EEA Report | No 05/2020

European Union emission inventory report 1990-2018

under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)

ISSN 1977-8449

European Environment Agency

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Cover design: EEA
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Luxembourg: Publications Office of the European Union, 2020

ISBN 978-92-9480-237-8
ISSN 1977-8449
doi:10.2800/233574

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Acknowledgements

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The EEA acknowledges comments received on the draft report from the Eionet National Reference Centres in EEA member countries and the European Commission (DG Environment).

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Executive summary

This document is the annual EU ([1]) emission inventory report under the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (LRTAP Convention) (UNECE, 1979). The report and its accompanying data constitute the official submission to the UNECE secretariat by the European Commission on behalf of the EU as a Party to the UNECE Executive Secretary (Box ES.1). The EEA compiled the report in cooperation with the EU Member States, the United Kingdom and the European Commission.

The LRTAP Convention obliges and invites Parties to report emission data for numerous air pollutants:

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

These pollutants harm human health and the environment. Certain species also contribute to the formation of ground-level ozone (O_3) and secondary PM in the atmosphere. Some pollutants have both an indirect and a direct effect on the sunlight absorbed by the Earth and reflected back to space (radiative forcing) and hence on climate (EEA, 2014, 2015, 2019a).

This report addresses:

- the institutional arrangements and preparation processes behind the EU's emission inventory, methods and data sources, reporting, key category analyses, information on quality assurance and control, general uncertainty evaluation, and information on completeness and underestimations (Chapter 1);
- information on approved adjustments and adjustment applications under the Gothenburg Protocol (Chapter 2);
- emission trends for the EU as a whole and for individual EU Member States, and the contribution of key categories to total emissions (Chapter 3);
- sectoral analyses and emission trends for key pollutants (Chapter 4);
- information on recalculations, as well as planned and implemented improvements (Chapter 5);
- brief information on the status of the (not mandatory) reporting of the condensable component of PM_{10} and $PM_{2.5}$ (Section 1.5.5).

Emission data presented in this report are presented in the accompanying annexes and are also available

([1]) The United Kingdom left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020. References to 'EU Member States' and 'EU-28' made in this report in relation to information to the period 1990-2018, therefore refers to the air pollutant emission totals of the EU-27 plus the emissions of the United Kingdom, i.e. the EU-28.

Box ES.1 The Gothenburg Protocol

The Gothenburg Protocol to the LRTAP Convention sets emission ceilings (UNECE, 1999). Parties to the convention must reduce their emissions to these levels. These ceilings, for 2010 and beyond, are for the pollutants nitrogen oxides, non-methane volatile organic compounds, sulphur oxides and ammonia. In addition to the ceilings for individual countries, the protocol also specifies ceilings for the EU, which is a Party to the protocol in its own right (UNECE, 1999). The protocol was amended in 2012. The ceilings set for 2010 and the years thereafter are still in place, but the amended version also specifies new emission reduction commitments in terms of percentage reductions by 2020, relative to the base year 2005. Parties are also encouraged to report primary particulate matter and black carbon emissions, in line with the revised emission-reporting guidelines (UNECE, 2014a) ([2]). The EU ratified the amended protocol in 2017.

Box ES.2 Status of reporting by EU Member States and the United Kingdom

In 2020, EU Member States and the United Kingdom were requested to report emission inventory data and an informative inventory report (IIR). All countries provided air emission inventories and activity data, but for those where emissions data were missing for certain years or pollutants, a gap-filling procedure was applied to obtain a European inventory that was as complete as possible.

The EU should deliver emission inventories and projections by 30 April, its IIR (i.e. this report) by 30 May and its gridded and large point source (LPS) data by 15 June. By 6 May, 26 EU Member States and the United Kingdom had provided IIRs. As there is no reporting obligation in 2020 for projections, gridded and LPS data, the reporting is voluntary. However, Finland, Ireland, Malta and the United Kingdom provided projections. Bulgaria, Estonia, Finland, Italy, Lithuania, Malta, Poland and Spain have provided gridded data. Czechia, Finland, Italy, Lithuania, Romania and Spain also reported LPS data in 2020. Detailed information on EU Member States' submissions is given in Appendix 3.

In 2012, the Executive Body of the LRTAP Convention decided that adjustments to emission reduction commitments, or to inventories for the purposes of comparing them with total national emissions, may be applied in some circumstances, if such a circumstance contributes to a Party being unable to meet one of its reduction commitments (UNECE, 2012a). Under the Gothenburg Protocol, the European Monitoring and Evaluation Programme (EMEP) Steering Body accepted inventory adjustment applications for emissions from 10 countries in 2014, 2015, 2016, 2017, 2018 and 2019.

Circumstances that allow adjustments to emission inventories are defined as follows:

- There are additional categories of emission sources that were not accounted for when the emission reduction commitments were made.
- Emission factors used to determine emission levels for particular source categories for the year in which emission reduction commitments are to be attained are significantly different from the emission factors applied to these categories at the time the emission reduction commitments were made.
- The methods for determining emissions from specific source categories have changed significantly between when emission reduction commitments were made and the year they are to be attained.

([2]) On 30 June 2020, the EEA published an annual briefing, which analyses the 2018 emission data for EU Member States reported under Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, known as the EU National Emission reduction Commitments (NEC) Directive (EU, 2016b). For the EU Member States, the NEC Directive retains the emission ceilings set for 2010 and the years thereafter until 2019 and establishes new national emission reduction commitments for NO_x, NMVOCs, SO_2, NH_3 and $PM_{2.5}$ for 2020-2029 and from 2030 onwards.

for direct download through the EEA's data service (EEA, 2019b). The following sections summarise the main findings.

EU emission trends

Figures ES.1-ES.3 present the trends in the emission of air pollutants between 1990 and 2018 ([3]). They are aggregated across the EU.

Emission trends for the main air pollutants between 1990 and 2018

With reference to the main air pollutants, SO_X registered the greatest reduction in emissions across the EU. In 2018, SO_X emissions were by 92 % lower than in 1990 (Figure ES.1). This reduction is the result of a combination of measures:

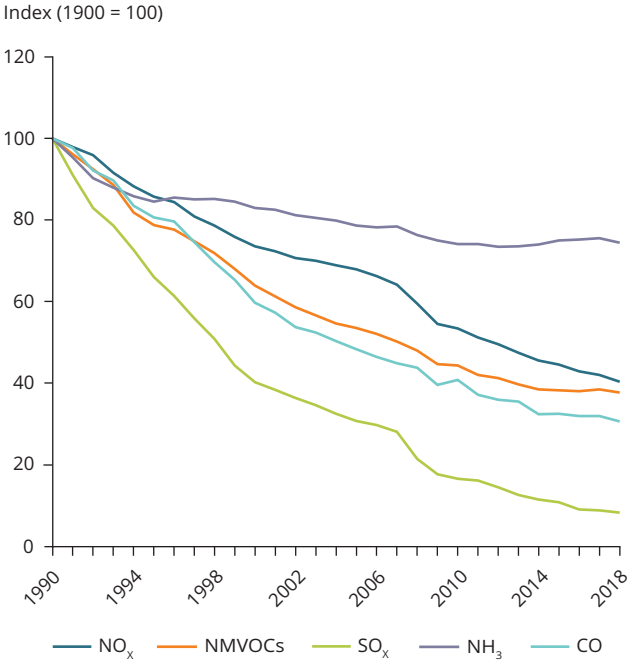
- fuel switching in energy-related sectors, away from solid and liquid fuels with high sulphur content to low-sulphur fuels such as natural gas;
- applying flue gas desulphurisation (FGD) techniques in industrial facilities;
- EU directives relating to the sulphur content of certain liquid fuels.

Emissions of the other main air pollutants have dropped considerably since 1990, including the three air pollutants primarily responsible for the formation of ground-level O_3: CO (69 % reduction), NO_X (60 % reduction) and NMVOCs (62 % reduction).

For most main air pollutants, emissions decreased more slowly from 2007 to 2018. NH_3 emissions have fallen less than emissions of the other main pollutants (26 %) since 1990, and since 2013 a positive NH_3 emission trend has been noted (plus 2.8 % from 2013 to 2017).

The road transport sector has reduced CO and NMVOCs emissions since 1990, and since 1992 NO_X emissions have also continued to decrease.

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



The sector has achieved this primarily through legislative measures requiring the abatement of vehicle exhaust emissions.

European legislation sets progressively stricter emission limits for air pollutants from cars and vans, lorries and buses and coaches, known as the 'Euro standards'. The standards apply to tailpipe emissions of NO_X, determined by laboratory-based tests. These official tests fail to measure the actual level of emissions that vehicles are producing under real driving conditions, i.e. NO_X emissions are higher than EU limits permit. This has contributed significantly to exceedances of the nitrogen dioxide (NO_2) air quality daily limit value at urban traffic stations ([4]) (EEA, 2019c). New tests under real driving conditions now complement laboratory-based testing. Such tests became mandatory for all new cars and vans as from September 2019 (EU, 2016a).

([3]) Each year, by 15 February, Member States must report emission data for the years up to and including the last calendar year but one. Thus, by 15 February 2020, Member States were obliged to report data for the years up to 2018. Typically, it takes countries about 12-15 months to compile and report emission inventory data (for both air pollutants and greenhouse gases). This delay is mainly because of the time needed for official national and/or trade statistics to become available (typically up to 12 months after the end of the calendar year), together with the time needed for subsequent data processing, calculations, and quality assurance and quality control (QA/QC) checks.

([4]) Stations in urban areas (mainly cities) close to main roads.

Box ES.3 Changes in the main pollutant emissions in the EU Member States between 2017 and 2018

Between 2017 and 2018, emissions of nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), sulphur oxides (SO_X), carbon monoxide (CO) and ammonia (NH_3) dropped by 4.1 %, 2.0 %, 6.7%, 4.3 %, and 1.6 %, respectively.

NMVOC emissions decreased in 17 EU Member States between 2017 and 2018. Italy, Germany, France and Poland (in order of the largest absolute emission reduction) were responsible for the highest decreases. The main emitter of NMVOCs is the 'industrial processes and product use' sector.

From 2017 to 2018, the largest reductions in SO_X emissions in absolute terms were reported by Poland, Spain, the United Kingdom and Bulgaria (in order of the largest absolute emission reduction). The 'energy production and distribution' sector was the main contributor to the reduction in SO_X emissions.

CO emissions decreased, mainly due to decreased emissions reported by Italy, France, Germany and Hungary (in order of the largest absolute emission reduction). The road transport sector contributed most to the decrease in CO emissions.

NH_3 emissions decreased in 22 EU Member States. Germany and Italy reported the highest decreases (in order of the largest absolute emission reduction). The rise in Spain in recent years was driven by a greater consumption of synthetic nitrogen fertilisers and an increase in the numbers of cattle and swine.

NO_X emissions declined considerably in the electricity/energy generation sectors as a result of certain technical measures, mainly:

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

Emission trends for particulate matter between 2000 and 2018

The LRTAP Convention formally requests Parties to report emissions of PM from the year 2000 onwards; hence, emission trends are shown for 2000 and the subsequent years only. Aggregated emissions of TSPs have fallen by 24 % across the EU since 2000 (and by 54 % since 1990) (Figure ES.2). Emissions of primary PM_{10}, $PM_{2.5}$ and BC have fallen by 29 %, 32 % and 46 %, respectively (since 2000).

The reporting of condensable components is not mandatory, and in recent years there has been no clear definition of whether PM emission reporting includes or excludes the condensable component. However, the reporting table on condensable components within Annex II was provided by 17 EU Member States and the UK in 2020. The level of information is rather inhomogeneous and for many categories no information is available at all.

Total PM emissions dropped, mainly thanks to the introduction or improvement of abatement measures across the energy, road transport and industry sectors. This has been coupled with other developments in industrial sectors, such as switching from fuels containing high amounts of sulphur to those with low amounts. SO_X, NO_X and NH_3 play an important role in the formation of secondary PM. Thus, if emissions of these pollutants decrease, this also influences PM formation (EEA, 2019c).

NH_3 emissions from agriculture contribute to episodes of high secondary inorganic PM concentrations being experienced across certain regions of Europe each spring. Such episodes contribute to exceedances of the PM_{10} daily limit values set in the EU's Air Quality Directive (e.g. CAMS, 2019).

Emission trends for heavy metals and persistent organic pollutants between 1990 and 2018

Since 1990, emissions of the main HMs (Pb, Cd, Hg), dioxins and furans, total PAHs, HCB and PCBs have also dropped substantially, by at least 44 % (Figure ES.3).

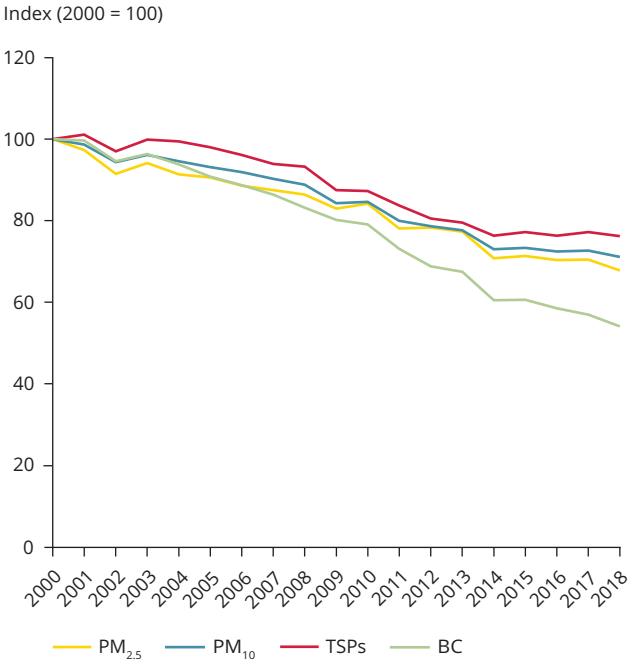
Much progress has been made since the early 1990s in reducing point source emissions of these substances, particularly from industrial facilities. This has been achieved partially through improved abatement techniques for waste water treatment and incinerators

in the metal-refining and smelting industries. In some countries, the reduction in emissions follows the closure of older industrial facilities due to economic restructuring. Total emissions fell faster between 1990 and 2000 than in the following years.

Emissions of HMs fell between 1990 and 2018: Pb by 94 %, Cd by 66 %, Hg by 72 %, As by 79 %, Cr by 69 %, Cu by 10 %, Ni by 74 %, Se by 41 % and Zn by 47 %.

Total PAHs decreased by 49 % from 1990 to 2018 ([5]). For individual PAHs, the reductions from 1990 to 2018 were 59 % for B(a)P, 48 % for B(b)F, 42 % for B(k) F and 44 % for IP. Dioxins and furans have decreased by 80 % since 1990. The reductions in HCB and PCB emissions were 97 % and 85 %, respectively. Although there have been clear decreases over the last 25 years, emissions of POPs have remained broadly stable since 2003 (Figure ES.3).

Figure ES.2 EU-28 emission trends for particulate matter



EU key categories and main emission sources

EU key categories refer to the individual sources that contributed the most, overall, to emissions of pollutants in 2018. They were determined by a level assessment ([6]) for NO_X, NMVOCs, SO_X, NH_3, CO, $PM_{2.5}$, PM_{10}, BC, Cd, Pb, Hg, PCDD/Fs, total PAHs, B(a)P, HCB and PCBs.

A total of 57 different emission inventory source categories were identified as being key for at least one pollutant. A number of emission categories were identified as being key for more than one of the 16 pollutants assessed. Table ES.1 lists the most relevant key categories.

Figure ES.4 shows the share of EU emissions in 2018 by sector group. As observed in previous years, each main air pollutant has one major source category:

1. For NO_X, the major source category is 'road transport'.

2. For SO_X, the major source category is 'energy production and distribution'.

3. For NH_3, the major source category is 'agriculture'.

4. For NMVOCs, the major source category is 'industrial processes and product use'.

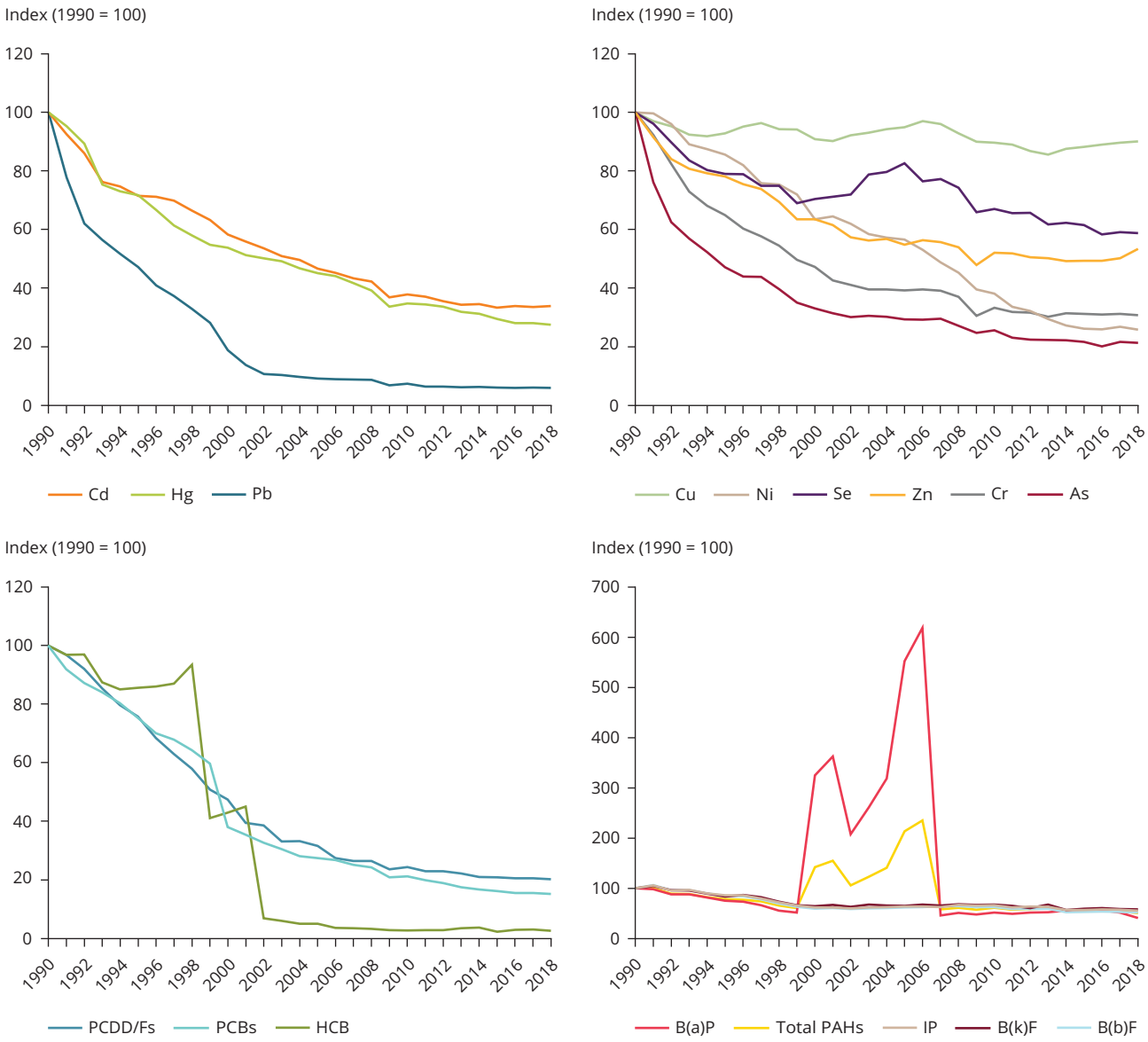
5. For CO, as well as PM, the major source category is 'commercial, institutional and households'.

Emissions of NO_X from the road transport sector fell by 63 % between 1990 and 2018. Nevertheless, in the EU, this sector is a major source of the ground-level O_3 precursors NO_X, CO and NMVOCs: in 2018, it contributed 39 %, 20 % and 8 %, respectively, to the total emissions of these pollutants in the EU. It is also a major source of primary $PM_{2.5}$, PM_{10}, BC and Pb emissions. Passenger cars, heavy-duty vehicles and buses are the principal contributors to NO_X emissions from this sector; in 2018, passenger cars alone contributed around 70 % of CO emissions from the road transport sector.

([5]) It is difficult to compare reductions in total PAHs and reductions in the other PAHs. The reporting completeness for the EU (sum of reporting/gap-filling of the Member States) differs strongly between total PAHs and the other PAHs.

([6]) A key category-level assessment identifies those source categories that have a significant influence on a country's total inventory in terms of its absolute level of emissions. In this report, key categories refer to those that are collectively responsible for 80 % of the total emissions of a given pollutant (EMEP/EEA, 2019).

Figure ES.3 EU-28 emission trends for heavy metals and persistent organic pollutants



Notes: The drop in HCB emissions between 1998 and 1999 is due to a considerable reduction reported by the United Kingdom. The decrease in HCB emissions between 2003 and 2004 is caused by reductions reported by Spain.

The trend in B(a)P emissions follows the trend in the data reported by Portugal and Bulgaria.

For certain pollutants, not all countries reported data.

Box ES.4 Effects of recalculating data for previously reported emissions in the EU Member States

In 2020, all EU Member States and the United Kingdom that provided submissions reported recalculations for one or more years; changes in gap filling also resulted in recalculations. This caused changes in emission inventories for all pollutants up to 2018.

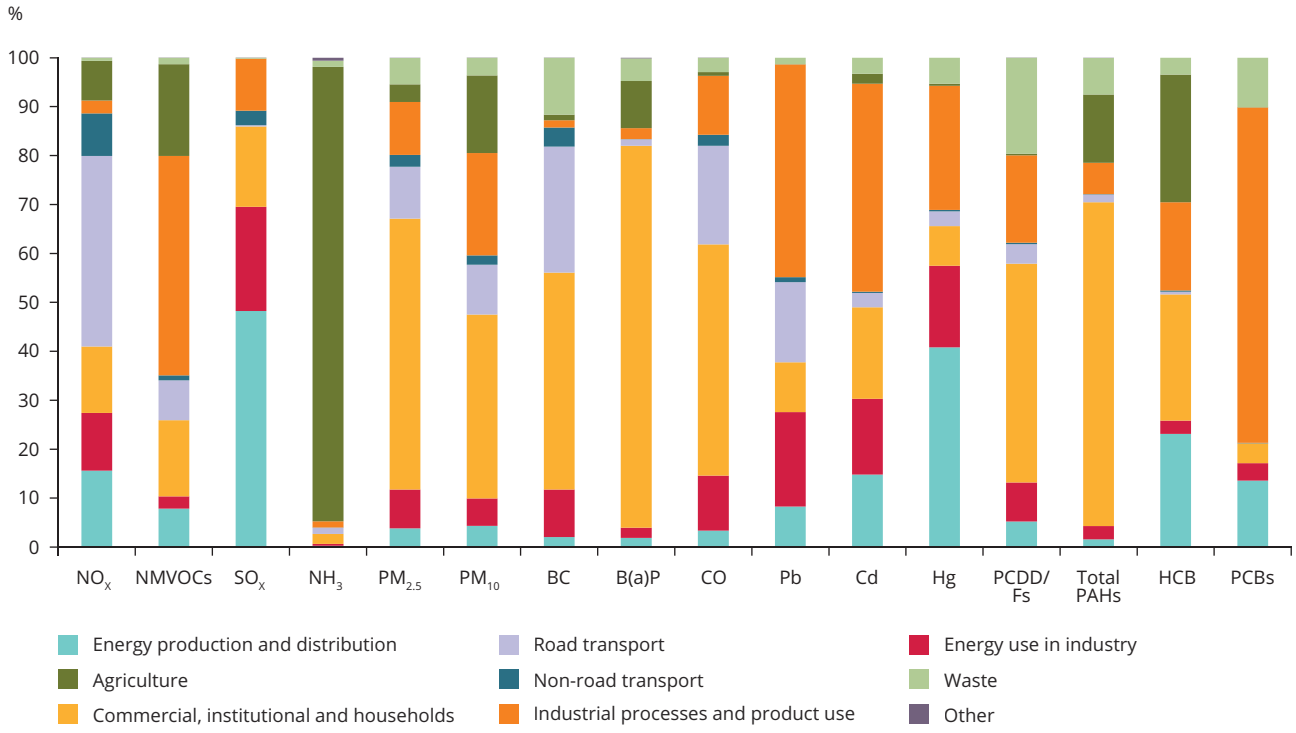
In their informative inventory reports (see Appendix 5), EU Member States and the United Kingdom gave an account of their reasons for recalculating parts of time series or whole time series. Explanations included methodological improvements, revision of emission factors or newly implemented emission factors, reallocations, availability of new data, and revision of activity data and correction of errors. They did not always provide information on the rationale behind the recalculations.

Table ES.1 Most relevant categories for air pollutant emissions

Name of key category	Number of occurrences as a key category
Residential: Stationary (combustion) (NFR 1A4bi)	14 (NO_x, NMVOCs, SO_x, CO, $PM_{2.5}$, PM_{10}, BC, Pb, Cd, Hg, PCDD/Fs, total PAHs, B(a)P, HCB)
Public electricity and heat production (NFR 1A1a)	11 (NO_x, SO_x, CO, $PM_{2.5}$, PM_{10}, Pb, Cd, Hg, PCDD/Fs, HCB, PCBs)
Stationary combustion in manufacturing industries and construction: Non-metallic minerals (NFR 1A2f)	8 (NO_x, SO_x, CO, $PM_{2.5}$, PM_{10}, Pb, Cd, Hg)
Road transport: Passenger cars (NFR 1A3bi)	8 (NO_x, NMVOCs, CO, $PM_{2.5}$, PM_{10}, BC, Hg, PCDD/Fs)
Iron and steel production (NFR 2C1)	8 (CO, $PM_{2.5}$, PM_{10}, Pb, Cd, Hg, PCDD/Fs, PCBs)
Stationary combustion in manufacturing industries and construction: Iron and steel (NFR 1A2gviii)	7 (NO_x, SO_x, $PM_{2.5}$, PM_{10}, BC, Cd, Hg)

Note: NFR, nomenclature for reporting.

Figure ES.4 Share of EU emissions of the main pollutants, by sector group in 2018



The commercial, institutional and households sector is the most important source of primary $PM_{2.5}$, PCDD/Fs, PAHs, CO, PM_{10} and BC. Energy- and process-related emissions from industry contribute considerably to the overall emissions of a number of NMVOC, HMs and POPs.

Adjustments to emission inventories under the Gothenburg Protocol

Parties to the LRTAP Convention may 'adjust' their emission inventories downwards if non-compliance with the ceilings set in the Gothenburg Protocol is caused by countries that have applied improved emission inventory methods in accordance with updated scientific knowledge since the 2010 ceilings were originally set. This is to avoid disadvantages when applying improved emission inventory methodologies.

Table ES.2 lists inventory adjustment applications that the European Monitoring and Evaluation Programme (EMEP) Steering Body accepted in 2014, 2015, 2016, 2017, 2018 and 2019.

Table ES.2 Accepted inventory adjustment applications (UNECE, 2014b, 2015, 2016, 2017, 2018, 2019)

Member State	Pollutant	NFR
Belgium	NO_X	Road transport (1A3bi-iv), Agriculture (3B, 3Da1, 3Da2a)
	NMVOCs	Agriculture (3B, 3De)
Denmark	NMVOCs	Agriculture (3B)
	NH_3	Agriculture (3Da1, 3De)
Finland	NH_3	Energy use in industry (1A2gviii), Commercial, institutional and households (1A4ai, 1A4bi, 1A4ci), Road transport (1A3bi-iv)
France	NO_X	Road transport (1A3bi-iv)
Germany	NO_X	Road transport (1A3bi-iv), Agriculture (3B, 3D, 3Da2c, 3I)
	NMVOCs	Agriculture (3B, 3De)
	NH_3	Agriculture (3Da2c, 3I)
Hungary	NMVOCs	Agriculture (3B, 3De)
Netherlands	NMVOCs	Agriculture (3B1a, 3B4h, 3B4d, 3B4e, 3B4giii, 3B4giv, 3B2, 3B4h, 3B4f, 3B1b, 3Da2a, 3Dc, 3B3, 3B4gii, 3B4gi, 3De, 3Da3)
	NH_3	Agriculture (3Da4, 3De, 3B3)
Luxembourg	NO_X	Road transport (1A3bi-iv), Agriculture (3B, 3De)
	NMVOCs	Agriculture (3B, 3De)
Spain	NO_X	Road transport (1A3bi, 1A3biii), Agriculture (3B)
United Kingdom	NO_X	Road transport (1A3bi-iv)

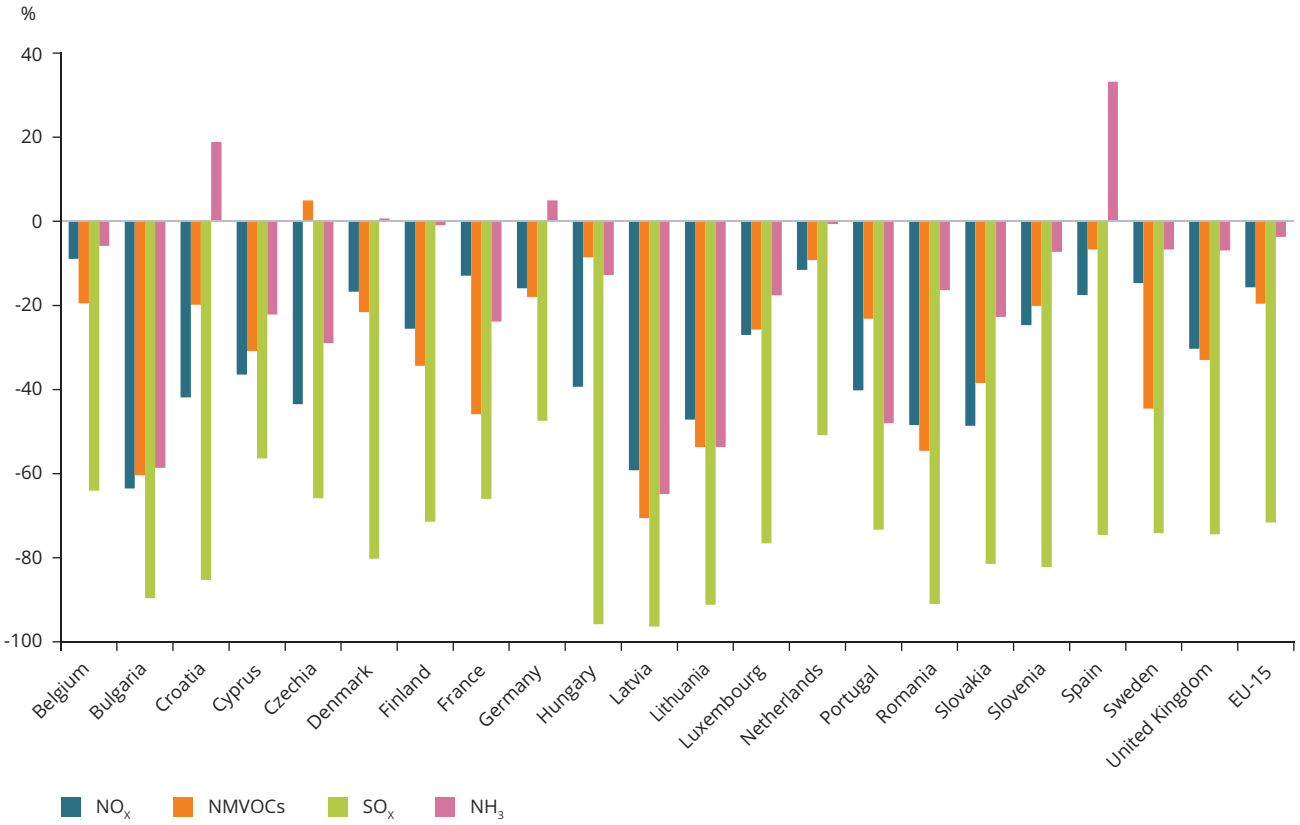
Note: For Nomenclature for Reporting (NFR) codes, see Appendix 4.

