10 348	10 157	9 658	9 217	8 640	7 995	7 831	7 636	6 365	5 015	**– 80**	**– 21.2**	**100**	**100**
EU-27 (b)	25 425	16 766	10 347	10 157	9 658	9 217	8 640	7 995	7 831	7 636	6 365	5 015				

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.

a — Public electricity and heat production' (– 78.5 %) and the third most important key category '1 A 4 b i — Residential: Stationary plants' (– 68.4 %).

For these main emitting sources, the reduction in emissions since 1990 has been achieved as a result of a combination of measures, including switching fuel in energy-related sectors away from high sulphur solid and liquid fuels to low sulphur fuels such as natural gas, the fitting of flue gas desulphurisation abatement technology in industrial facilities and the impact of European Community directives relating to the sulphur content of certain liquid fuels ([58]).

Figure 2.4 SO_x emissions from key categories in the EU-27: (a) trend in SO_x emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to SO_x emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1. Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

([58]) EEA, 2011b

2.6 Ammonia (NH_3) emission trends

Between 1990 and 2009, NH_3 emissions decreased in the EU-27 by 26 %. Between 2008 and 2009 the decrease was 1.4 %, mainly caused by reductions in France and Italy (Table 2.7). The two Member States that contributed most to the emissions of NH_3 in 2009 were France and Germany.

Categories '4 B 1 b — Cattle non-dairy', '4 B 1 a — Cattle dairy' and '4 D 1 a — Synthetic N-fertilisers' are the most important key categories for NH_3 emissions, together comprising 60 % of total NH_3 emissions (Figure 2.5). Among the top five key categories the highest relative reduction in emissions between 1990 and 2009 was achieved in the second most important key category '4 B 1 a — Cattle dairy' (– 35.1 %). The fall in NH_3 emissions in the agricultural sector was primarily due to reduced livestock numbers (especially cattle) since 1990, changes in the handling and management of organic manures and decreased use of nitrogenous fertilisers ([59]).

Table 2.7 Member State contributions to European Union NH_3 emissions (Gg)

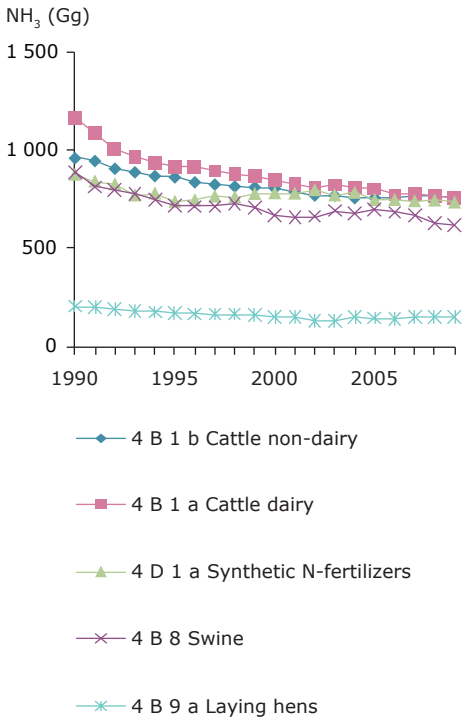
Member State	NH_3 (Gg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	65	71	65	65	64	64	63	63	63	63	63	64	– 3	1.2	1.3	1.7
Belgium	120	115	85	82	80	77	72	71	71	68	67	67	– 44	– 0.9	2.3	1.8
Bulgaria	144	99	109	56	56	52	54	57	55	58	58	51	– 64	– 11.9	2.8	1.4
Cyprus	5	6	6	6	6	6	6	6	5	5	5	5	2	– 3.0	0.1	0.1
Czech Republic	156	86	74	77	72	82	70	68	63	60	80	73	– 53	– 8.8	3.0	1.9
Denmark	117	101	93	92	89	88	88	84	80	80	78	77	– 34	– 1.6	2.3	2.0
Estonia	25	11	10	10	9	10	10	10	10	10	11	10	– 60	– 8.2	0.5	0.3
Finland	40	37	37	36	37	38	38	39	39	38	38	37	– 8	– 3.0	0.8	1.0
France	791	774	802	789	791	763	756	751	745	744	760	744	– 6	– 2.1	15.4	19.7
Germany	700	599	594	603	591	589	584	578	574	577	584	597	– 15	2.3	13.6	15.8
Greece	79	85	72	71	70	69	68	67	66	65	63	63	– 21	– 0.5	1.5	1.7
Hungary	124	77	71	66	65	67	74	80	81	71	69	68	– 45	– 1.2	2.4	1.8
Ireland	106	113	121	116	116	115	114	113	112	108	107	108	2	0.4	2.1	2.9
Italy	468	449	449	452	439	435	427	416	411	419	409	391	– 16	– 4.3	9.1	10.4
Latvia	48	16	13	15	14	15	15	16	16	16	16	16	– 66	0.0	0.9	0.4
Lithuania	84	38	25	38	51	34	33	39	35	36	29	28	– 66	– 2.6	1.6	0.8
Luxembourg	5	6	6	6	5	5	5	5	5	5	5	4	– 19	– 3.9	0.1	0.1
Malta	2	2	2	2	2	2	2	2	2	2	2	2	– 19	– 0.1	0.0	0.0
Netherlands	356	209	163	158	150	145	143	141	142	140	127	125	– 65	– 1.3	6.9	3.3
Poland	508	380	323	328	325	323	317	326	287	289	285	273	– 46	– 4.1	9.9	7.2
Portugal	63	59	61	59	59	53	54	52	50	51	49	48	– 23	– 1.7	1.2	1.3
Romania	300	217	206	164	156	182	191	204	199	203	187	188	– 37	0.3	5.8	5.0
Slovakia	65	40	32	32	33	32	29	29	27	27	25	25	– 62	– 0.8	1.3	0.7
Slovenia	20	18	19	19	20	19	17	18	18	19	18	18	– 11	0.5	0.4	0.5
Spain	318	311	380	381	378	392	385	367	378	388	356	357	12	0.0	6.2	9.4
Sweden	54	62	56	53	52	53	53	53	52	50	50	48	– 11	– 3.5	1.0	1.3
United Kingdom	368	347	333	328	322	311	316	311	311	302	288	288	– 22	– 0.1	7.2	7.6
EU-27 ([a])	5 131	4 327	4 204	4 101	4 053	4 022	3 985	3 965	3 896	3 896	3 829	3 775	**– 26**	**– 1.4**	**100**	**100**
EU-27 ([b])	5 130	4 327	4 203	4 101	4 053	4 021	3 985	3 964	3 896	3 895	3 829	3 775				

Note ([53]): ([a]) Sum of national totals as reported by Member States.
([b]) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.

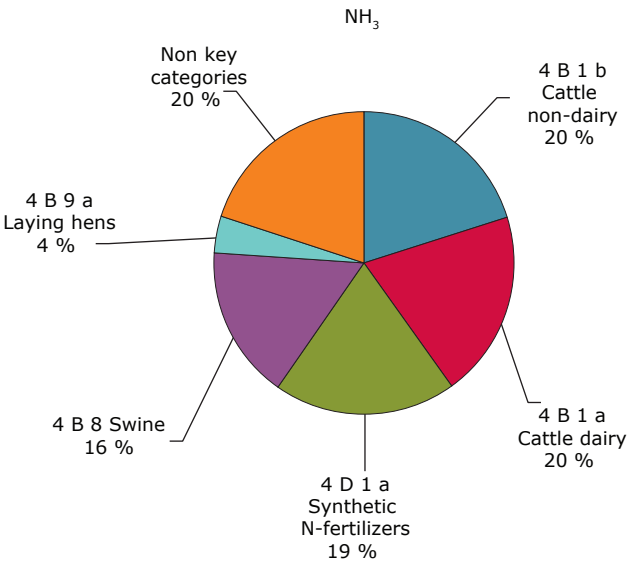
([59]) EEA, 2010d.

Figure 2.5 NH_3 emissions from key categories in the EU-27: (a) trend in NH_3 emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to NH_3 emissions, 2009

(a)



(b)



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

2.7 Particulate matter ($PM_{2.5}$) emission trends

Greece and Luxembourg did not report $PM_{2.5}$ emissions for any year and thus data for these countries could not be gap-filled. The EU-27 total is therefore underestimated. Between 2000 and 2009, $PM_{2.5}$ emissions decreased in the EU-27 by 20 %. Between 2008 and 2009, $PM_{2.5}$ emissions decreased by 4.6 %, mainly caused by reductions in France and Spain (Table 2.8). The Member State that contributed most to the emissions of $PM_{2.5}$ in 2009 was France.

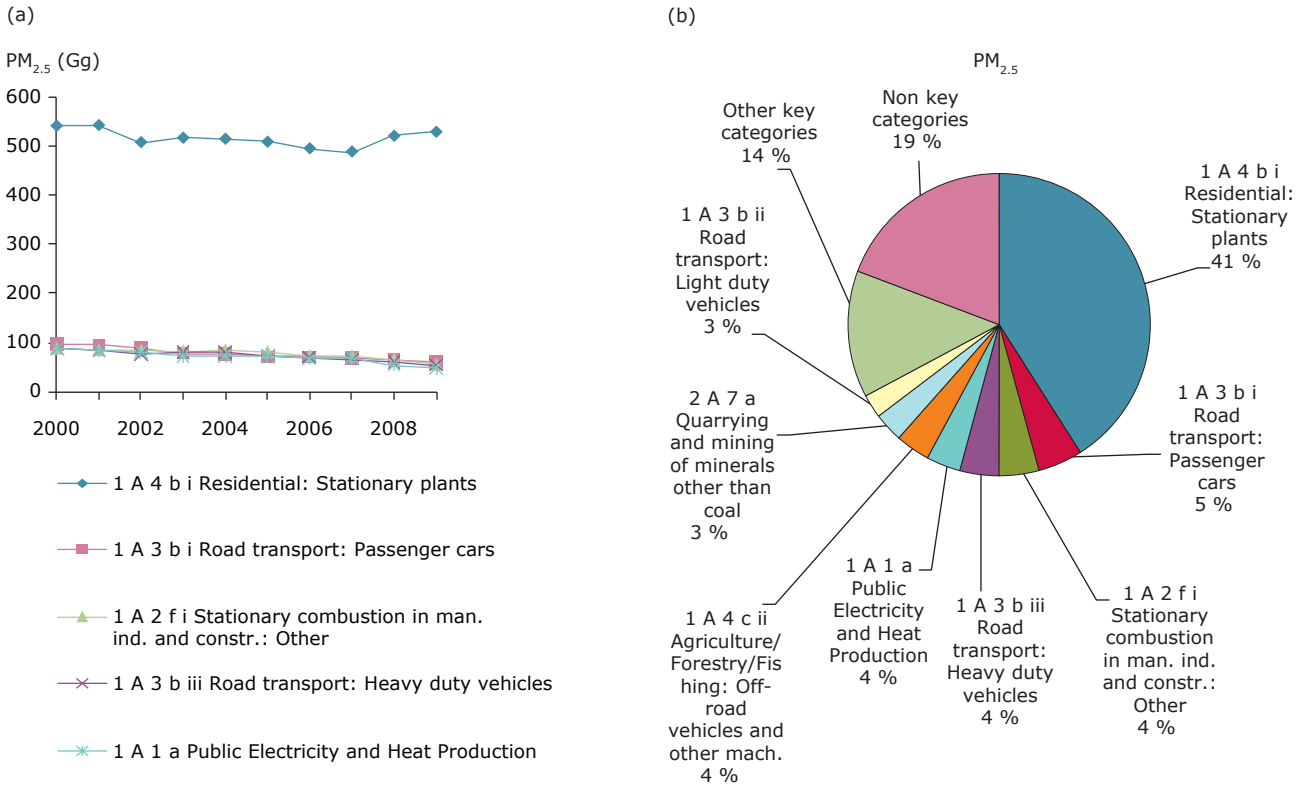
Domestic fuel use in the residential category '1 A 4 b i — Residential: Stationary plants' is the most important key category for $PM_{2.5}$ emissions, comprising 41 % of total $PM_{2.5}$ emissions (Figure 2.6). Among the top five key categories the highest relative reductions in emissions between 2000 and 2009 were achieved in the fifth most important key category '1 A 1 a — Public Electricity and Heat Production' (– 46 %) and the fourth most important key category '1 A 3 b iii — Road transport: Heavy duty vehicles' (– 39 %).

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

Member State	$PM_{2.5}$ (Gg)										Change in %		Share in EU-27 (%)	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000–2009	2008–2009	2000	2009
Austria	23	23	22	22	22	23	21	21	21	20	– 13	– 4.7	1.4	1.5
Belgium	33	30	30	29	28	26	25	21	20	16	– 53	– 20.9	2.1	1.2
Bulgaria	21	21	21	21	21	21	21	21	24	23	10	– 2.7	1.3	1.8
Cyprus	4	4	4	4	3	3	3	3	3	2	– 42	– 16.8	0.2	0.2
Czech Republic	61	53	44	38	35	21	22	21	21	20	– 67	– 2.6	3.8	1.6
Denmark	22	22	22	23	23	25	26	29	27	24	12	– 9.1	1.3	1.9
Estonia	21	22	23	21	22	20	15	20	20	19	– 13	– 7.2	1.3	1.4
Finland	40	41	41	41	41	36	37	34	38	38	– 5	– 0.6	2.5	3.0
France	381	370	348	346	338	319	303	290	285	270	– 29	– 5.2	23.5	20.9
Germany	143	140	133	129	127	122	120	114	106	100	– 30	– 6.0	8.8	7.7
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	26	24	25	27	27	31	29	21	23	28	8	22.7	1.6	2.2
Ireland	12	12	11	11	11	11	11	10	10	9	– 22	– 8.8	0.7	0.7
Italy	179	176	161	159	164	150	148	154	150	144	– 19	– 4.1	11.0	11.1
Latvia	23	26	25	26	28	27	27	26	26	28	21	9.3	1.4	2.2
Lithuania	9	9	9	9	9	9	9	10	10	10	9	– 7.2	0.5	0.7
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	1	1	1	1	1	1	1	1	1	1	42	1.4	0.1	0.1
Netherlands	24	23	22	21	20	19	18	18	17	16	– 34	– 7.9	1.5	1.2
Poland	135	142	142	141	134	138	136	134	122	120	– 12	– 2.2	8.3	9.2
Portugal	87	86	79	78	82	81	78	79	77	76	– 12	– 1.3	5.4	5.9
Romania	108	108	108	108	108	108	108	108	123	115	6	– 6.5	6.7	8.9
Slovakia	23	33	29	28	28	39	34	28	28	28	21	– 1.2	1.4	2.1
Slovenia	14	14	14	14	14	14	14	14	13	13	– 12	– 5.0	0.9	1.0
Spain	100	99	99	99	98	97	94	96	87	77	– 23	– 11.5	6.2	5.9
Sweden	28	28	28	29	29	29	29	29	28	27	– 3	– 1.7	1.7	2.1
United Kingdom	103	100	89	87	86	84	82	80	76	70	– 32	– 7.9	6.4	5.4
EU-27 (a)	1 621	1 607	1 531	1 513	1 498	1 454	1 412	1 382	1 356	1 293	**– 20**	**– 4.6**	**100**	**100**
EU-27 (b)	1 621	1 607	1 527	1 513	1 499	1 454	1 412	1 382	1 356	1 293				

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the years 2000 and onwards.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.

Figure 2.6 $PM_{2.5}$ emissions from key categories in the EU-27: (a) trend in $PM_{2.5}$ emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to $PM_{2.5}$ emissions, 2009



Note: Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.
In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

2.8 Particulate matter (PM_{10}) emission trends

Greece and Luxembourg did not report PM_{10} emissions for any year and thus data for these countries could not be gap-filled. The EU-27 total is therefore underestimated. Between 2000 and 2009 PM_{10} emissions in the EU-27 decreased by 14 %. Between 2008 and 2009, emissions decreased by 4.7 %, mainly caused by reductions in France, Bulgaria and Spain(Table 2.9). The three Member States that contributed most to the emissions of PM_{10} in 2009 were France, Poland and Germany.

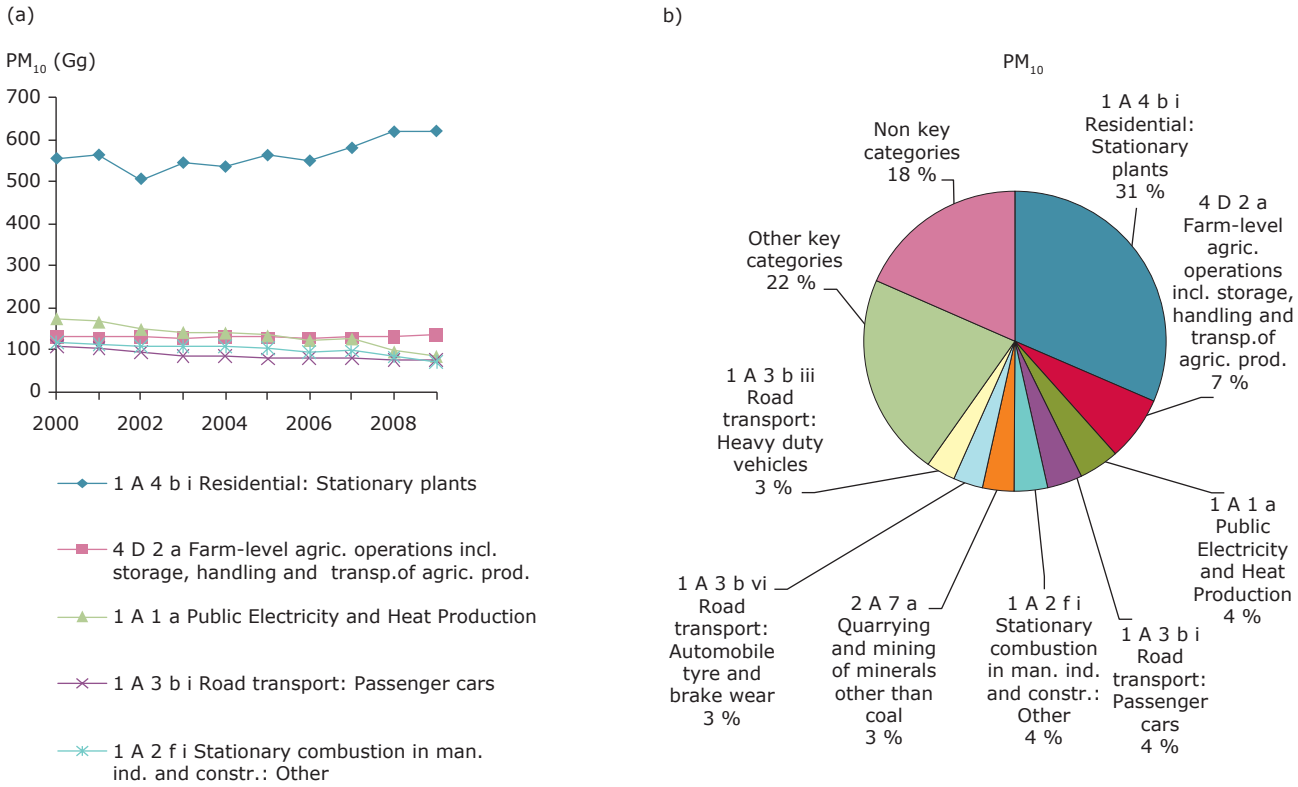
As for $PM_{2.5}$, the residential category'1 A 4 b i — Residential: Stationary plants' is the most important key category for PM_{10} emissions, accounting for 31 % of total PM_{10} emissions (Figure 2.7). Among the top five key categories the highest relative reductions in emissions between 1990 and 2009 were achieved in the third most important key category '1 A 1 a — Public electricity and heat production' (– 51.2 %) (Figure 2.7). However, the most important key category, '1 A 4 b i — Residential: Stationary plants', increased by 12 %.

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

Member State	PM_{10} (Gg)										Change (%)		Share in EU-27 (%)	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000–2009	2008–2009	2000	2009
Austria	39	39	38	38	38	39	37	36	37	35	– 9	– 4.4	1.7	1.8
Belgium	45	45	44	44	42	35	34	29	28	22	– 51	– 19.6	2.0	1.1
Bulgaria	44	44	44	44	44	44	44	44	59	45	1	– 23.8	1.9	2.3
Cyprus	6	6	5	5	5	4	4	4	4	4	– 38	– 14.7	0.3	0.2
Czech Republic	46	43	0	51	47	34	35	35	35	36	– 21	4.0	2.0	1.8
Denmark	29	29	29	30	30	32	33	36	33	31	7	– 8.1	1.2	1.6
Estonia	37	37	33	30	30	27	20	29	25	23	– 38	– 8.5	1.6	1.2
Finland	53	53	54	54	55	49	52	48	53	52	– 3	– 1.8	2.3	2.6
France	566	551	527	525	518	493	475	460	454	435	– 23	– 4.2	24.6	22.1
Germany	248	242	233	227	224	217	216	210	191	181	– 27	– 5.2	10.8	9.2
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	47	43	44	48	47	52	48	36	38	48	2	26.4	2.0	2.4
Ireland	18	18	17	16	17	17	16	15	15	14	– 24	– 9.8	0.8	0.7
Italy	209	208	193	191	196	182	179	185	180	173	– 18	– 4.3	9.1	8.8
Latvia	27	29	29	30	39	33	32	33	32	33	23	2.1	1.2	1.7
Lithuania	11	11	11	11	11	11	11	12	12	12	10	– 1.0	0.5	0.6
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	1	2	2	2	2	2	2	2	2	2	57	2.0	0.1	0.1
Netherlands	39	37	37	35	34	33	32	32	32	30	– 23	– 5.6	1.7	1.5
Poland	282	300	303	296	280	289	285	269	247	243	– 14	– 1.8	12.2	12.3
Portugal	116	123	109	104	112	115	108	106	106	106	– 9	– 0.2	5.0	5.4
Romania	19	19	19	19	19	47	46	130	142	132	609	– 7.3	0.8	6.7
Slovakia	45	48	41	37	33	47	41	35	34	33	– 26	– 1.2	2.0	1.7
Slovenia	19	19	19	18	18	19	18	18	17	16	– 19	– 4.6	0.8	0.8
Spain	144	143	145	143	142	140	135	138	122	109	– 24	– 10.6	6.3	5.5
Sweden	40	40	40	41	41	42	41	41	40	39	– 2	– 2.8	1.7	2.0
United Kingdom	174	167	145	143	141	137	136	133	129	119	– 32	– 8.0	7.5	6.0
EU-27 ([a])	2 304	2 297	2 161	2 181	2 164	2 137	2 084	2 118	2 067	1 971	**– 14**	**– 4.7**	**100**	**100**
EU-27 ([b])	2 304	2 304	2 149	2 181	2 164	2 137	2 084	2 118	2 067	1 971				

Note ([53]): ([a]) Sum of national totals as reported by Member States.
([b]) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the years 2000 and onwards.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.

Figure 2.7 PM_{10} emissions from key categories in the EU-27: (a) trend in PM_{10} emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to PM_{10} emissions, 2009



Note: Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.
In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

2.9 Carbon monoxide (CO) emission trends

Between 1990 and 2009, CO emissions decreased in the EU-27 by 62 %. Between 2008 and 2009 the decrease was 10.9 %, mainly caused by reductions in the United Kingdom, France and Germany (Table 2.10). The three Member States that contributed most to the emissions of CO in 2009 were France, Germany and Poland.

'1 A 4 b i — Residential: Stationary plants' and '1 A 3 b i — Road transport: Passenger cars' were the most important key categories for CO emissions, together accounting for 55 % of total CO emissions (Figure 2.8). Among the top five key categories the highest relative reductions in emissions between 1990 and 2009 were achieved in the second most important key category '1 A 3 b i — Road transport: Passenger cars' (– 80.1 %) (Figure 2.8).

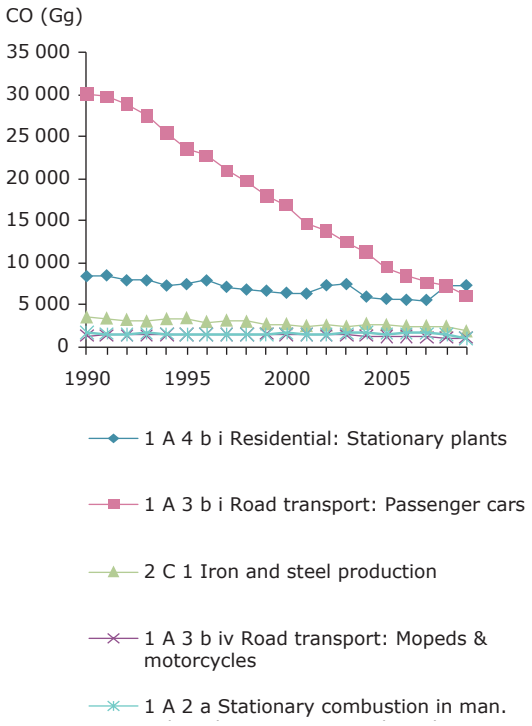
Table 2.10 Member State contributions to European Union CO emissions (Gg)

Member State	CO (Gg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2008
Austria	1 433	1 270	954	917	881	875	837	821	772	721	681	649	– 55	– 4.8	2.2	2.7
Belgium	1 330	1 057	1 002	1 008	980	948	895	790	762	600	594	367	– 72	– 38.3	2.1	1.5
Bulgaria	718	565	454	430	490	479	495	477	510	471	508	459	– 36	– 9.7	1.1	1.9
Cyprus	53	46	35	34	33	32	29	27	25	24	23	20	– 62	– 9.1	0.1	0.1
Czech Republic	1 030	897	643	649	546	579	575	511	484	509	439	404	– 61	– 8.0	1.6	1.7
Denmark	717	624	460	455	433	440	428	437	431	442	421	392	– 45	– 6.7	1.1	1.6
Estonia	227	197	183	188	182	174	171	158	144	163	167	168	– 26	0.9	0.4	0.7
Finland	561	436	610	604	600	564	551	522	511	501	485	465	– 17	– 4.1	0.9	1.9
France	10 891	9 312	6 710	6 280	6 085	5 763	5 919	5 411	4 886	4 624	4 478	3 951	– 64	– 11.8	17.1	16.4
Germany	12 263	6 565	4 900	4 646	4 351	4 166	3 940	3 725	3 657	3 563	3 497	3 095	– 75	– 11.5	19.2	12.9
Greece	1 240	1 061	1 017	1 014	974	931	920	721	737	682	622	590	– 52	– 5.2	1.9	2.5
Hungary	157	636	581	568	563	589	574	574	585	564	562	313	100	– 44.3	0.2	1.3
Ireland	420	316	256	245	226	214	204	194	185	174	165	158	– 62	– 4.3	0.7	0.7
Italy	7 131	7 096	4 857	4 563	4 173	3 953	3 759	3 364	3 153	3 003	2 865	2 617	– 63	– 8.7	11.2	10.9
Latvia	455	347	288	298	285	287	283	282	277	265	249	266	– 42	6.9	0.7	1.1
Lithuania	519	288	1 532	221	220	224	186	193	204	202	224	206	– 60	– 8.1	0.8	0.9
Luxembourg	17	10	7	7	7	7	4	4	4	3	2	1	– 94	– 33.4	0.0	0.0
Malta	24	30	30	29	29	29	28	28	28	29	30	31	29	2.4	0.0	0.1
Netherlands	1 119	911	755	735	708	687	697	669	661	644	649	599	– 46	– 7.6	1.8	2.5
Poland	7 406	4 547	3 463	3 528	3 410	3 318	3 426	2 521	2 603	2 603	2 717	2 695	– 64	– 0.8	11.6	11.2
Portugal	803	748	644	585	564	544	538	525	505	492	495	461	– 43	– 6.8	1.3	1.9
Romania	824	1 370	1 192	1 237	1 230	1 268	1 610	1 390	1 344	1 362	1 419	1 304	58	– 8.1	1.3	5.4
Slovakia	505	416	302	309	290	293	296	280	268	253	243	207	– 59	– 14.6	0.8	0.9
Slovenia	319	296	199	192	180	174	159	152	139	137	136	125	– 61	– 8.6	0.5	0.5
Spain	3 686	3 187	2 687	2 614	2 382	2 442	2 296	2 110	2 086	2 074	1 943	1 718	– 53	– 11.6	5.8	7.1
Sweden	937	866	664	626	610	613	583	581	549	544	533	536	– 43	0.5	1.5	2.2
United Kingdom	9 000	7 515	5 692	5 334	4 693	4 201	3 896	3 492	3 281	3 061	2 881	2 277	– 75	– 21.0	14.1	9.5
EU-27 (a)	63 785	50 610	40 115	37 313	35 124	33 794	33 299	29 960	28 793	27 708	27 027	24 073	**– 62**	**– 10.9**	**100**	**100**
EU-27 (b)	63 784	50 612	40 115	37 313	35 121	33 789	33 299	29 960	28 792	27 708	27 027	24 073				

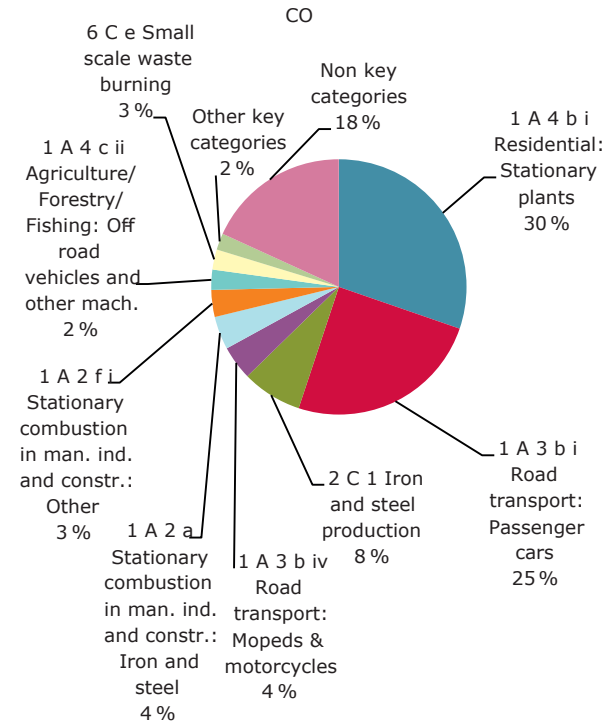
Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.

Figure 2.8 CO emissions from key categories in the EU-27: (a) trend in CO emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 CO emissions, 2009

(a)



(b)



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1. Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

2.10 Lead (Pb) emission trends

Greece and Luxembourg did not report Pb emissions for any year and thus data were not gap-filled. Therefore, the EU-27 total is underestimated. Between 1990 and 2009, Pb emissions decreased in the EU 27 by 91 %. Between 2008 and 2009, emissions decreased by 15.5 %, mainly caused by reductions in Italy and Poland (Table 2.11). The three Member States that contributed most to the emissions of Pb in 2009 were Poland, Bulgaria and Spain.

The categories '2 C 1 — Iron and steel production', '1 A 2 b — Stationary Combustion in manufacturing industries and construction: Non-ferrous metals' and '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' were the most important key categories for Pb emissions, together comprising 40 % of total Pb emissions (Figure 2.9).

The largest relative reductions in emissions between 1990 and 2009 were from the third most important key category '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' (– 71.8 %), the second most important key category '1 A 2 b — Stationary Combustion in manufacturing industries and construction: Non-ferrous metals' (– 70 %), and the fifth most important category '1 A 4 b i — Residential: Stationary plants' (– 62.3 %).

Much progress has been made since the early 1990s in reducing certain point source emissions of lead (e.g. emissions from industrial facilities). This has been achieved through improvements in, for example, abatement technologies for wastewater

Table 2.11 Member State contributions to European Union Pb emissions (Mg)

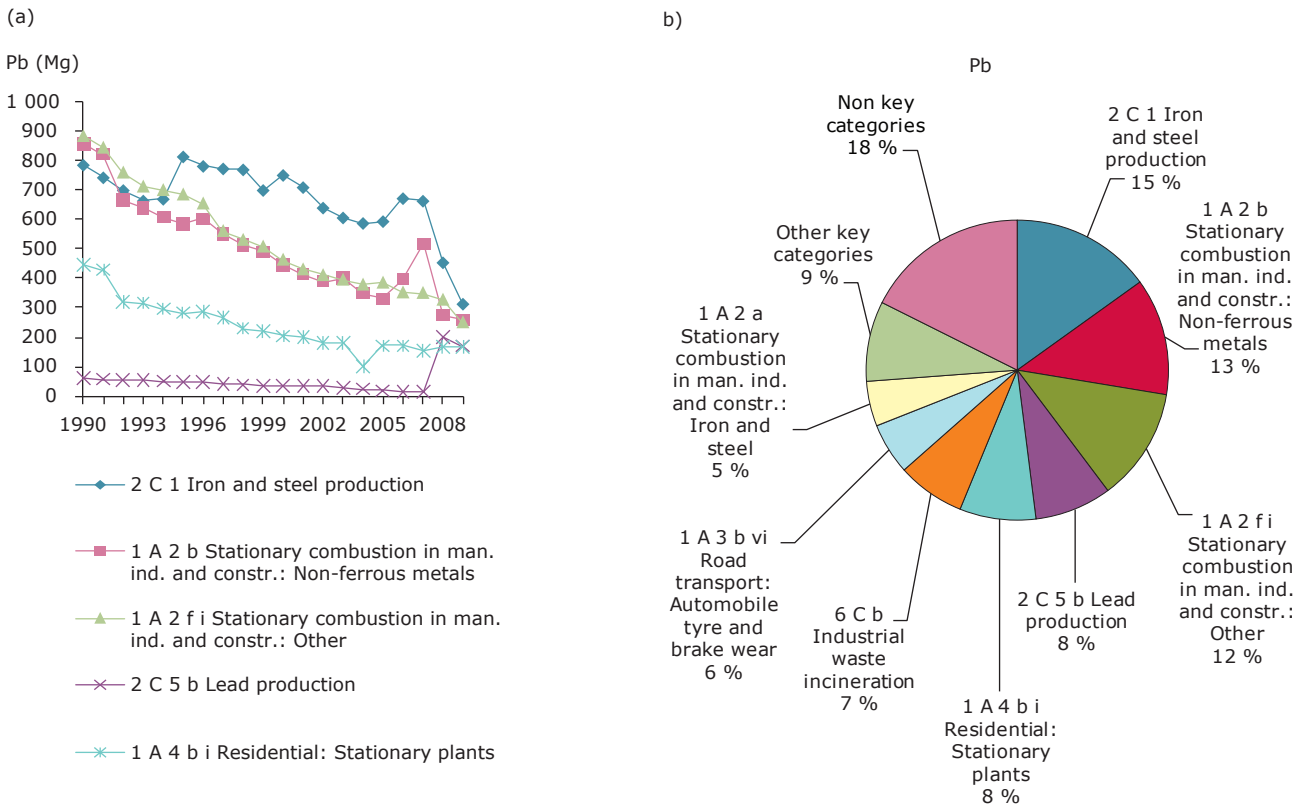
Member State	Pb (Mg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2008
Austria	218	16	12	12	12	13	13	14	14	14	15	13	– 94	– 13.8	0.9	0.6
Belgium	484	259	106	87	81	77	86	86	82	74	83	45	– 91	– 45.4	2.1	2.2
Bulgaria	436	297	200	177	105	148	143	115	124	264	297	291	– 33	– 2.1	1.9	14.2
Cyprus	25	26	21	20	18	17	7	2	2	2	3	3	– 89	3.1	0.1	0.1
Czech Republic	269	180	108	47	47	39	37	47	43	44	39	40	– 85	3.2	1.2	1.9
Denmark	125	24	17	17	16	17	19	15	14	12	12	10	– 92	– 10.9	0.5	0.5
Estonia	205	85	35	35	34	37	36	35	31	40	35	28	– 86	– 19.1	0.9	1.4
Finland	338	67	45	46	46	38	28	22	25	22	20	18	– 95	– 10.7	1.5	0.9
France	4 256	1 431	236	202	195	142	126	122	114	110	97	71	– 98	– 26.7	18.5	3.5
Germany	2 066	681	430	415	394	378	369	349	345	335	196	171	– 92	– 12.6	9.0	8.3
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	663	130	42	51	34	34	34	38	37	35	36	32	– 95	– 10.8	2.9	1.6
Ireland	125	80	18	17	16	16	16	17	17	17	17	15	– 88	– 9.0	0.5	0.7
Italy	4 412	2 013	944	711	250	255	270	279	288	291	282	210	– 95	– 25.5	19.1	10.2
Latvia	92	63	10	11	11	11	11	8	9	9	8	7	– 92	– 11.4	0.4	0.4
Lithuania	47	30	16	15	15	15	5	6	6	7	7	7	– 85	– 2.1	0.2	0.3
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	0,4	1	1	1	1	1	1	1	1	1	1	1	105	0	0.0	0.0
Netherlands	336	160	34	38	42	38	40	36	36	42	37	38	– 89	2.7	1.5	1.8
Poland	1 372	937	648	610	588	596	544	536	589	553	510	468	– 66	– 8.3	5.9	22.8
Portugal	557	772	72	87	84	86	107	119	132	151	199	164	– 70	– 17.5	2.4	8.0
Romania	481	373	263	245	221	198	179	162	118	106	92	54	– 89	– 41.4	2.1	2.6
Slovakia	150	71	76	73	79	84	78	84	83	69	79	49	– 67	– 37.8	0.7	2.4
Slovenia	357	260	63	57	13	13	13	13	15	15	15	14	– 96	– 12.4	1.5	0.7
Spain	2 788	967	626	409	275	271	267	274	276	276	270	235	– 92	– 12.9	12.1	11.5
Sweden	361	36	26	23	20	19	18	15	14	11	9	9	– 97	– 1.4	1.6	0.4
United Kingdom	2 890	1 531	150	142	132	117	121	110	89	79	73	60	– 98	– 17.5	12.5	2.9
EU-27 (a)	23 056	10 488	4 197	3 546	2 729	2 661	2 568	2 505	2 504	2 579	2 431	2 054	**– 91**	**– 15.5**	**100**	**100**
EU-27 (b)	22 867	10 488	4 197	3 547	2 729	2 660	2 569	2 505	2 504	2 579	2 431	2 054				

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.
The Czech Republic was unable to divide emissions of national and international civil aviation in 2001 and 2002. For this reason, the current inventory contains duplicate data in the category 1 A 3 a for the Czech Republic.

treatment, incinerators and in metal refining and smelting industries. Some countries have also closed older industrial facilities as a consequence of economic restructuring ([60]).

Between 2007 and 2009, emissions from category '2 C 5 b — Lead production' increased sharply (Figure 2.9). The increase is caused by data from Bulgaria, which reported rather high emission values for years 2008 and 2009 but 'NE' for 2007.

Figure 2.9 Pb emissions from key categories in the EU-27: (a) trend in Pb emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 Pb emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

2.11 Cadmium (Cd) emission trends

Greece and Luxembourg did not report Cd emissions for any year and thus data were not gap-filled. The EU-27 total is therefore underestimated. Between 1990 and 2009, Cd emissions decreased in the EU-27 by 70 %. Between 2008 and 2009 they decreased by 10.8 % (Table 2.12). The two Member States that contributed most to the emissions of Cd in 2009 were Spain, Italy, Portugal and Poland.

Categories '1 A 4 b i — Residential: Stationary plants' and '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' were the most important key categories for Cd emissions, comprising 38 % of total Cd emissions (Figure 2.10). Among the top five key categories the highest relative reductions in emissions between 1990 and 2009 were achieved from '1 A 2 b — Stationary combustion in manufacturing industry and construction: Non-ferrous metals'

Table 2.12 Member State contributions to European Union Cd emissions (Mg)