Progress towards meeting the EU's current emission ceilings and emission reduction commitments for 2020 under the Gothenburg Protocol

The Gothenburg Protocol (1999) set commitments for the European Community, at the time comprising 15 EU Member States (EU-15). Table ES.3 shows their aggregated emissions for 2018 compared with the emission ceilings the protocol specified for the EU in 2010 and for the years thereafter. In 2018, the EU-15 emissions of NO_X, NMVOCs, SO_X and NH_3 were below the ceilings (see Appendix 2, Table A2.2 for country groupings). The Gothenburg Protocol was amended in 2012 to set emission reduction commitments for 2020.

Figure ES.5 shows whether or not each EU Member State met the respective national Gothenburg ceiling in 2018. Estonia and Malta do not have such ceilings, as they have not signed the protocol. Austria, Greece, Ireland, Italy and Poland have signed but not yet ratified the Gothenburg Protocol and are therefore excluded from Figure ES.5. Four countries exceeded their NH_3 ceilings (Croatia, Denmark, Germany and Spain); one Member State (Czechia) did not comply with its ceiling for NMVOCs. All EU Member States complied with their NO_X and SO_X ceilings.

Figure ES.5 Distance to Gothenburg ceilings for EU Member States in 2018



Notes: Estonia and Malta have not signed the Gothenburg Protocol and therefore do not have ceilings. Austria, Greece, Ireland, Italy and Poland have a ceiling but have not yet ratified the protocol. For Spain, data for emission comparisons exclude emissions from the Canary Islands.

The comparison with emission ceilings is based on reporting of fuel sold data, except for Belgium, Lithuania, Luxembourg, the Netherlands and the United Kingdom. These countries may, instead, choose to use the total national emissions calculated on the basis of fuel used in the geographical area of the Party for comparing emissions with the ceilings (UNECE, 2014a). For the EU-15, the comparison is based on fuel sold.

Under the Gothenburg Protocol, the EMEP Steering Body accepted inventory adjustment applications for emissions from Belgium, Denmark, Finland, France, Germany, Hungary, Luxembourg, the Netherlands Spain and the United Kingdom in 2014, 2015, 2016, 2017, 2018 and 2019. This figure takes these adjusted data into account. The EU-15 did not apply for adjustments and thus data for the EU-15 are unadjusted.

Table ES.3 Emissions reported for 2018 by EU-15 EU Member States compared with Gothenburg Protocol EU emission ceilings for 2010 and the years thereafter

Pollutant	EU-15 emissions, 2018 (Gg)	EU-15 Gothenburg Protocol, 2010 ceilings (Gg)	Difference (%)	Sum of individual EU-15 ceilings (Gg) (a)
NO_x	5 625	6 671	-16	6 519
NMVOCs	5 307	6 600	-20	6 510
SO_x	1 150	4 059	-72	3 850
NH_3	3 014	3 129	-3.7	3 110

Notes: For Spain, data for emission comparisons exclude emissions from the Canary Islands. The comparison with emission ceilings is based on reporting on the basis of fuel sold for all EU Member States.

For Portugal's 2010 ceilings, emissions from the Azores and Madeira are excluded.

Hungary, Luxembourg, the Netherlands, Spain and the United Kingdom for emission inventory adjustments in 2014, 2015, 2016, 2017, 2018 and 2019. However, as the EU-15 itself has not applied for adjustments, this table does not take these adjusted data into account.

(a) The protocol also specifies emission ceilings for individual EU-15 EU Member States. In some cases, the sum of these ceilings is different from the ceilings specified for the EU-15 as a whole.

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

The Gothenburg Protocol specified emission ceilings for three non-EU EEA member countries (Liechtenstein, Norway and Switzerland) for 2010 and onwards (UNECE, 1979, 1999). Liechtenstein has signed but not yet ratified the protocol. EEA members, Iceland and Turkey, have not yet signed the Gothenburg Protocol. Emission data for Iceland, Norway, Switzerland and Turkey are the latest reported data under the LRTAP Convention (2020 submission round).

Data from the abovementioned countries show that, from 2010 to 2018, Norway exceeded its NO_X and NH_3 ceilings. Switzerland exceeded its ceilings for NO_X from 2010 to 2013 (see Table ES.4).

Actions and recommendations for better-quality data

Although reporting has become more complete in recent years, a number of data gaps remain in the official data sets received from EU Member States and the United Kingdom. Thus, the completeness of submissions can be further improved, particularly for historical data for 1990-2000 and for certain pollutants such as HMs and POPs. To compile as complete an EU inventory as possible, missing emission data are gap filled as far as is feasible (for details see Section 1.4.5).

This report also includes several recommendations that may further improve the quality of the EU inventory in the future. EU Member States should submit complete inventories and use proper notation keys, for instance where values are not available. They should recalculate emission data for past years when new methods or new scientific knowledge become available. In this context, EU Member States are recommended to review and apply the information contained in the updated *EMEP/EEA air pollutant emission inventory guidebook — 2019* (Inventory guidebook for short; EMEP/EEA, 2019) when compiling their emission inventory data sets.

EU Member States are encouraged to consider the findings of the annual quality checks performed by the EEA and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) and from 2019 onwards on Air Pollution, Transport, Noise and Industrial Pollution (ETC/ATNI) during the compilation of the EU inventory. Where necessary, they can either resubmit inventory data (in the new format for reporting of air pollutants — NFR19) or update next year's inventory to reflect new insights gained or errors identified. In 2020, several EU Member States and the United Kingdom were contacted by the EEA regarding potential errors identified by the quality assurance and quality control QA/QC procedure.

Table ES.4 Progress by non-EU EEA member countries in meeting Gothenburg Protocol emission ceilings for 2010 and the years thereafter

Member State	NO_x									NMVOCs								
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010	2011	2012	2013	2014	2015	2016	2017	2018
Norway	×	×	×	×	×	×	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Switzerland	×	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Member State	**SO_2**									**NH_3**								
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010	2011	2012	2013	2014	2015	2016	2017	2018
Norway	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×	×	×	×
Switzerland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes: ✓ indicates that the final (2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017) or provisional (2018) emission data reported by a country either meet or fall below its respective emission ceiling.

× indicates that a ceiling has been exceeded.

1 Introduction

The European Commission provides this report and its accompanying data (on behalf of the EU ([7])) as an official submission to the UNECE secretariat for the Executive Body of the Convention on Long-range Transboundary Air Pollution (LRTAP).

The report covers the following subjects: the formal institutional arrangements that underpin the EU's emission inventory, the inventory preparation process, methods and data sources, key category analyses, information on quality assurance (QA) and quality control (QC), general uncertainty evaluation, general assessment of completeness and information on underestimations (see Chapter 1); adjustments under the Gothenburg Protocol (Chapter 2); emission trends and the contribution of key categories to total emissions (Chapter 3); sectoral analysis and emission trends for key pollutants (Chapter 4); and information on recalculations and planned improvements (Chapter 5).

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

main pollutants:

- nitrogen oxides (NO_X)
- non-methane volatile organic compounds (NMVOCs)
- sulphur oxides (SO_X)
- ammonia (NH_3)
- carbon monoxide (CO);

particulate matter (PM):

- PM with a diameter of 10 µm or less (PM_{10})
- fine PM with a diameter of 2.5 µm or less ($PM_{2.5}$)
- total suspended particulates (TSPs)
- black carbon (BC);

priority heavy metals (HMs):

- lead (Pb)
- cadmium (Cd)
- mercury (Hg);

additional HMs:

- arsenic (As)
- chromium (Cr)
- copper (Cu)
- nickel (Ni)
- selenium (Se)
- zinc (Zn);

persistent organic pollutants (POPs):

- polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDD/Fs)
- polycyclic aromatic hydrocarbons (PAHs)
- hexachlorobenzene (HCB)
- polychlorinated biphenyls (PCBs);

additional reporting of PAHs:

- benzo(a)pyrene (B(a)P)
- benzo(b)fluoranthene (B(b)F)
- benzo(k)fluoranthene (B(k)F)
- indeno(1,2,3-cd)pyrene (IP).

([7]) The United Kingdom left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020. This report refers for 2018 to the air pollutant emission totals of the EU-27 plus the emissions of the United Kingdom, i.e. the EU-28.

Emission estimates are not always available for all pollutants every year, because there are gaps in the data reported in 2020 by the EU Member States and the United Kingdom. A gap-filling process was developed in 2010 for compiling the EU inventory and was refined in 2011 and 2017 (see Section 1.4.5). Nevertheless, for certain pollutants (additional HMs, BC, individual PAHs), some EU Member States did not report data for any year, which made it impossible to apply such gap-filling techniques. Thus, for these pollutants, the EU total remains incomplete.

Several annexes accompany this inventory report:

- Annex A provides a copy of the EU's formal LRTAP Convention data submission for 1990-2018 in the required United Nations Economic Commission for Europe (UNECE) format for reporting of air pollutants (NFR19).
- Annex B provides the updated EU NO_X emission data for 1987-1989, as required by the 1988 NO_X protocol of the LRTAP Convention.
- Annex C provides results of the key category analyses (KCAs) for the EU, showing the main emitting sectors for each pollutant.
- Annex D presents the EU's gap-filled inventory, colour-coded for the different data sources used and the various additional gap-filling methods applied.
- Annex E provides EU Member States' projections for NO_X, NMVOCs, SO_X, NH_3, $PM_{2.5}$ and BC emissions for 2020, 2025, 2030, 2040 and 2050.
- Annexes F to I present the EU's LRTAP Convention data submission for 1990-2018, for the EU-9, EU-12, EU-15 and EU-27_2007 ([8]). Table A2.2 of Appendix 2 provides information on the country groupings.
- Annex J gives an overview of the sources of data on emissions of the individual pollutants used when compiling the 2020 EU inventory.
- Annex K provides an overview of the completeness of the gap-filled inventory concerning the notation key 'NE' (not estimated).

1.1 Background

The EU ratified the UNECE's LRTAP Convention (UNECE, 1979) in 1982. Since 1984, eight protocols have come into force. Table 1.1 presents the ratification status of each protocol across the EU as a whole. The status differs across EU Member States.

On 4 May 2012, the Executive Body for the UNECE LRTAP Convention adopted amendments to the Gothenburg Protocol. Now the protocol's text includes national emission reduction commitments for the major air pollutants NO_X, NMVOCs, SO_X and NH_3, as well as for $PM_{2.5}$ (and BC as a component of PM). Countries are to achieve them in 2020 and beyond. For the EU, the emission reduction commitments from 2005 levels for 2020 and beyond are (UNECE, 2012b):

- -59 % for sulphur dioxide (SO_2)
- -42 % for NO_X
- -6 % for NH_3
- -28 % for NMVOCs
- -22 % for $PM_{2.5}$.

The EU ratified the amended Gothenburg Protocol on 30 August 2017.

The Executive Body of the LRTAP Convention adopted revised *Guidelines for reporting emissions and projections data under the Convention on Long-range Transboundary Air Pollution* (reporting guidelines) at its 32nd session, in March 2014 (UNECE, 2014a). Parties were to apply them in 2015 and subsequent years. A summary of the reporting requirements is presented in Appendix 2.

The deadline for individual Parties to submit data to the LRTAP Convention is 15 February each year. There is a separate deadline of 15 March for submitting the accompanying inventory reports. The reporting guidelines specify separate reporting dates for the EU. They allow time to compile an aggregated inventory based on the individual submissions from EU Member States. The EU should submit EU inventory data to the Executive Secretary of UNECE by 30 April each year, and the accompanying inventory report by 30 May. The reporting guidelines also request that Parties report

([8]) EU-27_2007 refers to the EU Member States without Croatia. The United Kingdom left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020. From 2021 onwards, EU-27_2020 will refer to the EU Member States without the United Kingdom.

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

Year	LRTAP Convention and its protocols	Ratification status
1979	'Geneva Convention': Convention on Long-range Transboundary Air Pollution (UNECE, 1979)	Signed and ratified (approval)
1984	'Geneva Protocol': Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (UNECE, 1984)	Signed and ratified (approval)
1985	'Helsinki Protocol': Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent (UNECE, 1985)	Not signed
1988	'Sofia Protocol': Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes (UNECE, 1988)	Ratified (accession)
1991	'Geneva Protocol': Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes (UNECE, 1991)	Signed
1994	'Oslo Protocol': Protocol on Further Reduction of Sulphur Emissions (UNECE, 1994)	Signed and ratified (approval)
1998	'Aarhus Protocol': Protocol on Persistent Organic Pollutants (UNECE, 1998a)	Signed and ratified (approval)
1998	'Aarhus Protocol': Protocol on Heavy Metals (UNECE, 1998b)	Signed and ratified (approval)
1999	'Gothenburg Protocol': Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (UNECE, 1999)	Ratified (accession)
2012	Amendments to the Gothenburg Protocol (UNECE, 2012b)	Ratified (acceptance)

emission inventory data using the new European Monitoring and Evaluation Programme (EMEP) NFR19 format.

In 2012, the Executive Body of the LRTAP Convention decided that adjustments to emission reduction commitments, or to inventories for the purpose of comparing them with total national emissions, may be applied in certain circumstances, if such a circumstance keeps a Party from meeting one of its reduction commitments (UNECE, 2012a; see also Chapter 2).

The EMEP Steering Body reviews any supporting documentation and assesses whether or not the adjustment is consistent with the circumstances and guidance for adjustments (UNECE, 2012c). It makes the review available to the Parties, which have the option of making a submission to the Implementation Committee under Decision 2006/2 (UNECE, 2006).

In 2014, the EMEP Steering Body accepted inventory adjustment applications for emissions from Denmark and Germany; in 2015, from Belgium, Denmark, Finland, France, Germany, Luxembourg and Spain; in 2016, from Germany and Luxembourg; in 2017, from Spain; in 2018, from Hungary and the United Kingdom; and in 2019, from the Netherlands (UNECE, 2014b, 2015, 2016, 2017, 2018, 2019).

More information and the adjusted emission data can be found in Chapter 2.

1.2 Institutional arrangements

1.2.1 EU Member States

EU Member States are responsible for selecting the activity data, emission factors and other parameters used for their national inventories. EU Member States should also follow the reporting guidelines (UNECE, 2014a) and apply the methodologies in the latest version of the EMEP/EEA Inventory guidebook (EMEP/EEA, 2019).

EU Member States are also responsible for establishing QA and QC programmes for their inventories. Each inventory report should include a description of the QA and QC activities and recalculations.

EU Member States submit their national LRTAP inventories and inventory reports by participating in Eionet (European Environment Information and Observation Network) (see Section 1.2.2 below). In addition, they take part in the annual review and commenting phase of the draft EU inventory report. EU Member States check their national data

and information used in the inventory report and, if necessary, send updates. They also provide general comments on the inventory report.

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

European Environment Agency

The EEA helps the European Commission's Directorate-General (DG) for Environment to compile the annual EU LRTAP inventory.

EEA activities include:

- overall coordination and management of the inventory compilation process;
- coordinating the activities of the EEA's European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution (ETC/ATNI) ([9]), which checks the data, compiles the inventory and writes the draft report;
- communication with the European Commission;
- communication with EU Member States;
- circulation of the draft EU emission inventory report;
- hosting the official inventory database and disseminating the data and inventory report on the web.

Since 2004, the EEA and EMEP have supported a separate annual quality review of emission data submitted by the countries. It provides findings for the countries each year to improve the quality of the emission data reported. Each year, EMEP publishes a joint report summarising the review's findings. Section 1.7 below provides further details of the annual data review process.

European Commission

The European Commission formally submits the EU emission inventory data and this informative inventory report (IIR) to EMEP via the Executive Secretary of UNECE.

European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution

The main activities of the ETC/ATNI ([10]) regarding the EU's LRTAP Convention emission inventory include:

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

European Environment Information and Observation Network

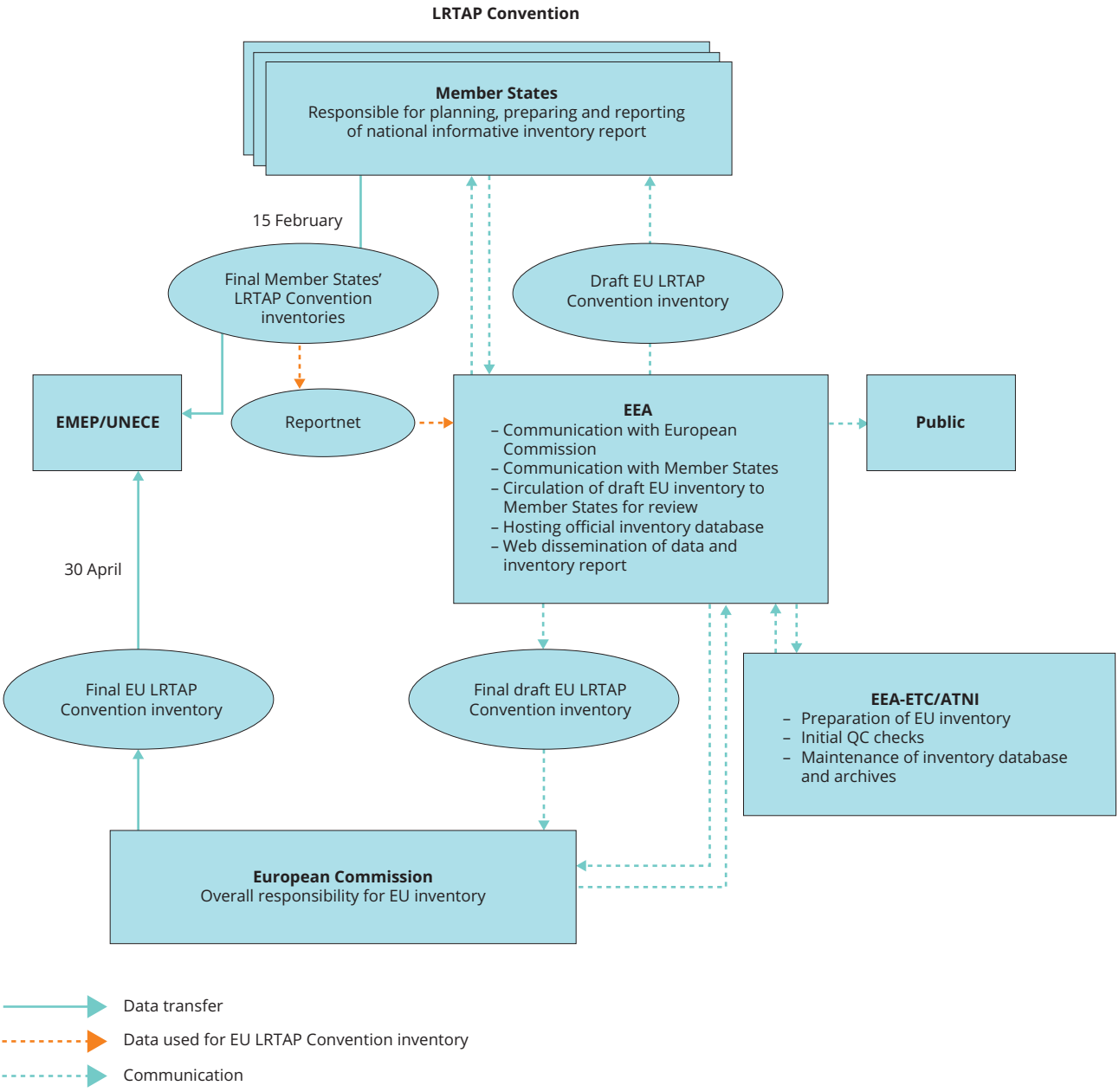
Eionet facilitates the work of the EEA and the respective ETC (EU, 1999) ([11]). It comprises the EEA (supported by its European topic centres) and a supporting network of experts from national environment agencies and other bodies that deal with environmental information (Eionet, 2020a). EU Member States are requested to use the tools of the Central Data Repository (CDR) (Eionet, 2020b) of the Eionet Reportnet to make their LRTAP Convention submissions available to the EEA.

1.3 Inventory preparation process

The basis of reporting for individual EU Member States and for the EU is the LRTAP Convention (UNECE, 1979), its protocols (Table 1.1) and subsequent decisions taken by the Executive Body. The reporting guidelines describe the data that Parties should report under the LRTAP Convention and its protocols. Under the agreement between Eionet countries and the EEA concerning priority data flows, EU Member States are

([9]) The current ETC/ATNI started its operations on 1 January 2019. Until the end of 2018, the EEA cooperated with the ETC on Air Pollution and Climate Change Mitigation (ETC/ACM).
([10]) The current ETC/ATNI was established in 2018 via a contract between the EEA and the lead organisation, the Stiftelsen Norsk Institutt for Luftforskning (Norwegian Institute for Air Research, NILU), and started its operations on 1 January 2019. It works with nine organisations and institutions across eight European countries.
([11]) A brochure describing the structure, working methods, outputs and activities of Eionet is available (EEA, 2012).

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



requested to post a copy of their official submission to the LRTAP Convention in the CDR by 15 February each year. The ETC/ATNI subsequently collects the data from the CDR, performs a QA and QC analysis, compiles the gap-filled EU LRTAP Convention emission inventory database and produces an EU LRTAP Convention emission inventory and inventory report. The European Commission formally submits the EU's emission inventory data and IIR to EMEP through the Executive Secretary of UNECE. The inventory and accompanying documentation are then made publicly available through the EEA's website (see summary in Figure 1.1).

1.4 Methods and data sources

1.4.1 Reporting obligations under the National Emission reduction Commitments Directive and the EU Greenhouse Gas Monitoring Mechanism

EU Member States report their emissions of NO_x, NMVOCs, SO_2, NH_3, CO, PM, BC, HMs and POPs under Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC (EU, 2016b). The 2016 National

Emission reduction Commitments (NEC) Directive, which entered into force on 31 December 2016, sets emission reduction commitments for five main air pollutants for 2020-2029 and 2030 onwards. The reduction commitments agreed for 2030 onwards are more ambitious and designed to reduce the health impacts of air pollution by half compared to 2005.

EU Member States also report emissions of NO_X, SO_2, NMVOCs and CO under EU Regulation No 525/2013, known as the EU Greenhouse Gas Monitoring Mechanism Regulation (MMR) (EU, 2013). EU Member States should also copy this information to the CDR (Eionet, 2020b). Table 1.2 provides an overview of the various reporting obligations for EU Member States.

Reporting obligations under the LRTAP Convention and NEC Directive have been harmonised since the adoption of the updated reporting guidelines (UNECE, 2014a) and the revision of the NEC Directive (EU, 2016b). Minor differences still occur between reporting under the LRTAP Convention and the NEC Directive:

- Reporting of emission data for B(a)P, B(b)F, B(k)F and IP is voluntary under the LRTAP Convention but is obligatory under the NEC Directive.
- Under the LRTAP Convention, Parties are invited to report their emissions for the EMEP domain. For Portugal, this means that emissions from the Azores and Madeira are included. This differs from reporting under the NEC Directive, for which the Azores and Madeira are excluded.
- Under the NEC Directive, some emissions are not counted for the purpose of compliance (see Directive 2016/2284/EU, Article 4(3)).
- While reporting of projections is required biennially under the NEC Directive, it is only obligatory every 4 years under the LRTAP Convention.

The NEC Directive and LRTAP Convention reporting obligations differ from the United Nations Framework Convention on Climate Change (UNFCCC) obligations by including domestic and international aviation and navigation in the reported national totals. Table 1.3 summarises the main differences between the reporting instruments, the overall impact of which is small for most EU Member States.

Under the LRTAP Convention, the EU may deliver its emission and projections report by 30 April, its IIR by 30 May, and its gridded data and large point source (LPS) data by 15 June.

1.4.2 General methods

The EU LRTAP Convention emission inventory is based on an aggregation of data reported by EU Member States. The methods that they use should follow those described in the Inventory guidebook (EMEP/EEA, 2019). Overall, EU Member States do follow this recommendation, which ensures that they use the best methods available to estimate national emissions and that inventories are improved continuously. Moreover, the technical review procedures set up by the EMEP CEIP check and assess Parties' data submissions, as per the review guidelines. The aim is to improve the quality of emission data and associated information reported to the LRTAP Convention.

The recommended structure for an IIR involves a general description of the methodologies and data sources

Table 1.2 Overview of air emission-reporting obligations in the EU, 2020

Legal obligation	Emissions to report	Annual reporting deadline for EU Member States	Annual reporting deadline for the EU [a]
LRTAP Convention [b]	NO_X (as nitrogen dioxide — NO_2), NMVOCs, SO_X (as SO_2), NH_3, CO, HMs, POPs and PM	15 February 2020	30 April 2020
NEC Directive	NO_X (as NO_2), NMVOCs, SO_X (as SO_2), NH_3, CO, HMs, POPs and PM	15 February 2020	Not applicable
EU MMR/United Nations Framework Convention on Climate Change (UNFCCC)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride, NO_X, CO, NMVOCs and SO_2	15 January 2020 to the European Commission and 15 April 2020 to the UNFCCC	15 April 2020

Notes: [a] Over the years, the European Community and the EU have signed a number of protocols. The commitments include varying numbers of EU Member States. Therefore, emissions must be reported separately for the EU-9, EU-12, EU-15, EU-27_2007 and EU-28 (see Table A2.2 in Appendix 2 for more information on EU country groupings).

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

Table 1.3 Comparison of air pollutant reporting obligations: the LRTAP Convention, NEC Directive and UNFCCC/MMR

Reporting item	NEC	LRTAP	UNFCCC/MMR
Domestic aviation (LTO)	Incl.	Incl.	Incl.
Domestic aviation (cruise)	Not incl.	Not incl.	Incl.
International aviation (LTO)	Incl.	Incl.	Not incl.
International aviation (cruise)	Not incl.	Not incl.	Not incl.
National navigation (domestic shipping)	Incl.	Incl.	Incl.
International inland shipping	Incl.	Incl.	Not incl.
International maritime navigation	Not incl.	Not incl.	Not incl.
Road transport (fuel sold) ([a])	Incl.	Incl.	Incl.

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

([a]) In addition, Parties may also report emission estimates based on fuel used as an additional 'memo item'. Austria, Belgium, Ireland, Lithuania, Luxembourg, the Netherlands, Switzerland and the United Kingdom may choose to use the national emission total calculated on the basis of fuel used in the relevant geographical area as a basis for compliance (UNECE, 2014a).

LTO, landing/take-off; Incl., included in national totals; not incl., not included in national totals: memo item.

used. This includes an overview of the emission factors used in the national inventory — country specific or default — given in the Inventory guidebook (EMEP/EEA, 2019) and the specification of the sources of default emission factors and methods. It also provides a detailed description of activity data sources where data differ from national statistics. The following two subsections summarise the information that EU Member States provide in their IIRs. This should help readers to understand the basis of the EU inventory. For detailed descriptions of methodologies and data sources, see EU Member States' IIRs (see Appendix 5 for IIR references).

1.4.3 Data sources

The data source for the EU inventory is EU Member States' emission inventories. The IIRs should document detailed information on the data sources used by EU Member States. The level of detail varies widely across EU Member States, although the main data sources are official national statistics. Table 1.4 summarises data sources commonly used for the various sectors.

Sources for emission factors vary according to the tier method used. One main source is the Inventory guidebook (EMEP/EEA, 2019), but emission factors can also be country or even plant specific. It is impossible to survey the emission factors used by the EU Member States for all emission sources, as this information is not uniformly available: some countries report details of their methodologies, while others do not. Detailed information is available in EU Member States' IIRs; see Appendix 5.

Table 1.4 Data sources commonly used for inventory sectors

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

1.4.4 Comparison of EU Member States' emissions calculated on the basis of fuel sold versus fuel consumed in road transport

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

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

Parties can estimate transport emissions using the amount of fuel sold within the country or the amount of fuel consumed. When fuel purchased within a country is used outside that country (and vice versa), these estimates can differ significantly. The EU inventory compiled in 2020 estimates emissions from road transport based on the fuel sold for all EU Member States.

1.4.5 Data gaps and gap filling

Ideally, there should be no need to fill gaps in the inventory data reported, as it is the responsibility of EU Member States to submit full and accurate inventory data sets. However, EU Member States' submissions include various data gaps for particular pollutants or years in the time series. Frequently, whole national inventories, emissions of some pollutants or sectoral emission data are missing.