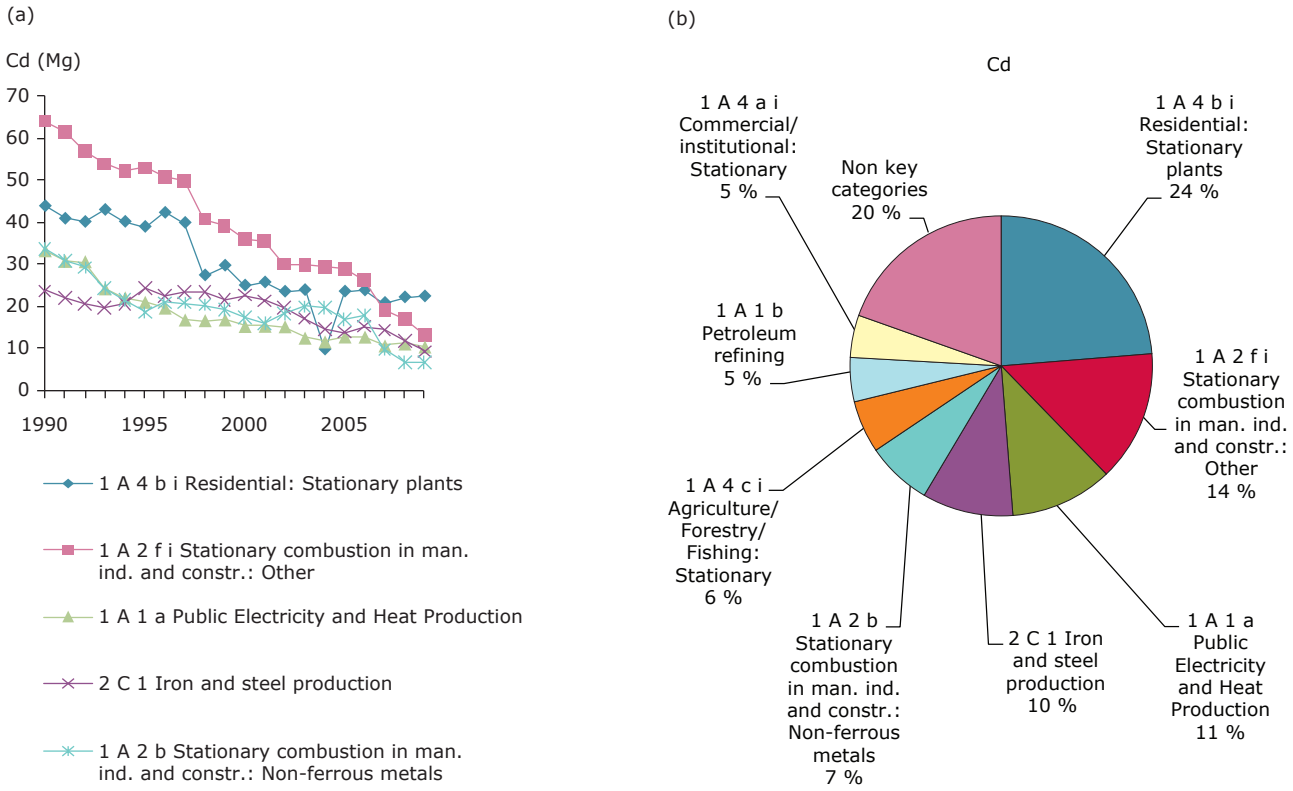
Member State	Cd (Mg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	2	1	1	1	1	1	1	1	1	1	1	1	– 33	– 7.6	0.5	1.1
Belgium	7	5	3	2	2	2	2	3	3	3	3	2	– 70	– 27.8	2.3	2.3
Bulgaria	28	13	12	10	12	15	15	12	12	4	4	3	– 88	– 11.0	9.0	3.5
Cyprus	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	71	1.4	0.02	0.1
Czech Republic	4	4	3	3	3	2	2	3	3	3	4	3	– 22	– 10.5	1.4	3.6
Denmark	1	1	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	– 81	– 14.0	0.3	0.2
Estonia	4	2	1	1	1	1	1	1	1	1	1	0.5	– 89	– 21.8	1.4	0.5
Finland	6	2	1	2	1	1	1	1	1	1	1	1	– 81	– 0.5	2.0	1.3
France	20	17	14	12	12	9	6	6	4	4	4	2	– 88	– 34.8	6.4	2.7
Germany	17	10	9	9	8	8	7	6	6	5	5	4	– 77	– 15.6	5.5	4.2
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	6	4	3	3	3	3	3	2	2	1	2	3	– 38	108.3	1.8	3.7
Ireland	1	1	1	1	1	1	1	1	1	1	1	0.4	– 49	– 24.8	0.3	0.5
Italy	10	9	9	9	7	7	8	8	8	8	8	6	– 38	– 22.1	3.2	6.7
Latvia	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	– 36	– 4.8	0.1	0.2
Lithuania	4	2	1	1	1	1	1	0.4	0.4	0.4	0.5	0.5	– 88	– 1.3	1.2	0.5
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	0.2	0.4	0.5	1	1	1	1	1	1	1	1	1	130	0.0	0.1	0.6
Netherlands	2	1	1	2	2	2	2	2	2	2	2	2	– 17	– 7.0	0.7	1.9
Poland	92	83	50	53	49	48	45	46	43	40	40	38	– 58	– 3.5	29.3	41.0
Portugal	5	6	6	5	6	5	5	6	5	5	5	3	– 37	– 32.3	1.7	3.6
Romania	40	30	19	17	16	13	11	10	6	4	3	3	– 93	– 10.6	12.8	3.0
Slovakia	9	10	8	8	6	8	8	7	7	2	3	2	– 83	– 39.6	3.0	1.7
Slovenia	1	1	1	1	1	1	1	1	1	1	1	1	– 33	– 8.9	0.3	0.6
Spain	27	23	20	20	21	19	19	19	18	15	15	13	– 52	– 14.6	8.6	13.6
Sweden	2	1	1	1	1	1	1	1	1	1	1	1	– 77	3.9	0.7	0.6
United Kingdom	23	11	6	5	5	3	4	4	4	3	3	2	– 90	– 16.5	7.4	2.5
EU-27 ([a])	312	236	170	165	158	152	143	140	131	106	105	94	**– 70**	**– 10.8**	**100**	**100**
EU-27 ([b])	312	236	170	165	158	152	143	140	131	106	105	94				

Note ([53]): ([a]) Sum of national totals as reported by Member States.
([b]) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.

(– 80.3 %), and '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' (– 79.4 %) (Figure 2.10). The low emissions from '1 A 4 b i — Residential: Stationary plants' in the year 2004 are mainly the result of exceptionally low emissions reported by Poland (data submitted to EMEP).

As was the case for lead, since the early 1990s industrial sources of cadmium emissions have in general decreased, reflecting improved abatement technologies for combustion facilities and in the metal refining and smelting industries ([61]).

Figure 2.10 Cd emissions from key categories in the EU-27: (a) trend in Cd emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 Cd emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

([61]) EEA, 2010e.

2.12 Mercury (Hg) emission trends

Greece and Luxembourg did not report Hg emissions for any year and the data thus were not gap-filled. The EU-27 total is therefore underestimated. Between 1990 and 2009, Hg emissions decreased in the EU-27 by 67 %. Between 2008 and 2009 the decrease was 15 % (Table 2.13). The three Member States that contributed most to the emissions of Hg in 2009 were Poland, Italy and Spain.

The categories'1 A 1 a — Public electricity and heat production' and '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' were the most important key categories for Hg emissions, comprising 44 % of total Hg emissions (Figure 2.11). Among the top five key categories the

Table 2.13 Member State contributions to European Union Hg emissions (Mg)

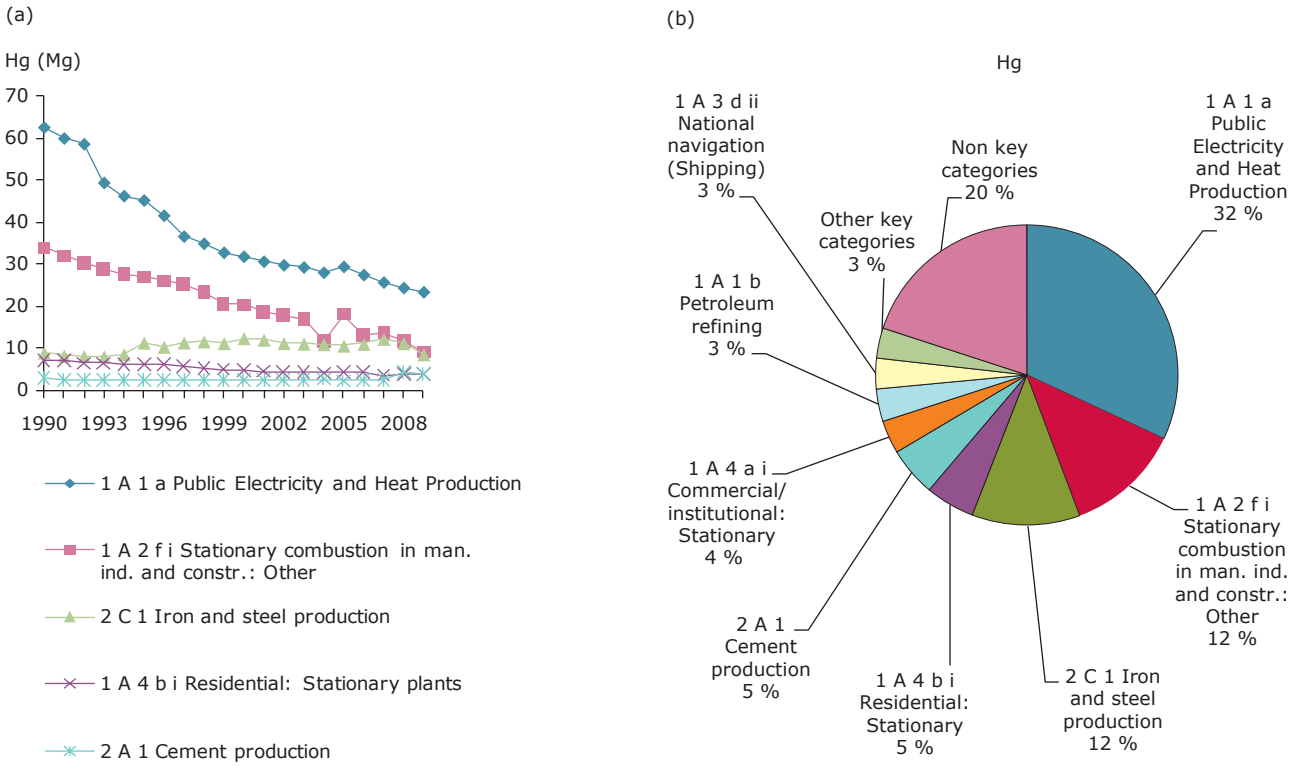
Member State	Hg (Mg)												Change in %		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	2	1	1	1	1	1	1	1	1	1	1	1	– 57	– 11.0	1.0	1.2
Belgium	7	4	3	2	3	3	3	2	2	3	4	2	– 71	– 48.8	3.0	2.7
Bulgaria	13	7	4	4	4	5	5	3	4	2	2	1	– 91	– 24.5	5.9	1.6
Cyprus	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	4	– 15.7	0.1	0.2
Czech Republic	8	7	4	3	3	2	2	4	4	4	4	4	– 43	4.4	3.4	5.8
Denmark	3	2	1	1	1	1	1	1	1	1	1	1	– 83	– 23.1	1.4	0.7
Estonia	1	1	1	1	1	1	1	1	1	1	1	0	– 60	– 22.7	0.5	0.6
Finland	1	1	1	1	1	1	1	1	1	1	1	1	– 33	– 1.6	0.5	1.0
France	24	20	11	10	9	6	6	6	6	4	4	4	– 84	– 8.7	10.7	5.4
Germany	25	11	11	11	10	9	9	8	8	7	6	6	– 78	– 11.4	11.4	7.6
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	6	5	4	4	4	4	4	4	3	3	3	3	– 55	– 6.3	2.8	3.8
Ireland	1	1	1	1	1	1	1	1	1	1	1	0.5	– 44	– 35.2	0.4	0.7
Italy	12	10	9	9	9	9	10	10	10	10	10	8	– 32	– 19.8	5.2	10.7
Latvia	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	– 72	– 4.2	0.1	0.1
Lithuania	0.02	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	2	8 525	472.6	0.0	2.1
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	0.3	0.4	0.5	1	1	1	1	1	1	1	1	1	120	0.0	0.1	0.8
Netherlands	4	1	1	1	1	1	1	1	1	1	1	1	– 77	7.7	1.6	1.1
Poland	33	32	26	23	20	20	20	20	16	16	16	15	– 56	– 7.1	14.9	19.8
Portugal	4	4	4	4	4	3	3	3	3	3	3	2	– 36	– 4.8	1.7	3.3
Romania	12	12	12	12	12	12	12	11	5	11	8	5	– 61	– 45.5	5.2	6.1
Slovakia	12	4	6	4	4	5	4	4	4	3	4	2	– 87	– 60.7	5.6	2.2
Slovenia	1	1	1	1	1	1	1	1	1	1	1	1	– 30	– 9.2	0.5	1.1
Spain	15	15	13	13	13	12	12	12	11	10	9	8	– 47	– 18.5	6.5	10.5
Sweden	2	1	1	1	1	1	1	1	1	1	1	1	– 63	9.4	0.7	0.8
United Kingdom	38	20	8	8	7	7	6	7	7	7	6	7	– 81	14.8	16.9	10.0
EU-27 (a)	223	159	122	114	108	105	103	104	91	91	86	73	**– 67**	**– 15.0**	**100**	**100**
EU-27 (b)	223	159	122	114	108	105	103	104	91	91	86	73				

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.

highest relative reductions in emissions between 1990 and 2009 were achieved from '1 A 2 f i — Stationary combustion in manufacturing industries and construction: Other' (– 73.2 %), and '1 A 1 a — Public electricity and heat production' (– 62.5 %) (Figure 2.11).

Emissions from these categories have decreased significantly since 1990, partly reflecting a general decline of coal use across Europe as a result of fuel switching (Figure 2.11) ([62]).

Figure 2.11 Hg emissions from key categories in the EU-27: (a) trend in Hg emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 Hg emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

([62]) EEA, 2010e.

2.13 Dioxins and furans (PCDD/F) emission trends

Greece, Luxembourg and Malta did not report PCDD/F emissions for any year and thus data were not gap-filled. The EU-27 total is therefore underestimated. Between 1990 and 2009, PCDD/F emissions decreased in the EU-27 by 83 %. Between 2008 and 2009 the decrease was 5 % (Table 2.14). In Bulgaria PCDD/F emissions increased considerably between 2008 and 2009. The two Member States that contributed most to the emissions of PCDD/F in 2009 were Poland and Italy.

Category '1 A 4 b i — Residential: Stationary plants' and '2 C 1 — Iron and steel production' were the most important key categories for PCDD/F emissions, together comprising 40 % of total PCDD/F emissions (Figure 2.12). Among the top five key categories the highest relative reductions in emissions between 1990 and 2009 were achieved in the fifth most important key category '1 A 2 a —

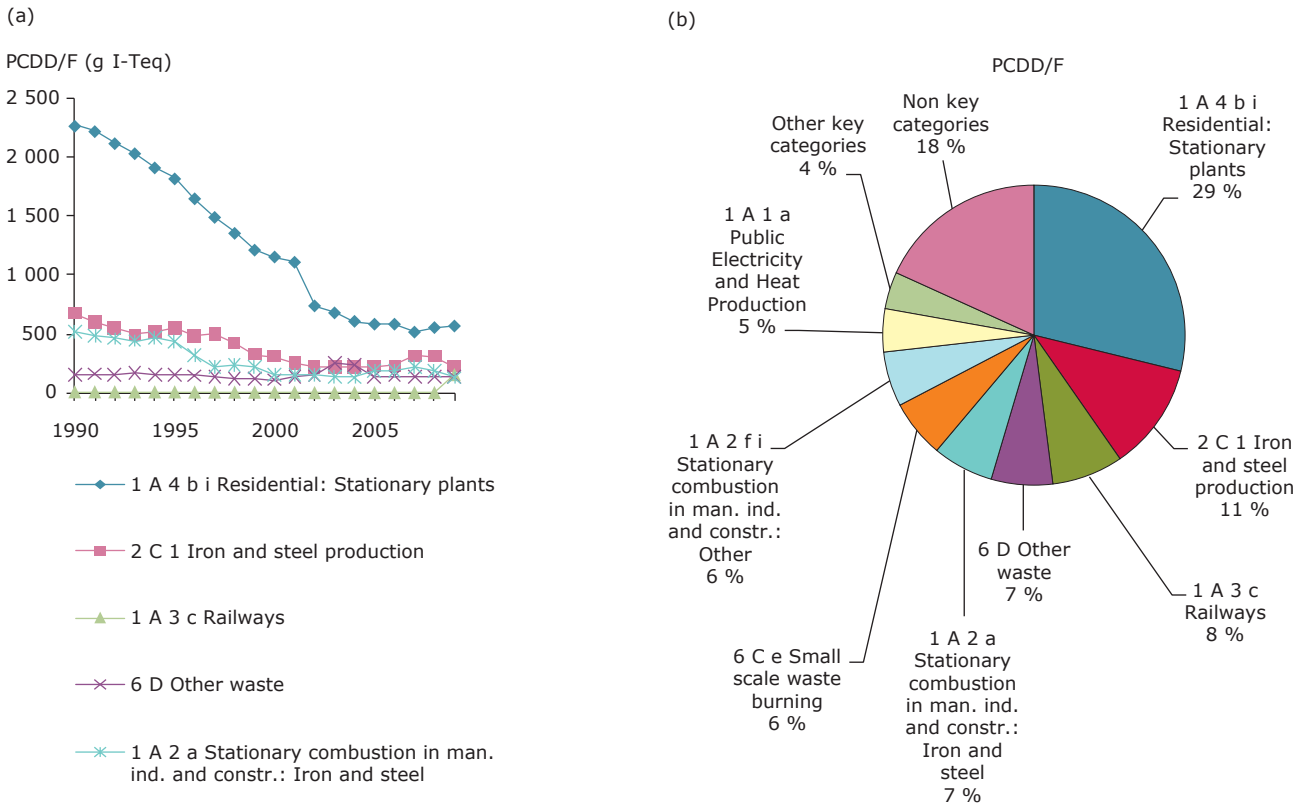
Table 2.14 Member State contributions to European Union PCDD/F emissions (g I-Teq)

Member State	PCDD/F (g I-Teq)												Change in %		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	161	58	52	53	40	40	40	43	40	39	39	36	– 78	– 6.6	1.4	1.8
Belgium	625	481	114	80	58	60	62	60	58	60	72	54	– 91	– 24.7	5.3	2.7
Bulgaria	554	456	223	201	219	255	239	230	247	69	52	187	– 66	257.9	4.7	9.5
Cyprus	2	2	2	2	2	1	1	1	1	1	1	1	– 61	9.0	0.0	0.03
Czech Republic	1 252	1 135	744	620	177	114	187	179	175	169	150	141	– 89	– 6.5	10.6	7.1
Denmark	69	53	33	32	28	33	26	27	27	31	30	28	– 59	– 4.9	0.6	1.4
Estonia	6	5	3	4	4	4	4	3	3	5	5	5	– 14	– 6.1	0.0	0.2
Finland	36	41	32	31	32	32	32	13	14	12	15	11	– 70	– 28.7	0.3	0.5
France	1 762	1 696	517	384	355	232	311	191	118	118	102	89	– 95	– 12.8	15.0	4.5
Germany	746	262	175	149	122	97	69	69	71	71	72	62	– 92	– 13.5	6.3	3.2
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	172	95	74	104	73	76	74	92	92	85	88	75	– 57	– 15.4	1.5	3.8
Ireland	26	25	23	23	30	35	27	23	23	16	16	16	– 40	– 2.7	0.2	0.8
Italy	473	462	374	298	288	287	294	298	305	318	308	233	– 51	– 24.1	4.0	11.9
Latvia	27	29	26	29	27	29	30	30	30	30	28	31	16	12.3	0.2	1.6
Lithuania	20	10	4	8	12	12	11	11	11	11	11	11	– 47	– 4.1	0.2	0.5
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Netherlands	743	69	30	31	30	28	28	38	27	28	28	29	– 96	3.2	6.3	1.5
Poland	529	515	333	447	433	482	483	416	449	396	400	393	– 26	– 1.6	4.5	20.0
Portugal	14	14	13	11	12	11	11	11	10	10	10	10	– 30	– 1.3	0.1	0.5
Romania	3 073	2 063	1 053	851	649	447	245	297	268	164	159	140	– 95	– 11.7	26.1	7.1
Slovakia	167	149	99	92	99	97	72	79	73	62	79	45	– 73	– 42.6	1.4	2.3
Slovenia	16	12	11	11	11	10	10	10	10	10	11	10	– 40	– 7.7	0.1	0.5
Spain	185	165	150	144	145	150	153	152	159	166	159	132	– 28	– 17.0	1.6	6.7
Sweden	60	40	33	34	34	34	37	39	38	36	38	37	– 39	– 3.3	0.5	1.9
United Kingdom	1 059	687	265	258	242	244	264	234	218	197	201	193	– 82	– 4.1	9.0	9.8
EU-27 (a)	11 777	8 524	4 385	3 896	3 123	2 811	2 710	2 544	2 470	2 102	2 073	1 968	**– 83**	**– 5.0**	**100**	**100**
EU-27 (b)	11 777	8 524	4 385	3 896	3 123	2 811	2 710	2 543	2 470	2 102	2 073	1 968				

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.

Stationary combustion in manufacturing industries and construction: Iron and steel' (– 75.1 %) and the most important key category 1 A 4 b i — Residential: Stationary plants' (– 75 %) (Figure 2.12). The pronounced increase in PCDD/F emissions from category '1 A 3 c — Railways' in the year 2009 is caused by a switch between data sources for Bulgarian emission data (only data for the year 2009 was provided to the EEA, the other data was taken from the EMEP database).

Figure 2.12 PCDD/F emissions from key categories in the EU-27: (a) trend in PCDD/F emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 PCDD/F emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

2.14 Polycyclic aromatic hydrocarbons (total PAHs) emission trends

Greece, Luxembourg and Malta did not report total PAHs emissions for any year and thus data were not gap-filled. The EU-27 total is therefore underestimated. Between 1990 and 2009, total PAHs emissions decreased in the EU-27 by 61 %. Between 2008 and 2009 they decreased by 0.5 % (Table 2.15). The two Member States that contributed most to the emissions of total PAHs in 2009 were Belgium ([63]) and Spain.

Category'1 A 4 b i — Residential: Stationary plants' was the most important key category for total PAHs emissions, comprising 46 % of total PAHs emissions (Figure 2.13). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2009 were achieved in the fourth most important key category '2 C 3 — Aluminium

Table 2.14 Member State contributions to European Union PAH emissions (Mg)

Member State	total PAH (Mg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	17	10	8	9	8	8	8	9	8	8	8	8	– 57	– 4.4	0.5	0.5
Belgium	420	274	242	243	235	247	244	258	244	253	256	244	– 42	– 4.5	11.4	16.8
Bulgaria	677	443	192	97	129	140	130	124	130	19	19	88	– 87	353.5	18.3	6.0
Cyprus	5	4	3	3	3	2	3	2	2	2	1	2	– 57	57.3	0.1	0.1
Czech Republic	752	1 357	488	460	24	21	24	24	17	16	19	15	– 98	– 20.9	20.3	1.0
Denmark	7	8	10	11	10	12	12	14	15	18	16	15	109	– 8.9	0.2	1.0
Estonia	12	14	13	13	13	13	14	13	12	13	14	15	24	7.3	0.3	1.0
Finland	16	17	16	16	17	17	17	13	13	13	15	16	– 3	5.6	0.4	1.1
France	39	38	28	27	24	25	24	22	20	19	19	19	– 51	– 0.2	1.1	1.3
Germany	382	163	156	165	155	153	143	141	147	141	154	155	– 59	0.7	10.3	10.7
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	48	26	19	55	20	22	21	23	23	13	15	22	– 54	49.3	1.3	1.5
Ireland	6	4	3	3	3	3	3	3	3	3	3	3	– 56	2.7	0.2	0.2
Italy	99	113	115	116	106	110	126	123	126	134	134	119	20	– 11.3	2.7	8.2
Latvia	26	29	28	28	28	29	29	29	29	28	27	30	15	12.4	0.7	2.1
Lithuania	18	56	34	39	45	47	15	16	16	15	15	15	– 19	1.0	0.5	1.0
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Netherlands	20	10	4	4	4	3	5	4	4	4	5	4	– 79	– 8.1	0.5	0.3
Poland	159	237	167	164	160	157	NE	NE	162	154	139	132	– 17	– 5.1	4.3	9.1
Portugal	131	120	117	120	120	121	124	124	129	134	144	141	8	– 2.3	3.5	9.7
Romania	274	182	91	72	54	36	17	17	17	139	157	134	– 51	– 14.9	7.4	9.2
Slovakia	29	15	13	14	13	13	16	19	18	18	18	18	– 39	– 2.8	0.8	1.2
Slovenia	13	12	12	10	10	10	10	10	10	10	10	10	– 26	– 3.4	0.4	0.7
Spain	321	307	274	259	227	280	254	224	250	258	247	230	– 28	– 6.7	8.7	15.8
Sweden	17	16	14	15	14	16	16	18	19	18	19	13	– 22	– 29.7	0.5	0.9
United Kingdom	203	91	14	15	13	11	11	10	9	9	9	9	– 96	– 1.9	5.5	0.6
EU-27 ([a])	3 694	3 549	2 060	1 956	1 434	1 497	1 266	1 241	1 421	1 439	1 464	1 457	**– 61**	**– 0.5**	**100**	**100**
EU-27 ([b])	3 694	3 549	2 060	1 956	1 434	1 508	159 413	166 610	1 421	1 439	1 464	1 457				

Note ([53]): ([a]) Sum of national totals as reported by Member States.
([b]) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data. The missing data for Poland in the years 2004 and 2005 are due to inconsistent data.

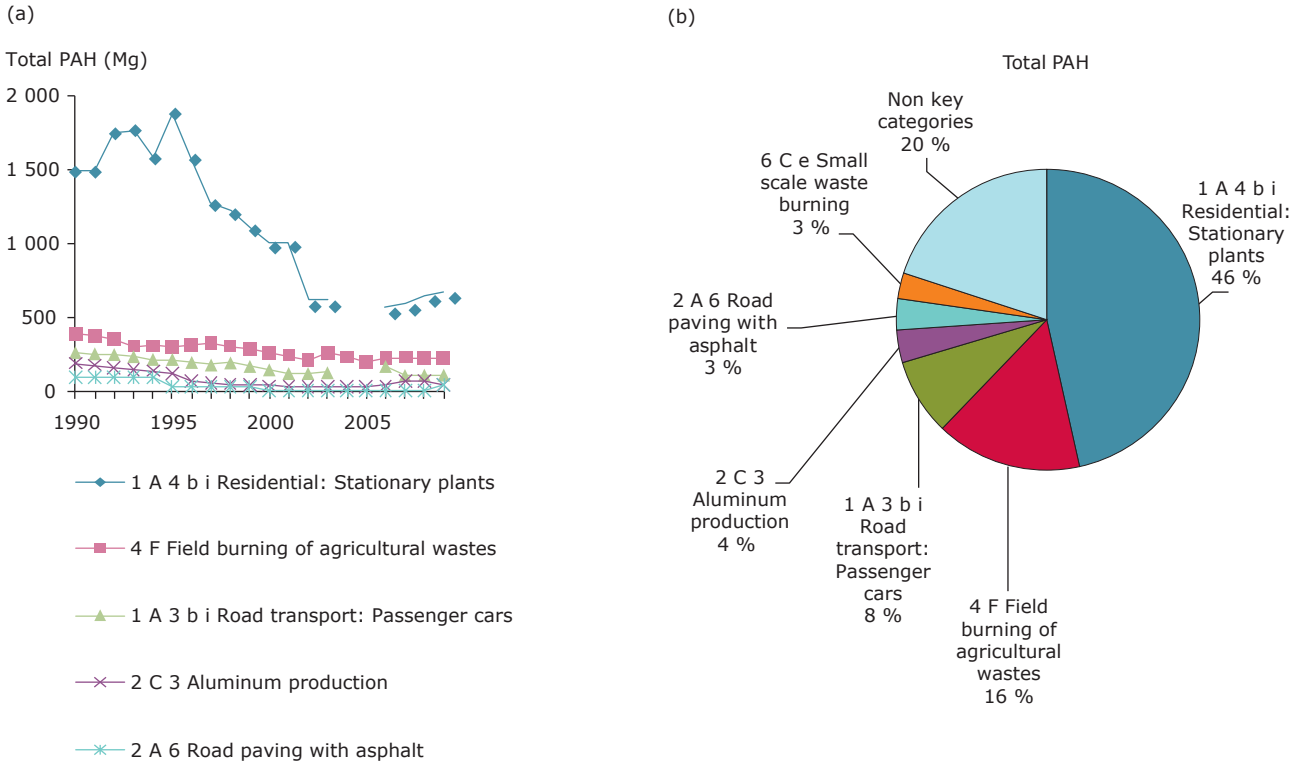
([63]) The Flanders region of Belgium has included additional PAH species in their total 1-4 PAHs emission estimate.

production' (– 74 %) and the third most important key category '1 A 3 b i — Road transport: Passenger cars' (– 55.4 %) (Figure 2.13).

The missing emission data in the categories '1 A 4 b i — Residential: Stationary plants' and '1 A 3 b i — Road transport: Passenger cars' in 2004 and 2005 are due to inconsistent data reported by Poland.

Emissions from these sources have in general declined since 1990 as a result of decreased residential use of coal, improvements in abatement technologies for metal refining and smelting, and stricter regulations on emissions from the road transport sector ([64]).

Figure 2.13 Total PAHs emissions from key categories in the EU-27: (a) trend in total PAHs emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 total PAHs emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

([64]) EEA, 2010f.

2.15 Hexachlorobenzene (HCB) emission trends

Greece, Lithuania, Luxembourg and Malta did not report HCB emissions for any year and thus data were not gap-filled. The EU-27 total is therefore underestimated. Between 1990 and 2009, HCB emissions decreased in the EU-27 by 92 %. Between 2008 and 2009 the decrease was 21.3 %, mainly caused by reductions in Spain and the United Kingdom (Table 2.16). The Member State that contributed most to the emissions of HCB in 2009 was Spain.

'2 C 1 — Iron and steel production' was the most important key category for HCB emissions, accounting for 63 % of total HCB emissions (Figure 2.14). Among the top five key categories the

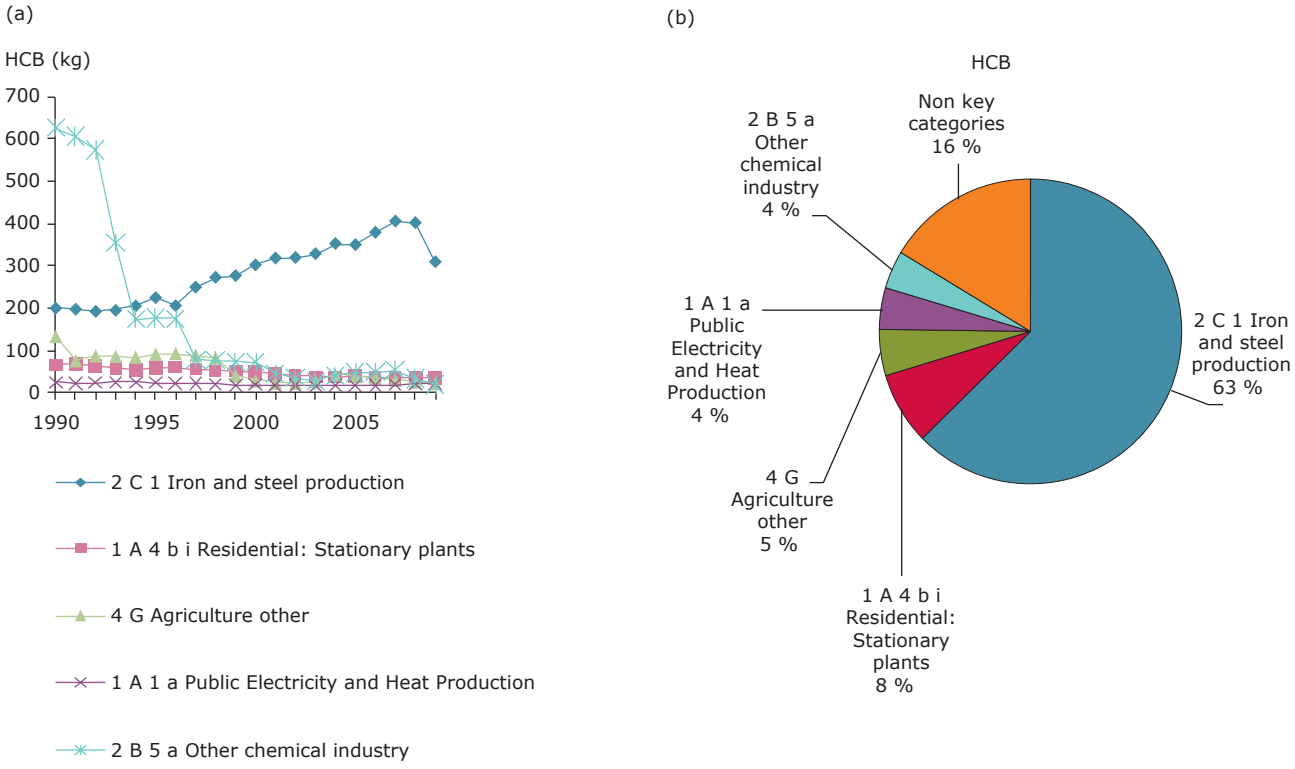
Table 2.16 Member State contributions to European Union HCB emissions (kg)

Member State	HCB (kg)												Change		Share in EU-27	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	92	53	44	46	43	42	41	46	42	41	41	38	– 58	– 6.4	1.6	7.7
Belgium	10	8	8	9	10	10	9	7	8	7	8	2	– 79	– 74.1	0.2	0.4
Bulgaria	544	79	44	43	38	45	21	19	25	23	26	23	– 96	– 14.1	9.3	4.6
Cyprus	0.1	0.1	0.1	0.1	0.1	0.03	0.02	0.02	0.02	0.02	0.02	0.01	– 75	– 16.6	0.0	0.0
Czech Republic	4	4	4	4	4	0	4	5	4	4	4	3	– 34	– 28.7	0.1	0.5
Denmark	3	2	1	1	1	1	1	0.5	1	1	1	1	– 83	– 1.6	0.1	0.1
Estonia	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	188	17.8	0.0	0.0
Finland	41	41	43	24	17	15	31	36	43	44	26	34	– 18	32.5	0.7	6.9
France	1 200	75	50	41	34	28	23	19	14	14	15	15	– 99	2.1	20.5	3.1
Germany	2	2	2	2	2	2	2	2	2	2	2	2	12	– 2.6	0.0	0.4
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	7	4	4	1	5	5	4	6	7	7	9	6	– 9	– 26.8	0.1	1.3
Ireland	40	40	0.5	0.1	0.2	1	2	1	1	1	1	1	– 97	0.02	0.7	0.2
Italy	23	24	23	33	34	35	26	24	30	31	31	29	30	– 5.7	0.4	5.9
Latvia	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	78	14.0	0.0	0.1
Lithuania	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO				
Poland	62	51	46	8	9	7	8	9	9	10	10	10	– 84	– 0.7	1.1	2.0
Portugal	1	1	1	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	– 95	0	0.0	0.0
Romania	99	64	29	22	15	8	1	2	2	2	2	2	– 98	– 6.5	1.7	0.3
Slovakia	3	3	2	2	2	2	2	2	1	1	1	1	– 62	– 25.3	0.0	0.2
Slovenia	47	37	38	38	0.3	0.3	0.3	0.3	0.3	0.4	0.3	1	– 99	49.0	0.8	0.1
Spain	510	366	472	470	478	517	464	474	389	402	393	294	– 42	– 25.3	8.7	59.5
Sweden	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	– 1	24.7	0.0	0.0
United Kingdom	3 170	4 128	80	70	66	64	75	71	66	62	58	33	– 99	– 44.0	54.1	6.6
EU-27 (a)	5 858	4 982	893	815	758	782	715	724	644	654	628	494	**– 92**	**– 21.3**	**100**	**100**
EU-27 (b)	5 858	4 982	893	815	758	782	715	724	644	654	628	494				

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.
See Appendix 1 for an explanation of the notation keys reported by Member States.

highest relative reductions in emissions between 1990 and 2009 were achieved in the fifth most important key category '2 B 5 a — Other chemical industry' (– 96.8 %). In contrast, emission from the most important key category '2 C 1 — Iron and steel production' show a pronounced increase (+ 53.9 %) since 1990 (Figure 2.14).

Figure 2.14 HCB emissions from key categories in the EU-27: (a) trend in HCB emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 HCB emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

2.16 Hexachlorocyclohexane (HCH) emission trends

Several Member States did not report HCH emissions for any year and the data thus could not be gap-filled. The EU-27 total is therefore far from complete. The available data are presented in Table 2.17.

There were only two key categories for HCH emissions '4 G — Agriculture other' and '2 F — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' which together contributed 99 % to total HCH emissions. High relative reductions in emissions between 1990 and 2009 were achieved in the key category '2 F — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' (– 85.3 %) (Figure 2.15). The data for category '2 F — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' were only based on data reported by a single Member State (the United Kingdom). The reliability of the EU-27 total is therefore not considered to be high.

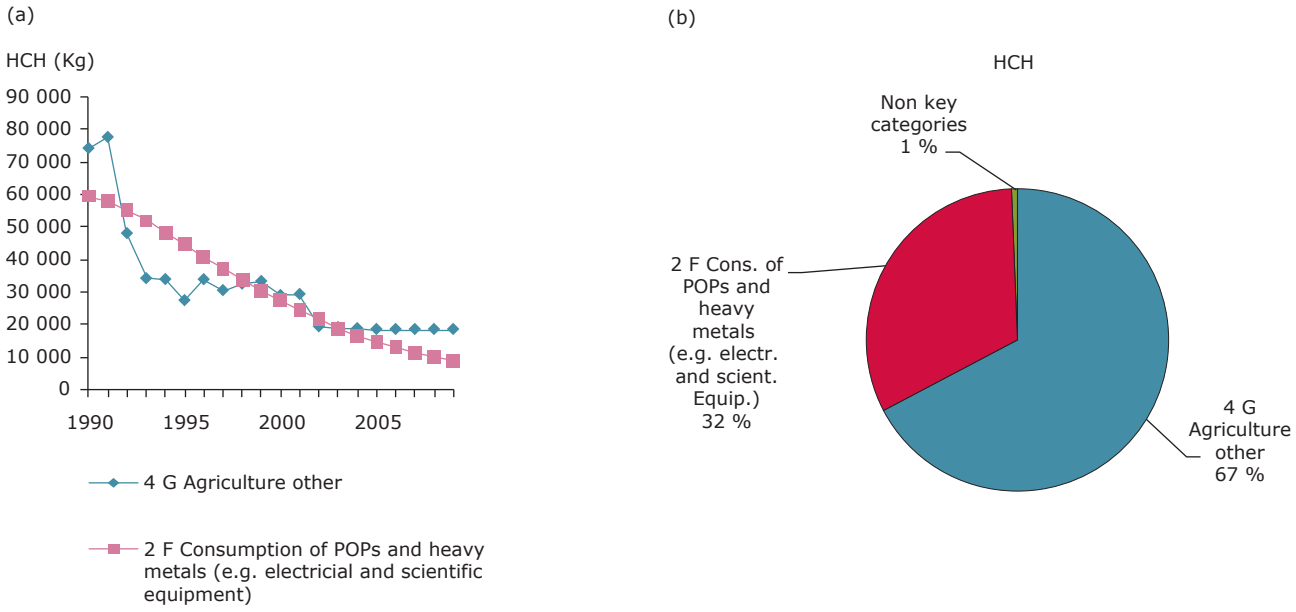
Table 2.17 Member State contributions to European Union HCH emissions (kg)

Member State	HCH (kg)												Change (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009
Austria	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Belgium	163	165	167	167	168	168	169	170	171	172	173	173	6	0.0
Bulgaria	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Cyprus	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Czech Republic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Denmark	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Estonia	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Finland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
France	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Germany	60 200	13 100	14 500	14 500	14 500	14 500	14 500	14 500	14 500	14 500	14 500	14 500	– 76	0.0
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Hungary	9 281	1 650	18	16	14	12	10	8	6	4	2	NA		
Ireland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Italy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Latvia	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Lithuania	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Malta	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
Poland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Portugal	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Romania	855	855	855	855	855	855	855	855	429	286	143	NA		
Slovakia	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Slovenia	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		
Spain	9 194	9 538	11 250	11 631	3 877	3 877	3 877	3 877	3 877	3 877	3 877	3 877	– 58	0.0
Sweden	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
United Kingdom	100 368	59 386	33 229	29 282	22 265	19 451	16 861	14 619	12 854	11 312	9 954	8 760	– 91	– 12.0
EU-27 (a)	180 061	84 694	60 019	56 451	41 679	38 864	36 272	34 028	31 837	30 151	**28 649**	**27 309**	**– 85**	**– 4.7**
EU-27 (b)	169 925	82 188	59 146	55 580	40 810	37 996	35 407	33 165	31 402	29 860	28 504	27 309		

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.
See Appendix 1 for an explanation of the notation keys reported by Member States.

The gap-filling procedure was refined in 2011, which enabled gap-filling for emissions of '4 G — Agriculture other' for three Member States this year. Last year therefore '4 G — Agriculture other' was not a key category as gap-filling for the year 2008 was not possible for any Member State. In contrast, in the 2010 reporting round data were given for the category '2 A 7 d — Other mineral products'. These data were only based on the report by a single Member State (the Netherlands) and for a single year (2001). In the 2011 reporting round, no Member State reported data for this category.

Figure 2.15 HCH emissions from key categories in the EU-27: (a) trend in HCH emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 HCH emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

2.17 Polychlorinated biphenyls (PCBs) emission trends

As was the case for HCH, several Member States did not report PCBs emissions for any year and the data thus were not gap-filled. The EU-27 total is therefore underestimated. Based on the limited data available, between 1990 and 2009, PCB emissions decreased in the EU-27 by 75.4 %. Between 2008 and 2009 the decrease was 17.7 %, mainly caused by reductions in Portugal, Bulgaria and Romania (Table 2.18). The two Member States that contributed most to the emissions of PCB in 2009 were the United Kingdom and Portugal.

The categories '6 C b — Industrial waste incineration' and '2 F — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' were the most important key categories for PCB emissions, together comprising 39 % of total PCB emissions (Figure 2.16). Among the top five key categories the highest relative reductions in emissions between 1990 and 2009 were achieved in the second most important key category '2 F — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' (– 91.2 %) (Figure 2.16).