The EMEP reporting guidelines (UNECE, 2014a) require that submitted emission inventories are complete. In 2020, the gap-filling procedure is identical to that in 2019 and follows a methodology paper by the EEA and the ETC/ACM (EEA, 2009) and some changes agreed at the meeting of the Task Force on Emission Inventories and Projections (TFEIP) in 2016 ([12]). This procedure is also consistent with the techniques used to fill emission data gaps proposed by the Inventory guidebook (EMEP/EEA, 2019). It applies a stepwise approach using emission data from other reporting obligations to fill gaps in the national data sets, followed by further gap-filling procedures such as inter- or extrapolation and manual changes. For further information on the gap-filling procedure, please see Box 1.1.

However, gap filling is applied only where national total and sectoral data are unavailable or where a national total was available but there were no sectoral data. In the former instance, sectors were first gap filled and then summed to determine the total. In the latter instance, the sectoral split of the previous or following year was used to fill the gaps. If a national total was available, but the sectoral data were incomplete, no gap filling was carried out. For BC, additional HMs, B(a)P, B(b)F, B(k)F and IP, some EU Member States lacked data for all years, making gap filling impossible. In such instances, the EU emission totals for these pollutants are considered incomplete (i.e. they are underestimated). Furthermore, inventories cannot be considered complete if the notation keys 'NE' (not estimated) and in some cases 'NR' (not relevant), or the value 0, are reported or are used for gap filling. For further information on the effect of gap filling on the EU inventory, see Section 1.9, Figure 1.5 and Figure 1.6.

Annex J shows how the various officially reported data sets were used to supplement the LRTAP Convention data submissions for those EU Member States where gap filling was required. Annex D offers a more detailed overview, showing each Member State for which data were gap filled and how this was performed. The trend tables in Chapter 3 (Table 3.6 to Table 3.31) also provide an initial overview, indicating which data have been derived by gap filling. One Member State (Malta) did not provide a complete time series in 2020. Malta indicated that it is currently working on the submission of a full time series for 2021 (Personal communication by Malta, 2020).

([12]) TFEIP/Eionet meeting and workshop, 16-18 May 2016 in Zagreb.

Box 1.1 Unified LRTAP gap filling for EU and EMEP inventories (ETC/ACM, 2015)

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

1. Emission trends for all pollutants have been compiled from 1990 onwards, using the Convention on Long-range Transboundary Air Pollution (LRTAP Convention) emission inventories provided by the EU Member States to the EEA in 2019.

2. LRTAP Convention data submitted to the European Monitoring and Evaluation Programme (EMEP) Centre on Emission Inventories and Projections (CEIP) in 2019 are the next source used to fill remaining gaps. All reported data (i.e. values and notation keys) are used. In fact, there should be no difference between the EU Member States' LRTAP Convention emission inventories provided to the EEA and the data submitted to the EMEP CEIP.

3. For those EU Member States not reporting complete data, emission data officially reported in the current reporting year by EU Member States under the EU Greenhouse Gas Monitoring Mechanism Regulation (MMR) are used to fill gaps. In this step, notation keys are not used.

4. Next, emission data reported officially by EU Member States under the 2016 National Emission Ceilings (NEC) Directive in the current reporting year are used to fill gaps. In this step, notation keys are not used.

5. In a further step, notation keys reported in the current reporting year by EU Member States under the MMR are used to fill any remaining gaps.

6. Subsequently, notation keys reported in the current reporting year by EU Member States under the NEC Directive are used to fill any remaining gaps.

7. Next, Member State LRTAP Convention emission inventories provided to the EEA in previous years are used to fill any gaps still remaining (values and notation keys).

8. Older LRTAP Convention data submitted to the EMEP CEIP are the next source of official information used to fill gaps (values and notation keys).

9. The gap filling continues with emission data reported in previous years under the MMR (values and notation keys).

10. For all remaining cases of missing data, further gap-filling procedures are applied:

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

    (b) Linear extrapolation is performed if one or several years are missing, either at the beginning or at the end of a time series, and if at least 5 consecutive years showing a clear trend ($r2 \geq 0.6$) are available. Extrapolation 'backwards' is never allowed to result in negative values.

    (c) If fewer than 5 consecutive years are available as a basis for extrapolation, or if years do not show a clear trend (as is the case when $r^2 < 0.6$), the value of the previous or next year is used to fill the gaps.

    (d) If the notation key 'NA' (not applicable) or 'NO' (not occurring) is used as a basis for gap filling, it is treated as '0' and is not gap filled.

    (e) When both national total and sectoral data are unavailable, sectors are first gap filled and then summed to determine the total.

    (f) When the national total is available but there are no sectoral data, the sectoral split of the previous or following year is used to fill the gaps.

11. After this automated gap-filling procedure, some manual corrections are made to the gap-filled data in all cases in which total suspended particulate (TSP) emissions are lower than particulate matter with a diameter of 10 µm or less (PM_{10}) emissions, PM_{10} emissions are lower than PM with a diameter of 2.5 µm or less ($PM_{2.5}$) emissions, or $PM_{2.5}$ emissions are lower than black carbon (BC) emissions. In these cases, PM_{10} data are equated with TSP data, $PM_{2.5}$ data with PM_{10} data, and BC data with $PM_{2.5}$ data.

1.5 Reporting

1.5.1 Emission reporting

The deadline for EU Member States to report by was 15 February 2020. In the 2020 reporting cycle, 24 EU Member States submitted their inventories and time series on time. Hungary, Italy, Malta and the Netherlands submitted their data after the formal deadline for submission (see Appendix 3, Figure A3.1). One Member State did not provide a complete time series in 2020 (Malta). All 28 EU Member States that submitted data used the new NFR19 reporting templates. Appendix 3 presents detailed information on EU Member States' submissions.

1.5.2 Projection data

In 2020, reporting of projection data was voluntary, and the deadline for EU Member States to report by was 15 March 2020. Four EU Member States have submitted information on their projections so far, three of them before the deadline. Submitted data are available in Annex E of this report.

1.5.3 Gridded data

According to the revised reporting guidelines, Parties within the geographical scope of EMEP should report gridded data in the resolution of 0.1 ° × 0.1 ° longitude-latitude every 4 years, starting in 2017. Since gridded data for the EU were last submitted in 2017 (EEA, 2017), they are not reported this year. However, in 2020, eight EU Member States (Bulgaria, Estonia, Finland, Ireland, Lithuania, Malta, Poland and Spain) provided gridded data (see Appendix 3, Table A3.1).

1.5.4 Large point sources

Parties within the geographical scope of EMEP are also required to provide data on LPSs every 4 years, commencing in 2017. LPS data for the EU were last submitted in 2017 (EEA, 2017) and did not have to be reported this year. In 2020, six EU Member States (Czechia, Finland, Italy, Lithuania, Romania and Spain) have provided LPS data.

1.5.5 Reporting on condensable components from $PM_{2.5}$ and PM_{10}

PM consists of a filterable fraction and a condensable fraction, which reacts upon cooling and dilution, shortly after release, to form solid or liquid PM. The reporting of condensable components is not mandatory, and in recent years there has been no clear distinction as to whether PM emission reporting includes or excludes the condensable component. However, in 2019, a new reporting table within Annex II to the reporting guidelines (EMEP CEIP, 2020a), Table A6.1, 'Inclusion/exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors', was established. In 2020, 18 EU Member States have provided information using this table. Finland and the Netherlands have not provided information using this table but have reported information on condensable components in their IIRs. The level of information is rather inhomogeneous and for many categories no information is available at all.

1.6 Key category analyses

A key category is an emission source category that has a significant influence on an inventory. It may affect the absolute level of emissions, the trend in emissions or both. This report classifies categories jointly responsible for 80 % of the national total emissions of a given pollutant as key categories (see EMEP/EEA,2019).

A level analysis of 2018 emissions for each pollutant (following any necessary gap filling) determined EU key categories. When a Member State used the notation 'IE' (included elsewhere) for a particular source/pollutant combination, the KCA is likely to have underestimated the category concerned and overestimated the one in which emissions were reported instead.

Chapter 3 provides a summary of the top five EU key categories in 2018, for NO_X, NMVOCs, SO_X, NH_3, $PM_{2.5}$, PM_{10}, BC, CO, HMs (Pb, Cd and Hg) and POPs (PCDD/Fs, total PAHs, B(a)P, HCB and PCBs). A complete list of all EU key categories for the emissions of these pollutants is also given in Figure 1.2. Additional HMs, TSPs or the remaining POPs are not considered here.

A total of 57 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 16 pollutants assessed. '1A4bi — Residential: Stationary' and '1A1a — Public electricity and heat production' were identified as being important emission sources for 15 and 11 pollutants, respectively. The categories '1A2f — Stationary combustion in manufacturing industries and construction: Non-metallic minerals', '1A3bi — Road transport: Passenger cars' and '2C1 — Iron and steel production' were key categories for eight pollutants, respectively, and the category '1A2gviii — Stationary combustion in manufacturing industries and construction: Other' was a key category for seven pollutants.

For NO_x and CO, 12 and 10 key categories were identified, respectively; as expected for both of these pollutants, the key categories with a large share of total emissions reported mainly involve fuel combustion. Ten key categories were identified for SO_x (mainly energy-related sectors) and six for NH_3 (all from the agriculture sector). PM_{10}, $PM_{2.5}$ and NMVOC emission sources are more diverse, so larger numbers of source categories make up the key category threshold of 80 % of total emissions. For the PM pollutants, key categories comprise all sectors, while a key aspect for NMVOCs was high activity levels associated with the industrial processes and product use sector.

For the HMs Cd and Hg, 12 key categories were identified, as were 10 for Pb. Emissions from these key categories were mostly related to the energy sectors and industrial processes and product use, resulting particularly from processes associated with metal production.

For the POPs, source categories from all sectors except 'non-road transport' were identified as key categories. On the whole, metal production was quite an important key source of POP emissions. However, emissions from 'Residential: Stationary' also contributed a large share of emissions from many of the POPs.

Several factors may influence the determination of key categories at EU level. The notation key 'IE' (see Appendix 1) means that a Member State can include emission estimates for one nomenclature for reporting (NFR) sector in those of a different sector. In addition, EU Member States have different ways of allocating emissions to the (sub)sector 'other', which might lead to inconsistencies. Given such issues, the EU KCA may not always accurately reflect the share of all main emission sources. It is also crucial to note that the results of a similar analysis of individual EU Member States will differ from the key sources determined for the EU.

1.7 Quality assurance, quality control and verification methods

EU Member States are encouraged to use appropriate QA and QC procedures to ensure data quality and to verify and validate their emission data. These procedures should be consistent with those described in the Inventory guidebook (EMEP/EEA, 2019).

The main activities improving the quality of the EU inventory, which is based on quality-assured data officially reported by the EU Member States, are the checks that the EEA's ETC/ATNI performs on the status of each Member State's submission. Since the emission inventories reported under LRTAP and the NEC Directive are almost the same, checks are compared with those run by the EEA under the NEC Directive.

In addition, ETC/ATNI checks the internal consistency of EU Member States' data tables before compiling the EU tables. The ETC checks Member State data at national total and sectoral levels: when it finds outliers, it identifies the categories responsible. When the ETC does not find any explanation for a notable trend in a country's IIR, it contacts the respective Member State or the United Kingdom. The checks focus on data that significantly affect EU trends. An overview of the checks performed is given in Table 1.5 and an overview of the findings in Table 1.6.

EU Member States also provide external checks through an Eionet review, before the EU submits the final version of the EU inventory to the LRTAP Convention secretariat. In addition, an important element in improving the quality of national and EU LRTAP Convention inventories is the annual meeting of the TFEIP. This expert meeting discusses quality issues concerning EU Member States' emission reporting. Due to the current situation in the wake of COVID-19 the meeting was held in the form of a web conference from the 11th to the 14th May 2020 (TFEIP, 2020).

The agreed gap-filling procedure is one of the instruments used to ensure and improve the quality of the EU inventory. It analyses and, where possible, fills gaps in reporting of sectoral emissions and total emissions for any year. This improves the key features of completeness, comparability and consistency over the years and motivates EU Member States to report their data in the following reporting cycle (further details on gap filling are available in Section 1.4.5).

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

The EMEP CEIP performs more detailed QA activities in an annual review process (EMEP CEIP, 2020b). It reviews Member State LRTAP Convention emission inventories at the same time as the European Commission, assisted by the EEA, reviews those reported under the NEC Directive (EU, 2016b). The EMEP CEIP technical review of inventories is carried out in three stages. Stages 1 and 2 include checks on timeliness, formats, consistency, accuracy, completeness and comparability of existing Member State inventory submissions. Test results, provided to EU Member States or to the EU as a whole, are used to improve the quality of the national emission inventories. Each year, a joint EMEP/EEA

Figure 1.2 EU KCA results for 2018

Note: Bubble size indicates amount of emissions in percent (%).

All values > 5 % are indicated. For NFR codes, see the list of source sector abbreviations (Appendix 4).

Table 1.5 Overview of quality checks during the preparation of the EU LRTAP inventory and report

	Check											
	Completeness	Consistency	Comparability	Accuracy	Transparency	level	years	First checks	Sub-sequ-ent checks (after gap-filling)	Checks within the draft report	Member States will be informed on the finding	changes/ corrections
Reporting overview	✓		✓		✓	Submissions	1990-2018	×			if submission is missing or in wrong format	gap-filling of missing data as far as possible
Adjustment overview	✓		✓		✓	Submissions	2010-2018	×			if a document is missing or in wrong format	
Completeness	✓				✓	Submissions	1990-2018	×			yes	only in case of resubmissions of the Member State
Time series checks	✓	✓				National Totals, Sectors	1990-2018	×			yes	only in case of resubmissions of the Member State
NFR template line 144 check			✓		✓	National Totals	1990-2018	×			yes	only in case of resubmissions of the Member State
Total PAHs = Sum of PAHs				✓		National Totals	1990-2018	×			yes	only in case of resubmissions of the Member State
TSP-PM_{10} ratio, PM_{10}-$PM_{2.5}$ ratio checks				✓		National Totals	1990-2018	×			yes	only in case of resubmissions of the Member State
TSP ≥ PM_{10}, PM_{10} ≥ $PM_{2.5}$, $PM_{2.5}$ ≥ BC checks				✓		National Totals, Categories	1990-2018	×			yes	only in case of resubmissions of the Member State
National Total = Sum of Sectors	✓			✓		National Totals, Sum of Sectors	1990-2018		×		if difference is more than 5 %	only in case of resubmissions of the Member State
'NE' analysis	✓					National Totals, Categories	2018		×	×	within the review of the draft version of the report	only in case of resubmissions of the Member State
'NA' and 'NO' checks				✓	✓	National Totals, Categories	2018		×		yes	only in case of resubmissions of the Member State
Recalculations		✓				National Totals	1990-2017			×	within the review of the draft version of the report	no
Effect of gap-filling	✓				✓	Whole EU inventory	1990, 2018			×	within the review of the draft version of the report	no
Completeness of the EU inventory	✓				✓	Whole EU inventory	1990, 2018			×	within the review of the draft version of the report	no

Table 1.6 Findings of the quality checks during preparation of the EU LRTAP inventory and report in 2020

Test/check	Findings	Number of EU Member States concerned
Completeness	1	1
Time series checks	149	26
NFR template line 144 check	3	2
Total PAHs = sum of PAHs	13	9
TSP:PM_{10} ratio, PM_{10}:$PM_{2.5}$ ratio checks	3	3
TSP ≥ PM_{10}, PM_{10} ≥ $PM_{2.5}$, $PM_{2.5}$ ≥ BC checks	50	19
National total = sum of sectors ([a])	0	0
'NE' analysis ([a])	655	27
'NA' and 'NO' checks ([a])	188	24

Notes: ([a]) The check was performed on the gap-filled EU inventory.
NA, not applicable; NO, not occurring; NE, not estimated.

review report publishes summary results of the review (stages 1 and 2) ([13]).

Stage 3 is a technical in-depth review of selected countries. It checks if submitted emission inventories are complete, consistent over time, properly documented and accurate. The annual in-depth review aims to be consistent across the Parties. The process should ensure that the Parties follow the same approach each year. The CEIP selects the countries in cooperation with the EEA and EMEP. In 2019, it reviewed Albania, Georgia, Norway, Russia, Serbia and Turkey. The results are included in individual country-specific reports (EMEP CEIP, 2019c). In 2020, the CEIP plans to review the EU, North Macedonia, Iceland, Kazakhstan, Kyrgyzstan, Liechtenstein, Monaco and Switzerland.

1.8 General uncertainty evaluation

To quantify uncertainty in the EU LRTAP emission inventory, EU Member States first need to provide detailed information on emission uncertainties. Only 17 EU Member States (Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Latvia, the Netherlands, Poland, Spain, Sweden and the United Kingdom) provided detailed tables quantifying uncertainty in their 2018 emission inventories. Czechia and Lithuania mentioned uncertainties for certain categories on a basic level. The pollutants that they consider and the assumptions behind the uncertainty analysis vary across EU Member States. Because so few countries provide an uncertainty estimate, the overall uncertainty of the EU LRTAP inventory cannot be estimated.

1.9 Completeness and underestimations

In this context, completeness means that reports include estimates for all pollutants, all relevant source categories, all years and all territorial areas. For substances for which there are existing reporting obligations under the Convention and the protocols as further specified by Executive Body Decision 2013/4, (see Appendix 3), one Member State (Malta) did not provide a complete time series in 2020. Malta indicated that it is currently working on the submission of a full time series for 2021 (Personal communication by Malta, 2020). For substances and data for which reporting is encouraged, Austria and Luxembourg submitted no data for additional HMs. Finland does not report national totals for the additional heavy metal selene (Se), however, provides most of the sectoral data. Austria and Luxembourg did not report data for BC; Austria submitted data for total PAHs only and either no or insufficient data for all the individual components. Austria mentions in the IIR that individual PAH values will be included in the 2021 submission. All 28 EU Member States and the United Kingdom reported activity data ([14]), and 27 countries reported

([13]) EMEP and the EEA will jointly publish a summary of the results of the stages 1 and 2 review performed in 2020 (EMEP/EEA, forthcoming).
([14]) Activity data should be reported, together with emissions, from 2009 onwards (UNECE, 2009).

activity data for the complete time series (1990-2018). The stage 1 review provides detailed results for the completeness of Member State submissions (EMEP CEIP, 2020d).

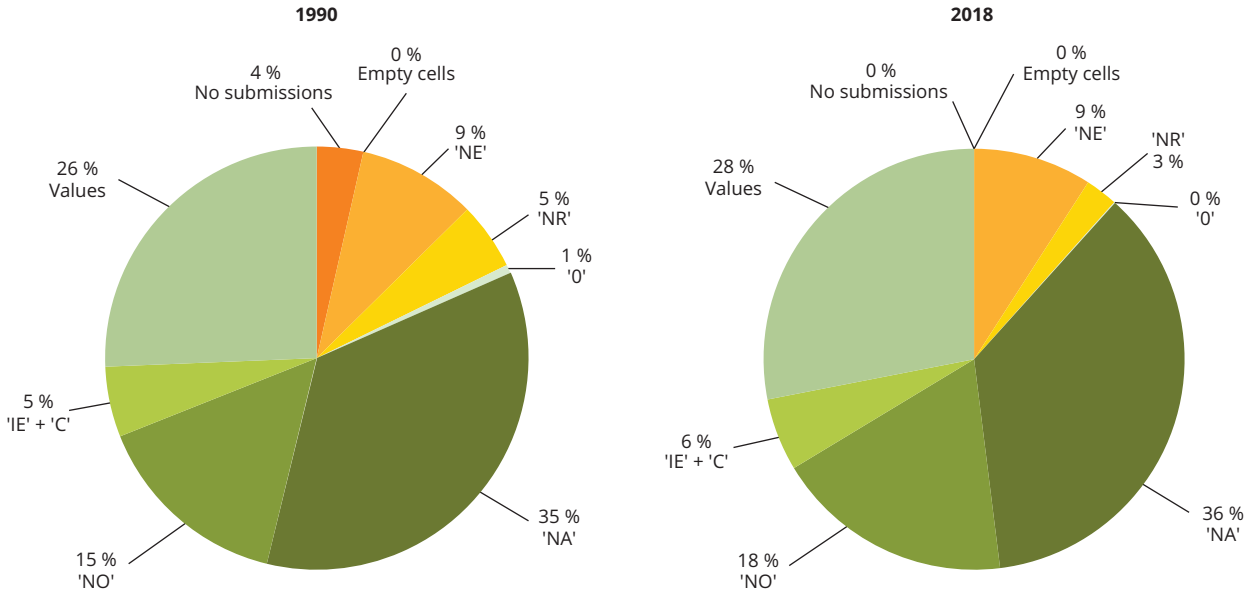
Figure 1.3 shows a simple compilation indicating the completeness of Member State reporting for the inventory years 1990 and 2018. It uses the NFR templates that were submitted originally, i.e. before gap filling. It gives the percentages of each notation key or values that the reports present for source categories. The data are for all EU Member States and all pollutants (excluding national totals). The figures show that more data are available for 2018 than for 1990. The notation key 'NA' (not applicable) appears often because an air pollutant is relevant only to specific emission sources (e.g. NH_3 for agriculture). This makes it necessary to use 'NA' for other sources. The use of the notation key 'NE', the reporting of empty cells, '0', and in some circumstances the reporting of the notation key 'NR' ([15]), as well as 'No submissions' and 'Empty cells', count as incomplete reporting. EU Member States and the United Kingdom reported 12 % of the 2018 data entries incompletely, while for 1990 they reported 17 % of the data incompletely.

The EMEP emission-reporting guidelines (UNECE, 2014a) require Parties to report data at least for the base year of the relevant protocol, and from the year it entered into force, and up to the latest year (2 years before the present) (see Appendix 2, Table A2.1). So, ideally, there should be no difference between the availability of data submissions for 1990 and for 2018.

There are many instances in which some countries report emissions for a particular NFR category and pollutant while others use the notation keys 'NA' or 'NO'. Annex K shows, for each Member State and the United Kingdom and for all categories, where data were reported, although 80 % or more of the other countries reported 'NA' or 'NO' (not occurring) for these categories.

The official reporting guidelines of the LRTAP Convention (UNECE, 2014a) allow countries to report emissions as 'NE' for some sectors. This is carried out where they know that emissions occur but have not estimated or reported them. Countries should report in their IIR why they have not estimated emissions.

Figure 1.3 Completeness of reporting of NFR templates submitted by EU Member States and the United Kingdom (all data entries for all pollutants, excluding national totals)



Notes: Appendix 1 provides further explanations on notation keys.

C, confidential; NO, not occurring.

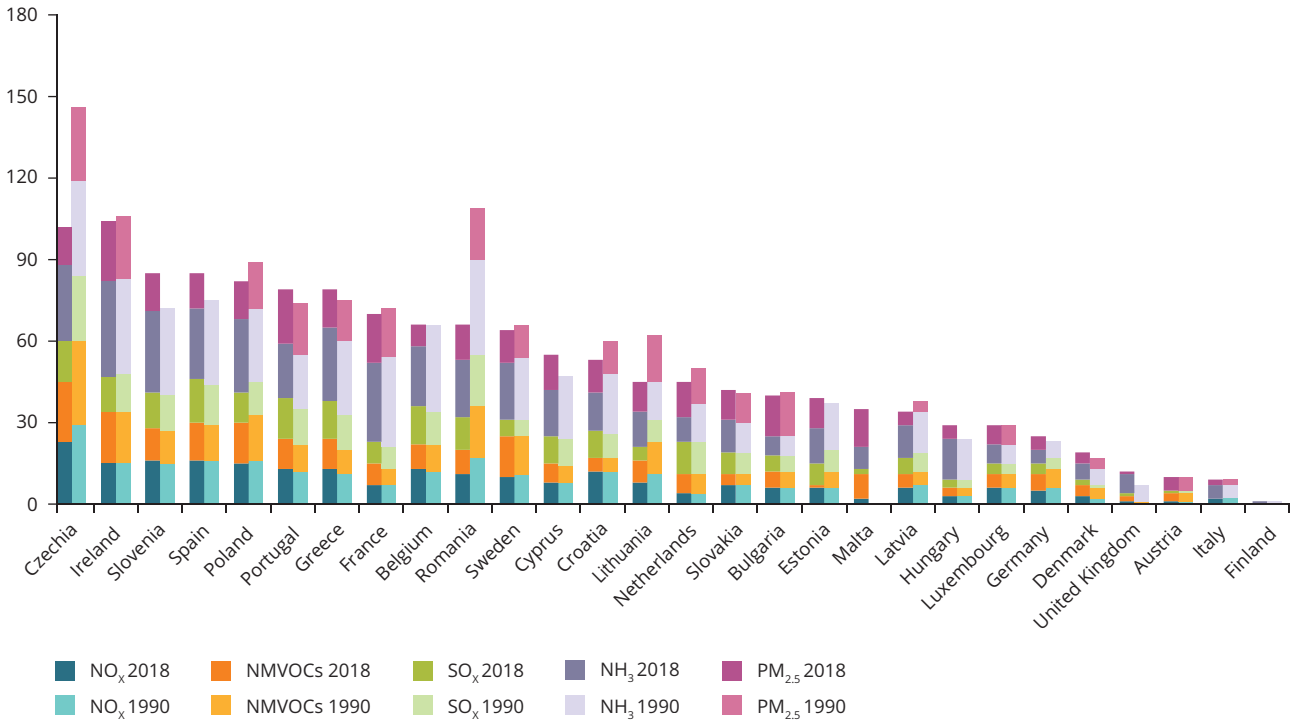
([15]) According to the emission-reporting guidelines (UNECE, 2014a), emission inventory reporting should cover all years from 1990 onwards if data are available. However, 'NR' has been added to ease reporting where the different protocols do not strictly require details of emissions. Only in these circumstances is 'NR' correct and appropriate.

Certain EU Member States use the notation key NE for many source categories (see Figure 1.4). For example, in 1990, Czechia and Ireland reported 35 source categories of NH_3 as NE. Overall, in most cases, the use of NE in reporting in 2018 is quite similar to its use in 1990. Most uses (across all pollutants and EU Member States) are in the categories '5E — Other waste', '1A3ai(i) — International aviation LTO (civil)', '2D3g — Chemical products', , '1A3bvii — Road transport: Automobile road abrasion', 1A3aii(i) — Domestic aviation LTO (civil)' and '2C2 — Ferroalloys production'. Within these categories, more than 25 % of the entries mention NE.

Figure 1.5 and Figure 1.6 show the proportions of gap-filled data and the estimated underestimation of the EU inventory for 1990 (2000 for PMs and BC) and 2018. The calculated underestimation comprises missing data (e.g. if emission data of a pollutant were not estimated by a Member State and no data were available for gap filling) and the use of the notation keys 'NE' and 'NO' and zero values. To calculate the underestimation, the specific share of total emissions for each Member State was first assessed. The share was calculated as the mean value of the respective EU Member State's share of those pollutants where a national total (gap filled or reported) from all EU Member States was available. In the gap-filled inventory, whenever the notation key 'NE' or 'NR' was used, or zero data were reported within a sector, this EU Member State's share was used to calculate the missing emissions within the respective sector. The sum of the missing emissions from all sectors and EU Member States was then calculated as the percentage value of the total emissions of a pollutant.

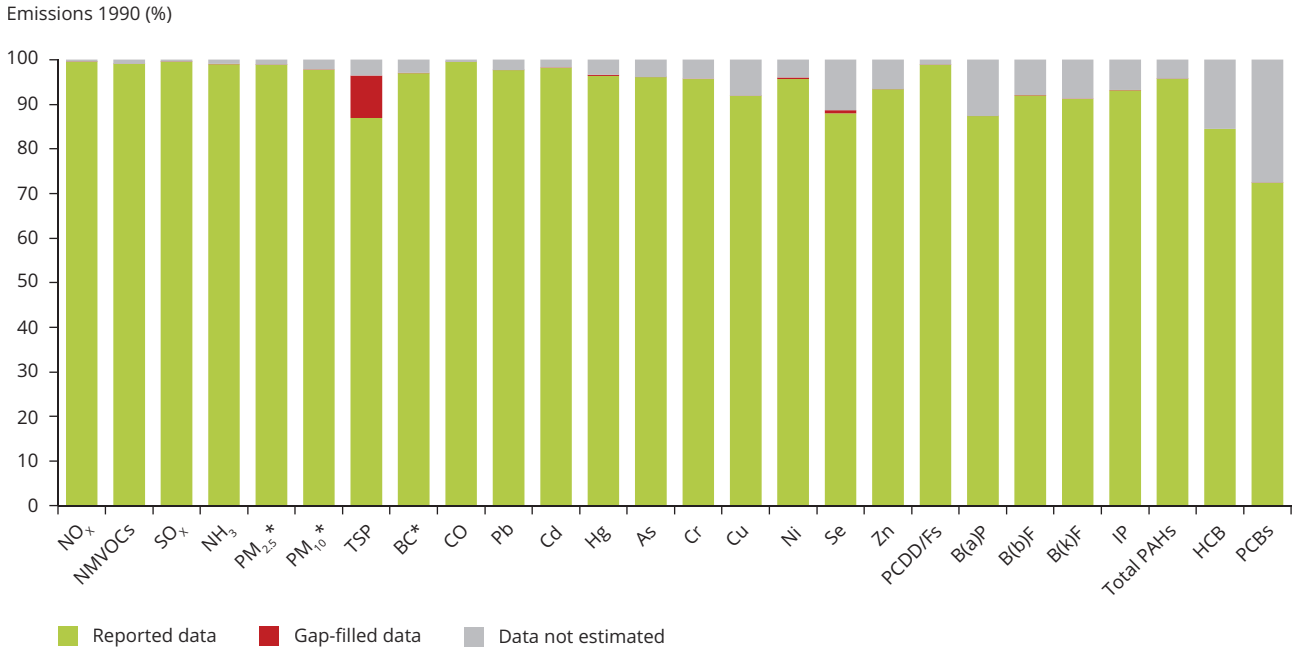
This year gap-filled data only had a minor impact on the EU totals. For TSP 9 % of the EU's national total for 1990 represent gap-filled data. For all other pollutants the share of gap-filled data was below 1 %.