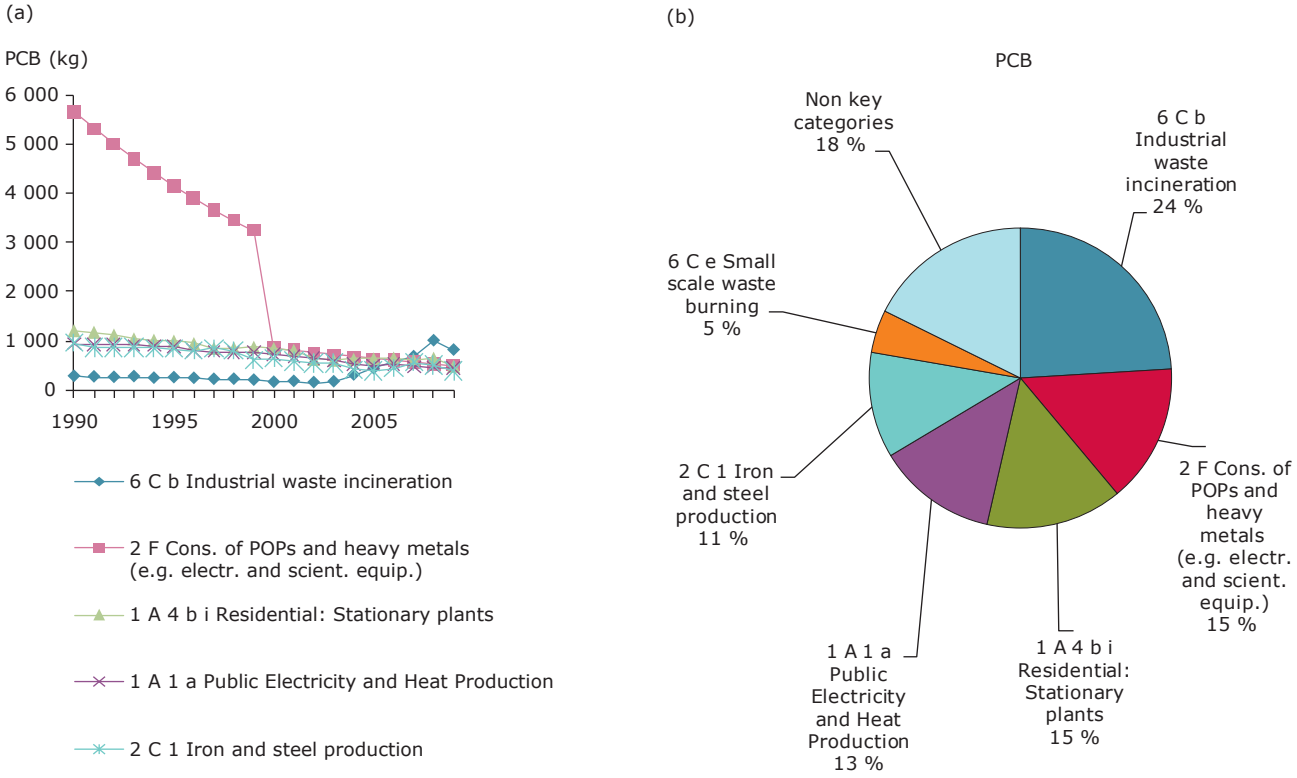
Table 2.18 Member State contributions to European Union PCB emissions (kg)

Member State	PCB (kg)												Change (%)		Share in EU-27 (%)	
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	1990–2009	2008–2009	1990	2009
Austria	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Belgium	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Bulgaria	258	382	230	212	250	261	270	259	282	213	221	58	– 78	– 73.7	1.9	1.7
Cyprus	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	– 2	– 16.7	0.0	0.0
Czech Republic	773	623	474	407	82	3	88	82	89	48	43	33	– 96	– 22.7	5.7	1.0
Denmark	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Estonia	90	52	45	47	47	54	52	50	46	57	51	43	– 52	– 15.1	0.7	1.3
Finland	314	284	221	209	192	192	180	174	177	164	156	148	– 53	– 5.0	2.3	4.4
France	179	157	105	96	75	74	76	75	72	67	65	58	– 68	– 11.4	1.3	1.7
Germany	1 672	1 536	1 071	884	712	518	195	202	223	228	212	221	– 87	4.2	12.2	6.6
Greece	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Hungary	151	113	102	101	99	103	103	103	103	103	103	103	– 32	0.0	1.1	3.0
Ireland	68	63	58	49	66	79	55	43	42	20	20	18	– 74	– 10.2	0.5	0.5
Italy	279	289	253	258	261	264	269	266	273	269	263	188	– 32	– 28.4	2.0	5.6
Latvia	4	1	1	1	1	1	1	1	1	1	1	1	– 80	– 13.8	0.0	0.0
Lithuania	43	21	11	14	13	13	24	25	26	29	18	7	– 83	– 61.2	0.3	0.2
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Malta	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Netherlands	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	– 100	0.0	0.0	0.0
Poland	2 425	2 323	2 265	2 327	2 282	2 281	2 256	2 281	2 292	641	663	653	– 73	– 1.5	17.7	19.4
Portugal	59	66	37	67	93	117	246	374	503	632	955	768	1191	– 19.6	0.4	22.8
Romania	135	87	39	30	20	11	1	2	2	224	205	63	– 53	– 69.4	1.0	1.9
Slovakia	67	40	33	32	31	34	31	36	35	35	37	31	– 54	– 17.1	0.5	0.9
Slovenia	448	321	231	213	184	170	150	124	107	107	73	65	– 85	– 11.5	3.3	1.9
Spain	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Sweden	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	– 3	21.1	0.0	0.0
United Kingdom	6 698	5 008	1 406	1 342	1 256	1 225	1 195	1 137	1 085	1 046	1 001	906	– 86	– 9.4	49.0	26.9
EU-27 (a)	13 663	11 366	6 581	6 287	5 663	5 398	5 193	5 233	5 356	3 884	4 088	3 364	**– 75.4**	**– 17.7**	**100**	**100**
EU-27 (b)	13 663	11 366	6 581	6 287	5 663	5 398	5 193	5 233	5 356	3 884	4 088	3 364				

Note ([53]): (a) Sum of national totals as reported by Member States.
(b) Sum of sectors: Differences are due to reallocation of memo items in line with the new UNECE reporting guidelines ([2]) for countries that reported emissions in older NFR formats, and due to Member States only providing national total data.
Negative percentage values indicate that emissions have fallen.
Empty rows indicate that the Member State has not reported any data.
See Appendix 1 for an explanation of the notation keys reported by Member States.

The large decrease in emissions from '2 F — 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. The EU introduced controls on disposal of PCBs through Directive 76/403/EEC ([65]). The EU later banned the use of PCBs in new facilities in 1985 under Directive 85/467/EEC ([66]) on restrictions on the marketing and use of certain dangerous substances and preparations. Then in 1996 the EU required Member States to develop plans for existing electrical equipment above a specified size to be removed to a hazardous waste facility, under Directive 96/59/EC ([67]) on the disposal of PCBs. This was implemented in the United Kingdom as the Waste Management (Hazardous Waste) Regulations 1998 ([68]). Any equipment identified as containing more than 5 litres of PCB fluids were to be removed from service and disposed of accordingly. This results in a significant drop in emissions from the beginning of 2000 assuming the emissions to air from leak of dielectric equipment still in use reduces due to smaller stock remaining.

Figure 2.16 PCB emissions from key categories in the EU-27: (a) trend in PCB emissions from the five most important key categories, 1990–2009; (b) contribution of key categories to EU-27 PCB emissions, 2009



Note: In some instances Member States did not report data but instead used the notation keys listed in Appendix 1.

([65]) Directive 76/403/EEC.
([66]) Directive 85/467/EEC.
([67]) Directive 96/59/EC.
([68]) Waste Management (Hazardous Waste) Regulations 1998.

3 Emission trends by sector

This chapter sets out emission trends of the key pollutants aggregated into the following main sector groups:

- energy production and distribution
- energy use in industry
- industrial processes
- solvent and product use
- commercial, institutional and households (energy use)
- 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.

Figure 3.1 shows, for each pollutant, the contribution to total EU-27 emissions made by the aggregated sector groups. For NO_X, SO_X and the heavy metals, common important emission sources are the energy and transport sectors, and 'commercial, institutional and households' energy use sector. The latter sector group is also a very significant source of $PM_{2.5}$, PM_{10} and total PAHs, PCDD/F and PCBs. A single sector group, agriculture, is responsible for the vast majority (94 %) of NH_3 emissions in the EU-27. Similarly, for certain other pollutants such HCH, just two sector groups — agriculture and industrial processes — contribute the majority of emissions. The following sections of this chapter show the trends of important pollutants in each of the grouped sectors.

Figure 3.1 Share of emissions per pollutant by sector group

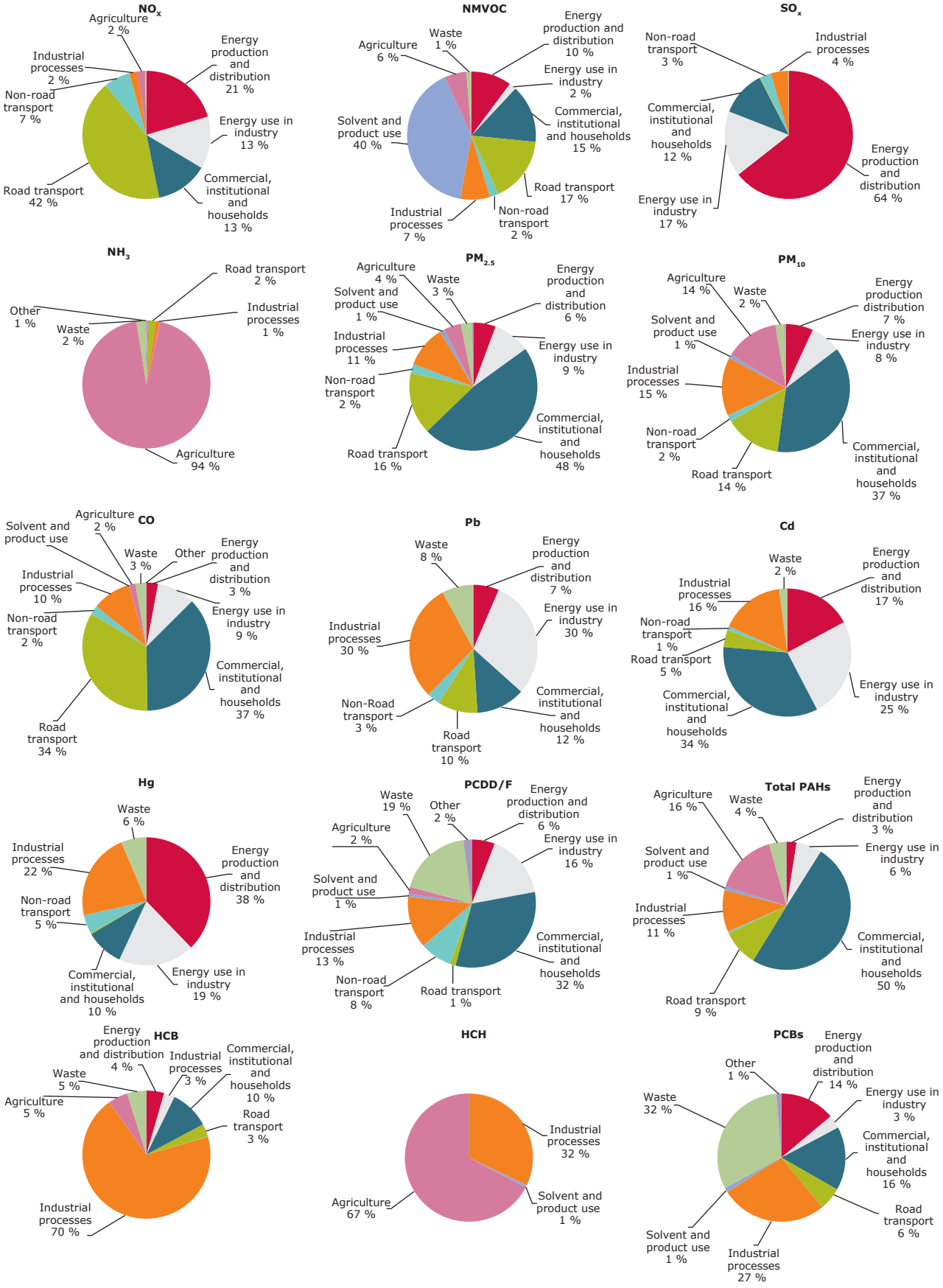
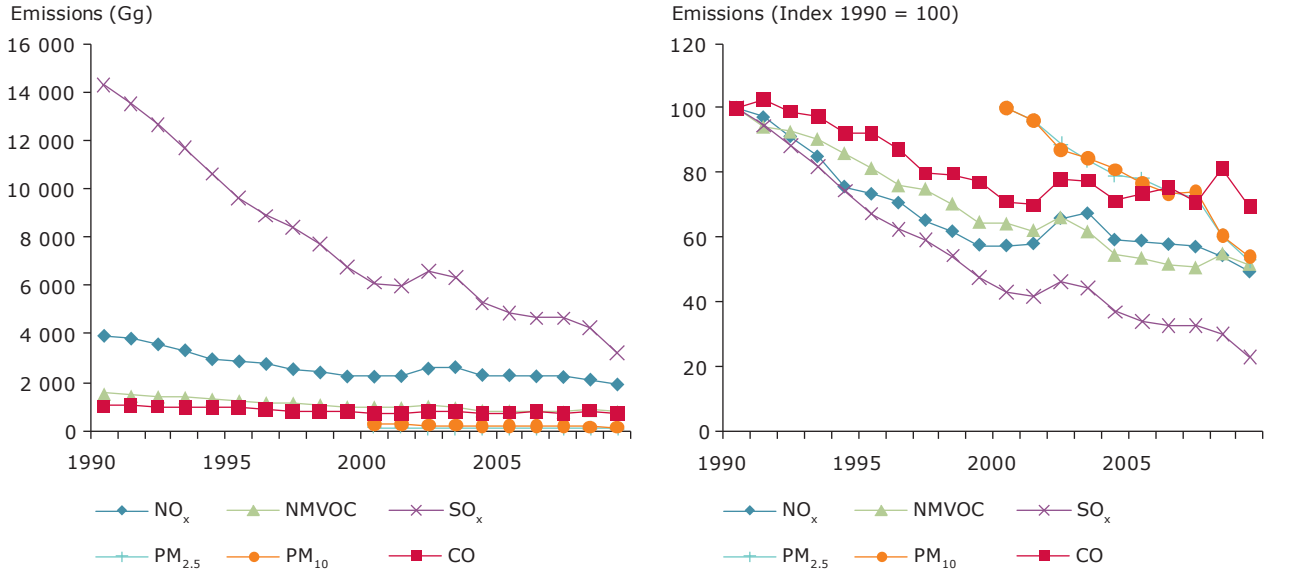


Figure 3.2 EU-27 emission trends in the sector 'energy production and distribution' for NO_x, NMVOCs, SO_x and CO in Gg between 1990 and 2009 (index year 1990 = 100), and for PM_{10} and $PM_{2.5}$ between 2000 and 2009 (index year 2000 = 100)



Note: For particulate matter, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

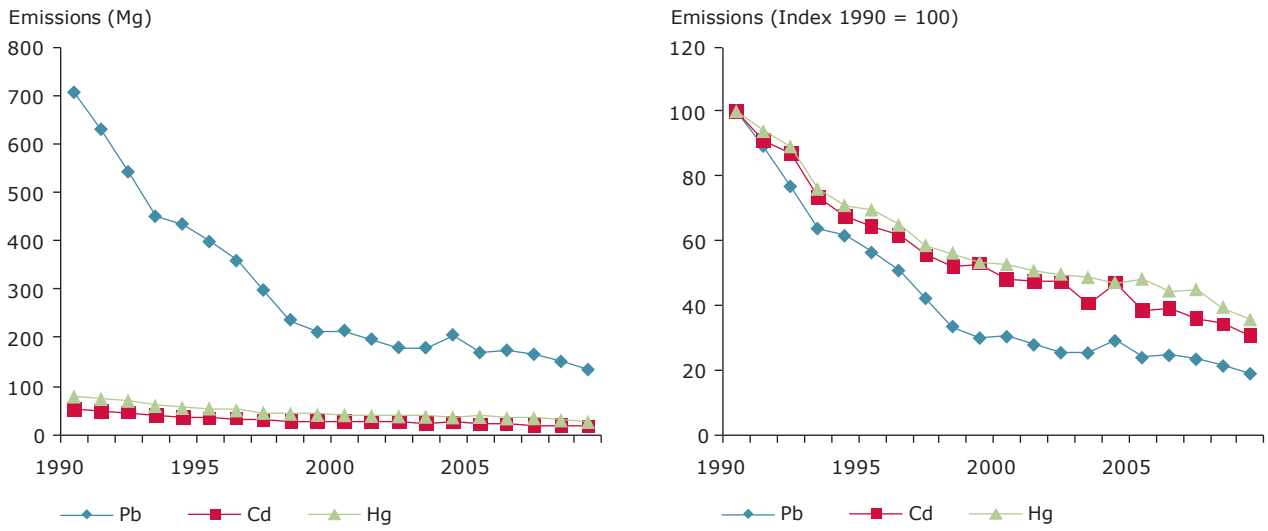
3.1 Emission trends for 'energy production and distribution'

The sector grouping 'energy production and distribution' comprises emissions from a number of activities involving fuel combustion in order, for example, to produce energy products and electricity. It is an important source of many pollutants, especially SO_x. Despite significant past reductions, this sector group still contributes 64 % of the total EU-27 emissions of this pollutant.

For emissions of the main pollutants (Figure 3.2), the highest absolute and relative reduction (– 77 %) was for SO_x between 1990 and 2009. For $PM_{2.5}$ a notable relative reduction of more than 47 % has occurred within this sector group since 2000.

Of the three heavy metals, lead shows the highest emission reduction in absolute and relative terms (– 81 %) (Figure 3.3). For emissions of POPs, the highest relative reduction occurred for PCDD/F (– 95 %) (Figure 3.4).

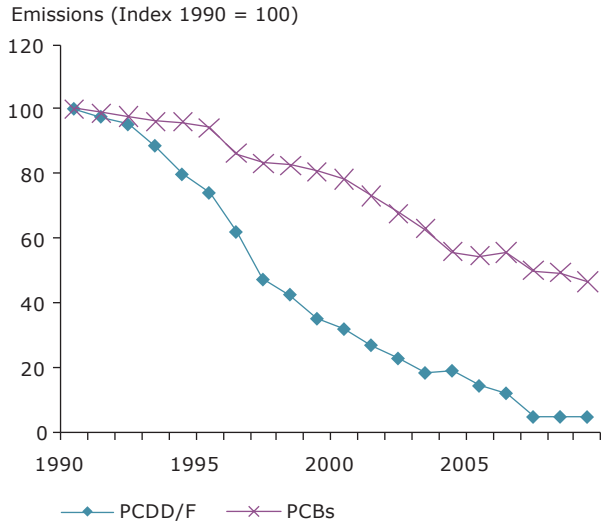
Figure 3.3 EU-27 emission trends in the sector group 'energy production and distribution' for the heavy metals Pb, Cd, Hg between 1990 and 2009 (index year 1990 = 100)



Note: For the heavy metals, data for one or more Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

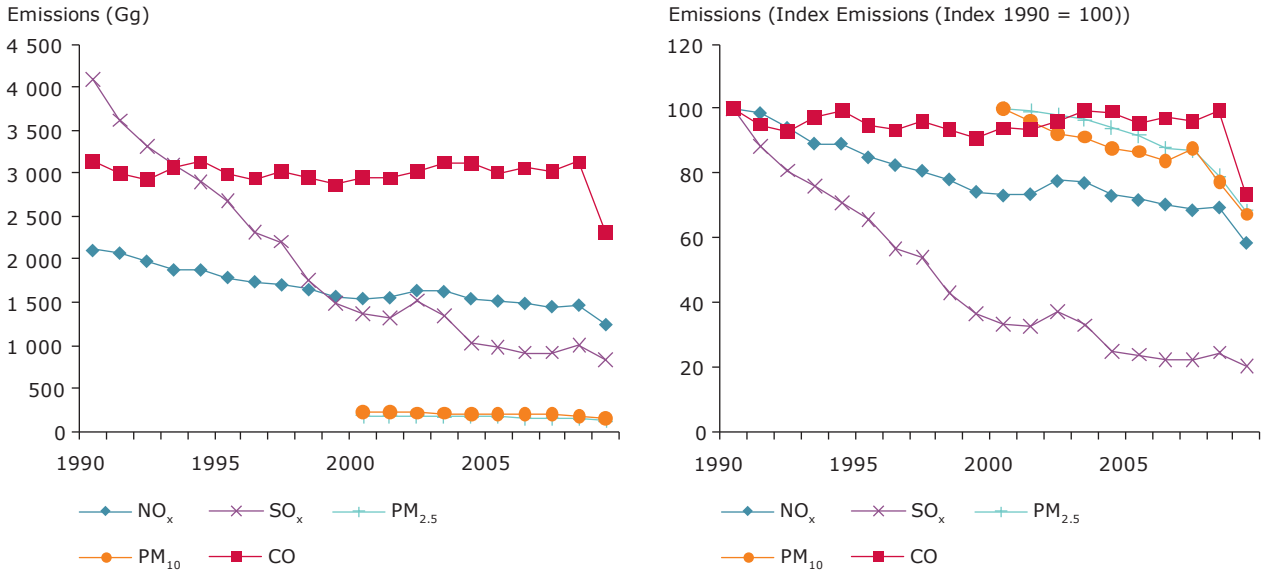
Figure 3.4 EU-27 emission trends in the sector group 'energy production and distribution' for POPs (PCDD/F and PCBs) between 1990 and 2009 (index year 1990 = 100)



Note: For POPs, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Figure 3.5 EU-27 emission trends in the sector group 'energy use in industry' for NO_x, SO_x and CO in Gg between 1990 and 2009 (index year 1990 = 100), and for PM_{10} and $PM_{2.5}$ between 2000 and 2009 (index year 2000 = 100)



Note: For particulate matter, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

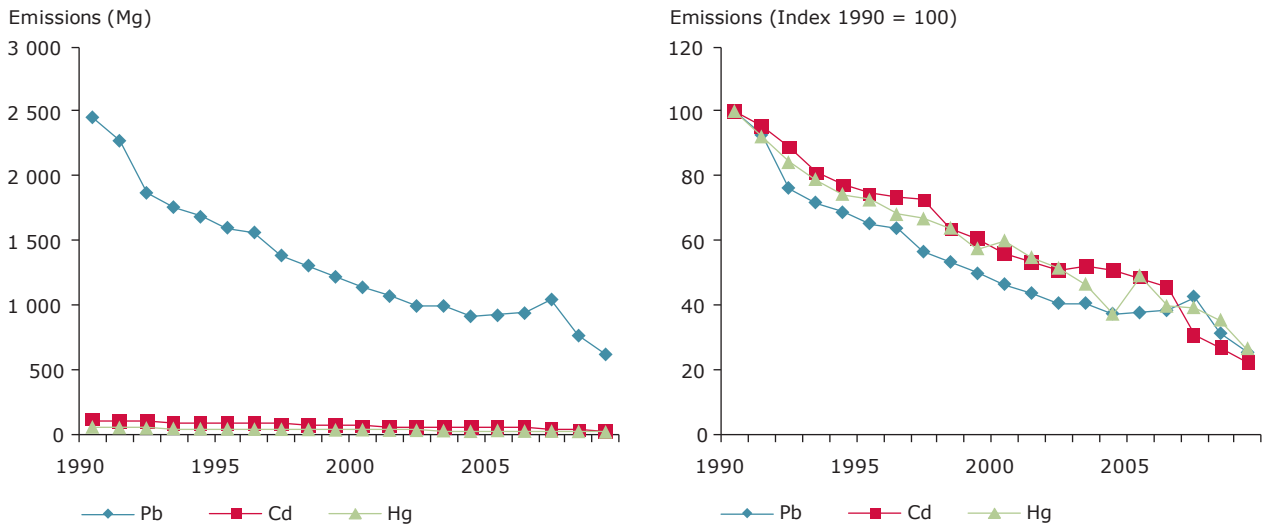
3.2 Emission trends for 'energy use in industry'

Energy use (fuel combustion) in industry is an important source of many pollutants. For the main pollutants, the highest absolute and relative reduction (– 80 %) between 1990 and 2009 occurred for SO_x (Figure 3.5).