Figure 1.4 Number of 'NE' source categories for 2018 and 1990



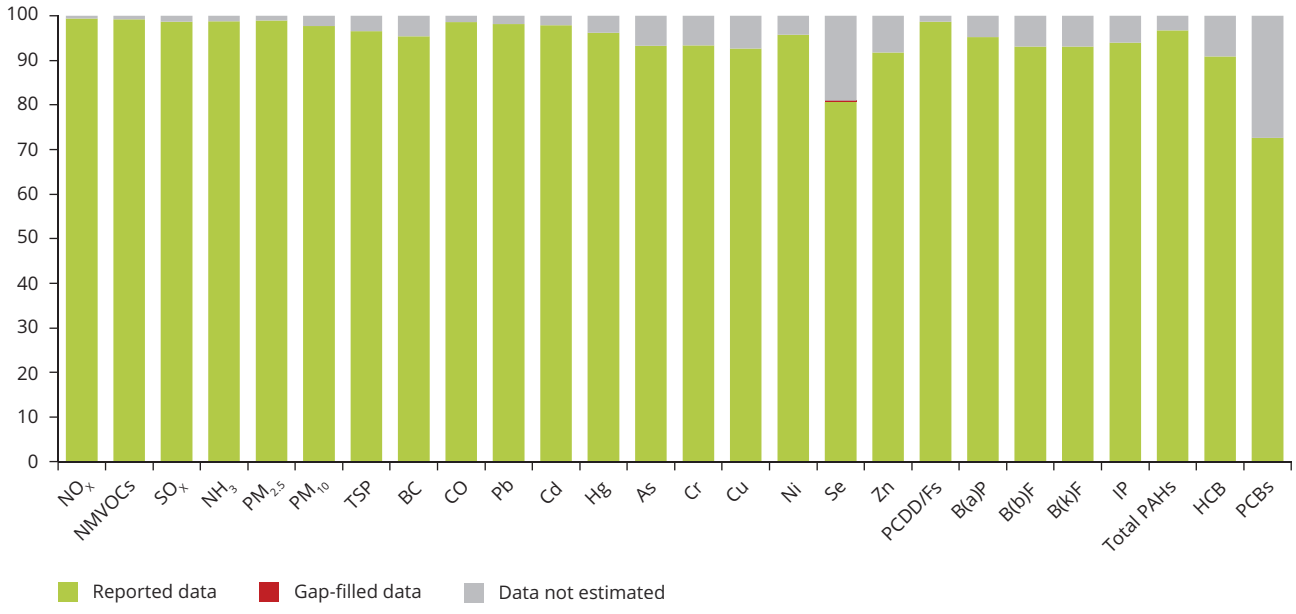
Note: The LRTAP Convention formally requests Parties to report emissions of PM for 2000 and thereafter. Therefore, 'NE' reporting for $PM_{2.5}$ in 1990 might be high for several countries.

Figure 1.5 Completeness and effect of gap filling on EU emission data for 1990



Note: * For PM and BC, data for the year 2000 are shown.

Figure 1.6 Completeness and effect of gap filling on EU emission data for 2018



Note: For TSP 9 % of the EU's national total for 1990 represent gap-filled data.
For all other pollutants the share of gap-filled data was below 1 %.

2 Adjustments made under the Gothenburg Protocol

In 2012, the Executive Body of the Convention on Long-range Transboundary Air Pollution (LRTAP Convention) decided that adjustments to emission reduction commitments or inventories may be applied in some circumstances (UNECE, 2012a). The European Monitoring and Evaluation Programme (EMEP) Centre on Emission Inventories and Projections (CEIP) leads the adjustment procedure, coordinates the review of any supporting documentation and assesses whether the adjustment is consistent with the particular circumstances and the guidance for adjustments (UNECE, 2012c). It makes the review available to the Parties, which then have the option of making a submission to the Implementation Committee under Decision 2006/2 (UNECE, 2006).

These circumstances are as follows:

- Emission source categories are identified that were not accounted for at the time the emission reduction commitments were made.
- Emission factors used to determine emission levels for particular source categories have changed since the emission reduction commitments were made.
- The ways of determining emissions from specific source categories have changed significantly between the time when emission reduction commitments were made and the year that they are to be attained.

Table 2.1 Accepted inventory adjustment applications (UNECE, 2014b, 2015, 2016, 2017, 2018, 2019)

Year of acceptance	Member State	Pollutant	NFR19 code	Years
2014	Denmark	NH_3	3Da1, 3De	2010-2012
2014	Germany	NO_X	1A3b	2010-2012
2014	Germany	NO_X	3B, 3D	2005-2012
2015	Belgium	NO_X	1A3bi-iv, 3B, 3Da1, 3Da2a	2010-2013
2015	Belgium	NMVOCs	3B, 3De	2010-2013
2015	Denmark	NMVOCs	3B	2010-2013
2015	Finland	NH_3	1A2gviii, 1A4ai, 1A4bi, 1A4ci, 1A3bi-iv	2010-2013
2015	France	NO_X	1A3bi-iv	2010-2013
2015	Germany	NMVOCs	3B, 3De	2010-2013
2015	Luxembourg	NO_X	1A3bi-iv	2010-2013
2015	Spain	NO_X	1A3bi, 1A3biii	2010-2012
2016	Germany	NO_X	3Da2c, 3I	2010-2014
2016	Germany	NH_3	3Da2c, 3I	2010-2014
2016	Luxembourg	NO_X	3B, 3De	2010-2014
2016	Luxembourg	NMVOCs	3B, 3De	2010-2014
2017	Spain	NO_X	3B	2010-2015
2018	Hungary	NMVOCs	3B, 3De	2010-2016
2018	United Kingdom	NO_X	1A3bi-iv	2010
2019	Netherlands	NMVOCs	3B1a, 3B4h, 3B4d, 3B4e, 3B4giii, 3B4giv, 3B2, 3B4h, 3B4f, 3B1b, 3Da2a, 3Dc, 3B3, 3B4gii, 3B4gi, 3De, 3Da3	2010-2017
2019	Netherlands	NH_3	3Da4, 3De, 3B3	2014-2017

Notes: For nomenclature for reporting (NFR) codes, see the list of source sector abbreviations in Appendix 4.
NH_3, ammonia; NMVOCs, non-methane volatile organic compounds; NO_X, nitrogen oxides.

Table 2.1 lists inventory adjustment applications accepted by the EMEP Steering Body in 2014, 2015, 2016, 2017, 2018 and 2019.

If a Party is planning to adjust its inventory for the purpose of comparing total national emissions with emission reduction commitments, it indicates in its notification to the United Nations Economic Commission for Europe (UNECE) secretariat and the CEIP which categories and pollutants are affected. It uses Annex II to the reporting guidelines as a basis (UNECE, 2014a). Table 2.2 shows EU Member States that submitted their adjustment applications, together with their LRTAP submissions, via the Central Data Repository (CDR) in 2020. In 2020, Czechia applied for adjustments.

Table 2.3 gives an overview of reported adjustments within the LRTAP submission in 2020. All approved and reported adjustments also appear in the emission trend tables in Sections 3.3 (nitrogen oxides, NO_X; Table 3.6), 3.4 (non-methane volatile organic compounds, NMVOCs; Table 3.7) and 3.6 (ammonia, NH_3; Table 3.9). Parties must report details of their approved adjusted aggregated emissions using the appropriate row in the main emissions reporting template (Annex I to the reporting guidelines; UNECE, 2014a). They must also provide detailed information by pollutant and sector for each adjustment, using the template provided in Annex VII to the reporting guidelines. Reporting of information on adjusted emissions in no way suspends the mandatory requirement for Parties to report unadjusted emissions, as laid down in section v, subsections A-D, of the guidelines.

Table 2.2 Adjustment application within the LRTAP submission 2020 (Annex II to the reporting guidelines; UNECE, 2014a) (as of 25 February 2020)

Member State	Pollutant	NFR 19 code	Years
Czechia	NO_X	3B	2010-2018
	NMVOC	3B	2010-2018

Table 2.3 Reporting of approved adjustments within the LRTAP submission 2020 (Annex I and Annex VII to the reporting guidelines; UNECE, 2014a) (as of 10 March 2020)

Member State	Pollutant	Years	Annex I ('adjustment row')	Annex VII	Declaration on consistent reporting of approved adjustments
Belgium	NO_X	2010-2015	Yes	Yes	Yes
Belgium	NMVOCs	2010	Yes	Yes	Yes
Denmark	NH_3	2010-2018	Yes	Yes	Yes, in the cover letter
Denmark	NMVOCs	2010-2018	Yes	Yes	Yes, in the cover letter
Finland	NH_3	2010-2018	Yes	Yes	Yes
France	NO_X	2010-2016	Yes	Yes	Yes
Germany	NO_X	2010-2018	Yes	Yes	Yes
Germany	NMVOCs	2010-2018	Yes	Yes	Yes
Germany	NH_3	2010-2018	Yes	Yes	Yes
Hungary	NMVOCs	2010-2013	Yes	Yes	Yes
Luxembourg	NO_X	2010-2018	Yes	Yes	Yes
Luxembourg	NMVOCs	2010-2018	Yes	Yes	Yes
Netherlands	NMVOCs	2010-2018	Yes	Yes	Yes
Netherlands	NH_3	2014-2018	Yes	Yes	Yes
Spain	NO_X	2010-2018	Yes (2010-2012)	Yes	Yes
United Kingdom	NO_X	2010	Yes	Yes	Yes

Figure 2.1 **Adjusted and unadjusted emissions of NO_X, NMVOCs and NH_3 for the EU, 2010-2018**

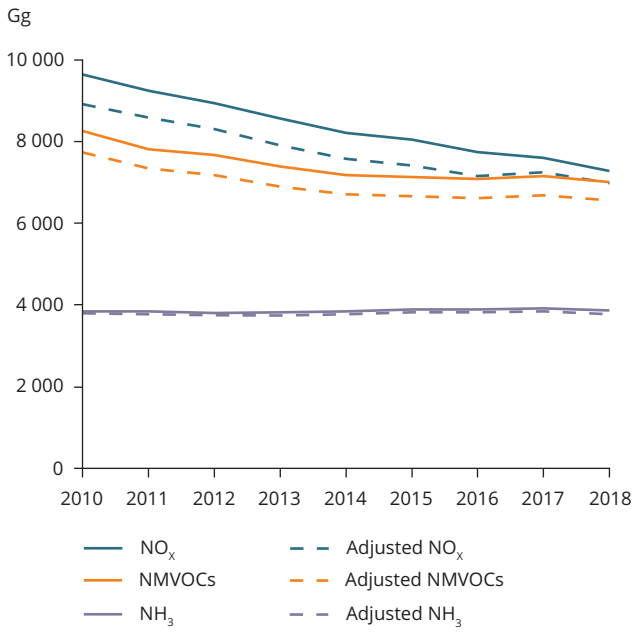


Figure 2.1 shows the effect in the EU of the adjustments on the emissions (sum of EU Member States' adjustments). For the years 2010-2016, adjusted NO_X emissions had a considerable impact on EU emissions; only slight effects can be seen for NMVOC and NH_3 emissions.

3 Trends and key categories of EU pollutant emissions

The present EU inventory lists emissions for all the main air pollutants: particulate matter (PM), heavy metals (HMs) and persistent organic pollutants (POPs). It also reports the individual polycyclic aromatic hydrocarbons (PAHs) for which the Convention on Long-range Transboundary Air Pollution (LRTAP Convention) requires or recommends inventory reporting (UNECE, 1979).

In Chapter 3, the following sections summarise the contributions each Member State has made to total EU emissions of nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), sulphur oxides (SO_X), ammonia (NH_3), carbon monoxide (CO), PM with a diameter of 2.5 µm or less ($PM_{2.5}$), PM with a diameter of 10 µm or less (PM_{10}), total suspended particulates (TSPs), black carbon (BC), lead (Pb), cadmium (Cd), mercury (Hg), arsenic (As), chromium (Cr), copper (Cu), nickel (Ni), selenium (Se), zinc (Zn), polychlorinated dibenzodioxins/dibenzofurans (PCDD/Fs), total PAHs, benzo(a)pyrene (B(a)P), benzo(b)fluoranthene (B(b)F), benzo(k)fluoranthene (B(k)F) and indeno(1,2,3-cd)pyrene (IP), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs). For BC, TSP, additional HMs, B(a)P, B(b)F, B(k)F and IP, data for several countries (at least for some years) were missing and could not be gap filled. Therefore, the EU total is not complete (see also Section 1.9). For the main pollutants, PM, HMs and POPs, as well as B(a)P and BC, the EU's trend in emissions from the five most important key categories, share by sector group and sectoral emission trends are given.

In the following pollutant-specific chapters, Section 3.3 to Section 3.28, the countries in enumerations are always ranked according to certain criteria, e.g. the percentage of their share in the EU total. The criteria for the ranking are specified in brackets.

Table 3.6 to Table 3.31 include two EU totals. The first is the sum of national totals that EU Member States and the United Kingdom officially reported. The second is the sum of the sectors of all EU Member States. A difference between these two EU totals occurs when only national totals and no sectoral data are available. There is a third EU total for NO_X (Table 3.6), NMVOCs (Table 3.7) and NH_3 (Table 3.9). This total allows for approved adjustments (see also Chapter 2).

3.1 Total EU emission trends, projection reporting and progress towards the Gothenburg Protocol 2010 emission ceilings

3.1.1 Total trends in EU emissions

In 2018, emissions of all pollutants were lower than in 1990 (or in 2000 for PM). Among the main air pollutants, the largest reductions across the EU (in percentage terms) since 1990 were for SO_X emissions (which decreased by 92 %), followed by CO (69 %), NMVOCs (by 62 %), NO_X (60 %) and NH_3 (by 26 %) (Figure 3.1). NH_3 emissions decreased around 1990, but since then emissions have remained stable with minor fluctuations. The biggest contributors to the total EU emissions are Germany, France and Spain. The NH_3 emissions of these countries have not fluctuated much over the years either.

Emissions of PM, BC and TSPs have also dropped substantially since 1990 (Figure 3.2). Emission data for 2000-2018 indicate that $PM_{2.5}$ and PM_{10} emissions fell by 32 % and 29 %, respectively. BC emissions also dropped by 46 % during the same time period (Figure 3.2).

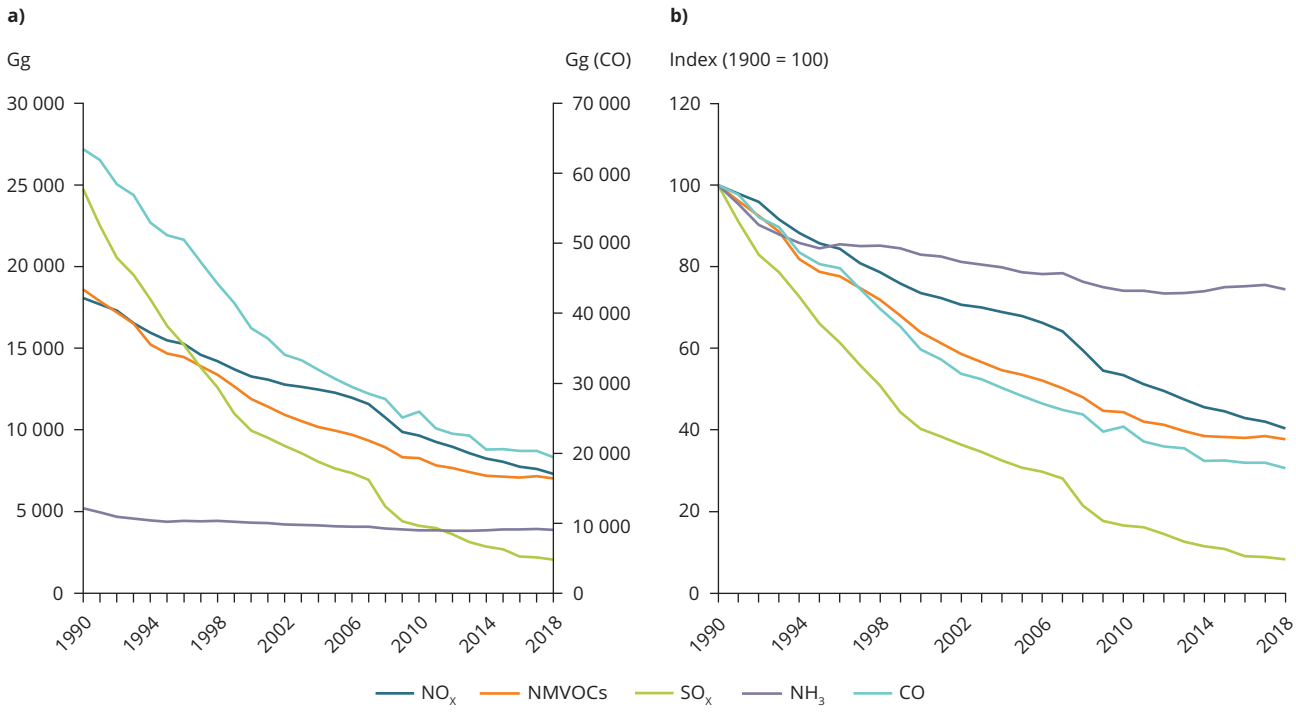
In addition, for HMs and POPs, emissions have reduced significantly since 1990 (Figure 3.3). Reductions are especially high for Pb (94 % decrease) and HCB (97 % decrease).

For various pollutants (e.g. BC, HMs and POPs), some EU Member States either did not report data or reported the notation key 'NE' or 'NR' for certain years or the whole time series. In some cases, the data could not be gap filled, so they were not included in the EU total. See also Section 1.9 for details on completeness and underestimations.

The trend in the B(a)P emissions, and therefore also the trend in total PAH emissions, follows data reported by Portugal and Bulgaria.

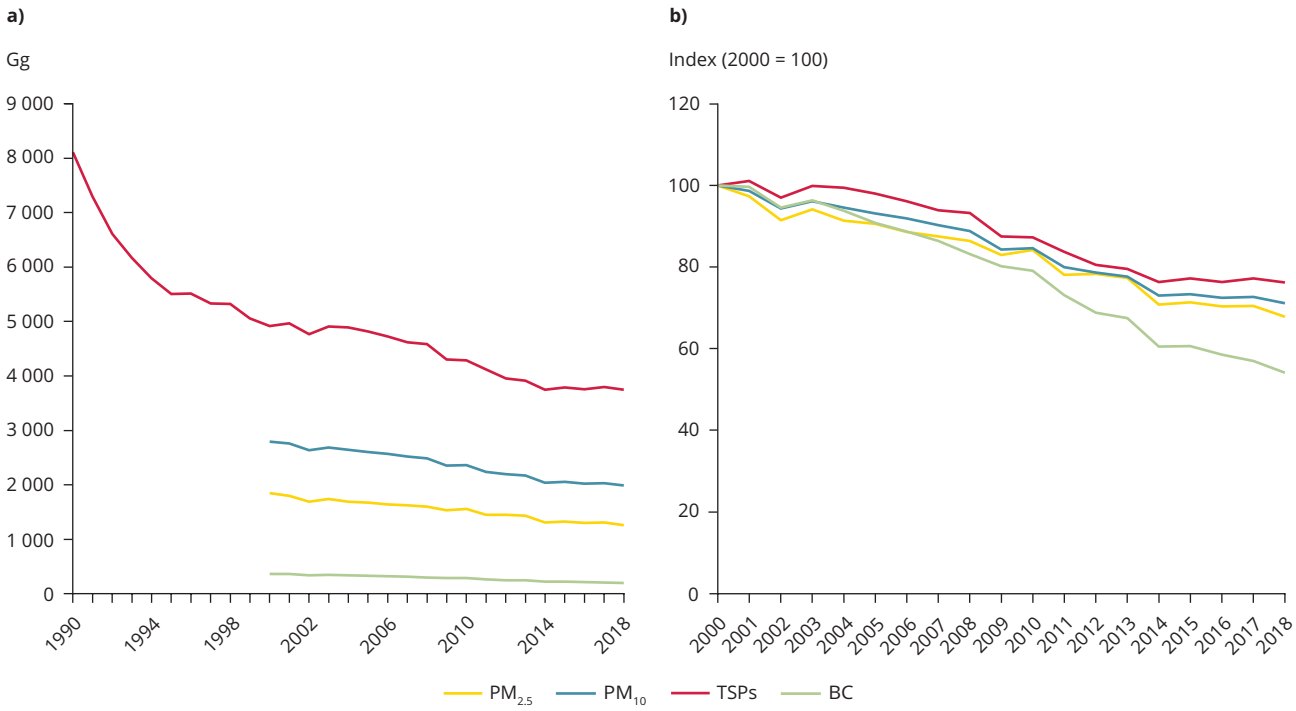
Table 3.6 to Table 3.31 show each Member State's and the United Kingdom's reported emissions. They indicate instances where emissions of a certain pollutant are unrecorded for all years. Furthermore,

Figure 3.1 (a) EU emission trends and (b) indexed emissions for the main air pollutants



Note: The right-hand axis gives values for CO emissions.

Figure 3.2 (a) EU emission trends and (b) indexed emissions for PM and BC

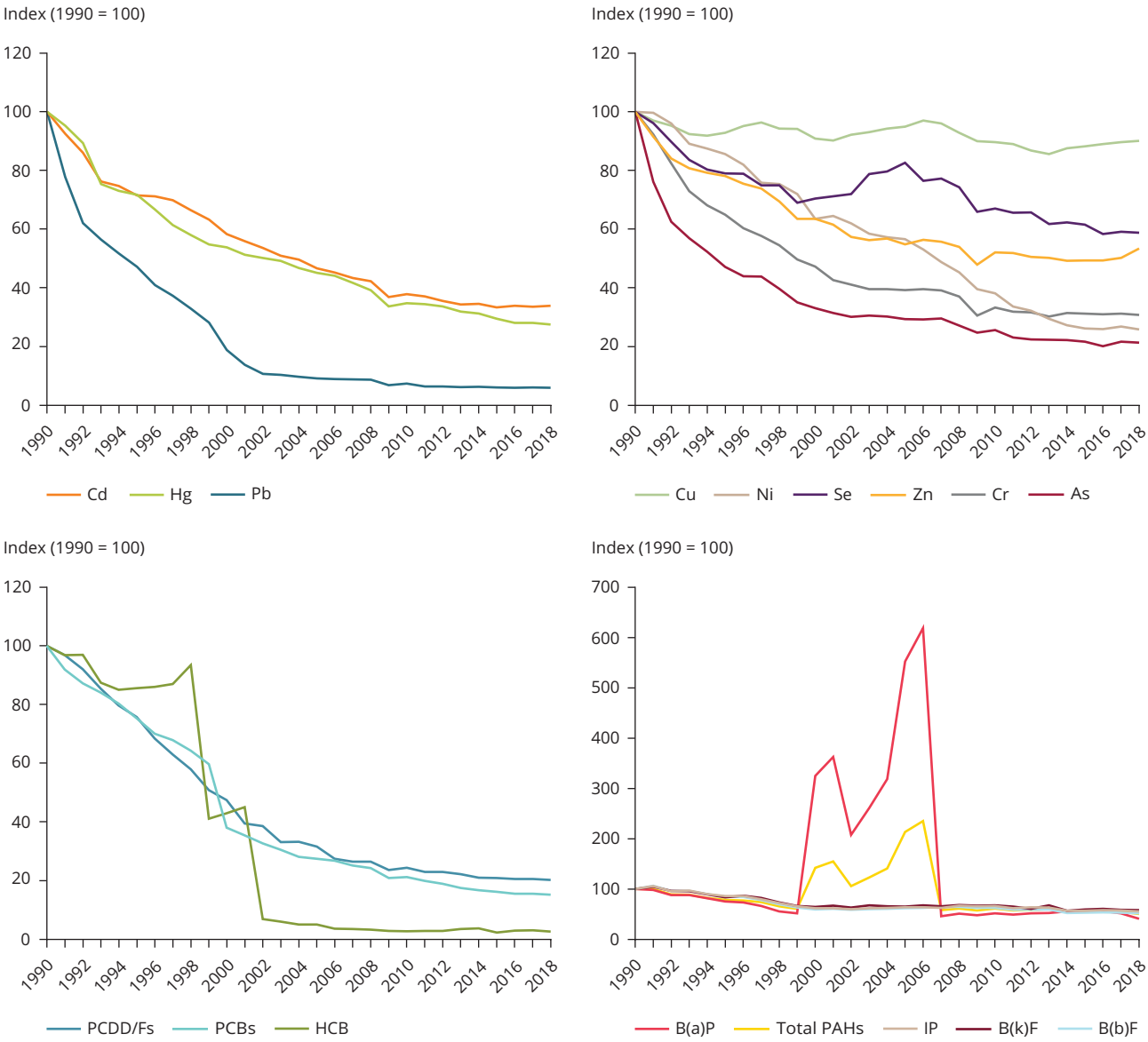


Notes: Not all countries reported data for BC.

The LRTAP Convention formally requests Parties to report emissions of PM for 2000 and thereafter. Thus, emission trends can be shown for these years only.

The indexed emissions are based on emissions in 2000 (= 100 %).

Figure 3.3 Indexed EU emission trends for HMs and POPs



Notes: The drop in HCB emissions between 1998 and 1999 is because the UK reported a considerable reduction over this period. The drop in HCB emissions between 2001 and 2002 was caused by reductions reported by Germany.

information received from the EU Member States or found in their informative inventory reports (IIRs) is included in the trend sections (see Sections 3.3-3.28). If no information is provided on unusual trends, EU Member States are contacted by the European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution (ETC/ATNI) and/or the EEA, informed about the findings and requested to send an explanation. As information on unusual trends is often not received, Sections 3.3-3.28 are very inconsistent as regards which variations in trends are explained and which are not.

3.1.2 Progress towards the Gothenburg Protocol 2010 emission ceilings

The Gothenburg Protocol to the UNECE LRTAP Convention (UNECE, 1999) specifies emission ceilings for the pollutants NO_x, NMVOCs, SO_x and NH_3. Parties to the protocol must meet them by 2010 and thereafter.

In addition to ceilings for individual countries, the protocol also specifies ceilings for the EU as a whole, which is also a Party to the LRTAP Convention and has

Table 3.1 Total EU emissions of the main air pollutants, HMs, POPs and PM

Pollutant	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change 1990-2018 (%)	Change 2017-2018 (%)
NO_x	Gg	18 069	15 481	13 283	12 274	9 652	9 250	8 952	8 565	8 226	8 047	7 749	7 597	7 287	-59.7	-4.1
NO_x (adjusted data*)	Gg					8 776	8 467	8 184	7 906	7 577	7 421	7 165	7 251	6 989		
NMVOCs	Gg	18 616	14 669	11 899	9 960	8 267	7 830	7 671	7 401	7 176	7 131	7 090	7 156	7 014	-62.3	-2.0
NMVOCs (adjusted data*)	Gg					7 742	7 341	7 179	6 908	6 716	6 663	6 630	6 699	6 566		
SO_x	Gg	24 764	16 365	9 961	7 621	4 112	3 992	3 599	3 121	2 851	2 678	2 234	2 190	2 043	-91.7	-6.7
NH_3	Gg	5 185	4 380	4 301	4 080	3 844	3 845	3 807	3 814	3 839	3 887	3 901	3 920	3 859	-25.6	-1.6
NH_3 (adjusted data*)	Gg					3 794	3 786	3 746	3 745	3 768	3 816	3 829	3 847	3 786		
TSPs	Gg	8 114	5 505	4 912	4 816	4 288	4 117	3 955	3 911	3 749	3 792	3 753	3 795	3 748	-53.8	-1.3
CO	Gg	63 458	51 170	37 875	30 653	25 924	23 571	22 796	22 544	20 548	20 614	20 305	20 304	19 433	-69.4	-4.3
Pb	Mg	22 996	10 871	4 341	2 115	1 711	1 492	1 480	1 444	1 455	1 405	1 378	1 405	1 384	-94.0	-1.5
Cd	Mg	184	132	107	86	70	68	65	63	64	62	62	62	63	-66.0	1.0
Hg	Mg	184	132	99	83	64	64	62	59	58	55	52	52	51	-72.4	-2.0
As	Mg	622	293	206	183	159	144	140	139	138	135	126	135	133	-78.7	-1.7
Cr	Mg	1 186	770	561	465	395	378	375	359	374	371	368	371	365	-69.2	-1.5
Cu	Mg	2 259	2 098	2 053	2 145	2 025	2 010	1 960	1 933	1 977	1 994	2 009	2 024	2 036	-9.9	0.6
Ni	Mg	2 214	1 895	1 406	1 253	846	745	713	652	605	579	574	595	572	-74.2	-3.9
Se	Mg	270	213	190	223	181	177	177	167	168	166	158	160	159	-41.2	-0.7
Zn	Mg	7 965	6 217	5 056	4 368	4 145	4 135	4 030	4 003	3 923	3 933	3 926	3 998	4 250	-46.6	6.3
PCDD/Fs	g I-Teq	9 243	7 006	4 395	2 924	2 261	2 129	2 128	2 058	1 944	1 941	1 906	1 907	1 881	-79.6	-1.4
B(a)P	Mg	676	511	2 199	3 735	351	334	350	354	374	382	381	348	275	-59.4	-21.1
B(b)f	Mg	600	510	356	371	377	353	353	357	315	317	321	319	312	-48.0	-2.2
B(k)f	Mg	303	253	195	197	206	197	184	205	171	181	183	178	175	-42.0	-1.7
IP	Mg	238	205	148	152	159	147	153	150	136	136	138	137	133	-44.2	-2.9
Total PAHs	Mg	2 180	1 711	3 104	4 656	1 334	1 253	1 283	1 312	1 207	1 230	1 229	1 195	1 103	-49.4	-7.6
HCB	kg	8 241	7 056	3 546	420	231	241	240	298	316	200	254	264	225	-97.3	-14.9
PCBs	kg	11 839	8 927	4 509	3 257	2 518	2 366	2 254	2 075	1 996	1 922	1 852	1 846	1 804	-84.8	-2.3
															Change 2000-2018 (%)	Change 2017-2018 (%)
$PM_{2.5}$	Gg			1 851	1 677	1 558	1 445	1 450	1 431	1 311	1 322	1 303	1 304	1 255	-32.2	-3.8
PM_{10}	Gg			2 793	2 602	2 364	2 236	2 196	2 170	2 040	2 051	2 025	2 031	1 989	-28.8	-2.1
BC	Gg			360	327	285	263	248	243	218	218	211	205	195	-45.9	-5.0

Notes: Negative percentage values indicate that emissions have decreased.