For the three heavy metals, lead shows the highest emission reduction in absolute terms (– 834 Mg, – 75 %) (Figure 3.6). Cadmium and mercury had similar reductions to lead in relative terms (– 78 % and – 74 %, respectively).

For POPs, only PCDD/F and total PAHs are important pollutants in the sector group 'energy use in industry'. Trends of these pollutants are given in Figure 3.7. The missing data of total PAH in 2004–2005 are due to inconsistent data reported by Poland.

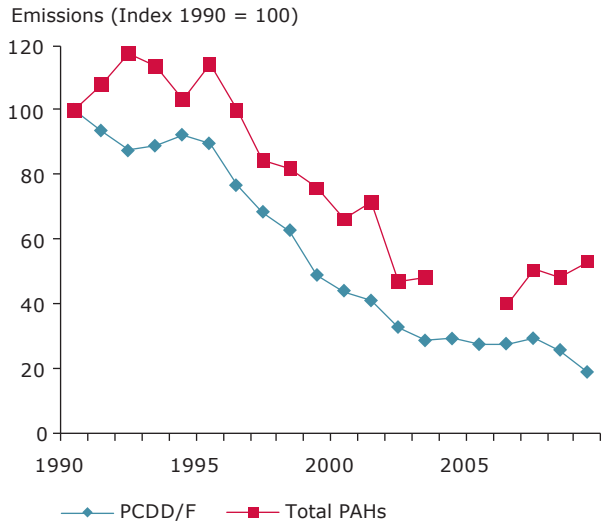
Figure 3.6 EU-27 emission trends in the sector group 'energy use in industry' for the heavy metals Pb, Cd, Hg between 1990 and 2009 (index year 1990 = 100)



Note: For the heavy metals, data for one or more Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

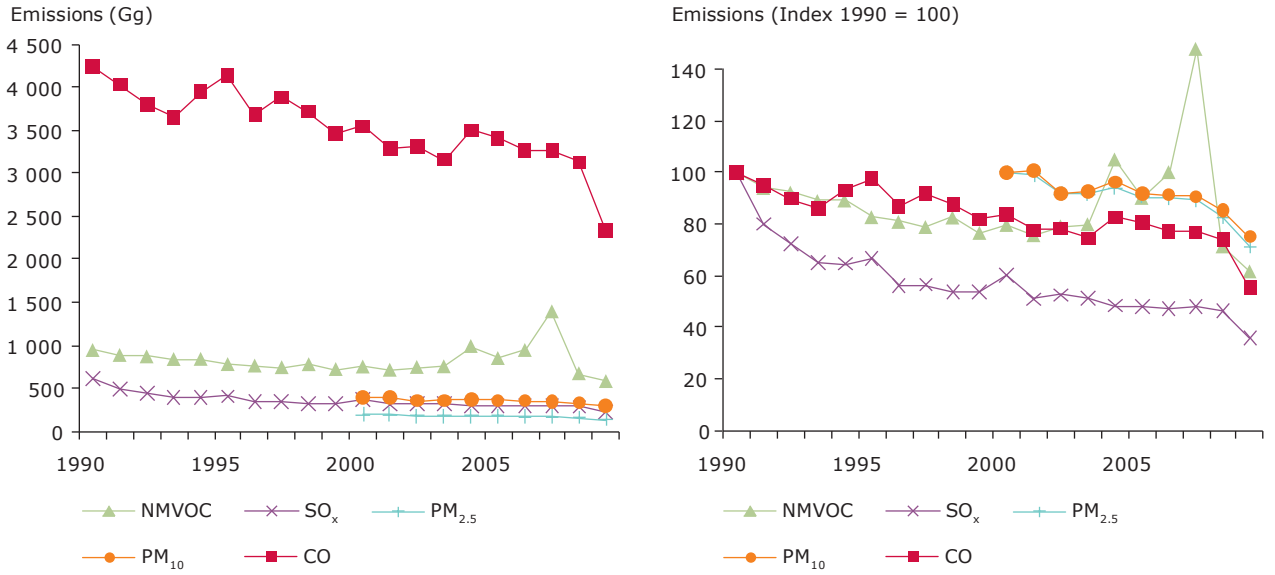
Figure 3.7 EU-27 emission trends in the sector group 'energy use in industry' for the POPs (PCDD/F and total PAHs) between 1990 and 2009 (index year 1990 = 100)



Note: For POPs, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Figure 3.8 EU-27 emission trends in the sector group 'industrial processes' for NMVOCs, SO_x and CO in Gg between 1990 and 2009 (index year 1990 = 100), for PM_{10} and $PM_{2.5}$ between 2000 and 2009 (index year 2000 = 100)



Note: For particulate matter, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

The missing data of NMVOCs in the years 2004–2007 are due to high emission data reported by Romania.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

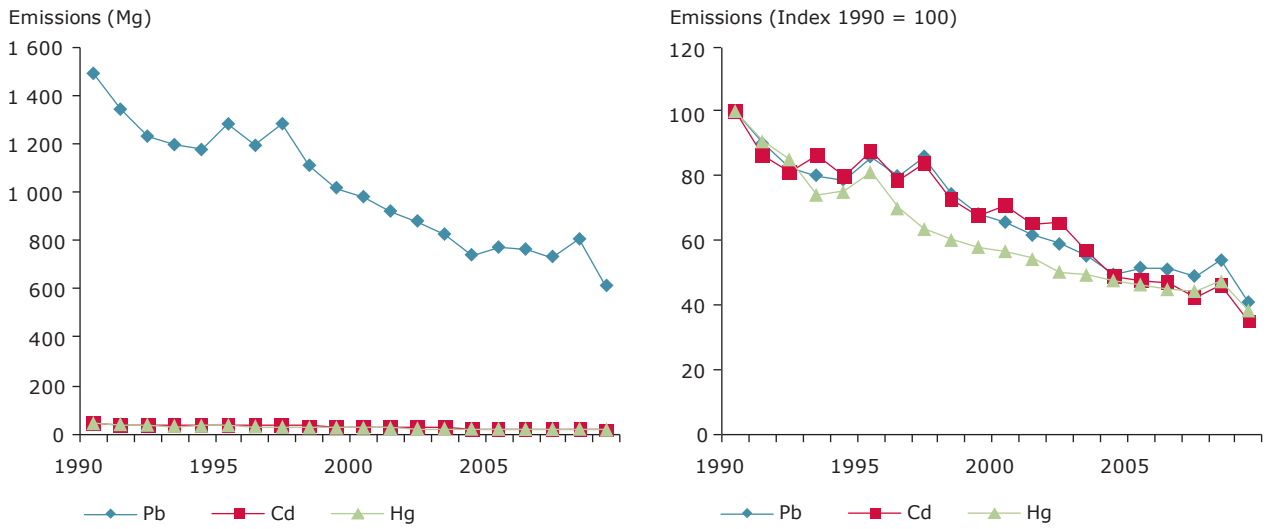
3.3 Emission trends for 'industrial processes'

The industrial process sector grouping refers to emissions from industrial sources other than those arising from fuel combustion within the industrial sector. This sector group is the most important sector for HCB emissions and makes important contributions to emissions of CO, particulate matter, heavy metals and POPS; past emission trends of the relevant main pollutants are shown in Figure 3.8. The increase of NMVOCs between 2004 and 2007 are due to high emission data reported by Romania.

Industrial processes make a significant contribution to the total EU-27 emissions of heavy metals, despite significant reductions since 1990. Past emission trends for these pollutants are shown in Figure 3.9. Lead shows the highest absolute emission reduction between 1990 and 2009; in relative terms Cd shows the highest percentage reduction (– 65 %).

For POPs, the highest relative reduction between 1990 and 2009 occurred for total HCB (– 91 %), although the emission trend was far from consistent, increasing until 1998 then falling abruptly in 1999 and remaining fairly constant since (Figure 3.10). This significant change is mainly caused by a reported increase and a subsequent drop in HCB emissions from '2 C 3 — Aluminium production' in the United Kingdom. Historically within the United Kingdom, HCE (Hexachloroethane) has been used

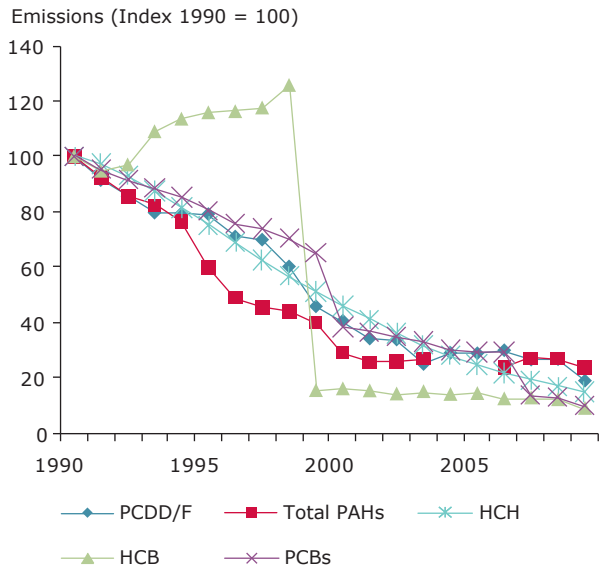
Figure 3.9 EU-27 emission trends in the sector group 'industrial processes' for the heavy metals Pb, Cd, Hg between 1990 and 2009 (index year 1990 = 100)



Note: For the heavy metals, data for one or more Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

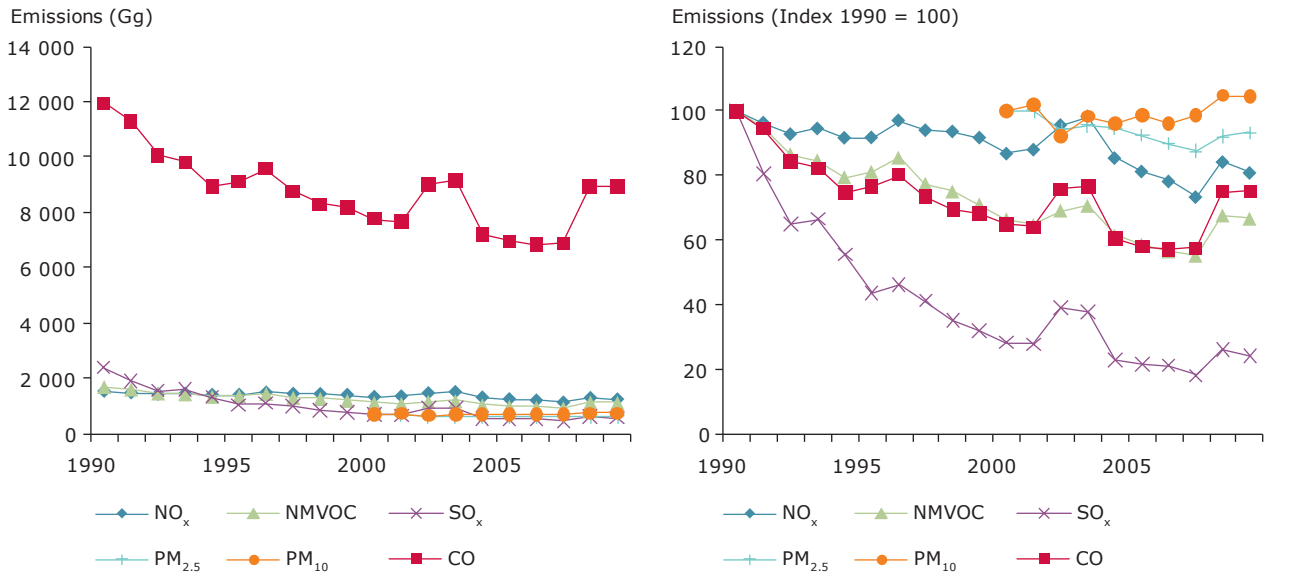
Figure 3.10 EU-27 emission trends in the sector group 'industrial processes' for the POPs (PCDD/F, total PAHs, HCB, HCH and PCBs) between 1990 and 2009 (index year 1990 = 100)



Note: For POPs, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Figure 3.11 **EU-27 emission trends in the sector group 'commercial, institutional and households' for NO_x, NMVOCs, SO_x, and CO, in Gg between 1990 and 2009 (index year 1990 = 100), for PM_{10} and $PM_{2.5}$ between 2000 and 2009 (index year 2000 = 100)**



Note: For particulate matter, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

as a cover gas within the secondary aluminium industry. The nature of how HCE is manufactured meant that it was contaminated with HCB and Pentachlorobenzene. Van der Most ([69]) quotes the emission factor for HCB within HCE as 5 g/t of HCE used. As of 1999 the use of HCE for this application was banned within the United Kingdom causing the resulting emissions to cease.

A similar high reduction was observed for PCBs emissions (– 90 %). The missing data of total PAH in 2004–2005 are due to inconsistent data reported by Poland.

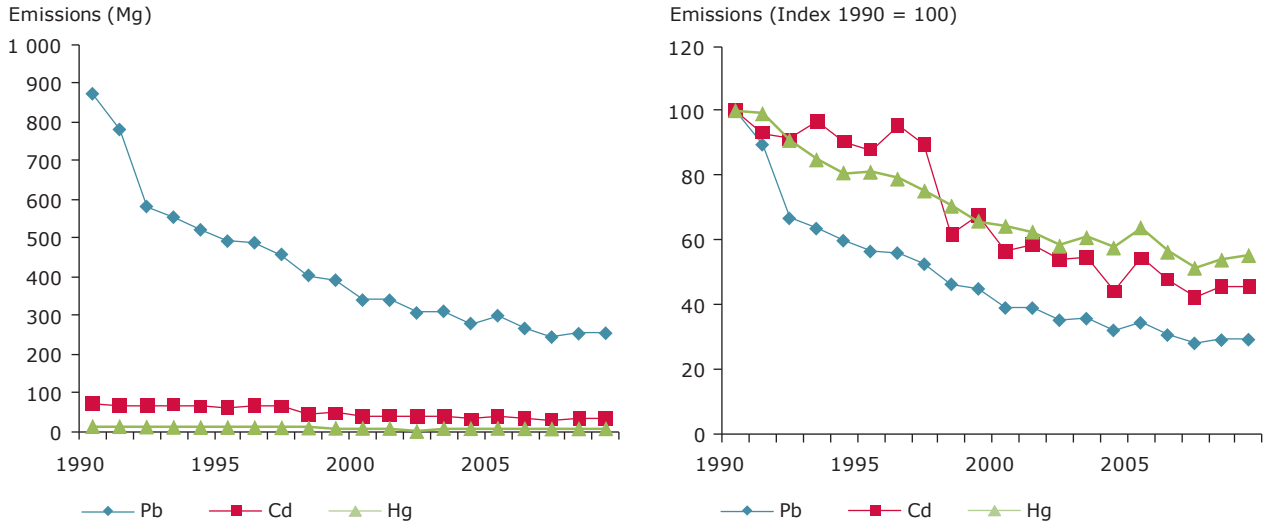
3.4 Emission trends for 'commercial, institutional and households'

As shown earlier in Figure 3.1, emissions arising from fuel combustion by commercial and institutional facilities and households make a significant contribution to total emissions of many pollutants. For the main pollutants, the highest relative reduction between 1990 and 2009 for the sector grouping again occurred for SO_x (– 76 %). In contrast, particulate matter emissions have changed little since 1990 and 2000 respectively (Figure 3.11).

Of the three heavy metals in the sector 'commercial, institutional and households', Pb shows the highest emission reduction in absolute and relative terms (– 71 %) (Figure 3.12).

([69]) Van der Most, 1992.

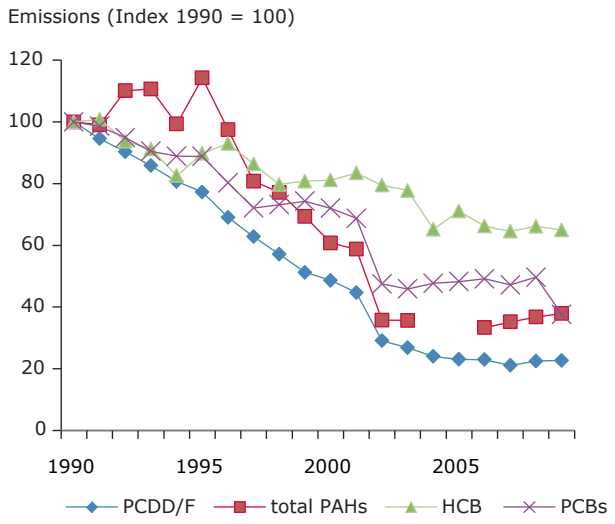
Figure 3.12 EU-27 emission trends in the sector group 'commercial, institutional and households' for the heavy metals Pb, Cd, Hg between 1990 and 2009 (index year 1990 = 100)



Note: For the heavy metals, data for one or more Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

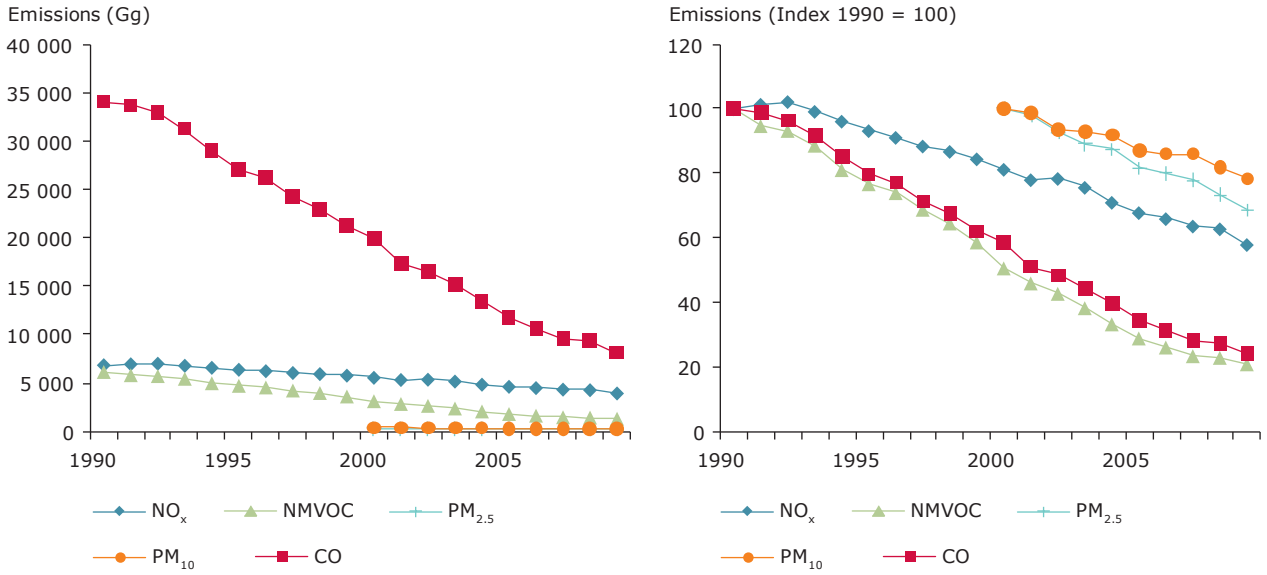
Figure 3.13 EU-27 emission trends in the sector group 'commercial, institutional and households' for POPs (PCDD/F, total PAHs, HCB and PCBs) between 1990 and 2009 (index year 1990 = 100)



Note: For POPs, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Figure 3.14 **EU-27 emission trends in the sector group 'road transport' for NO_x, NMVOCs and CO in Gg between 1990 and 2009 (index year 1990 = 100), for PM_{10} and $PM_{2.5}$ between 2000 and 2009 (index year 2000 = 100)**



Note: For particulate matter, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

For POPs relevant to the sector 'commercial, institutional and households' the highest relative reduction occurred for PCDD/F (– 77 %) (Figure 3.13). The missing data of total PAH in 2004–2005 are due to inconsistent data reported by Poland.