Table 3.1 and subsequent tables (Table 3.6 to Table 3.31) express changes in emissions between 1990 and 2018 as $100 \times (E_{2018} - E_{1990}) / E_{1990}$ (%), where E_{2018} and E_{1990} are 2018 and 1990 total emissions, respectively. They express changes in emissions from 2017 to 2018 as $100 \times (E_{2018} - E_{2017}) / E_{2017}$ (%), where E_{2018} and E_{2017} are the 2018 and 2017 total emissions, respectively.

The bases for the EU inventory shown in Table 3.1 and subsequent tables (Table 3.6 to Table 3.31, inclusive) are total national data for the entire territory based on fuel sold for all EU Member States. See Section 1.4.4 for further details.

*Adjusted data: under the Gothenburg Protocol, the EMEP Steering Body accepted inventory adjustment applications ([16]) for emissions from several EU Member States. This table takes these adjustments into account, whereas emission data are based on fuel sold. See Chapter 2 for further details.

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

Table 3.2 Comparison of emissions reported for 2018 by the EU-15 EU Member States with emission ceilings for the EU specified in the UNECE Gothenburg Protocol

Pollutant	EU-15 emissions, 2018 (Gg)	EU-15 Gothenburg Protocol, 2010 ceilings (Gg)	Difference (%)	Sum of individual EU-15 ceilings (Gg) ([a])
NO_x	5 625	6 671	-16	6 519
NMVOCs	5 307	6 600	-20	6 510
SO_x	1 150	4 059	-72	3 850
NH_3	3 014	3 129	-3.7	3 110

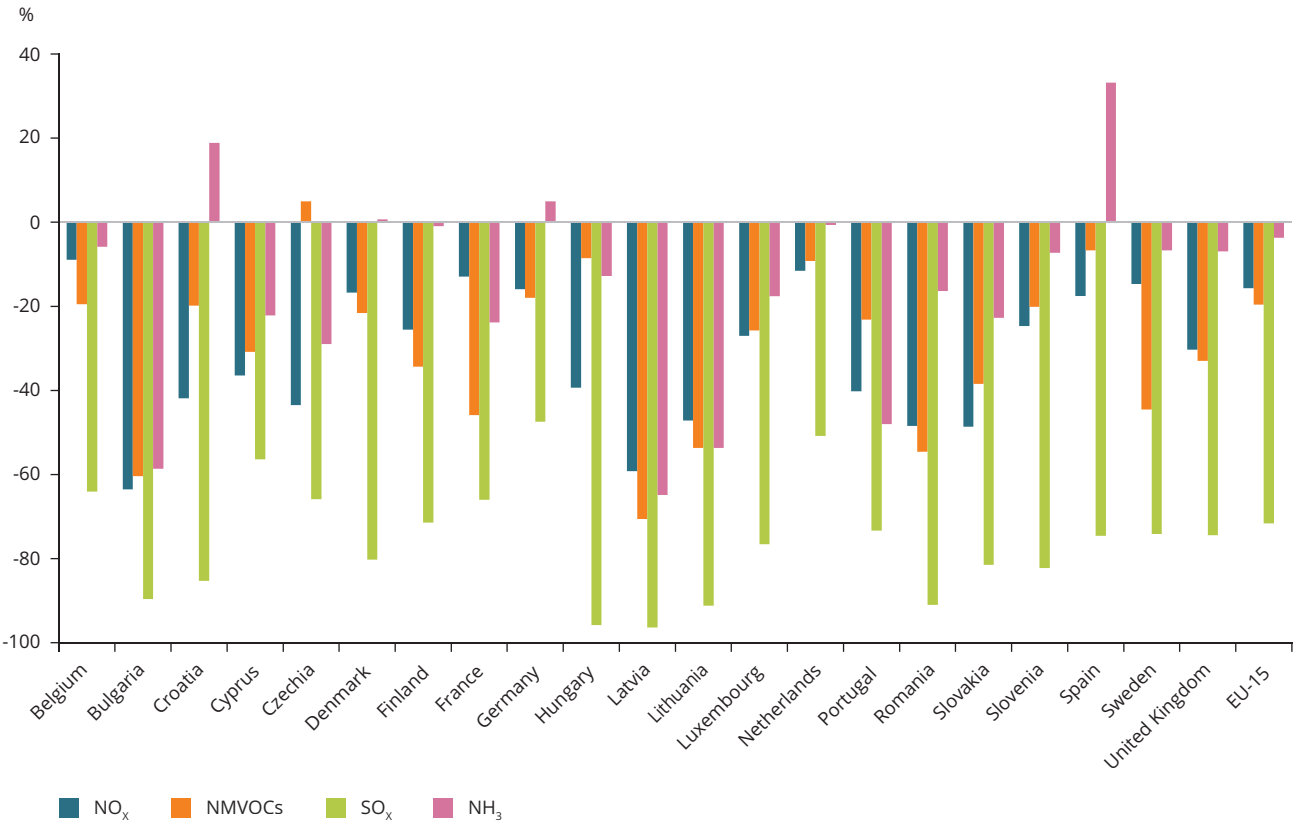
Notes: For Spain, data for emission comparisons exclude emissions from the Canary Islands, i.e. data comprise the EMEP domain only.

For Portugal 2010 ceilings, emissions from the Azores and Madeira are excluded.

Under the Gothenburg Protocol, the EMEP Steering Body accepted inventory adjustment applications for emissions from Belgium, Denmark, Finland, France, Germany, Hungary, Luxembourg, the Netherlands, Spain and the United Kingdom in 2014, 2015, 2016, 2017, 2018 and 2019. However, as the EU-15 as a whole has not applied for adjustments, this table does not take these adjusted data into account.

([a]) Emission ceilings are also specified for individual EU-15 EU Member States. The sum of these ceilings is different from the ceilings specified for the EU-15 as a whole.

Figure 3.4 Distance to Gothenburg ceilings for EU Member States in 2018



Notes: Estonia and Malta do not have Gothenburg ceilings. Austria, Greece, Ireland, Italy and Poland have ceilings but have not yet ratified the protocol. For Spain, data for emission comparisons exclude emissions from the Canary Islands.

The comparison with emission ceilings is based on reported fuel sold data, except for Belgium, Luxembourg, the Netherlands and the United Kingdom. These countries chose instead to calculate their emissions on the basis of fuel used in their territories (UNECE, 2014a). For the EU-15, the comparison is based on fuel sold. Under the Gothenburg Protocol, the EMEP Steering Body accepted inventory adjustment applications for emissions from Belgium, Denmark, Finland, France, Germany, Hungary, Luxembourg, the Netherlands, Spain and the United Kingdom in 2014, 2015, 2016, 2017, 2018 and 2019. This figure takes these adjusted data into account. The EU-15 did not apply for adjustments and thus data for the EU-15 are unadjusted.

ratified the protocol. Table 3.2 sets out the emissions reported for 2018 by the EU-15 EU Member States, compared with the respective emission ceilings specified for the EU (see Table A2.2 in Appendix 2 for an explanation of the country groupings). In this report, the comparison with the EU-15 ceilings in the Gothenburg Protocol is based on fuel sold. For all pollutants, emissions in 2018 were below the ceilings.

Figure 3.4 shows whether or not EU Member States met the Gothenburg ceilings in 2018. Estonia and Malta do not have Gothenburg ceilings, and Austria, Greece, Ireland, Italy and Poland have not yet ratified the Gothenburg Protocol and are therefore excluded from Figure 3.4. Four countries exceeded their NH_3 ceilings (Croatia, Denmark, Germany and Spain), and one Member State (Czechia) did not comply with its ceiling for NMVOCs. All EU Member States complied with their NO_X and SO_X ceilings.

The EEA plans to publish its annual National Emission Reduction Commitment Directive (NEC Directive) reporting in June 2020. The reporting analyses the emission data reported under the EU NEC Directive for EU Member States and the United Kingdom (EEA, forthcoming). For EU Member States, the new NEC Directive (EU, 2016b) contains national emission reduction commitments for NO_X, NMVOCs, SO_2, NH_3 and $PM_{2.5}$ for 2020-2029 and for any year from 2030.

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

3.2.1 Emissions of the non-EU EEA member countries Iceland, Liechtenstein, Norway, Switzerland and Turkey

In 2020, all EEA-5 member countries (non-EU EEA member countries, i.e. Iceland, Liechtenstein, Norway, Switzerland and Turkey) except Liechtenstein submitted their emission data (see Table 3.3).

3.2.2 Progress in meeting the ceilings

The Gothenburg Protocol of the LRTAP Convention specifies emission ceilings for 2010 and onwards for three EEA-5 member countries (Liechtenstein, Norway and Switzerland) (UNECE, 1979, 1999); see Table 3.4. Liechtenstein has signed but not yet ratified the protocol. EEA members Iceland and Turkey have not yet signed the Gothenburg Protocol. Emission data for Norway and Switzerland are compared with the countries' emission ceilings under the Gothenburg Protocol.

Table 3.3 Emissions reported by the EEA-5 member countries from 2010 to 2018

EEA Member Country	Emission data (Gg)																		
	NO_x									NMVOCs									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010	2011	2012	2013	2014	2015	2016	2017	2018
Iceland	26	24	24	23	23	23	21	22	22	5.8	5.6	5.5	5.3	5.4	5.6	5.8	5.5	5.5
Liechtenstein																		
Norway	202	203	199	192	185	175	166	159	160	179	170	171	169	172	173	170	167	167
Switzerland (a)	84	80	80	81	77	75	74	71	67	97	94	92	89	85	83	80	80	79
Turkey	959	963	838	816	804	805	809	780	786	1 103	1 078	1 133	1 072	1 065	1 109	1 086	1 112	1 089
	SO_x									NH_3								
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010	2011	2012	2013	2014	2015	2016	2017	2018
Iceland	82	84	87	72	65	61	52	50	55	5.3	5.4	5.3	5.1	5.5	5.5	5.6	5.5	5.2
Liechtenstein																		
Norway	19	19	17	17	17	17	16	15	16	34	34	34	34	33	34	34	34	35
Switzerland (a)	10	8.5	8.7	8.1	7.4	5.8	5.3	5.2	5.1	59	58	57	56	57	56	55	55	55
Turkey	2 557	2 637	2 703	1 939	2 149	1 950	2 254	2 364	2 528	589	616	679	719	717	697	760	796	997

Note: (a) Data are based on fuel used for road transport.

Table 3.4 Gothenburg Protocol UNECE LRTAP Convention ceilings

	Gothenburg Protocol Ceilings			
	NO_x	NMVOCs	SO_x	NH_3
Liechtenstein	0.37	0.86	0.11	0.15
Norway	156	195	22	23
Switzerland	79	144	26	63

Table 3.5 Progress in meeting Gothenburg Protocol UNECE LRTAP Convention emission ceilings

Member State	NO_x									NMVOCs								
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010	2011	2012	2013	2014	2015	2016	2017	2018
Norway	×	×	×	×	×	×	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Switzerland	×	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Member State	SO_2									NH_3								
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010	2011	2012	2013	2014	2015	2016	2017	2018
Norway	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	×	×	×	×	×	×
Switzerland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: Switzerland's assessment is based on data for fuel used.

Data from the abovementioned countries show that Norway exceeded its NO_X and NH_3 ceilings from 2010 to 2018. Switzerland is reporting values above the ceiling for NO_X for the years 2010-2013 (see Table 3.5).

3.3 Nitrogen oxide emission trends and key categories

Between 1990 and 2018, NO_X emissions dropped by 60 % in the EU. Between 2017 and 2018, the decrease was 4.1 %, mainly because Germany, France, the United Kingdom, Spain and Poland (countries ranked according to the size of their contributions to the absolute change) reported reductions (Table 3.6). The EU Member States that contributed most (i.e. more than 10 %) to NO_X emissions in 2018 were Germany, the United Kingdom, Poland and France (countries ranked according to their shares of the EU total).

Spain stated that the drop in NO_X emissions between 2005 and 2010 (the value for the national total in 2008 was 15.4 % lower than in the previous year) was due to the closure of the main brown coal mine in Spain in 2007. In addition, the necessary retrofitting in 2008 of the adjacent thermal power plant and the introduction of abatement techniques reduced NO_X emissions during this period (see Spain's IIR p. 21, listed in Appendix 5).

Luxembourg explained that an upwards trend in air pollutant emissions recorded from 1999 to 2004 was due to increasing energy consumption and fuel sales in the transport sector. The stabilisation noted in inventory years 2004-2006 was largely the result of relatively steady sales of road fuels that peaked in 2005 (see Luxemburg's IIR p. 97, listed in Appendix 5).

The main key categories for NO_X emissions were '1A3bi— Road transport: Passenger cars', '1A1a — Public electricity and heat production' and '1A3biii — Road transport: Heavy duty vehicles and buses'. Together, they made up 44 % of total emissions (see Figure 3.5). Of the top five key categories, the highest relative reduction in emissions between 1990 and 2018 occurred in the second most important, '1A1a — Public electricity and heat production' (75.1 % decrease) (see Figure 3.5(a)). There were also significant reductions in the most important key category, '1A3bi — Road transport: Passenger cars' (68.4% decrease), and in the third most important, '1A3biii — Road transport: Heavy duty vehicles and buses' (65.7 % decrease).

Figure 3.5(b) shows the contribution made by each aggregated sector group to total EU emissions. For NO_X, common key emission sources are the energy and transport sectors. Emission reductions from the

Table 3.6 Member State contributions to EU emissions of NO_x

Member State	NO_x (Gg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	217	198	211	246	202	194	189	188	179	176	170	162	151	-31	-6.8	1.2	2.1
Belgium	425	412	356	322	243	226	215	205	196	196	185	174	169	-60	-3.1	2.4	2.3
*Adjusted data**					*180*	*163*	*151*	*143*	*134*	*137*	*129*						
Bulgaria	281	182	144	174	125	133	129	112	119	116	110	100	97	-66	-2.9	1.6	1.3
Croatia	108	80	87	86	69	66	60	59	55	55	55	55	51	-53	-7.6	0.6	0.7
Cyprus	17	20	22	22	19	22	22	17	18	15	15	15	15	-16	-3.5	0.1	0.2
Czechia	729	371	281	272	230	217	205	190	186	180	171	168	162	-78	-3.8	4.0	2.2
Denmark	302	290	226	205	149	140	129	124	115	114	114	111	106	-65	-4.6	1.7	1.5
Estonia	80	48	45	42	43	42	39	37	37	33	33	33	32	-60	-4.0	0.4	0.4
Finland	306	273	241	208	187	171	161	158	151	139	134	130	127	-59	-2.7	1.7	1.7
France	1 973	1 799	1 629	1 420	1 072	1 011	985	970	896	870	827	804	749	-62	-6.8	10.9	10.3
*Adjusted data**					*929*	*862*	*834*	*811*	*736*	*711*	*677*						
Germany	2 884	2 211	1 911	1 641	1 474	1 455	1 440	1 441	1 395	1 366	1 336	1 288	1 202	-58	-6.7	16.0	16.5
*Adjusted data**					*1 060*	*1 027*	*1 017*	*1 010*	*974*	*964*	*963*	*948*	*909*				
Greece	404	396	425	477	357	320	279	267	263	257	256	262	255	-37	-2.7	2.2	3.5
Hungary	246	190	187	177	146	137	129	126	124	126	119	121	120	-51	-0.5	1.4	1.6
Ireland	169	169	177	170	118	105	108	110	109	112	113	110	110	-35	-0.2	0.9	1.5
Italy	2 123	1 987	1 505	1 291	945	900	854	787	767	732	712	672	669	-68	-0.4	11.8	9.2
Latvia	97	51	42	44	40	37	37	36	36	35	33	33	34	-65	3.0	0.5	0.5
Lithuania	156	74	62	68	65	62	64	62	61	62	61	58	58	-63	0.8	0.9	0.8
Luxembourg	41	35	40	56	39	40	37	34	32	28	25	22	20	-50	-8.4	0.2	0.3
*Adjusted data**					*33*	*33*	*31*	*27*	*25*	*22*	*19*	*17*	*16*				
Malta	7.4	8.9	9.5	9.6	9.1	7.6	8.5	7.1	7.1	5.9	5.4	5.9	5.8	-22	-1.1	0.0	0.1
Netherlands	657	557	465	407	340	324	308	299	278	277	263	252	244	-63	-3.1	3.6	3.4
Poland	1 075	1 044	858	868	881	866	830	788	739	723	737	780	762	-29	-2.3	6.0	10.5
Portugal	252	286	285	270	193	177	165	162	159	163	157	160	155	-38	-3.0	1.4	2.1
Romania	424	351	287	327	240	250	246	226	222	222	214	223	225	-47	1.1	2.3	3.1
Slovakia	135	114	108	104	86	78	76	74	75	73	69	67	67	-51	-1.0	0.7	0.9
Slovenia	72	72	59	56	49	48	46	44	39	35	36	34	34	-53	-0.1	0.4	0.5
Spain	1 348	1 363	1 366	1 357	931	921	871	784	785	792	746	739	698	-48	-5.5	7.5	9.6
*Adjusted data**					*783*	*784*	*746*										
Sweden	276	251	213	182	156	149	143	140	138	134	132	128	126	-54	-1.5	1.5	1.7
United Kingdom	3 264	2 650	2 044	1 770	1 242	1 152	1 178	1 118	1 046	1 011	921	890	843	-74	-5.3	18.1	11.6
*Adjusted data**					*1 140*												
EU-28 ([a])	**18 069**	**15 481**	**13 283**	**12 274**	**9 652**	**9 250**	**8 952**	**8 565**	**8 226**	**8 047**	**7 749**	**7 597**	**7287**	**-60**	**-4.1**	**100**	**100**
EU-28 ([b])	18 069	15 481	13 283	12 274	9 652	9 250	8 952	8 565	8 226	8 047	7 749	7 597	7 287				
EU-28 ([c])	18 069	15 481	13 283	12 274	8 776	8 467	8 184	7 906	7 577	7 421	7 165	7 251	6 989				

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

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

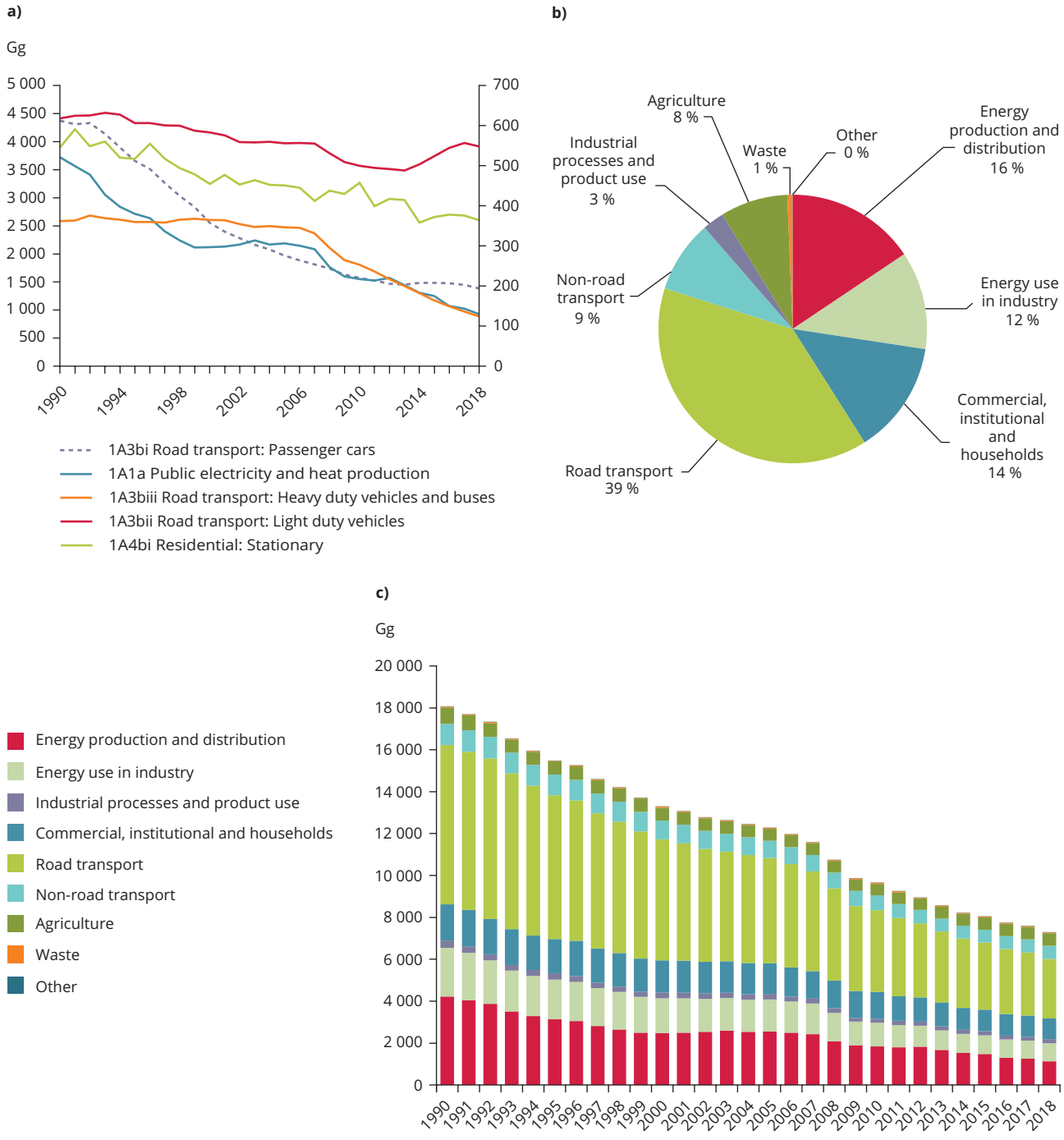
([b]) Sum of sectors: differences arise when only national totals and no sectoral data are available.

([c]) Sum of national totals, as reported by EU Member States and the United Kingdom, allowing for approved adjustments.

*Adjusted data: under the Gothenburg Protocol, the EMEP Steering Body accepted inventory adjustment applications for emissions from Belgium, France, Germany, Luxembourg, Spain and the United Kingdom.

road transport sector are primarily a result of fitting catalytic converters to vehicles (EEA, 2019d). The legislative standards, known as 'Euro' standards, have driven this move. Nevertheless, the road transport sector represents the largest source of NO_x emissions, accounting for 39 % of total EU emissions in 2018. The electricity/energy production sectors have also reduced their emissions, thanks to measures such as introducing combustion modification technologies (e.g. low-NO_x burners), implementing flue gas abatement techniques (e.g. NO_x scrubbers and selective catalytic reduction — SCR — and selective non-catalytic reduction — SNCR — techniques) and switching from coal to gas (EEA, 2019d).

Figure 3.5 **NO_x emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions**



Note: In Figure 3.5(a), the right-hand axis shows values for '1A3bii — Road transport: Light duty vehicles' and '1A4bi — Residential: Stationary'.

3.4 Non-methane volatile organic compound emission trends and key categories

Between 1990 and 2018, NMVOC emissions dropped by 62 % in the EU. Between 2017 and 2018, EU Member States and the United Kingdom reported a decrease of 2.0 % (Table 3.7) due to slightly lower emissions in Italy, Germany, France, Poland and the Netherlands (countries ranked according to the size of their contributions to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to NMVOC emissions were Germany, Italy, the United Kingdom and Poland (countries ranked according to their shares of the EU total).

Figure 3.6 NMVOC emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions

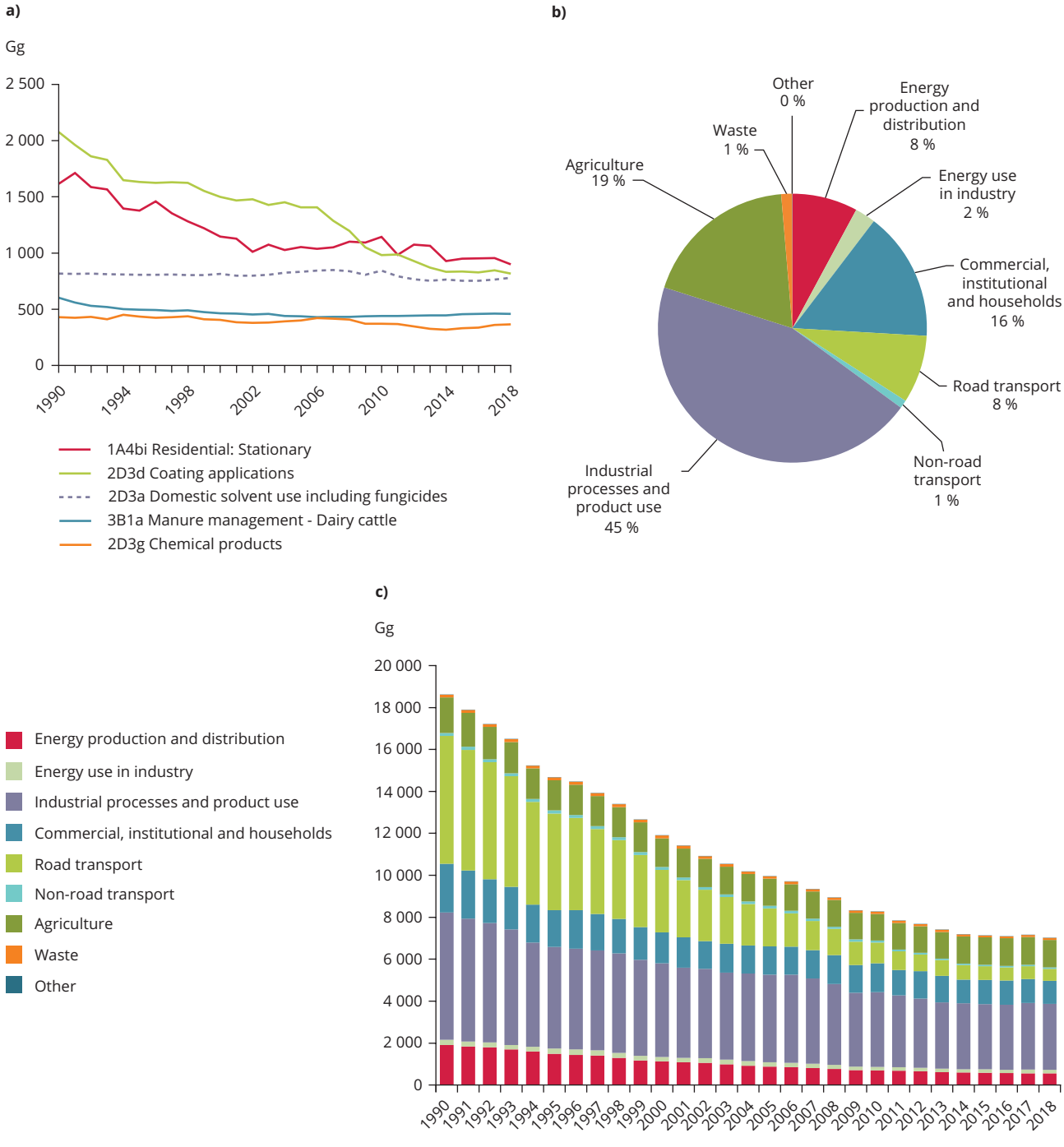


Table 3.7 Member State contributions to EU emissions of NMVOCs

Member State	NMVOCs (Gg)													Change (%)		Share in EU–28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990–2018	2017–2018	1990	2018
Austria	334	247	180	157	135	130	127	122	115	111	110	111	107	-68	-3.2	1.8	1.5
Belgium	351	308	233	184	147	134	131	128	121	119	119	117	116	-67	-0.7	1.9	1.7
*Adjusted data**					*114*												
Bulgaria	547	145	104	91	83	85	82	77	76	77	78	78	73	-87	-5.6	2.9	1.0
Croatia	171	120	101	114	93	87	82	77	71	72	74	71	72	-58	2.0	0.9	1.0
Cyprus	13	13	13	16	13	11	11	9.0	8.5	8.8	9.0	11	9.7	-25	-12.6	0.1	0.1
Czechia	584	411	329	277	265	253	247	244	238	237	233	233	231	-60	-0.9	3.1	3.3
Denmark	220	220	191	158	137	131	129	127	119	122	119	118	120	-46	1.4	1.2	1.7
*Adjusted data**					*86*	*80*	*79*	*76*	*68*	*71*	*67*	*66*	*67*				
Estonia	64	40	36	32	23	23	24	23	23	23	22	23	22	-65	-4.3	0.3	0.3
Finland	231	202	177	144	113	104	101	97	94	89	90	88	85	-63	-2.7	1.2	1.2
France	2 466	2 070	1 649	1 178	814	734	697	688	663	634	618	620	595	-76	-4.0	13.2	8.5
Germany	4 033	2 407	1 841	1 512	1 384	1 273	1 279	1 235	1 196	1 166	1 160	1 165	1 140	-72	-2.2	21.7	16.3
Adjusted data*					1057	947	950	900	858	831	828	835	816				
Greece	318	305	310	337	220	205	198	180	177	169	161	157	150	-53	-4.5	1.7	2.1
Hungary	311	214	194	178	139	143	144	141	131	133	134	131	125	-60	-4.5	1.7	1.8
*Adjusted data**					*110*	*114*	*115*	*112*									
Ireland	140	132	119	117	106	104	105	108	104	104	105	110	110	-22	-0.1	0.8	1.6
Italy	1 965	2 022	1 601	1 361	1 137	1 045	1 036	1 008	940	917	901	947	913	-54	-3.6	10.6	13.0
Latvia	85	63	53	53	44	44	44	43	43	41	39	40	40	-53	0.5	0.5	0.6
Lithuania	103	66	56	56	53	49	50	47	47	45	45	43	43	-58	-0.6	0.6	0.6
Luxembourg	28	21	16	15	11	11	12	11	11	10	10	10	10	-62	-1.0	0.1	0.1
*Adjusted data**					*8.3*	*8.3*	*8.8*	*8.3*	*7.6*	*7.2*	*7.2*	*7.2*	*7.1*				
Malta	1.5	1.7	1.5	3.4	3.1	2.9	2.6	2.6	2.6	2.6	2.5	3.0	3.	93	-1.2	0.0	0.0
Netherlands	609	437	337	269	270	268	263	259	247	255	253	253	240	-61	-5.0	3.3	3.4
Adjusted data*					188	186	182	184	180	175	180	181	172				
Poland	822	944	825	811	806	793	762	709	708	729	755	757	733	-11	-3.3	4.4	10.4
Portugal	243	236	235	195	160	150	147	145	150	152	148	151	155	-36	2.9	1.3	2.2
Romania	274	231	265	315	259	255	253	246	242	237	236	240	237	-13	-1.0	1.5	3.4
Slovakia	309	210	175	159	139	134	129	112	93	102	101	96	86	-72	-9.8	1.7	1.2
Slovenia	65	63	54	48	40	37	36	35	32	32	33	32	32	-51	0.0	0.4	0.5
Spain	1 018	959	948	803	629	605	583	568	572	592	605	618	624	-39	1.0	5.5	8.9
Sweden	359	273	220	202	175	172	164	156	153	154	146	139	134	-63	-3.9	1.9	1.9
United Kingdom	2 952	2 309	1 633	1 175	867	848	834	804	799	798	784	794	806	-73	1.6	15.9	11.5
EU-28 ([a])	**18 616**	**14 669**	**11 899**	**9 960**	**8 267**	**7 830**	**7 671**	**7 401**	**7 176**	**7 131**	**7 090**	**7 156**	**7014**	**-62**	**-2.0**	**100**	**100**
EU-28 ([b])	18 616	14 669	11 899	9 960	8 267	7 830	7 671	7 401	7 176	7 131	7 090	7 156	7 014				
EU-28 ([c])	18 616	14 669	11 899	9 960	7 742	7 341	7 179	6 908	6 716	6 663	6 630	6 699	6 566				

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

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

([c]) Sum of national totals, as reported by EU Member States and the United Kingdom, allowing for approved adjustments.

*Adjusted data: under the Gothenburg Protocol, the EMEP Steering Body accepted inventory adjustment applications for emissions from Belgium, Denmark, Germany, Hungary, Luxembourg and the Netherlands.

The strong decline in emissions reported by Bulgaria between 1990 and 1995 was due to a drop between 1993 and 1994 (not shown in Table 3.7). This was mainly caused by drastically declining emissions from the industrial processes and product use sector, namely '2D3d — Coating applications' and '2D3e — Degreasing' (see Bulgaria's IIR. p. 57f., listed in Appendix 5).

Emissions in Germany decreased by 40 % between 1990 and 1995 (-1 626 kt NMVOC). A decline in emissions in subcategory '1A3bi — Road Transport — passenger cars' was responsible for these reductions because of increasingly stricter regulations, especially incentives for automobile users to retrofit/buy cars with catalytic converters, and the implementation of the Technical Instruction on Air Quality Control (TA-Luft 2002). Furthermore, decreases in subcategory '1B2av — Emissions from petrol storage and from fuelling of motor vehicles' can be explained by the implementation of the 20th and 21st Ordinances on the Execution of the Federal Immission Control Act (BImSchV). A decline in petrol consumption has played a major role with regard to the reduction of NMVOC emissions (see Germany's IIR, listed in Appendix 5).

The most important key categories for NMVOC emissions were '1A4bi — Residential: Stationary', '2D3d — Coating applications' and '2D3a — Domestic solvent use including fungicides'. Together, they made up 36% of total emissions (Figure 3.6(a)). Among the top five key categories, the highest relative reduction in emissions between 1990 and 2018 was in the second most important, '2D3d — Coating applications' (60.7 % decrease).

Figure 3.6(b) shows the contribution made by each aggregated sector group to total EU emissions. The main emission source of NMVOCs is industrial processes and product use (45 %), followed by agriculture (19 %), commercial, institutional and households (16 %), road transport (8 %) and energy production and distribution (8 %).

3.5 Sulphur oxide emission trends and key categories

Between 1990 and 2018, SO_X emissions dropped by 92 % in the EU. Between 2017 and 2018, emissions decreased by 6.7 % (see Table 3.8), mainly because of reduced emissions in Poland, Spain, the United Kingdom and Bulgaria (countries ranked according to the size of their contribution to the absolute change). The EU Member States contributing most (i.e. more than 10 %) to SO_X emissions in 2018 were Poland (24.6 % of EU-28) and Germany (14.1 % of EU-28).

Spain stated that the dramatic drop in SO_X emissions in 2008 (the value for the national total is 63.3 % lower than in the previous year) was due to the closure of the main brown coal mine in Spain in 2007. In addition, the necessary retrofitting in 2008 of the adjacent thermal power plant and the implementation of desulphurisation abatement techniques reduced SO_X emissions during this period (see Spain's IIR p. 21, listed in Appendix 5).

In Slovakia, data reported for 2015 were significantly higher than for the year 2014. Slovakia explained that all SO_X emissions were emitted from Slovenské elektrárne (an electricity company), which apparently had no emission limitations or abatement technologies in place in 2015. From 2016 onwards, it has been possible to operate such facilities only when they comply with the strict limits set in the legislation. The considerable drop in SO_X emissions is due to the strict regulations in place (see Slovakia's IIR p. 33, listed in Appendix 5).

The strong decrease in SO_X emissions in Romania since 2008 has been, according to Romania's IIR, due to the use of low-sulphur fuels and also the regulatory binding on maximal fuel content in transport diesel/gas oil, installations of large combustion plant desulphurisation equipment and national legislation (see Romania's IIR p. 35, listed in Appendix 5).

Category '1A1a — Public electricity and heat production' is the most significant key category for SO_X emissions, making up 35 % of total SO_X emissions (Figure 3.7(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2018 were achieved in the most important, '1A1a — Public electricity and heat production' (95.0 %), and the third most important, '1A1b — Petroleum refining' (87.7 % decrease). The other three top five key categories also saw significant reductions.

Since 1990, several measures have been combined to reduce emissions from these main emitting sources: switching fuel in energy-related sectors away from high-sulphur solid and liquid fuels to low-sulphur fuels such as natural gas; fitting flue gas desulphurisation (FGD) abatement technology in industrial facilities; and the impact of EU directives relating to the sulphur content of certain liquid fuels (EEA, 2018b).

Figure 3.7(b) shows the contribution made by each aggregated sector group to total EU emissions. For SO_X, the common main emission sources are the energy sectors.

Table 3.8 Member State contributions to EU emissions of SO_x

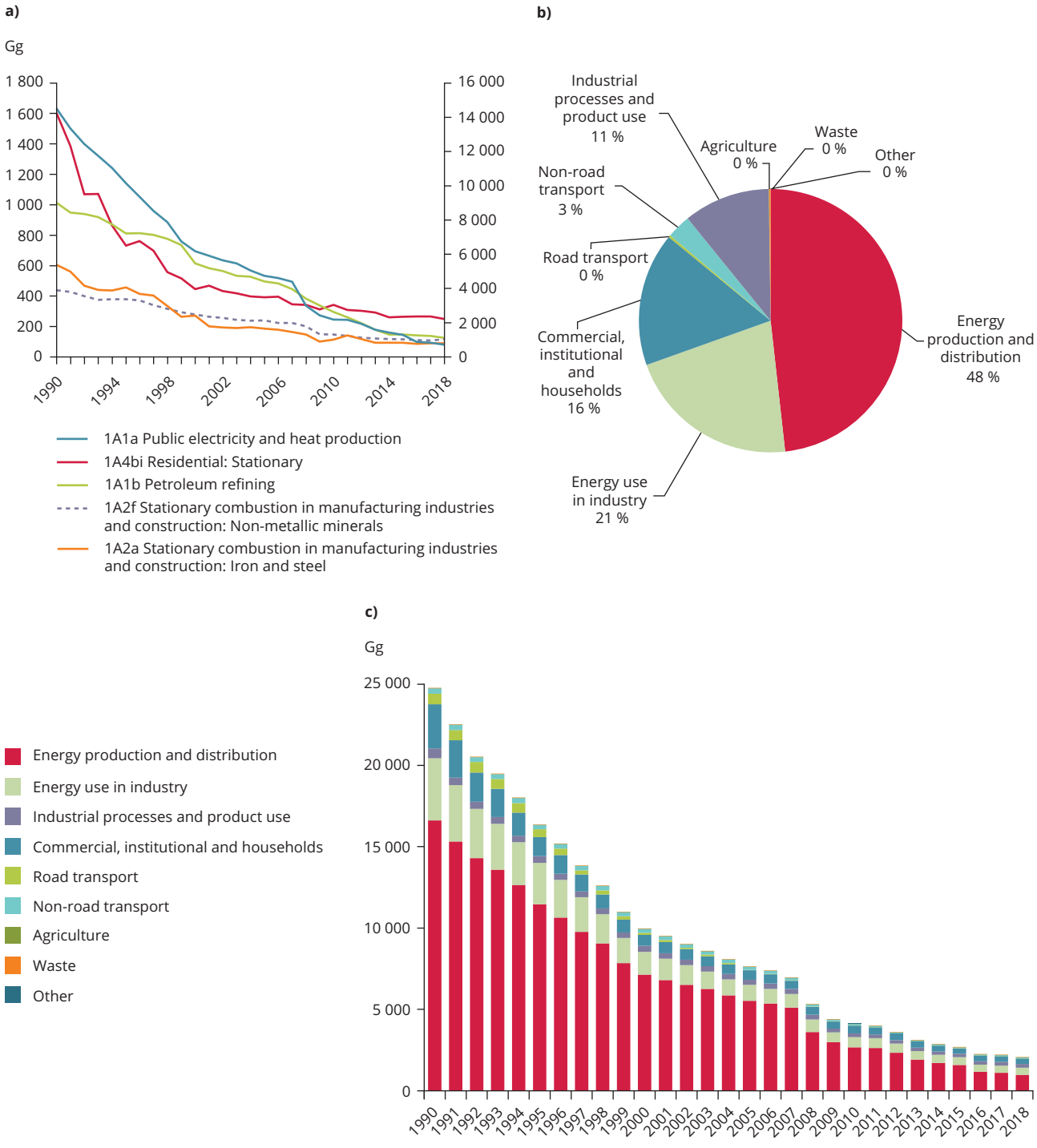
Member State	SO_x (Gg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	74	47	32	26	16	15	15	14	15	14	13	13	12	-84	-8.4	0.3	0.6
Belgium	365	258	171	143	61	53	47	43	41	41	40	38	38	-90	-1.0	1.5	1.9
Bulgaria	1 106	1 302	863	779	387	514	328	194	187	142	105	103	89	-92	-13.7	4.5	4.3
Croatia	169	77	60	59	35	29	25	17	14	16	15	13	10	-94	-18.7	0.7	0.5
Cyprus	32	40	48	38	22	21	16	14	17	13	16	16	17	-47	3.7	0.1	0.8
Czechia	1 755	1 059	233	208	164	168	160	145	134	129	115	110	97	-94	-12.2	7.1	4.7
Denmark	178	146	32	26	15	14	12	13	10	9.6	10	10	11	-94	5.5	0.7	0.5
Estonia	272	116	97	76	83	73	43	42	47	36	35	39	31	-89	-20.2	1.1	1.5
Finland	249	105	82	70	66	60	50	48	44	41	40	35	33	-87	-5.4	1.0	1.6
France	1 283	958	626	458	275	235	227	211	166	159	140	140	136	-89	-2.7	5.2	6.7
Germany	5 473	1 751	650	477	405	389	372	360	339	336	311	302	289	-95	-4.2	22.1	14.1
Greece	484	492	532	550	205	146	120	106	89	84	61	69	65	-87	-6.8	2.0	3.2
Hungary	830	614	427	43	30	34	31	29	26	24	23	28	23	-97	-17.7	3.4	1.1
Ireland	183	163	144	73	27	25	24	24	17	15	14	14	12	-93	-9.5	0.7	0.6
Italy	1 784	1 322	756	409	218	196	178	146	131	124	117	115	110	-94	-4.3	7.2	5.4
Latvia	100	49	18	8.8	4.3	4.3	4.4	3.9	3.9	3.6	3.5	3.6	3.9	-96	6.8	0.4	0.2
Lithuania	185	74	38	27	18	20	17	15	13	15	15	13	13	-93	0.4	0.7	0.6
Luxembourg	16	8.8	3.3	2.4	1.7	1.3	1.5	1.5	1.5	1.3	1.0	1.0	1.0	-94	-3.8	0.1	0.0
Malta	10	11	10	12	8.0	7.9	7.8	5.1	4.7	2.2	1.8	.8	0.2	-98	-75.5	0.0	0.0
Netherlands	196	136	78	67	36	34	34	30	30	31	28	26	25	-87	-6.0	0.8	1.2
Poland	2 613	2 066	1 341	1 132	817	771	739	702	660	639	533	526	502	-81	-4.5	10.6	24.6
Portugal	318	322	295	190	63	57	52	48	44	46	46	47	45	-86	-4.2	1.3	2.2
Romania	828	702	493	604	353	323	259	208	180	157	107	87	82	-90	-5.3	3.3	4.0
Slovakia	149	130	117	86	68	67	57	52	44	67	26	28	20	-86	-27.3	0.6	1.0
Slovenia	201	124	94	40	10	11	11	9.6	7.7	5.5	4.7	4.9	4.8	-98	-2.2	0.8	0.2
Spain	2 039	1 763	1 390	1 206	244	280	284	221	242	259	216	216	197	-90	-9.0	8.2	9.6
Sweden	103	72	45	37	29	26	26	23	21	18	18	18	17	-83	-1.9	0.4	0.8
United Kingdom	3 769	2 458	1 287	773	450	416	460	397	322	251	180	175	160	-96	-8.5	15.2	7.8
EU-28 (a)	**24 764**	**16 365**	**9 961**	**7 621**	**4 112**	**3 992**	**3 599**	**3 121**	**2 851**	**2 678**	**2 234**	**2 190**	**2043**	**-92**	**-6.7**	**100**	**100**
EU-28 (b)	24 764	16 365	9 961	7 621	4 112	3 992	3 599	3 121	2 851	2 678	2 234	2 190	2043				

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

Figure 3.7 **SO_x emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions**



Note: In Figure 3.7(a), the right-hand axis shows values for '1A1a — Public electricity and heat production'.

3.6 Ammonia emission trends and key categories

Between 1990 and 2018, NH_3 emissions dropped by 26 % in the EU. Between 2017 and 2018, emissions decreased by 1.6 % (see Table 3.9) because of decreases in Germany, Italy, Spain, France and Slovakia (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to NH_3 emissions were Germany, France and Spain (countries ranked according to their shares of the EU total).

In Belgium, the significant decrease in NH_3 emissions between 1999 and 2000 (not shown in Table 3.9) was mainly because of the implementation of successive manure action plans in Flanders (see Belgium's IIR p.153, listed in Appendix 5).

The rising NH_3 emission trend reported by Germany, over the period 2009-2015, reflects data mainly reported for the categories '3Da1 — Inorganic N-fertilizers (also includes urea application)' and '3Da2c — Other organic fertilizers applied to soils (including compost)'.

Spain offered the following explanation for the national NH_3 emission trend observed during the period 1990-2015. Between 1990 and 1993, the decline in NH_3 emissions is related to the significant economic recession and the drought in Spain. From 1994 onwards, agricultural emissions underwent a notable increase, reaching a maximum in 2003. This rise was mainly caused by significant growth in both the national cattle herd and the swine population. The use of synthetic nitrogen fertilisers also increased during that period. Until 2012, a gradual decline in NH_3 emissions was registered at the national level. This reduction was probably due to a combination of factors, including the use of inorganic fertilisers linked to another drought period (2005-2008), a reduction in the number of cattle and the gradual introduction of abatement techniques in manure management and improvements in animal feed formulations. Total NH_3 emissions increased between 2012 and 2017, driven by an increase in the consumption of synthetic nitrogen fertilisers and a greater number of cattle and swine (see Spain's IIR p. 91, listed in Appendix 5).

The principal key categories for NH_3 emissions are '3Da2a — Animal manure applied to soils', '3Da1 — Inorganic N-fertilisers' and '3B1b — Manure management — Non-dairy cattle'. They jointly make up 54 % of total NH_3 emissions (see Figure 3.8(a)). Among the top five key categories, the highest relative reduction in emissions between 1990 and 2018 was in the fifth most important, '3B3 — Manure management — Swine' (38.9 % decrease). There were also large reductions in the most important category, '3Da2a — Animal manure applied to soils' (37.2 % decrease).

Figure 3.8(b) shows the contribution made by each aggregated sector group to total EU emissions. A single sector group, agriculture, is responsible for most (93 %) of the NH_3 emissions in the EU.

Table 3.9 Member State contributions to EU emissions of NH_3

Member State	NH_3 (Gg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	62	63	61	60	63	62	62	62	63	64	65	66	65	5	-1.6	1.2	1.7
Belgium	130	135	93	78	75	73	73	72	71	72	72	70	70	-46	-0.1	2.5	1.8
Bulgaria	115	61	51	48	43	43	43	45	45	45	47	45	45	-61	-1.3	2.2	1.2
Croatia	54	40	41	43	39	40	39	32	31	34	32	35	36	-34	1.4	1.0	0.9
Cyprus	6.2	7.6	7.3	7.5	7.3	7.2	6.8	6.5	6.6	6.4	6.7	6.8	7.0	12	2.7	0.1	0.2
Czechia	140	98	89	82	77	77	71	80	83	91	81	75	72	-49	-3.9	2.7	1.9
Denmark	127	109	99	90	81	79	78	76	76	76	76	77	77	-39	-0.4	2.4	2.0
*Adjusted data**					*74*	*72*	*71*	*68*	*68*	*69*	*68*	*70*	*69*				
Estonia	22	11	9.0	10	10	10	10	11	11	10	10	10	10	-54	-1.1	0.4	0.3
Finland	35	34	35	38	37	35	35	35	35	33	33	32	32	-7	-0.4	0.7	0.8
*Adjusted data**					*34*	*33*	*33*	*33*	*33*	*32*	*32*	*31*	*31*				
France	653	635	647	606	605	595	595	593	597	603	603	599	594	-9	-0.8	12.6	15.4
Germany	760	655	667	641	641	670	658	674	676	684	676	666	636	-16	-4.4	14.7	16.5
*Adjusted data**					*600*	*620*	*606*	*614*	*616*	*624*	*616*	*607*	*577*				
Greece	90	81	78	77	73	72	70	70	67	65	65	64	63	-30	-1.4	1.7	1.6
Hungary	134	79	84	79	71	72	71	73	74	78	79	80	78	-42	-1.5	2.6	2.0
Ireland	110	113	115	113	108	104	106	108	108	111	116	118	119	9	0.8	2.1	3.1
Italy	467	453	458	426	387	390	400	389	378	379	386	379	366	-22	-3.5	9.0	9.5
Latvia	35	17	14	14	15	15	15	15	16	15	16	16	15	-55	-2.9	0.7	0.4
Lithuania	77	36	32	37	37	37	36	35	37	39	38	39	39	-50	-1.2	1.5	1.0
Luxembourg	6.7	6.9	7.0	6.1	5.9	5.8	5.6	5.6	5.7	5.8	5.8	6.0	5.9	-11	-1.0	0.1	0.2
Malta	1.9	1.9	1.8	1.7	1.6	1.4	1.4	1.4	1.4	1.4	1.3	1.2	1.3	-33	4.6	0.0	0.0
Netherlands	350	223	175	153	133	129	124	123	126	128	128	131	129	-63	-1.4	6.8	3.4
*Adjusted data**									*124*	*126*	*126*	*126*	*125*				
Poland	453	368	331	325	303	304	295	295	289	285	292	307	317	-30	3.2	8.7	8.2
Portugal	76	71	75	62	56	57	55	53	55	56	56	57	56	-26	-1.5	1.5	1.5
Romania	347	235	193	208	181	182	178	179	175	179	174	175	176	-49	0.6	6.7	4.6
Slovakia	65	43	37	36	32	31	33	33	33	33	33	35	30	-53	-13.2	1.2	0.8
Slovenia	23	21	22	20	20	19	19	18	18	19	19	19	19	-19	-0.8	0.4	0.5
Spain	463	425	516	476	431	418	414	421	439	448	460	479	470	2	-1.9	8.9	12.2
Sweden	60	61	60	58	55	54	53	54	54	54	53	53	53	-12	-0.2	1.2	1.4
United Kingdom	323	299	303	280	258	262	259	255	267	272	276	278	277	-14	-0.6	6.2	7.2
EU-28 (a)	**5 185**	**4 380**	**4 301**	**4 080**	**3 844**	**3 845**	**3 807**	**3 814**	**3 839**	**3 887**	**3 901**	**3 920**	**3859**	**-26**	**-1.6**	**100**	**100**
EU-28 (b)	5 185	4 380	4 301	4 080	3 844	3 845	3 807	3 814	3 839	3 887	3 901	3 920	3 859				
EU-28 (c)	5 185	4 380	4 301	4 080	3 794	3 786	3 746	3 745	3 768	3 816	3 829	3 847	3 786				

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

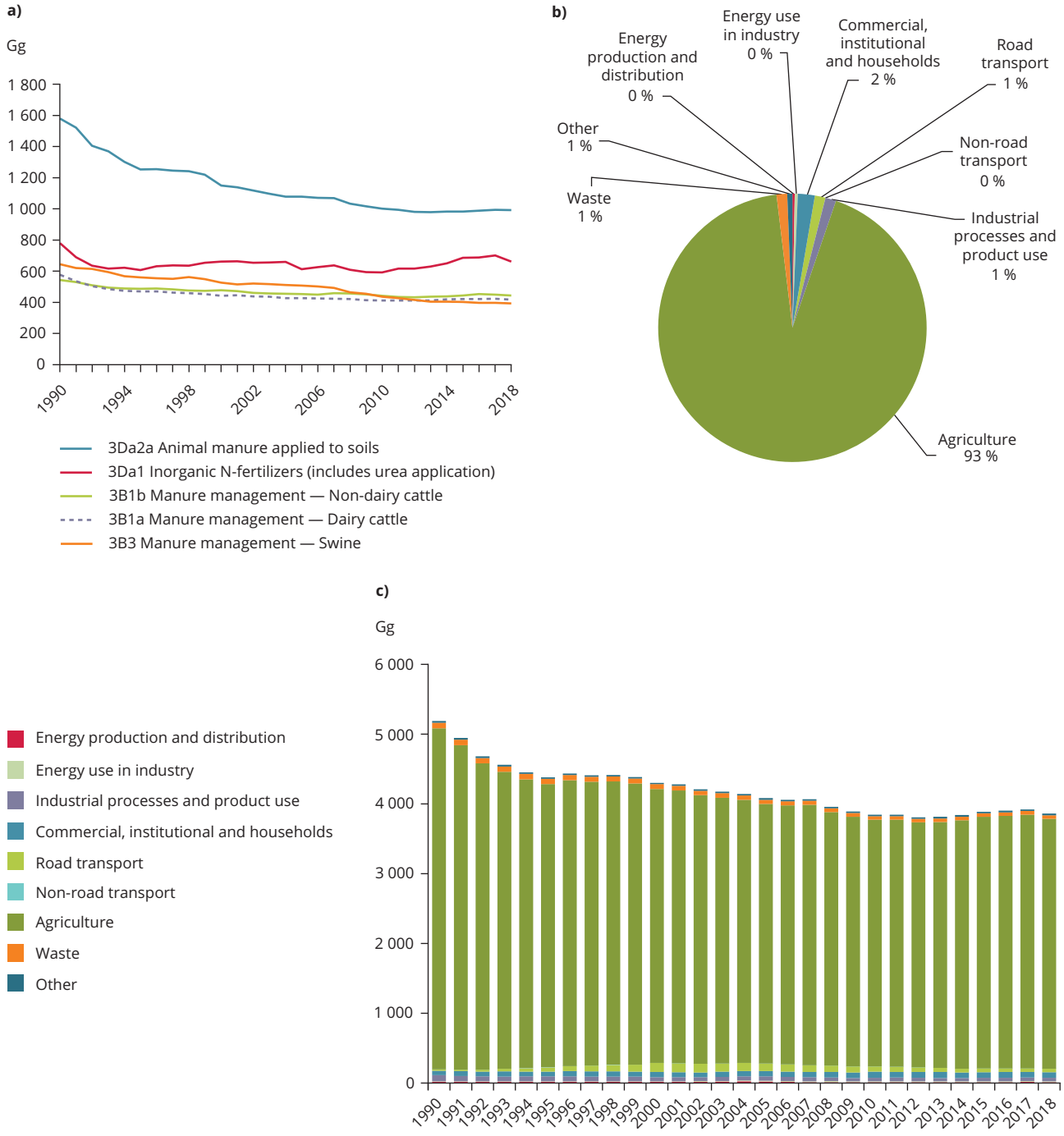
(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

(b) Sum of sectors.

(c) Sum of national totals, as reported by EU Member States and the United Kingdom, under consideration of approved adjustments.

*Adjusted data: under the Gothenburg Protocol, the EMEP Steering Body accepted inventory adjustment applications for emissions from Denmark, Finland, Germany and the Netherlands.

Figure 3.8 **NH_3 emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions**



3.7 Fine particulate matter emission trends and key categories

Between 2000 and 2018, $PM_{2.5}$ emissions dropped by 32. % in the EU. Between 2017 and 2018, there was a decrease of 3.8 % (see Table 3.10), mainly because emissions decreased in Italy, France, Hungary and Slovakia (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to $PM_{2.5}$ emissions were Italy, Poland, France and Spain (countries ranked according to their shares of the EU total).

Estonia reported that the growth in $PM_{2.5}$ emissions from 2010 to 2011 resulted from greater electricity production during that period. In 2011, the significant growth in primary PM emissions in general was due to an increase in electricity production at Estonia's Balti power station (Eesti Energia Narva Elektrijaamad AS) and to the incorrect operation of electric precipitators in two of its power units. In 2018, particulate emissions

Table 3.10 Member State contributions to EU emissions of $PM_{2.5}$

Member State	$PM_{2.5}$ (Gg)											Change (%)		Share in EU-28 (%)	
	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2000-2018	2017-2018	2000	2018
Austria	24	23	20	19	18	18	16	16	16	15	14	-41	-6.8	1.3	1.1
Belgium	41	35	32	26	27	28	22	24	25	23	22	-45	-3.1	2.2	1.8
Bulgaria	25	30	31	33	33	32	31	32	32	32	30	19	-4.0	1.4	2.4
Croatia	34	42	37	35	34	33	29	32	31	30	29	-15	-3.0	1.8	2.3
Cyprus	2.6	2.2	1.7	1.6	1.3	1.2	1.1	1.2	1.3	1.4	1.4	-47	-0.4	0.1	0.1
Czechia	49	43	44	43	43	43	41	40	39	40	39	-20	-2.2	2.6	3.1
Denmark	21	22	21	19	18	18	17	17	17	17	16	-23	-2.2	1.2	1.3
Estonia	15	13	14	18	8.7	12	8.9	9.7	7.9	9.4	6.8	-56	-27.2	0.8	0.5
Finland	26	25	24	21	21	20	19	18	18	18	18	-31	-0.2	1.4	1.4
France	320	247	197	170	173	173	148	149	149	143	134	-58	-6.2	17.3	10.7
Germany	174	141	123	118	117	115	107	106	100	98	97	-44	-1.7	9.4	7.7
Greece	61	63	42	42	43	39	39	37	34	35	33	-46	-4.5	3.3	2.6
Hungary	48	40	50	56	58	59	50	52	50	48	42	-14	-13.3	2.6	3.3
Ireland	20	19	16	15	14	15	14	14	13	12	12	-40	0.5	1.1	1.0
Italy	197	176	198	151	177	171	154	159	155	162	143	-27	-11.4	10.6	11.4
Latvia	27	28	22	22	23	21	21	18	18	20	20	-25	4.2	1.5	1.6
Lithuania	7.1	9.2	7.9	9.3	8.1	6.6	6.3	5.5	5.4	6.0	5.8	-18	-3.8	0.4	0.5
Luxembourg	2.4	2.5	1.8	1.6	1.6	1.5	1.6	1.3	1.5	1.3	1.4	-41	9.4	0.1	0.1
Malta	1.0	0.7	0.5	0.5	0.5	0.4	0.5	0.4	0.3	0.3	0.3	-67	-6.5	0.1	0.0
Netherlands	29	23	18	17	15	15	14	14	13	13	12	-58	-4.0	1.6	1.0
Poland	150	154	153	146	143	137	129	129	134	138	137	-9	-0.8	8.1	10.9
Portugal	74	67	56	57	55	52	52	52	51	52	51	-31	-1.2	4.0	4.1
Romania	104	120	129	119	122	114	115	110	110	111	111	6	-0.4	5.6	8.8
Slovakia	42	34	25	23	24	22	17	18	19	18	15	-64	-16.6	2.3	1.2
Slovenia	11	14	14	13	13	13	11	12	12	12	11	-5	-6.6	0.6	0.9
Spain	163	146	136	138	123	135	121	128	126	126	125	-23	-0.2	8.8	10.0
Sweden	33	31	26	25	24	23	20	19	19	20	18	-44	-5.3	1.8	1.5
United Kingdom	148	126	119	106	112	113	107	108	106	106	108	-27	1.8	8.0	8.6
EU-28 ([a])	**1 851**	**1 677**	**1 558**	**1 445**	**1 450**	**1 431**	**1 311**	**1 322**	**1 303**	**1 304**	**1255**	**-32**	**-3.8**	**100**	**100**
EU-28 ([b])	1 851	1 677	1 558	1 445	1 450	1 431	1 311	1 322	1 303	1 304	1255				

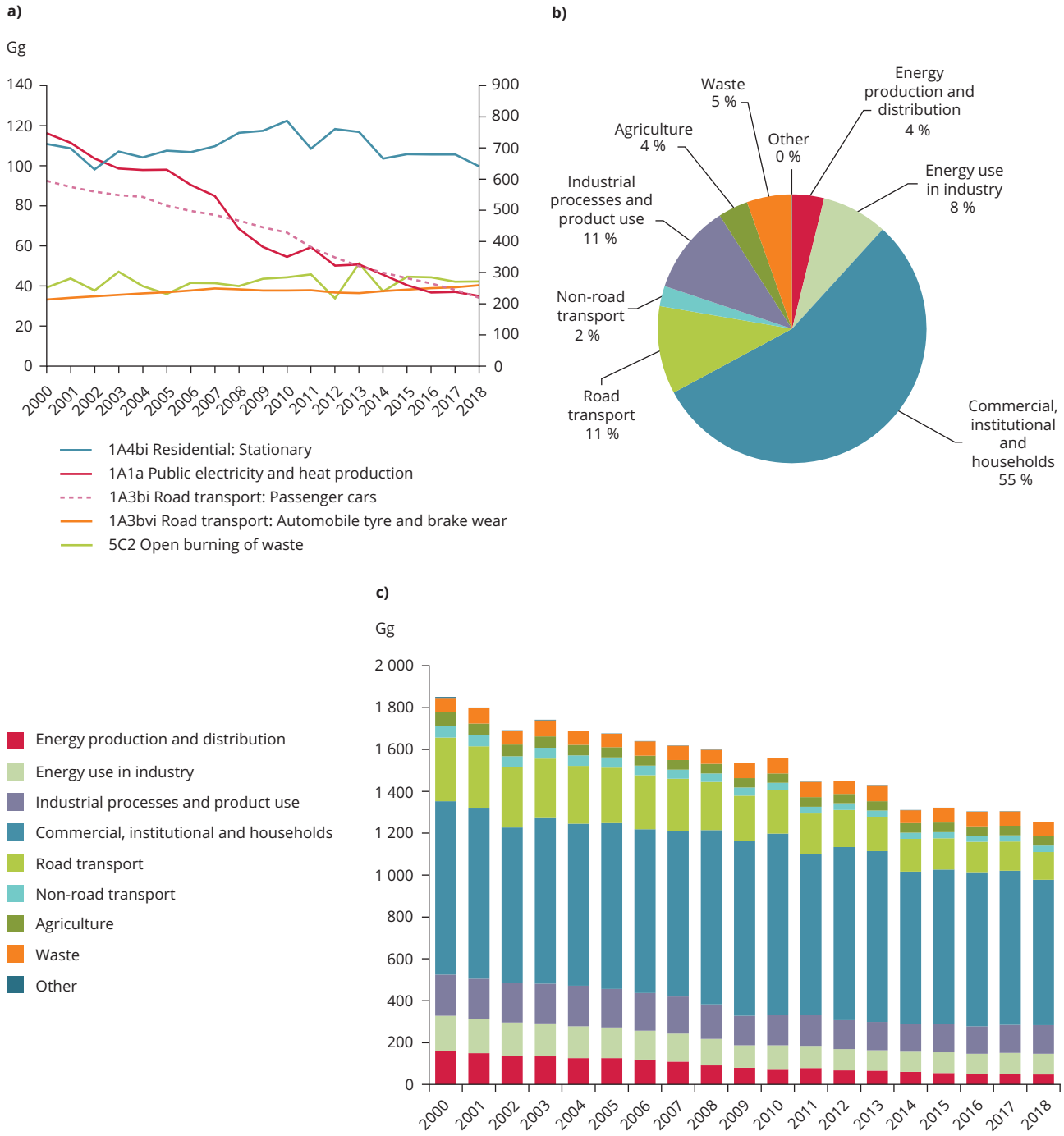
Notes: Light-blue shaded cells denote gap-filled data. For more detailed information, see Annex D.