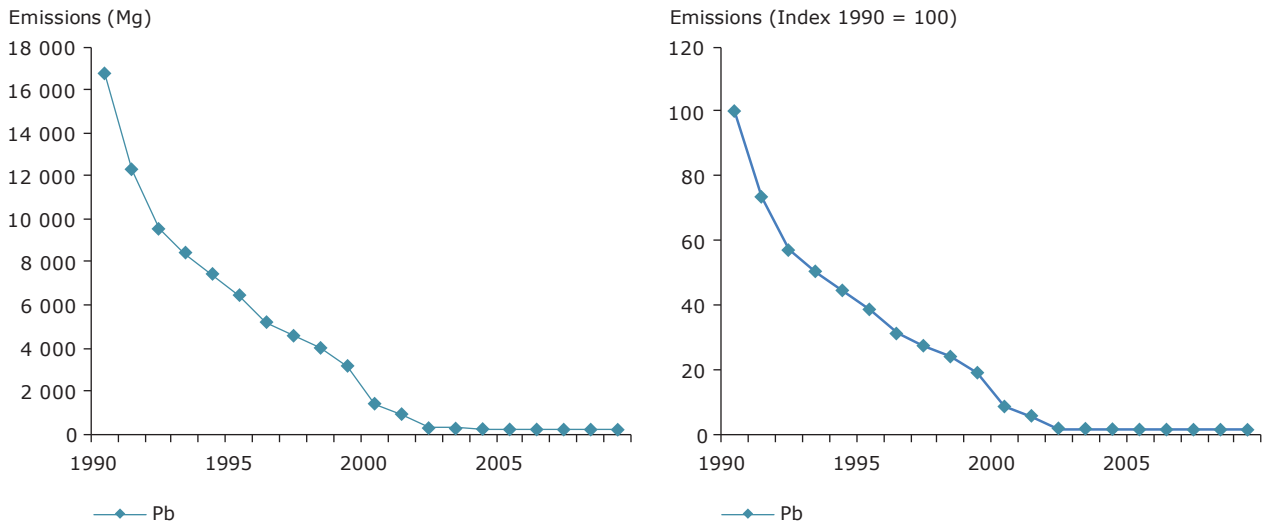
3.5 Emission trends for 'road transport'

As noted earlier, together, the individual NFR sources that make up the grouped road transport sector group contribute significantly to emissions of a number of pollutants, including NO_x, NMVOCs, CO, $PM_{2.5}$, PM_{10} and certain POPs. Figure 3.14 shows the past emission trends for these pollutants in this sector.

For the sector 'road transport' the main heavy metal is Pb, showing high relative emission reduction (– 99 %) between 1990 and 2009 (Figure 3.15). However over the last 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 particular success story. EU Member States have for example completely phased out the use of leaded petrol, a goal that was regulated by Directive 98/70/EC ([70]). Nevertheless, the road transport sector still remains an important source of Pb, still contributing around 10 % of total Pb emissions in the EU-27.

([70]) Directive 98/70/EC.

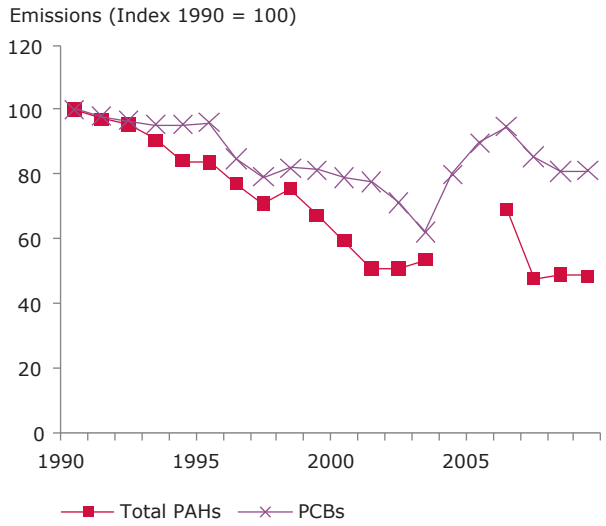
Figure 3.15 EU-27 emission trends in the sector group 'road transport' for the priority heavy metal Pb between 1990 and 2009 (index year 1990 = 100)



Note: For the heavy metals, data for one or more Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

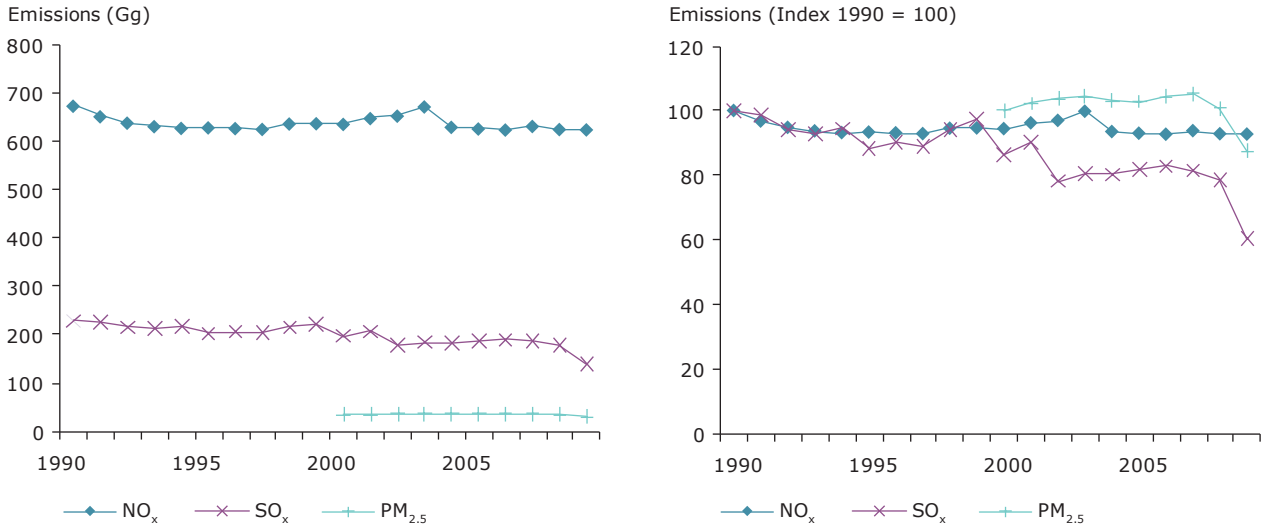
Figure 3.16 EU-27 emission trends in the sector group 'road transport' for POPs (total PAHs and PCBs) between 1990 and 2009 (index year 1990 = 100)



Note: For POPs, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Figure 3.17 EU-27 emission trends in the sector group 'non-road transport' for NO_x and SO_x in Gg between 1990 and 2009 (index year 1990 = 100), for $PM_{2.5}$ between 2000 and 2009 (index year 2000 = 100)



Note: For particulate matter, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

3.6 Emission trends for 'non-road transport'

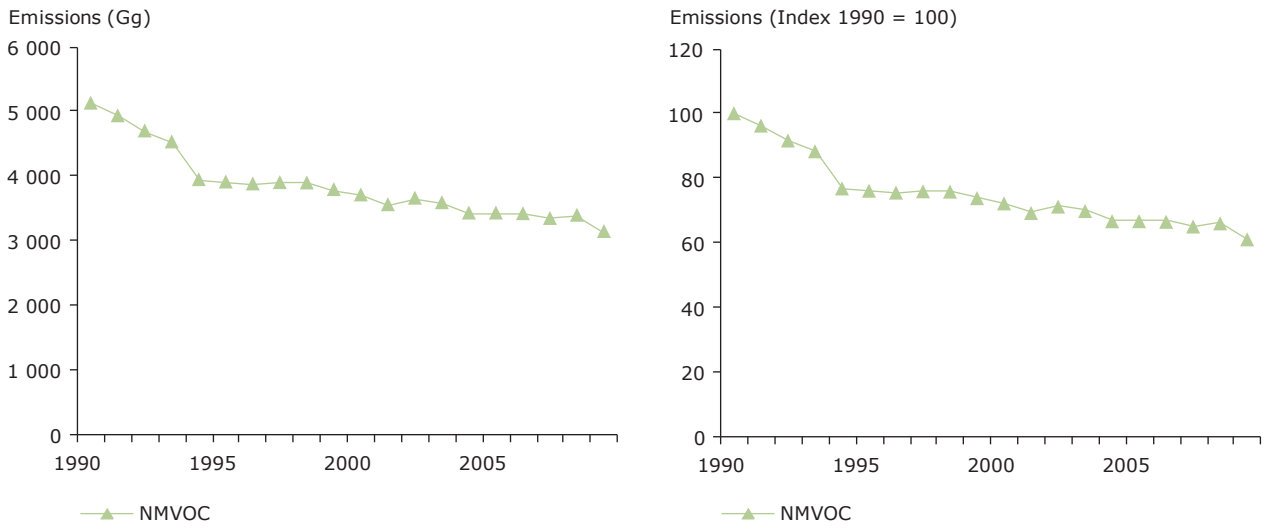
Nitrogen oxides are important pollutants in the sector group 'non-road transport'. Little progress has been made since 1990 in reducing emissions from this source (Figure 3.17). For the main pollutants the highest relative reduction between 1990 and 2009 occurred for SO_X (– 40 %).

The sector group 'non-road transport' makes only a small contribution to emissions of heavy metals and POPs. Trends of pollutants from these two groups of substances are therefore not shown.

3.7 Emission trends for 'solvent and product use'

The only significant emissions from this sector group are NMVOCs. Between 1990 and 2009, NMVOC emissions decreased by – 39 % in the EU-27 (Figure 3.18).

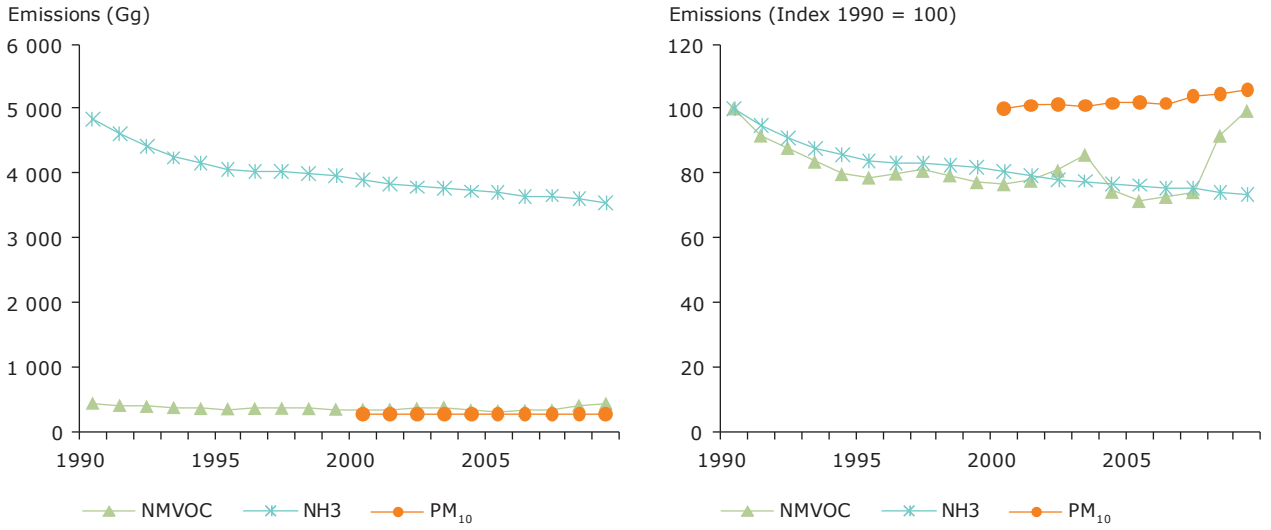
Figure 3.18 EU-27 emission trends in the sector group 'solvent and product use' NMVOCs in Gg between 1990 and 2009 (index year 1990 = 100)



Note: Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

Figure 3.19 **EU-27 emission trends in the sector group 'agriculture' for NMVOCs and NH_3 in Gg between 1990 and 2009 (index year 1990 = 100), for PM_{10} between 2000 and 2009 (index year 2000 = 100)**



Note: For particulate matter, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Parties to the LRTAP Convention are formally requested to report emissions of particulate matter (PM) only for the year 2000 and onwards.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Poland submitted data for the years 2002, 2003, 2008 and 2009 under CLRTAP during the 2011 reporting round. For other years data for NO_x, NMVOC, SO_x and CO was gap-filled with data submitted in CRF format under Council Decision 280/2004/EC. Poland reported all NO_x, NMVOC, SO_x and CO emissions in the CRF format under '7A — Other'. In some instances this influences the EU-27 total (higher emissions for the years 2002 and 2003).

3.8 Emission trends for 'agriculture'

As noted earlier, the agriculture sector group is particularly important in terms of its being responsible for the vast majority of NH_3 emissions in the EU-27. Agricultural emissions of NH_3 have decreased by around – 27 % since 1990 (Figure 3.19). The sector also contributes around 14 % of PM_{10} emissions, and 6 % of total NMVOC emissions. Emissions of PM_{10} increased between 2000 and 2009 by 6 %.

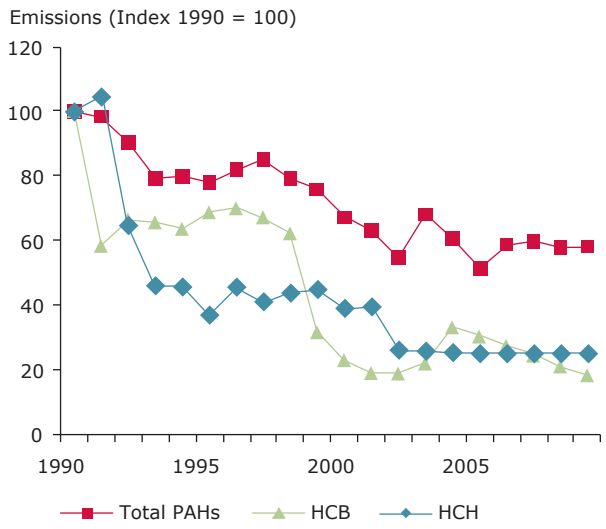
The agriculture sector group does not contribute significantly to emissions of heavy metals.

Of the POPs, the 'agriculture' sector contributes significantly to emissions of HCH, PAHs and HCB. Trends of past emissions for these pollutants are shown in Figure 3.20.

3.9 Emission trends for 'waste'

The waste sector group is an important source of certain pollutants, including PCBs, PCDD/F, Pb and Hg. Figure 3.21 shows the past emission trends for these pollutants. The high peak of PCBs in 2008 is due to emission data reported by Portugal.

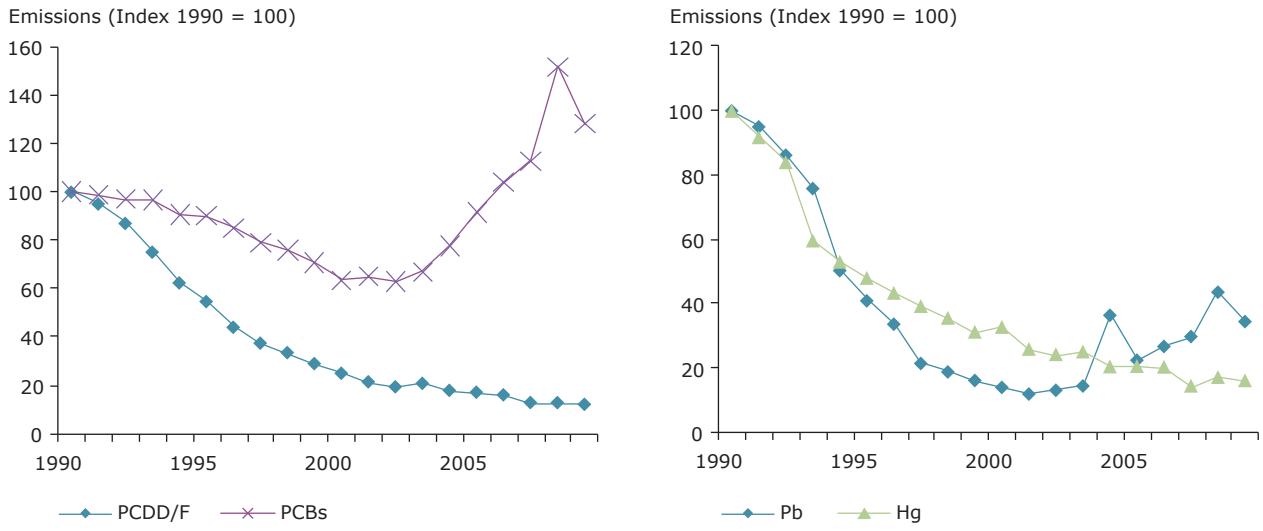
Figure 3.20 EU-27 emission trends in the sector group 'agriculture' for POPs (total PAHs, HCB and HCH) between 1990 and 2009 (index year 1990 = 100)



Note: For POPs, data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

Figure 3.21 EU-27 emission trends in the sector group 'waste' for POPs (PCDD/F and PCBs) and the heavy metals Pb and Hg between 1990 and 2009 (index year 1990 = 100)



Note: The Pb, Hg and POPs data from some Member States could not be gap-filled as values were not reported for any year. To enable presentation of provisional emission trends, in these instances emissions have been aggregated without including data for all the EU-27 Member States.

Several Member States reported notation keys (see Appendix 1) for some of the individual NFR source categories included in this grouped sector.

4 Recalculations and planned improvements

4.1 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 ([71]) 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 insufficient to reflect mitigation activities in a transparent manner;
- 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. It is often not documented why Member States have reported different numbers in one year compared to an earlier year.

Table 4.1 and Table 4.2 show a comparison of EU-27 total emissions submitted in 2010 and 2011. Differences are due to changes in the submissions of the Member States from one year to the next and because of refinements of the gap filling procedures. Data are not shown for total PAH (2004–2005) due to inconsistencies in the original data reported by a Member State. For HCH, notable recalculations between the submissions of 2010 and 2011 were made, especially for the years 1990 and 1995. Last year the Netherlands reported HCH emissions for the year 2001 only. All other years were gap-filled with these 2001 data. In the current submission, the Netherlands reported only the notation key 'NO'. Only a few other Member States reported data for HCH, therefore the data of the Netherlands influenced the EU-27 total notably.

The recalculations for cadmium of the years 1990 and 1995 are mainly due to refinements of the gap-filling procedure for Romanian data. The recalculations of the years 2007 and 2008 for cadmium are mainly due to recalculations reported by Slovakia and due to changes of the gap-filling procedure for Greek and Bulgarian data.

The recalculations for PCB emissions are due to a change of the emission data reported by Germany, Italy, Portugal and Spain in 2011.The major recalculations for PM_{10} data for the year 2002 are due to a change of data sources (CLRTAP to EMEP) for the Czech Republic, and due to the replacement of interpolated data of Poland with reported data.

The recalculations for Pb emissions for the years 2000–2007 are due to a change of the emission data reported by Germany in 2011.

Under the revised Reporting Guidelines ([72]) all countries should submit explanatory Informative Inventory Reports (IIRs) which should include details of recalculations made. In their IIR, Austria ([73]), Cyprus ([74]), Denmark ([75]), Estonia ([76]), France ([77]), Ireland ([78]), Italy ([79]), Latvia ([80]), Portugal ([81]),

([71]) EMEP/EEA, 2009.
([72]) UNECE, 2009.
([73]) IIR of Austria, 2011.
([74]) IIR of Cyprus, 2011.
([75]) IIR of Denmark, 2011.
([76]) IIR of Estonia, 2011.
([77]) IIR of France, 2011.
([78]) IIR of Ireland, 2011.
([79]) IIR of Italy, 2011.
([80]) IIR of Latvia, 2011.
([81]) IIR of Portugal, 2011.

Table 4.1 Comparison of data submitted for 2010 and 2011 by the Member States (absolute data, EU-27 national total)

Pollutant	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
NO_X	Gg	– 286	– 39	– 64	– 46	– 89	– 133	– 151	– 125	– 252	– 71	– 184
NMVOC	Gg	357	149	133	75	– 157	– 26	– 103	– 275	– 253	660	5
SO_X	Gg	– 783	63	100	162	211	316	309	– 132	– 38	297	498
NH_3	Gg	134	28	6	30	24	28	22	20	18	19	31
CO	Gg	– 741	– 169	– 656	– 529	– 579	– 13	– 190	– 1 834	– 1 158	– 331	– 201
Pb	Mg	658	633	393	366	295	252	248	237	260	422	138
Cd	Mg	32	24	14	10	8	5	5	2	1	– 12	– 13
Hg	Mg	5	7	8	7	6	5	5	5	4	3	– 1
PCDD/F	g I-Teq	532	106	112	81	61	53	3	– 24	5	– 110	– 52
total PAH	Mg	278	175	129	108	114	107			115	70	105
HCB	kg	121	87	49	50	43	36	5	0	3	– 2	– 4
HCH	kg	– 16 671	– 16 667	– 2 168	– 2 170	– 2 171	1 704	1 702	1 700	1 699	1 554	1 409
PCB	kg	1 931	1 883	1 348	1 155	985	787	583	721	873	956	1 272
				2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
$PM_{2.5}$	Gg			9	14	5	– 1	– 12	– 12	– 16	– 18	– 47
PM_{10}	Gg			5	1	– 226	– 21	– 22	0	– 3	– 4	– 59

Table 4.2 Comparison of data submitted for 2010 and 2011 by the Member States (relative data, EU-27 national total)

Pollutant	Unit	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
NO_X	Gg	– 2 %	0 %	– 1 %	0 %	– 1 %	– 1 %	– 1 %	– 1 %	– 2 %	– 1 %	– 2 %
NMVOC	Gg	2 %	1 %	1 %	1 %	– 2 %	0 %	– 1 %	– 3 %	– 3 %	8 %	0 %
SO_X	Gg	– 3 %	0 %	1 %	2 %	2 %	4 %	4 %	– 2 %	0 %	4 %	8 %
NH_3	Gg	3 %	1 %	0 %	1 %	1 %	1 %	1 %	1 %	0 %	1 %	1 %
CO	Gg	– 1 %	0 %	– 2 %	– 1 %	– 2 %	0 %	– 1 %	– 6 %	– 4 %	– 1 %	– 1 %
Pb	Mg	3 %	6 %	10 %	12 %	12 %	10 %	11 %	10 %	12 %	20 %	6 %
Cd	Mg	11 %	11 %	9 %	7 %	5 %	3 %	4 %	1 %	1 %	– 10 %	– 11 %
Hg	Mg	2 %	5 %	7 %	6 %	6 %	5 %	5 %	5 %	5 %	3 %	– 1 %
PCDD/F	g I–Teq	5 %	1 %	3 %	2 %	2 %	2 %	0 %	– 1 %	0 %	– 5 %	– 2 %
total PAH	Mg	8 %	5 %	7 %	6 %	9 %	8 %			9 %	5 %	8 %
HCB	kg	2 %	2 %	6 %	7 %	6 %	5 %	1 %	0 %	0 %	0 %	– 1 %
HCH	kg	– 8 %	– 16 %	– 3 %	– 4 %	– 5 %	5 %	5 %	5 %	6 %	5 %	5 %
PCB	kg	16 %	20 %	26 %	23 %	21 %	17 %	13 %	16 %	19 %	33 %	45 %
				2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
$PM_{2.5}$	Gg			1 %	1 %	0 %	0 %	– 1 %	– 1 %	– 1 %	– 1 %	– 3 %
PM_{10}	Gg			0 %	0 %	– 9 %	– 1 %	– 1 %	0 %	0 %	0 %	– 3 %

Slovakia ([82]), Slovenia ([83]), Sweden ([84]) and the United Kingdom ([85]) gave detailed explanations and justifications for their recalculations of parts or the whole time series (e.g. methodological improvements, revisions of emission factors, reallocations, revisions of activity data, and corrections of errors). Lithuania ([86]) only noted that some changes in their calculations have been made because of more detailed methodology. Belgium ([87]), Bulgaria ([88]), Finland ([89]) and Poland ([90]) mentioned that recalculations of some years and sectors have been made, but are not yet completed for the whole period from 1990 or for all sectors. In other instances, although Member States have submitted IIRs, information on the rationale behind recalculations is not always provided.