The LRTAP formally requests Parties to report emissions of PM for 2000 and thereafter.

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

([b]) Sum of sectors.

Figure 3.9 **$PM_{2.5}$ emissions in the EU: (a) trend in emissions from the five most important key categories, 2000-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions**



Notes: In Figure 3.9(a), the right-hand axis shows values for '1A4bi — Residential: Stationary'.

The LRTAP Convention formally requests Parties to report emissions of PM for 2000 and thereafter.

decreased by 14 % in comparison with 2017, mainly because of a decrease in the use of wood and wood waste in the industrial combustion sector and a decrease in electricity production at oil shale power plants. (see Estonia's IIR p. 46, listed in Appendix 5).

Domestic fuel use in '1A4bi — Residential: Stationary' is the principal key category for $PM_{2.5}$ emissions, making up 51 % of the total (Figure 3.9(a)). Among the top five key categories, the highest relative reduction in emissions between 2000 and 2018 was in the fourth most important, '1A1a — Public electricity and heat production' (70 % decrease). There were also large reductions in the fifth most important category, '1A3bi — Road transport: Passenger cars' (63.2 % decrease).

In contrast, emissions from the third most important key category, '1A3bvi — Road transport: Automobile tyre and brake wear' have increased by 21.4 % since 2000.

Figure 3.9(b) shows the contribution to total EU emissions made by each aggregated sector group. The commercial, institutional and households sector group is a major source of $PM_{2.5}$, as well as PM_{10}, CO and PCDD/Fs.

3.8 Particulate matter emission trends and key categories

Between 2000 and 2018, PM_{10} emissions decreased by 29 % in the EU. Between 2017 and 2018, the decrease was 2.1 % (see Table 3.11) mainly because emissions dropped in Italy, France, Greece and Hungary (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to PM_{10} emissions were Poland, France, Germany and Spain (countries ranked according to their shares of the EU total).

As for $PM_{2.5}$, '1A4bi — Residential: Stationary' is the most significant key category for PM_{10} emissions, accounting for 35 % of total PM_{10} emissions (see Figure 3.10(a)). Among the top five key categories, the highest relative reduction in emissions between 1990 and 2018 was in the third most important, '2A5b — Construction and demolition' (27.9 % decrease). Reductions in emissions were also observed in the fifth most important category, '2A5a — Quarrying and mining of minerals other than coal' (21.2 % decrease). Emissions of the fourth most important key category, '1A3bvi — Road transport: Automobile tyre and brake wear' (21.4 %), have increased since 2000. Emissions from the other two top five key categories, namely '1A4bi — Residential: Stationary' and '3Dc — Farm-level agricultural operations including storage, handling and transport of agricultural products', have remained quite constant (decreased by 9.9 % and increased by 1.0 %, respectively).

Figure 3.10(b) shows the contribution of each aggregated sector group to total EU emissions. The commercial, institutional and households sector group is a major source of $PM_{2.5}$, and also of PM_{10}, CO, PAHs and PCDD/Fs.

Table 3.11 Member State contributions to EU emissions of PM_{10}

Member State	PM_{10} (Gg)											Change (%)		Share in EU-28 (%)	
	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2000-2018	2017-2018	2000	2018
Austria	38	36	32	31	31	30	28	28	28	28	26	-30	-4.3	1.4	1.3
Belgium	56	47	42	35	36	38	32	34	35	33	32	-42	-1.6	2.0	1.6
Bulgaria	46	56	53	57	56	52	52	55	48	47	48	3	1.9	1.7	2.4
Croatia	42	53	47	45	43	42	38	41	40	39	38	-10	-2.2	1.5	1.9
Cyprus	4.8	4.1	3.3	3.0	2.3	2.0	1.9	2.0	2.1	2.3	2.3	-52	1.2	0.2	0.1
Czechia	65	57	57	55	55	55	52	52	50	51	51	-23	-1.7	2.3	2.5
Denmark	35	35	34	32	30	30	29	28	28	28	29	-17	0.6	1.2	1.4
Estonia	32	21	23	34	14	20	15	15	12	14	11	-65	-20.8	1.1	0.6
Finland	43	41	39	36	35	34	34	31	32	31	31	-27	0.4	1.5	1.6
France	423	340	280	253	256	256	227	230	230	227	216	-49	-4.8	15.2	10.8
Germany	310	253	233	231	230	230	223	219	204	207	211	-32	2.0	11.1	10.6
Greece	122	120	85	72	70	66	70	64	64	62	57	-54	-8.5	4.4	2.9
Hungary	72	72	72	75	74	78	73	74	71	67	62	-14	-6.6	2.6	3.1
Ireland	39	41	35	29	29	29	28	28	28	28	28	-29	-2.2	1.4	1.4
Italy	252	227	238	189	213	206	188	194	189	196	177	-29	-9.3	9.0	8.9
Latvia	31	36	29	31	32	29	29	27	26	27	28	-10	3.7	1.1	1.4
Lithuania	8.7	14	13	14	14	12	12	11	11	11	11	31	0.6	0.3	0.6
Luxembourg	2.9	3.0	2.3	2.2	2.1	2.1	2.1	2.0	2.0	1.9	2.0	-31	5.4	0.1	0.1
Malta	1.4	1.0	0.8	0.8	0.8	0.7	0.8	0.6	0.5	0.5	0.5	-64	-4.4	0.1	0.0
Netherlands	42	34	28	28	26	25	25	25	24	24	23	-46	-3.5	1.5	1.1
Poland	264	278	274	260	254	241	229	230	237	243	243	-8	0.0	9.5	12.2
Portugal	111	109	89	96	87	75	69	71	73	74	71	-36	-4.0	4.0	3.6
Romania	136	157	165	156	162	152	152	147	144	143	146	7	2.5	4.9	7.4
Slovakia	51	40	29	27	28	26	21	23	24	23	20	-61	-13.3	1.8	1.0
Slovenia	15	18	16	15	15	15	13	14	14	14	13	-10	-4.1	0.5	0.7
Spain	261	251	214	214	194	205	190	200	201	198	198	-24	0.0	9.3	10.0
Sweden	52	50	44	45	41	43	39	38	38	39	38	-27	-2.7	1.9	1.9
United Kingdom	238	205	186	168	169	176	168	167	170	174	176	-26	1.2	8.5	8.9
EU-28 (a)	**2 793**	**2 602**	**2 364**	**2 236**	**2 196**	**2 170**	**2 040**	**2 051**	**2 025**	**2 031**	**1 989**	**-29**	**-2.1**	**100**	**100**
EU-28 (b)	2 793	2 602	2 364	2 236	2 196	2 170	2 040	2 051	2 025	2 031	1 989				

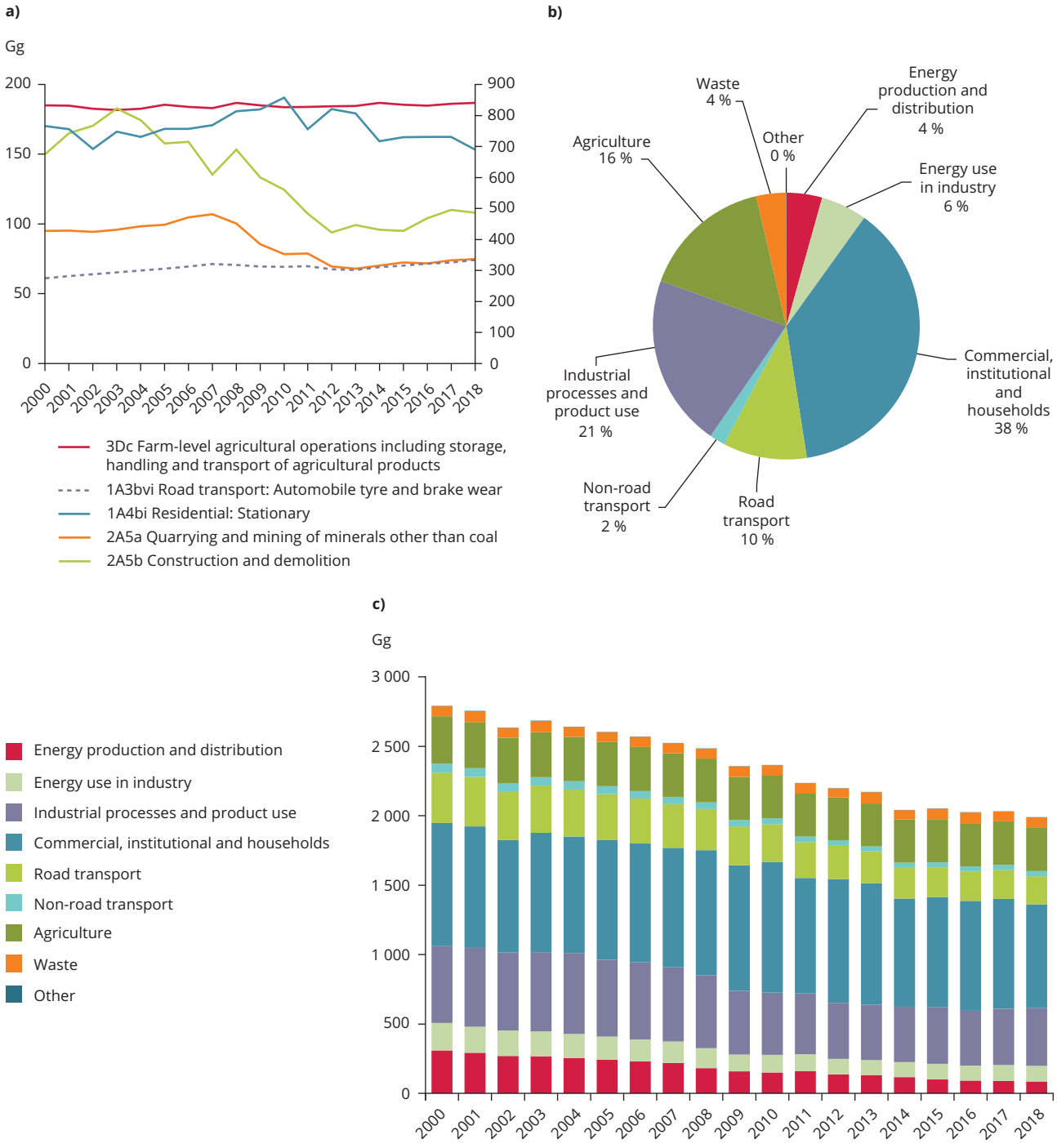
Notes: Light-blue shaded cells denote gap-filled data. For more detailed information, see Annex D.

The LRTAP Convention formally requests Parties to report emissions of PM for 2000 and thereafter.

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

Figure 3.10 **PM_{10} emissions in the EU: (a) trend in emissions from the five most important key categories, 2000-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions**



Notes: In Figure 3.10(a), the right-hand axis shows values for '1A4bi — Residential: Stationary'.

The LRTAP Convention formally requests Parties to report emissions of PM for 2000 and thereafter.

3.9 Total suspended particulate emission trends

Between 1990 and 2018, TSP emissions dropped by 54 % in the EU. Between 2017 and 2018, emissions decreased by 1.3 % (Table 3.12), mainly because of decreases in the Italy, France, Greece, and Portugal (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to TSP emissions were France, the United Kingdom, Germany and Poland (countries ranked according to their shares of the EU total).

Germany explained that, between 1990 and 2018, total TSP emissions dropped by 81.2 % because of the application of the former West Germany's stricter regulations in the new German *Länder* following Germany's reunification, the transition from solid to gaseous and liquid fuels, and improved filter technologies for combustion plants and industrial processes (see Germany's IIR, listed in Appendix 5).

Latvia stated that the high TSP emissions in 2004 (not shown in Table 3.12) can be explained by increased road-paving activities. The new 'Via Baltica' motorway was built, connecting the capitals of all Baltic States.

Table 3.12 Member State contributions to EU emissions of TSPs

Member State	TSPs (Gg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	2000	2018
Austria	53	52	51	48	44	43	42	42	40	40	39	40	38	-28	-3.4	0.7	1.0
Belgium	97	90	84	72	60	52	53	55	48	50	52	51	51	-47	0.9	1.2	1.4
Bulgaria	100	126	102	153	114	127	113	108	111	139	100	97	106	6	9.4	1.2	2.8
Croatia	60	53	52	72	62	61	58	54	51	54	52	52	52	-14	-1.1	0.7	1.4
Cyprus	15	12	9.5	6.6	5.6	5.0	3.8	3.0	2.7	2.8	3.1	3.4	3.5	-77	2.4	0.2	0.1
Czechia	581	215	89	72	69	67	66	67	64	63	61	62	62	-89	-0.9	7.2	1.6
Denmark	112	108	105	100	99	96	94	93	95	89	88	94	94	-16	-0.3	1.4	2.5
Estonia	279	127	70	34	30	43	21	27	22	20	17	20	17	-94	-14.0	3.4	0.5
Finland	98	68	56	56	54	51	49	49	48	45	47	45	45	-54	-0.2	1.2	1.2
France	1 201	1 111	1 043	936	842	823	825	818	777	791	801	801	780	-35	-2.6	14.8	20.8
Germany	2 057	588	539	437	401	405	402	411	402	393	366	378	388	-81	2.6	25.4	10.3
Greece	112	109	239	225	163	118	108	108	121	113	121	115	99	-11	-13.2	1.4	2.7
Hungary	107	98	105	133	107	103	91	105	110	108	102	93	93	-14	-0.3	1.3	2.5
Ireland	85	68	87	101	81	60	61	61	59	61	61	66	63	-26	-4.4	1.0	1.7
Italy	355	348	308	282	292	235	263	254	233	240	235	243	222	-37	-8.8	4.4	5.9
Latvia	38	38	40	57	47	57	57	51	50	54	49	46	47	24	2.3	0.5	1.3
Lithuania	24	12	11	19	18	18	18	16	16	15	15	16	17	-30	4.2	0.3	0.4
Luxembourg	17	9.0	3.5	3.8	3.0	2.9	2.9	2.8	2.8	3.1	2.7	2.8	2.8	-84	0.2	0.2	0.1
Malta	2.8	3.8	4.6	1.5	1.1	1.1	1.1	0.9	1.1	0.8	0.8	0.8	0.7	-73	-2.8	0.0	0.0
Netherlands	97	73	51	43	36	35	35	34	33	32	31	30	30	-70	-3.0	1.2	0.8
Poland	925	682	402	431	429	415	397	376	359	364	369	377	378	-59	0.1	11.4	10.1
Portugal	183	240	266	301	223	244	213	173	149	154	165	172	157	-14	-8.6	2.3	4.2
Romania	282	234	230	296	285	282	281	254	256	234	216	206	223	-21	8.3	3.5	5.9
Slovakia	132	80	71	55	37	35	37	34	30	31	32	31	27	-79	-10.6	1.6	0.7
Slovenia	14	17	21	26	20	18	17	17	15	17	18	18	18	28	-0.9	0.2	0.5
Spain	338	332	343	343	279	277	250	259	245	261	262	261	262	-22	0.3	4.2	7.0
Sweden	86	82	70	68	62	65	59	63	57	57	58	59	58	-32	-2.0	1.1	1.6
United Kingdom	665	527	457	444	423	378	338	377	351	359	389	417	416	-37	-0.2	8.2	11.1
EU-28 (a)	**8 114**	**5 505**	**4 912**	**4 816**	**4 288**	**4 117**	**3 955**	**3 911**	**3 749**	**3 792**	**3 753**	**3 795**	**3748**	**-54**	**-1.3**	**100**	**100**
EU-28 (b)	8 114	5 505	4 912	4 816	4 288	4 117	3 955	3 911	3 749	3 792	3 753	3 795	3748				

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

The largest part of TSP emissions in 2018 were produced in the industrial processes and product use sector 46.2 %. Compared to 2017 emissions have increased by 2.3 % (see Latvia's IIR p. 27, listed in Appendix 5).

Malta reported a significant drop in TSP emissions from 2004 to 2005, reflected mainly by data for the category '1A1a — Public electricity and heat production'.

The emissions reported by Portugal for TSPs in the category '2A5b — Construction and demolition' are responsible for the peak in 1998 (not shown in Table 3.12).

Greece reported an increase from 1995 to 2000 as a result of higher emissions in the categories '11B — Forest fires', '1A3di(i) — International maritime navigation', '1A1a — Public electricity and heat production' and '2D3b — Road paving with asphalt'.

3.10 Black carbon emission trends

Between 2000 and 2018, BC emissions dropped by 46 % in the EU. Between 2017 and 2018, emissions fell by 5 %, mainly because of slightly lower emissions from France, Italy, Germany and Hungary (countries ranked according

Table 3.13 Member State contributions to EU emissions of BC

Member State	Black Carbon (Gg)											Change (%)		Share in EU-28 (%)	
	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2000-2018	2017-2018	2000	2018
Austria														0.0	0.0
Belgium	8.6	7.5	6.7	5.5	5.2	4.9	3.9	3.9	3.8	3.3	3.0	-65	-8.1	2.4	1.6
Bulgaria	2.9	3.8	3.8	4.0	4.1	3.8	3.8	3.8	3.9	3.8	3.7	28	-3.2	0.8	1.9
Croatia	4.8	5.8	5.2	4.9	4.7	4.5	4.0	4.3	4.2	4.1	3.9	-19	-4.1	1.3	2.0
Cyprus	0.6	0.6	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-51	-7.3	0.2	0.2
Czechia	6.2	6.0	5.7	5.3	5.2	5.2	5.0	4.9	4.8	4.8	4.7	-24	-2.4	1.7	2.4
Denmark	5.0	4.6	4.0	3.9	3.5	3.4	3.1	2.9	2.8	2.7	2.6	-48	-5.5	1.4	1.3
Estonia	3.4	3.1	3.2	3.6	2.2	2.6	2.1	2.6	2.2	2.6	2.0	-43	-24.0	1.0	1.0
Finland	6.4	5.6	5.6	4.9	5.0	4.6	4.5	4.2	4.3	4.1	4.0	-37	-2.7	1.8	2.1
France	70	57	45	40	39	37	33	31	29	27	24	-65	-9.8	19.4	12.5
Germany	40	32	23	21	20	19	17	16	15	14	13	-68	-10.5	11.0	6.4
Greece	8.0	9.0	7.3	6.4	6.4	5.4	5.7	6.9	5.8	5.9	5.7	-28	-2.2	2.2	2.9
Hungary	7.1	6.4	7.4	7.9	8.2	8.1	7.0	7.4	7.1	6.8	6.0	-15	-12.3	2.0	3.1
Ireland	4.0	3.8	3.0	2.7	2.5	2.5	2.4	2.3	2.2	2.0	1.9	-52	-3.7	1.1	1.0
Italy	42	38	32	26	27	25	23	22	21	20	19	-56	-9.3	11.6	9.5
Latvia	3.4	3.7	3.1	3.1	3.3	3.0	3.0	2.6	2.6	2.7	2.8	-16	4.0	0.9	1.5
Lithuania	2.5	2.9	2.7	2.8	2.8	2.0	2.0	2.0	1.9	1.8	1.8	-27	-0.8	0.7	0.9
Luxembourg														0.0	0.0
Malta	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-32	-11.0	0.1	0.1
Netherlands	9.8	7.9	5.3	4.8	4.3	3.9	3.4	3.1	2.8	2.6	2.4	-75	-7.6	2.7	1.2
Poland	15	17	18	17	16	15	14	14	15	16	16	6	-0.2	4.2	8.2
Portugal	10	9.1	8.0	7.9	7.3	7.1	7.0	6.6	6.5	6.5	6.4	-38	-1.9	2.9	3.3
Romania	12	14	15	14	14	14	13	13	13	14	13	14	-1.5	3.3	6.9
Slovakia	3.1	3.9	3.5	3.0	3.2	2.9	2.4	2.5	2.6	2.4	2.1	-32	-13.6	0.9	1.1
Slovenia	2.2	2.7	2.7	2.6	2.5	2.5	2.2	2.2	2.3	2.1	2.0	-9	-6.0	0.6	1.0
Spain	46	43	43	44	34	42	33	37	36	35	34	-26	-1.1	12.8	17.6
Sweden	5.3	4.5	3.8	3.6	3.3	3.1	2.9	2.7	2.6	2.5	2.3	-56	-8.6	1.5	1.2
United Kingdom	42	35	27	23	23	21	19	19	18	18	18	-57	-0.5	11.6	9.3
EU-28 ([a])	**360**	**327**	**285**	**263**	**248**	**243**	**218**	**218**	**211**	**205**	**195**	**-46**	**-5.0**	**100**	**100**
EU-28 ([b])	360	327	285	263	248	243	218	218	211	205	195				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

([b]) Sum of sectors.

to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to BC emissions were Spain and France (countries ranked according to their shares of the EU total). Austria and Luxembourg did not provide data for BC, and some of these gaps could not be filled with data. Thus, the EU total is an underestimate.

3.11 Carbon monoxide emission trends and key categories

Between 1990 and 2018, CO emissions fell by 69.4 % in the EU. Between 2017 and 2018, the decrease was 4.3 % (Table 3.14), mainly because emissions fell in Italy, France, Germany and Hungary (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to CO emissions were Germany, France, Poland and Italy (countries ranked according to their shares of the EU total).

Belgium explained that the peak of CO emissions in 2013 was because one of its plants produced lime without oxygen (see Belgium's IIR p. 45, listed in Appendix 5).

Romania reported a significant increase in CO emissions from 2004 to 2005, reflected mainly by data for the category '1A3bi — Road transport: Passenger cars'.

Table 3.14 Member State contributions to EU emissions of CO

Member State	CO (Gg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	1 249	968	722	625	577	560	560	564	529	542	538	529	490	-61	-7.4	2.0	2.5
Belgium	1 355	1 140	873	715	498	398	345	519	321	374	363	297	344	-75	15.8	2.1	1.8
Bulgaria	817	575	371	333	312	313	304	281	273	273	285	285	266	-68	-6.9	1.3	1.4
Croatia	554	444	454	417	328	305	289	279	246	268	258	253	235	-58	-7.0	0.9	1.2
Cyprus	43	38	30	26	18	17	15	14	14	14	14	14	12	-72	-11.1	0.1	0.1
Czechia	2 054	1 562	1 072	921	924	893	878	880	851	836	835	834	831	-60	-0.5	3.2	4.3
Denmark	728	653	476	426	351	309	291	277	253	258	248	245	237	-67	-3.1	1.1	1.2
Estonia	236	212	199	153	157	132	142	134	129	129	140	138	130	-45	-6.1	0.4	0.7
Finland	754	665	595	509	454	414	407	389	383	361	368	359	351	-54	-2.4	1.2	1.8
France	10 287	8 968	6 532	5 242	4 176	3 499	3 160	3 204	2 677	2 671	2 703	2 655	2 514	-76	-5.3	16.2	12.9
Germany	13 716	7 435	5 241	3 959	3 642	3 568	3 315	3 272	3 111	3 176	3 039	3 068	2 938	-79	-4.2	21.6	15.1
Greece	1 170	995	935	794	541	523	566	477	484	463	407	418	396	-66	-5.2	1.8	2.0
Hungary	1 420	951	828	670	519	528	543	537	458	444	435	423	362	-75	-14.4	2.2	1.9
Ireland	350	292	246	215	143	131	124	118	111	108	102	88	78	-78	-11.6	0.6	0.4
Italy	6 797	7 072	4 749	3 494	3 114	2 470	2 702	2 528	2 288	2 304	2 228	2 333	2 082	-69	-10.8	10.7	10.7
Latvia	469	332	263	234	167	168	168	149	142	118	115	121	124	-74	1.9	0.7	0.6
Lithuania	458	283	184	179	158	173	169	160	152	145	144	141	140	-69	-0.5	0.7	0.7
Luxembourg	469	211	40	36	29	27	27	27	26	22	23	23	21	-96	-8.9	0.7	0.1
Malta	20	20	14	13	11	9,7	7,1	7,2	6,8	6,6	6,1	10	8,4	-58	-15.5	0.0	0.0
Netherlands	1 150	929	760	731	670	651	620	588	566	562	555	549	549	-52	0.0	1.8	2.8
Poland	3 442	4 556	3 360	2 968	2 999	2 701	2 667	2 525	2 274	2 247	2 358	2 390	2 339	-32	-2.1	5.4	12.0
Portugal	799	828	682	520	399	367	353	333	316	323	310	326	285	-64	-12.7	1.3	1.5
Romania	673	488	750	1 062	896	827	834	792	795	773	778	782	779	16	-0.4	1.1	4.0
Slovakia	1 041	678	546	557	453	421	429	400	337	352	358	347	301	-71	-13.1	1.6	1.6
Slovenia	305	282	190	165	132	129	124	123	102	108	111	106	99	-68	-6.5	0.5	0.5
Spain	3 977	3 107	2 626	1 999	1 774	1 761	1 524	1 747	1 588	1 676	1 655	1 663	1 647	-59	-0.9	6.3	8.5
Sweden	1 088	945	671	530	446	426	399	389	377	364	361	356	337	-69	-5.5	1.7	1.7
United Kingdom	8 035	6 541	4 464	3 163	2 036	1 850	1 832	1 830	1 739	1 698	1 568	1 551	1 541	-81	-0.6	12.7	7.9
EU-28 ([a])	**63 458**	**51 170**	**37 875**	**30 653**	**25 924**	**23 571**	**22 796**	**22 544**	**20 548**	**20 614**	**20 305**	**20 304**	**19 433**	**-69**	**-4.3**	**100**	**100**
EU-28 ([b])	63 458	51 170	37 875	30 653	25 924	23 571	22 796	22 544	20 548	20 614	20 305	20 304	19 433				

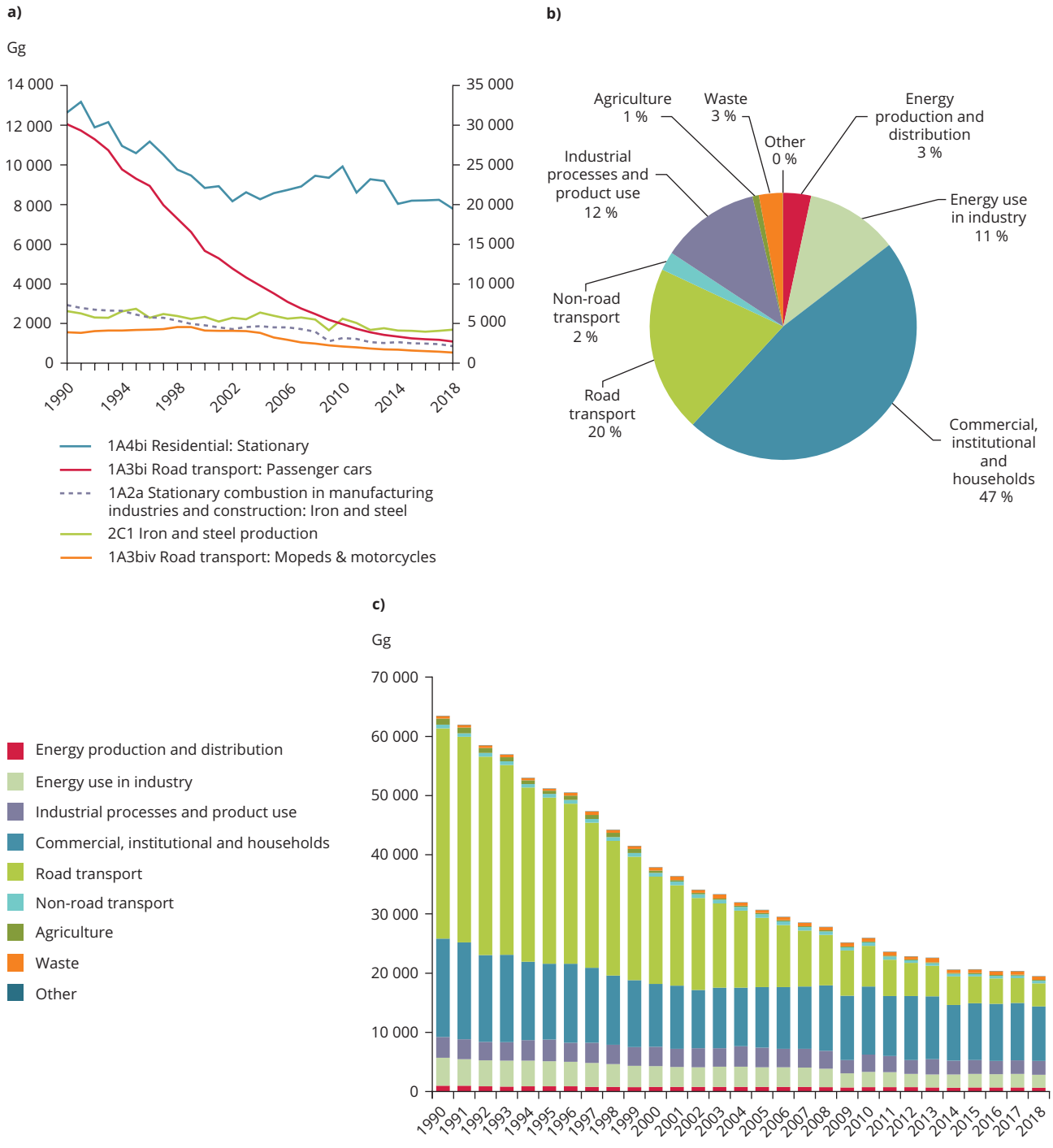
Notes: Light-blue shaded cells denote gap-filled data. For more detailed information, see Annex D.