This year — as in 2010 — a detailed analysis of the recalculations reported by Member States has not been performed as a result of the methodological changes involved with refining the gap-filling procedure for the compilation of EU-27 LRTAP Convention inventory. This avoids the situation that for some Member States the recalculations might reflect changes in compilation methods rather than true recalculations performed by the countries themselves.

A summary of the individual recalculations reported by Member States is made available in the annual joint EMEP/EEA inventory review report. This report is made available through the CEIP website in July of each year ([91]).

4.2 Planned improvements

4.2.1 Consistency and completeness

The EEA-ETC/ACM has noted that the main future challenge for European Union Member States continues to be to improve the quality of data submissions particularly in order to obtain more complete and timely UNECE LRTAP Convention emission inventories. The improvements cannot be implemented at the EU level alone but also need the development and prioritisation of reliable and timely inventory reporting systems in the Member States themselves.

Despite clear progress in recent years concerning the completeness of reporting, as noted earlier in this report a complete set of emission inventory data for the air pollutants is still not available for all Member States. Further, for certain pollutants including particulate matter, the heavy metals and POPs, data could not be fully gap-filled as emission values for some Member States were not reported in any year.

A further issue identified by 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 datasets, inconsistencies are unavoidably introduced into the EU-27 inventory. The quality of the European Union's inventory would thus be further improved if the consistency and completeness of Member States' submissions further improves, particularly for reporting of 1990–2001 data and POPs data in general. Such improvements would facilitate reliable trend analysis and inform policy.

The improved inventory gap-filling procedure performed in 2011 has helped ensure a more complete European Union emission inventory. Based on experiences of last year's inventory compilation process, the methods used will be reviewed and feedback concerning options for further improvements will be provided to Member State representatives.

Comparing Member States shares of the EU-27 total (Tables 2.4 to 2.18) shows that in some instances the share of a certain Member State is extraordinary high, e.g. for cadmium of Poland (41.0 %), for PCB of the United Kingdom (26.9 %), for PCB of Portugal (22.8 %), and for PM 10 and PM 2.5 of France (22.1 % and 20.9 %, respectively). It could be investigated in the future if these high emission shares reflect

([82]) IIR of Slovakia, 2011.
([83]) IIR of Slovenia, 2011.
([84]) IIR of Sweden, 2011.
([85]) IIR of the United Kingdom, 2011.
([86]) IIR of Lithuania, 2011.
([87]) IIR of Belgium, 2011.
([88]) IIR of Bulgaria, 2011.
([89]) IIR of Finland, 2011.
([90]) IIR of Poland, 2011.
([91]) http://www.ceip.at/review-process.

true emissions or if they are caused by incomplete reporting (or underestimates) of other Member States.

4.2.2 Format of reported data

The updated reporting guidelines ([92]) request that all Parties to the LRTAP Convention report emissions using the new NFR09 reporting format for their 2009 submissions. Of the 25 Member States that submitted inventories in 2011, 22 used the new template for at least one inventory year; only three used older formats solely or in addition to the new format.

4.2.3 Data review and improved explanatory information

Improvements to the Member States' inventory quality 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 National Emissions Ceilings Directive ([93]). Since 2009 a centralised Stage 3 review process is in place that aims to review inventories from 10 countries annually. The reviews are performed by two teams of emission experts. Member States are encouraged to nominate reviews to the EMEP roster of emission review experts; details on the nomination process may be obtained from the CEIP website.

An uncertainty and sensitivity analysis of the European Union's LRTAP Convention emission inventory could be used in the future to identify specific sources within the inventories of Member States that would benefit from further improvements, for example scientific research to improve the robustness of emission factors. However, this type of analysis also requires Member States to report sufficient information to underpin the analysis, which is not yet done.

Finally, for this 2011 European Union inventory report cycle, this report was partially adapted to EMEP's recommended structure for IIRs, with further adaptations needed to comply in full. Further improvements are somewhat dependent on improved information being provided by Member States. For example, further explanatory information on trends and recalculations could be provided if such information is present in the IIRs received.

([92]) UNECE, 2009.
([93]) Directive 2001/81/EC.

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Units and abbreviations

kg	1 kilogram = 10^3 g (gram)
t	1 tonne (metric) = 1 megagram (Mg) = 10^6 g
Mg	1 megagram = 10^6 g = 1 tonne (t)
Gg	1 gigagram = 10^9 g = 1 kilotonne (kt)
Tg	1 teragram = 10^{12} g = 1 megatonne (Mt)
TJ	1 terajoule
As	arsenic
Cd	cadmium
CDR	central data repository of the EEA's Eionet Reportnet
CEIP	EMEP Centre on Emission Inventories and Projections
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
Cr	chromium
CRF	UNFCCC common reporting format for greenhouse gases
Cu	copper
EEA	European Environment Agency
Eionet	European environmental information and observation network
EMEP	Cooperative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe
ERT	expert review team
ETC/ACM	European Topic Centre on Air pollution and Climate change mitigation of the EEA
EU	European Union
HCB	hexachlorobenzene
HCE	hexachloroethane
HCH	hexachlorocyclohexane
HFCs	hydrofluorocarbons
Hg	mercury
HMs	heavy metals
IIR	informative inventory report
KCA	key category analysis
LRTAP Convention	UNECE Convention on Long-range Transboundary Air Pollution
N_2O	nitrous oxide
NECD	EU National Emission Ceilings Directive (2001/81/EC)
NFR	UNECE nomenclature for reporting of air pollutants
NH_3	ammonia
Ni	nickel
NMVOCs	non-methane volatile organic compounds
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
PAHs	polycyclic aromatic hydrocarbons
Pb	lead
PCDD/F	polychlorinated dibenzodioxin/polychlorinated dibenzofuran
PCBs	polychlorinated biphenyls
PFCs	perfluorocarbons
PM	particulate matter
PM_{10}	particles measuring 10 µm or less
$PM_{2.5}$	particles measuring 2.5 µm or less
POPs	persistent organic pollutants
Se	selenium
SF_6	sulphur hexafluoride
SO_2	sulphur dioxide
SO_X	sulphur oxides
TSP	total suspended particles
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
Zn	zinc

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 but included in the *EMEP/EEA air pollutant emission inventory guidebook* (EMEP/EEA, 2009), 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 notation 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 notation is as follows ([94]):

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 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' (not relevant) is introduced to ease the reporting where emissions are not strictly required by the different protocols, e.g. for some Parties 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.

([94]) Further explanation and guidance concerning the use of these notation codes may be found in the EMEP emission reporting guidelines (UNECE, 2009).

Appendix 2 LRTAP Convention emission reporting programme for 2011

This appendix contains a summary of the information provided in the EMEP emission reporting guidelines ([95]).

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

Description of contents	Components	Reporting years ([a])
Yearly: minimum (and additional)		
A. National totals:		
1. Main pollutants	NO_x, NMVOCs, SO_x, NH_3, CO	1980–2009
2. Particulate matter	$PM_{2.5}$, PM_{10}, TSP	2000–2009
3. Heavy metals	Pb, Cd, Hg/(As, Cr, Cu, Ni, Se, Zn)	1990–2009
4. POPs	([b])	1990–2009
B. Sector emissions:		
1. Main pollutants	NO_x, NMVOCs, SO_x, NH_3, CO	1980–2009
2. Particulate matter	$PM_{2.5}$, PM_{10}, TSP	2000–2009
3. Heavy metals	Pb, Cd, Hg/(As, Cr, Cu, Ni, Se, Zn)	1990–2009
4. POPs	([b])	1990–2009
5. Activity data		1990–2009
5-yearly: minimum reporting		
C. Gridded data in the EMEP 50 × 50 km² grid		
1. National totals	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCH, HCB, PCBs, PCDD/F	1990, 1995, 2000 and 2005 (PM for 2000 and 2005)
2. Sector emissions	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCH, HCB, PCBs, PCDD/F	1990, 1995, 2000 and 2005 (PM for 2000 and 2005)
D. Emissions from large-point sources	Main pollutants, PM, HMs, PCDD/F, PAHs, HCB, HCH, PCBs	1990, 1995, 2000 and 2005 (PM for 2000 and 2005)
E. Historical and projected activity data and projected national total emissions		
1. National total emissions	See Table IV 2A in the emission reporting guidelines	2010, 2015,2020, 2030 and 2050
2. National sector emissions	See Table IV 2A in the emission reporting guidelines	2010, 2015,2020, 2030 and 2050
3. National projection activity data	See Table IV 2B in the Emission reporting guidelines	2010, 2015,2020, 2030 and 2050
5-yearly: additional reporting for review and assessment purposes		
VOC speciation/height distribution/temporal distribution		Parties are encouraged to review the information used for modelling at http://www.ceip.at/emission-data-webdab/emissions-as-used-in-emep-models/ (accessed 24 May 2011).
Land-use data/mercury breakdown		
Percentage of toxic congeners of PCDD/F emissions		
Pre-1990 emissions of PAHs, HCB, PCDD/F and PCB		
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]) Polychlorinated dibenzodioxin/polychlorinated dibenzofuran (PCDD/F), polycyclic aromatic hydrocarbons (PAHs), hexachlorobenzene (HCB), hexachlorocyclohexane (HCH), polychlorinated biphenyls (PCBs). (See revised emission reporting guidelines: http://www.ceip.at/reporting-instructions/ (accessed 24 May 2011).)

([95]) UNECE, 2009.

Reporting format

Each Party should use the reporting format set out in Annex IV of the reporting guidelines ([96]) 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 NFR, is a standardised format for reporting estimates of emissions — i.e. the 'Nomenclature for reporting' (NFR) format — including activity data, projected activity data, projected emissions and other relevant information. The reporting format aims to facilitate electronic submissions to simplify the processing of emissions information and the preparation of useful technical analysis and synthesis documentation. The reporting format covers:

- national annual emissions and national annual sector emissions using NFR09 (Annex IV, Table 1);
- total and aggregated sector emissions for reporting emissions of nitrogen oxides, non-methane volatile organic compounds, sulphur, ammonia, particulate matter, carbon monoxide, lead, cadmium, mercury, PCDD/F, PAHs, HCB, HCH and PCBs, for the EMEP grid squares of 50 km × 50 km and emissions from large point sources (Annex IV, Tables IV 3A gridded and IV 3B LPS);
- for the years 2010, 2015, 2020, 2030 and 2050 projected activity data and projected national total emissions of sulphur, nitrogen oxides, ammonia and non-methane volatile organic compounds to be reported for the source categories listed in Annex IV (2A-WM, 2B WM, 2A-WaM, 2B WaM).

([96]) UNECE, 2009.

Appendix 3 Mapping tables

To allow the European Union inventory to be reported in the requested NFR09 format, emissions inventories that were not available in NFR09 format (because either historic years were not resubmitted in 2010 or an 'older' NFR format was used for the 2011 submission) needed to be transferred into NFR09 format. A procedure for allocating the source categories from older formats to NFR09 was developed. Details of the mapping schema used can be found in the *European Union emission inventory report 1990–2008 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)* ([97]).

([97]) EEA, 2010a.

Appendix 4 Schema for mapping EMEP NFR09 sectors

To enable the presentation of sectoral emission trends (Chapter 3), individual NFR source categories for the EU-27 inventory were aggregated into the following main sector groups:

- energy production and distribution
- energy use in industry
- industrial processes
- solvent and product use
- commercial, institutional and households (energy use)
- 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. Schema for mapping EMEP NFR09 sectors

NFR Code	Longname	EEA aggregated sector name
1 A 1 a	1 A 1 a Public electricity and heat production	Energy production and distribution
1 A 1 b	1 A 1 b Petroleum refining	Energy production and distribution
1 A 1 c	1 A 1 c Manufacture of solid fuels and other energy industries	Energy production and distribution
1 A 2 a	1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	Energy use in industry
1 A 2 b	1 A 2 b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Energy use in industry
1 A 2 c	1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	Energy use in industry
1 A 2 d	1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, paper and print	Energy use in industry
1 A 2 e	1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Energy use in industry
1 A 2 f i	1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)	Energy use in industry
1 A 2 f ii	1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)	Energy use in industry
1 A 3 a ii (i)	1 A 3 a ii (i) Civil aviation (Domestic, LTO)	Non-road transport
1 A 3 a i (i)	1 A 3 a i (i) International aviation (LTO)	Non-road transport
1 A 3 b i	1 A 3 b i Road transport: Passenger cars	Road transport
1 A 3 b ii	1 A 3 b ii Road transport: Light duty vehicles	Road transport
1 A 3 b iii	1 A 3 b iii Road transport: Heavy duty vehicles	Road transport
1 A 3 b iv	1 A 3 b iv Road transport: Mopeds and motorcycles	Road transport
1 A 3 b v	1 A 3 b v Road transport: Gasoline evaporation	Road transport
1 A 3 b vi	1 A 3 b vi Road transport: Automobile tyre and brake wear	Road transport
1 A 3 b vii	1 A 3 b vii Road transport: Automobile road abrasion	Road transport
1 A 3 c	1 A 3 c Railways	Non-road transport
1 A 3 d i (ii)	1 A 3 d i (ii) International inland waterways	Non-road transport
1 A 3 d ii	1 A 3 d ii National navigation (Shipping)	Non-road transport
1 A 3 e	1 A 3 e Pipeline compressors	Energy production and distribution
1 A 4 a i	1 A 4 a i Commercial/institutional: Stationary	Commercial, institutional and households
1 A 4 a ii	1 A 4 a ii Commercial/institutional: Mobile	Commercial, institutional and households
1 A 4 b i	1 A 4 b i Residential: Stationary plants	Commercial, institutional and households
1 A 4 b ii	1 A 4 b ii Residential: Household and gardening (mobile)	Commercial, institutional and households
1 A 4 c i	1 A 4 c i Agriculture/forestry/fishing: Stationary	Commercial, institutional and households
1 A 4 c ii	1 A 4 c ii Agriculture/forestry/fishing: Off-road vehicles and other machinery	Commercial, institutional and households
1A 4 c iii	1A 4 c iii Agriculture/forestry/fishing: National fishing	Non-road transport
1 A 5 a	1 A 5 a Other stationary (including military)	Commercial, institutional and households
1 A 5 b	1 A 5 b Other, Mobile (including military, land-based and recreational boats)	Commercial, institutional and households
1 B 1 a	1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	Energy production and distribution
1 B 1 b	1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	Energy production and distribution
1 B 1 c	1 B 1 c Other fugitive emissions from solid fuels	Energy production and distribution
1 B 2 a i	1 B 2 a i Exploration, production, transport	Energy production and distribution
1 B 2 a iv	1 B 2 a iv Refining/storage	Energy production and distribution
1 B 2 a v	1 B 2 a v Distribution of oil products	Energy production and distribution
1 B 2 b	1 B 2 b Natural gas	Energy production and distribution

NFR Code	Longname	EEA aggregated sector name
1 B 2 c	1 B 2 c Venting and flaring	Energy production and distribution
1 B 3	1 B 3 Other fugitive emissions from geothermal energy production, peat and other energy extraction not included in 1 B 2	Energy production and distribution
2 A 1	2 A 1 Cement production	Industrial processes
2 A 2	2 A 2 Lime production	Industrial processes
2 A 3	2 A 3 Limestone and dolomite use	Industrial processes
2 A 4	2 A 4 Soda ash production and use	Industrial processes
2 A 5	2 A 5 Asphalt roofing	Industrial processes
2 A 6	2 A 6 Road paving with asphalt	Industrial processes
2 A 7 a	2 A 7 a Quarrying and mining of minerals other than coal	Industrial processes
2 A 7 b	2 A 7 b Construction and demolition	Industrial processes
2 A 7 c	2A 7 c Storage, handling and transport of mineral products	Industrial processes
2 A 7 d	2 A 7 d Other mineral products (Please specify the sources included/excluded in the notes column to the right)	Industrial processes
2 B 1	2 B 1 Ammonia production	Industrial processes
2 B 2	2 B 2 Nitric acid production	Industrial processes
2 B 3	2 B 3 Adipic acid production	Industrial processes
2 B 4	2 B 4 Carbide production	Industrial processes
2 B 5 a	2 B 5 a Other chemical industry (Please specify the sources included/excluded in the notes column to the right)	Industrial processes
2 B 5 b	2 B 5 b Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)	Industrial processes
2 C 1	2 C 1 Iron and steel production	Industrial processes
2 C 2	2 C 2 Ferroalloys production	Industrial processes
2 C 3	2 C 3 Aluminum production	Industrial processes
2 C 5 a	2 C 5 a Copper production	Industrial processes
2 C 5 b	2 C 5 b Lead production	Industrial processes
2 C 5 c	2 C 5 c Nickel production	Industrial processes
2 C 5 d	2 C 5 d Zinc production	Industrial processes
2 C 5 e	2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)	Industrial processes
2 C 5 f	2 C 5 f Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)	Industrial processes
2 D 1	2 D 1 Pulp and paper	Industrial processes
2 D 2	2 D 2 Food and drink	Industrial processes
2 D 3	2 D 3 Wood processing	Industrial processes
2 E	2 E Production of POPs	Industrial processes
2 F	2 F Consumption of POPs and heavy metals (e.g. electricial and scientific equipment)	Industrial processes
2 G	2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/ excluded in the notes column to the right)	Industrial processes
3 A 1	3 A 1 Decorative coating application	Solvent and product use
3 A 2	3 A 2 Industrial coating application	Solvent and product use
3 A 3	3 A 3 Other coating application (Please specify the sources included/excluded in the notes column to the right)	Solvent and product use
3 B 1	3 B 1 Degreasing	Solvent and product use
3 B 2	3 B 2 Dry cleaning	Solvent and product use
3 C	3 C Chemical products	Solvent and product use
3 D 1	3 D 1 Printing	Solvent and product use
3 D 2	3 D 2 Domestic solvent use including fungicides	Solvent and product use
3 D 3	3 D 3 Other product use	Solvent and product use
4 B 1 a	4 B 1 a Cattle dairy	Agriculture
4 B 1 b	4 B 1 b Cattle non-dairy	Agriculture

NFR Code	Longname	EEA aggregated sector name
4 B 2	4 B 2 Buffalo	Agriculture
4 B 3	4 B 3 Sheep	Agriculture
4 B 4	4 B 4 Goats	Agriculture
4 B 6	4 B 6 Horses	Agriculture
4 B 7	4 B 7 Mules and asses	Agriculture
4 B 8	4 B 8 Swine	Agriculture
4 B 9 a	4 B 9 a Laying hens	Agriculture
4 B 9 b	4 B 9 b Broilers	Agriculture
4 B 9 c	4 B 9 c Turkeys	Agriculture
4 B 9 d	4 B 9 d Other poultry	Agriculture
4 B 13	4 B 13 Other	Agriculture
4 D 1 a	4 D 1 a Synthetic N-fertilisers	Agriculture
4 D 2 a	4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	Agriculture
4 D 2 b	4 D 2 b Off-farm storage, handling and transport of bulk agricultural products	Agriculture
4 D 2 c	4 D 2 c N-excretion on pasture range and paddock unspecified (Please specify the sources included/excluded in the notes column to the right)	Agriculture
4 F	4 F Field burning of agricultural wastes	Agriculture
4 G	4 G Agriculture other (c)	Agriculture
6 A	6 A Solid waste disposal on land	Waste
6 B	6 B Wastewater handling	Waste
6 C a	6 C a Clinical waste incineration (d)	Waste
6 C b	6 C b Industrial waste incineration (d)	Waste
6 C c	6 C c Municipal waste incineration (d)	Waste
6 C d	6 C d Cremation	Waste
6 C e	6 C e Small scale waste burning	Waste
6 D	6 D Other waste(e)	Waste
7 A	7 A Other (included in national total for entire territory)	Other

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