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

([b]) Sum of sectors: differences arise when only national totals and no sectoral data are availabl

'1A4bi — Residential: Stationary' and '1A3bi — Road transport: Passenger cars' were the most important key categories for CO emissions, jointly accounting for 54.2 % of the total. Among the top five key categories, the highest relative reduction in emissions between 1990 and 2018 was in the second most important, '1A3bi — Road transport: Passenger cars' (90.9 % decrease) (see Figure 3.11(a)). Reductions in emissions were also observed in the other four top-five key categories: '1A4bi — Residential: Stationary' (38.4 % decrease), '2C1 — Iron and steel production' (35.5 % decrease), '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel' (70.7 % decrease) and '1A3biv — Road

Figure 3.11 CO emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions



Note: In Figure 3.11(a), the right-hand axis gives values for '1A3bi — Road transport: Passenger cars'.

transport: Mopeds & motorcycles' (65.4 % decrease) (key categories ranked according to their contribution to the total emissions).

Figure 3.11(b) shows the contribution to total EU emissions made by each aggregated sector group. For CO, the common major emission sources are commercial, institutional and households, and road transport.

3.12 Lead emission trends and key categories

Between 1990 and 2018, Pb emissions dropped by 94 % in the EU. Between 2017 and 2018, emissions decreased by 1.5 % (see Table 3.15), mainly in Belgium, Germany Estonia and the United Kingdom (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Pb emissions were Poland, Italy and Germany (countries ranked according to their shares of the EU total).

Austria stated that the significant reduction in Pb emissions from 1990 to 1995 was linked to the ban on Pb in gasoline, abatement techniques and product substitutions. During this period, emissions from the transport sector fell by nearly 100 %. Compared with 2017, Pb emissions decreased by 6.2 % in 2018 as a result of reduced iron and steel production activities (see Austria's IIR p. 13, listed in Appendix 5).

Belgium explained that the decrease in Pb emissions between 1995 and 2000 was mainly due to certain measures taken in two large plants in Flanders. At one plant (2C7c), a number of installations were taken out of service at the end of 1997 (electric kiln, agglomeration and roasting) and the ore park was evacuated. This led to a significant decrease in Pb, Cd and Zn emissions. At another plant (2C1), there were lower mass flows of Pb emissions in 1997, possibly as a result of replacing the sintering plant's electro-filter with a sleeve filter. Another factory (2A3) reporting Pb emissions in 1997 did not produce an annual industrial report in 1998 and stopped activities in 1999 (personal communication by Belgium in 2018).

Croatia explained that, between 1990 and 2018, Pb emissions from the transport sector fell by 98.4 % as the result of legislative moves to remove Pb from petrol. Efforts began in 1996 when the Pb content in leaded petrol was reduced, before it was reduced again in 2003. Finally, in 2006, leaded petrol was completely removed from use (personal communication by Croatia in 2017).

Czechia explained that the fall in Pb emissions since the year 2000 is due to the ban on leaded fuel in 2001 (personal communication by Czechia in 2017).

In 2018, Latvia's Pb emissions fell by 98.6 % compared with 1990. In 1999, a significant drop in lead emissions can be seen in the transport sector, which can be explained by changes in international legislation that prohibited the use of liquid fuels with high Pb content. The most significant drop of 97.4 % in emissions occurred in 2011, because of a change in the type of furnace used in metal production (see Latvia's IIR p. 28, listed in Appendix 5).

In 2012, the Pb emission peak reported by Malta was caused by higher emissions in the category '1A1a — Public electricity and heat production'.

Portugal stated that the Pb emissions registered from 1990 to 2018 showed a downwards trend, decreasing by 92.5 %. This was mainly the result of lower emissions from road transport, due to the phasing out of leaded petrol in the EU (see Portugal's IIR pp. 2-5, listed in Appendix 5).

The strong decrease in Pb emissions from 2003 to 2005, reported by Cyprus, is solely attributed to the road transport sector because of the big reduction in the Pb content of petrol (see Cyprus's IIR p. 52, listed in Appendix 5).

2C1 — Iron and steel production', '1A3bvi — Road transport: Automobile tyre and brake wear' and '1A1a — Public electricity and heat' were the leading key categories for Pb emissions in 2018, together making up 47 % of total Pb emissions (see Figure 3.12(a)).

The largest relative reductions in emissions between 1990 and 2018 were from the third most important key category, '1A1a — Public electricity and head production' (84.4 % decrease), and the most important, '2C1 — Iron and steel production' (82.1 % decrease). The second most important key category, '1A3bvi — Road transport: Automobile tyre and brake wear', has increased by 36.5 % since 1990.

EU total emissions of Pb have declined to less than a 10th of the emissions in 1990, primarily because of reduced emissions from the road transport sector.

Table 3.15 Member State contributions to EU emissions of Pb

Member State	Pb (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	232	20	17	18	20	20	20	21	20	20	20	21	19	-92	-6.2	1.0	1.4
Belgium	264	207	107	74	40	30	29	26	23	29	27	25	14	-95	-46.6	1.1	1.0
Bulgaria	448	369	275	124	63	67	69	72	81	74	68	75	74	-83	-0.6	1.9	5.4
Croatia	523	264	145	14	8.1	7.9	7.1	8.5	7.9	7.9	8.0	8.1	8.4	-98	4.3	2.3	0.6
Cyprus	25	26	20	0.6	0.5	0.5	0.5	0.3	0.3	0.4	0.4	0.4	0.4	-98	0.7	0.1	0.0
Czechia	328	266	219	35	22	20	21	22	22	20	16	17	18	-94	8.6	1.4	1.3
Denmark	130	26	20	17	13	13	12	12	12	12	12	12	13	-90	3.1	0.6	0.9
Estonia	207	88	40	37	41	40	36	42	39	31	35	36	33	-84	-8.8	0.9	2.4
Finland	321	73	31	21	20	19	16	16	17	15	16	16	15	-95	-1.5	1.4	1.1
France	4 294	1 476	283	179	138	127	128	124	120	114	114	115	114	-97	-1.2	18.7	8.2
Germany	1 919	716	401	269	212	207	202	200	201	209	203	211	207	-89	-1.7	8.3	15.0
Greece	504	404	339	66	30	29	26	24	26	9	8.7	10.3	11	-98	2.7	2.2	0.8
Hungary	815	143	19	10.6	8.3	9.4	9.3	8.8	8.4	8.9	9.0	8.7	8.2	-99	-5.4	3.5	0.6
Ireland	158	98	14	8.1	6.2	5.8	5.7	5.7	5.5	5.5	5.4	5.1	5.1	-97	0.9	0.7	0.4
Italy	4 289	2 005	967	299	221	232	225	211	214	207	212	214	214	-95	-0.1	18.6	15.5
Latvia	233	127	153	169	164	4.3	5.9	3.8	3.6	3.4	3.3	3.4	3.3	-99	-4.0	1.0	0.2
Lithuania	88	53	4.8	3.2	2.9	2.9	2.8	2.7	2.6	2.5	2.6	2.6	2.6	-97	0.8	0.4	0.2
Luxembourg	19	9.0	1.1	1.4	1.0	1.5	1.7	1.1	1.2	1.3	1.3	1.3	1.2	-94	-10.3	0.1	0.1
Malta	0.4	0.5	0.7	3.9	3.8	2.6	10	3.5	4.5	1.4	0.8	0.2	0.2	-45	-3.2	0.0	0.0
Netherlands	90	75	27	29	37	22	15	13	8.2	7.9	8.1	7.7	5.0	-94	-34.9	0.4	0.4
Poland	549	582	396	279	305	302	315	307	310	301	294	305	303	-45	-0.3	2.4	21.9
Portugal	575	796	44	43	40	41	40	40	40	40	39	40	43	-93	7.3	2.5	3.1
Romania	727	355	49	67	43	43	40	36	37	40	39	39	40	-95	3.1	3.2	2.9
Slovakia	54	48	48	38	30	28	30	31	30	29	30	32	31	-42	-2.0	0.2	2.2
Slovenia	341	192	36	9.7	8.9	8.9	8.5	7.7	7.1	7.3	7.3	7.1	7.6	-98	5.9	1.5	0.5
Spain	2 587	856	476	130	117	96	88	95	95	94	90	87	90	-97	3.8	11.2	6.5
Sweden	354	32	22	14	13	11	11	11	11	10	11	11	9.8	-97	-11.7	1.5	0.7
United Kingdom	2 921	1 563	189	155	102	101	105	99	107	106	96	96	93	-97	-2.9	12.7	6.7
EU-28 (a)	**22 996**	**10 871**	**4 341**	**2 115**	**1 711**	**1 492**	**1 480**	**1 444**	**1 455**	**1 405**	**1 378**	**1 405**	**1 384**	**-94**	**-1.5**	**100**	**100**
EU-28 (b)	22 996	10 871	4 341	2 115	1 711	1 492	1 480	1 444	1 455	1 405	1 378	1 405	1 384				

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

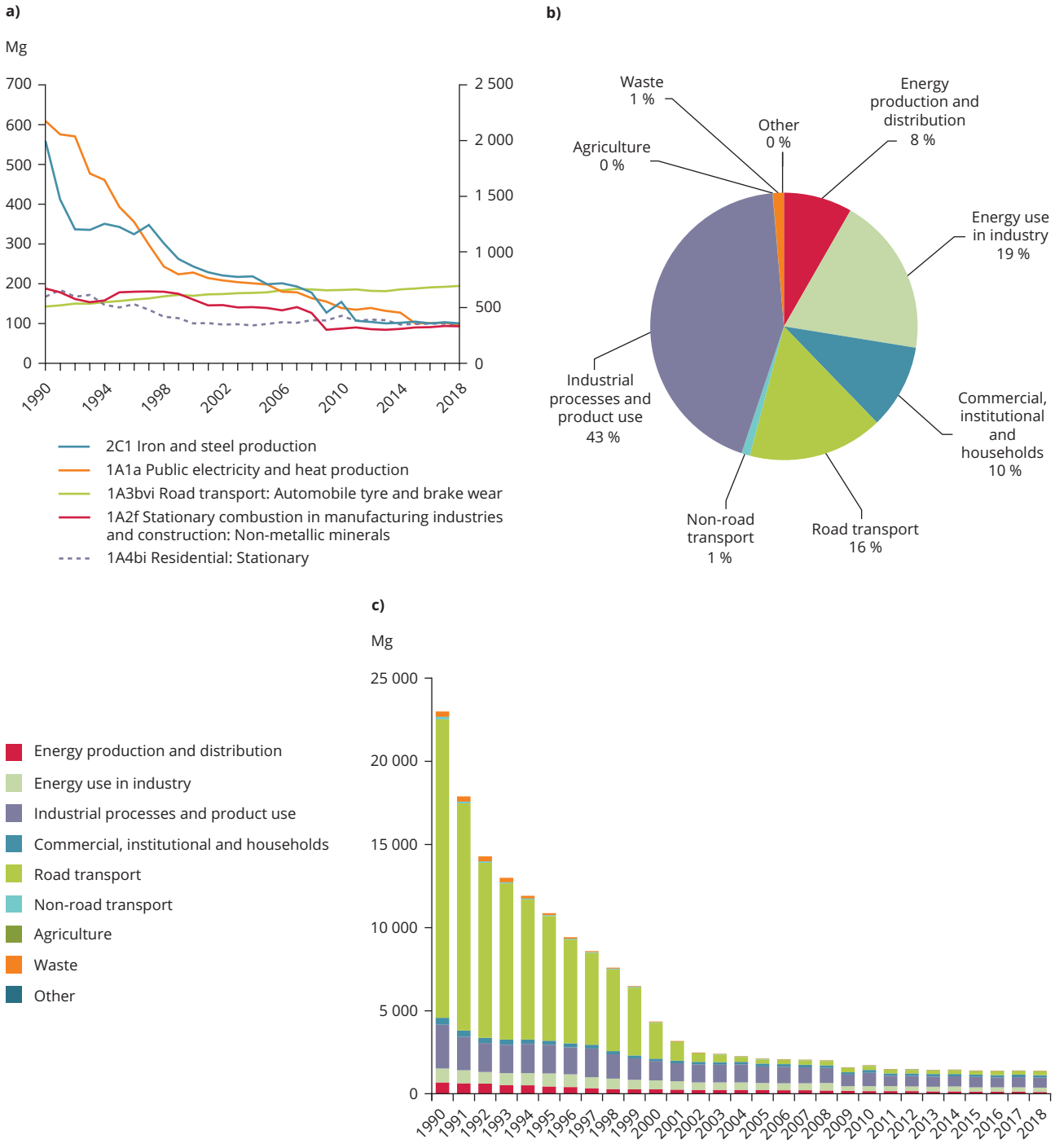
(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

Thanks to a combination of fiscal and regulatory measures, the promotion of unleaded petrol within the EU has proved a notable success. EU Member States and other EEA member countries have now phased out the use of leaded petrol. In the EU, the Directive on the Quality of Petrol and Diesel Fuels (98/70/EC) regulated that goal (EEA, 2018c).

Figure 3.12(b) shows the contribution that each aggregated sector group made to total EU emissions. The sector groups industrial processes and product use, road transport, energy use in industry and commercial, institutional and households are significant sources of Pb.

Figure 3.12 **Pb emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions**



Note: In Figure 3.12(a), the right-hand axis gives values for '2C1 — Iron and steel production'.

3.13 Cadmium emission trends and key categories

Between 1990 and 2018, Cd emissions fell by 66 % in the EU. However, between 2017 and 2018, they increased by 1 % (Table 3.16), mainly because of a slight increase in the Netherlands, Czechia, the United Kingdom and Poland (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Cd emissions were Germany and Poland (countries ranked according to their shares of the EU total).

'1A4bi — Residential: Stationary', '2C1 — Iron and steel production' and '2C7a — Copper production' were the principal key categories for Cd emissions, making up 41 % of total Cd emissions (see Figure 3.13(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2018 were in the fourth most important, '1A1a — Public electricity and heat production' (82.9 % decrease), the third most important, '2C7a — Copper Production (13.9 % decrease) and the second most important, '2C1 — Iron and steel production' (69.9% decrease). In the most important key category, '1A4bi — Residential: Stationary', the values of reported emissions have increased since 1990 (33.2 %).

Table 3.16 Member State contributions to EU emissions of Cd

Member State	Cd (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	1.8	1.1	1.0	1.0	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.2	1.1	-35	-3.7	1.0	1.8
Belgium	6.2	5.1	2.8	2.1	2.0	1.7	1.5	1.5	1.2	1.6	2.6	1.3	1.2	-81	-10.9	3.4	1.9
Bulgaria	5.7	3.9	3.8	3.4	1.5	1.6	1.6	1.6	2.5	1.6	1.8	1.8	1.8	-68	1.3	3.1	2.9
Croatia	1.1	0.8	0.9	1.0	0.9	0.9	0.9	0.9	0.8	0.9	0.8	0.8	0.8	-25	4.1	0.6	1.3
Cyprus	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-57	-1.0	0.0	0.1
Czechia	4.1	2.1	1.7	1.6	1.4	1.4	1.3	1.3	1.3	1.3	1.2	1.2	1.4	-66	16.0	2.2	2.2
Denmark	1.2	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	-34	1.6	0.7	1.3
Estonia	4.6	2.3	0.9	0.8	1.0	0.9	0.9	1.0	1.0	0.8	0.9	0.9	0.8	-82	-7.3	2.5	1.3
Finland	6.7	2.1	1.4	1.5	1.3	1.2	1.2	1.1	0.9	0.9	0.9	1.0	0.9	-87	-7.6	3.6	1.4
France	20	18	14	5.9	3.3	3.1	3.0	3.0	3.2	2.9	3.4	3.1	2.6	-87	-15.1	11.1	4.2
Germany	30	20	19	13	13	13	13	13	13	13	13	13	13	-58	-2.9	16.5	20.3
Greece	7.4	7.7	8.3	8.8	4.6	4.4	4.2	3.6	3.9	2.0	1.8	2.0	1.9	-74	-1.0	4.0	3.1
Hungary	1.7	1.6	1.7	1.2	1.5	1.6	1.7	1.7	1.5	1.6	1.5	1.5	1.4	-21	-10.6	0.9	2.2
Ireland	0.6	0.6	0.6	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-53	-7.3	0.3	0.4
Italy	11	11	10	9.5	6.3	6.5	6.3	5.7	5.6	5.4	5.5	5.4	5.3	-52	-2.0	6.0	8.5
Latvia	0.9	0.8	0.9	1.1	1.0	0.6	0.8	0.7	0.6	0.6	0.6	0.6	0.6	-32	3.7	0.5	1.0
Lithuania	0.3	0.2	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-37	-1.1	0.2	0.3
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-30	-5.7	0.1	0.1
Malta	0.2	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-98	81.8	0.1	0.0
Netherlands	2.1	1.1	0.9	1.7	2.5	1.1	0.8	0.6	0.5	0.5	0.5	0.6	2.3	12	269.3	1.1	3.7
Poland	12	11	8.8	8.5	9.0	9.1	9.2	8.9	9.2	9.4	9.2	9.4	9.5	-21	0.8	6.5	15.1
Portugal	2.4	2.6	2.8	2.5	2.1	2.2	2.1	2.0	2.0	2.1	2.0	2.0	2.0	-17	0.1	1.3	3.3
Romania	5.0	3.9	3.3	3.7	3.4	3.3	3.3	3.0	2.9	2.9	2.9	3.0	3.0	-41	-1.1	2.7	4.7
Slovakia	1.5	1.4	1.3	1.5	1.7	1.8	1.7	1.3	1.4	1.5	1.8	1.7	1.7	10	-3.4	0.8	2.7
Slovenia	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0	-3.5	0.3	0.9
Spain	28	21	15	9.8	5.3	5.9	5.0	5.0	4.8	5.0	4.7	4.9	4.9	-82	0.8	15.1	7.8
Sweden	2.3	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-79	-6.3	1.3	0.8
United Kingdom	26	11	5.7	4.5	3.8	3.9	3.5	3.7	4.1	3.9	3.7	3.9	4.0	-84	4.2	13.9	6.5
EU-28 ([a])	**184**	**132**	**107**	**86**	**70**	**68**	**65**	**63**	**64**	**62**	**62**	**62**	**63**	**-66**	**1.0**	**100**	**100**
EU-28 ([b])	184	132	107	86	70	68	65	63	64	62	62	62	63				

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

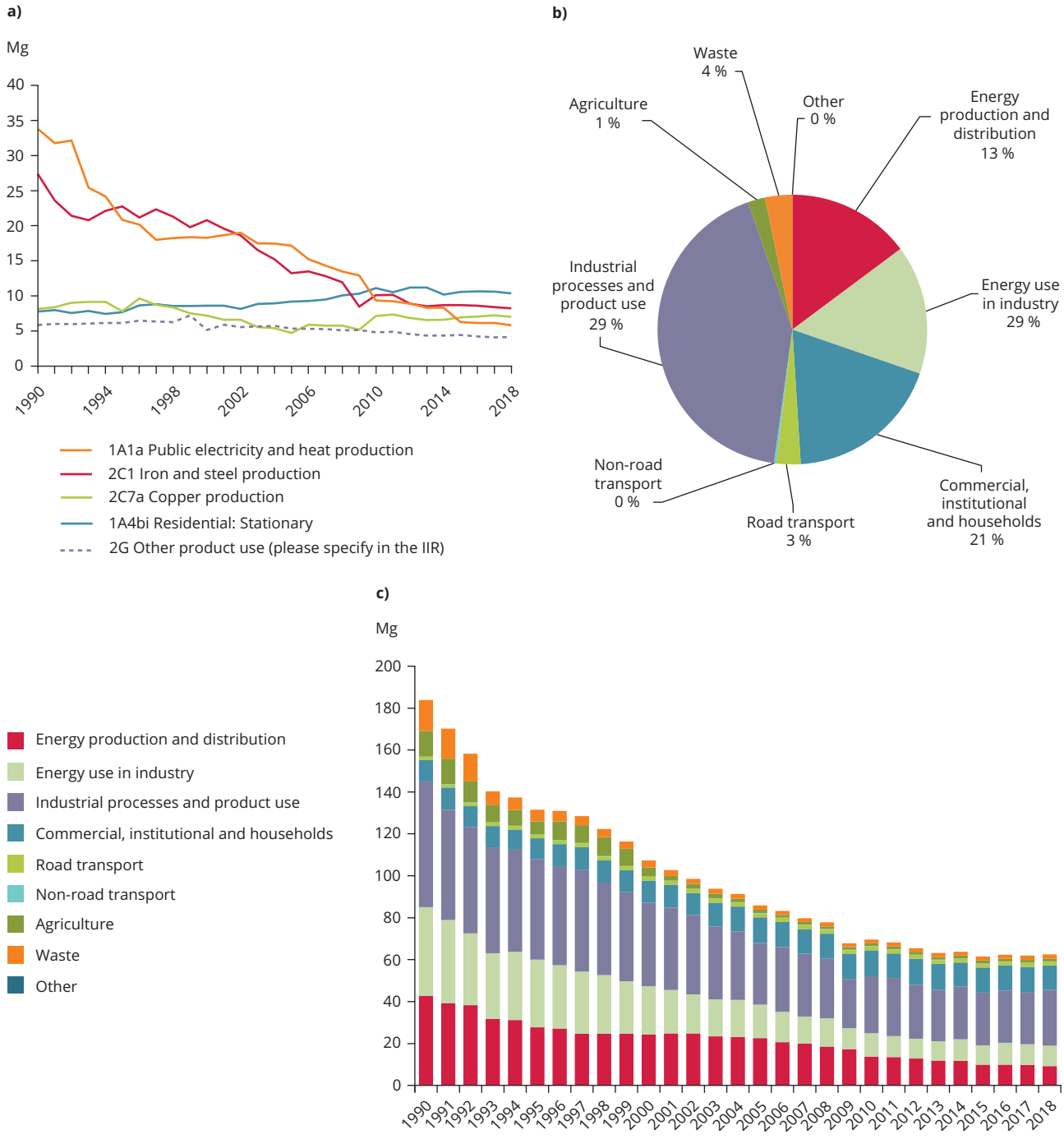
([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

As with Pb, industrial sources of Cd emissions have fallen since the early 1990s in all EU Member States. This is largely because the abatement technologies for waste water treatment and incinerators have improved, as have metal refining and smelting facilities (EEA, 2018c).

Figure 3.13(b) shows the contribution made by each aggregated sector group to total EU emissions. The common leading emission sources of Cd are the industrial processes and product use sector and the commercial, institutional and households energy sector.

Figure 3.13 Cd emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions



3.14 Mercury emission trends and key categories

Between 1990 and 2018, Hg emissions dropped by 72 % in the EU. Between 2017 and 2018, the decrease was 2.0 % (see Table 3.17), mainly because of lower emissions in Germany, Spain, Poland and Italy (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Hg emissions were Poland, Germany and Italy (countries ranked according to their shares of the EU total).

'1A1a — Public electricity and heat production', '2C1 — Iron and steel production' and '1A4bi — Residential: Stationary' were the main key categories for Hg emissions, making up 58 % of the total (see Figure 3.14(a)). Among the top five key categories, the highest relative reduction in emissions between 1990 and 2018 was in the most important, '1A1a — Public electricity and heat production' (69.7 % decrease). The fourth most important key category, '1A2f — Stationary combustion in manufacturing industries and construction: Non-metallic minerals' (69.2 % decrease) and the third most important, '1A4bi — Residential: Stationary' (55.3 % decrease) also show high reductions. In the fifth most important key category, '5C1bv — Cremation', the values of reported emissions have increased since 1990 (45.4 %).

Table 3.17 Member State contributions to EU emissions of Hg

Member State	Hg (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	2.2	1.2	0.9	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	-56	-7.0	1.2	1.9
Belgium	6.1	3.4	3.2	2.2	1.7	1.7	1.3	1.4	1.5	1.1	1.4	1.0	1.4	-77	30.9	3.3	2.7
Bulgaria	2.6	2.0	1.5	1.6	0.9	1.0	0.8	0.8	0.8	0.8	0.8	0.9	0.8	-68	-4.3	1.4	1.6
Croatia	1.1	0.3	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	-64	-3.7	0.6	0.8
Cyprus	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-65	-3.5	0.1	0.1
Czechia	5.0	4.3	3.4	3.5	3.4	3.4	3.0	2.8	2.8	2.7	2.7	2.6	2.7	-45	3.6	2.7	5.4
Denmark	3.2	2.3	1.0	0.7	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-91	-4.1	1.7	0.5
Estonia	1.2	0.7	0.6	0.6	0.7	0.7	0.6	0.7	0.7	0.6	0.7	0.6	0.6	-50	-6.3	0.7	1.2
Finland	1.1	0.8	0.6	0.9	0.9	0.8	0.7	0.8	0.7	0.6	0.6	0.6	0.7	-38	16.8	0.6	1.3
France	26	21	12	7.2	4.8	4.9	4.4	4.3	4.6	4.0	3.5	3.3	3.2	-88	-3.5	13.9	6.3
Germany	35	20	18	14	11	10	10	9.8	9.6	9	8.6	8.5	8.2	-77	-3.5	19.2	16.2
Greece	2.2	2.3	2.6	2.6	2.3	2.3	2.3	2.0	1.4	1.3	1.1	1.1	1.1	-49	-0.9	1.2	2.2
Hungary	3.1	2.2	2.0	1.6	1.1	1.1	1.1	1.0	1.0	1.1	1.0	1.2	1.0	-67	-11.6	1.7	2.0
Ireland	0.8	0.7	0.4	0.4	0.4	0.3	0.4	0.4	0.3	0.4	0.4	0.3	0.3	-63	-10.2	0.4	0.6
Italy	15	14	14	12	8.3	8.5	9.2	7.7	8.4	7.2	6.6	7.2	7.0	-54	-2.6	8.3	13.7
Latvia	0.3	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	-67	-8.8	0.2	0.2
Lithuania	0.5	0.2	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-69	4.3	0.3	0.3
Luxembourg	0.4	0.2	0.3	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	-86	-10.2	0.2	0.1
Malta	0.4	0.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-92	1.1	0.2	0.1
Netherlands	3.5	1.4	1.0	0.9	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.5	0.5	-85	1.8	1.9	1.0
Poland	15	13	11	10	9.4	9.4	9.7	9.6	9.1	9.0	8.9	8.9	8.7	-43	-2.2	8.3	17.2
Portugal	2.2	2.5	2.4	1.8	1.7	1.5	1.5	1.4	1.4	1.4	1.4	1.5	1.4	-35	-3.7	1.2	2.8
Romania	4.0	2.6	2.4	3.1	2.0	2.4	1.8	1.4	1.4	1.4	1.3	1.3	1.4	-66	0.7	2.2	2.7
Slovakia	2.4	2.1	2.1	1.7	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.3	1.2	-49	-3.2	1.3	2.4
Slovenia	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	-53	-0.8	0.2	0.3
Spain	11	13	8.8	7.3	4.2	4.3	4.6	4.0	4.2	4.3	4.4	4.3	4.1	-62	-5.6	5.7	8.0
Sweden	1.5	1.0	0.7	0.7	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-74	0.2	0.8	0.8
United Kingdom	38	20	8.3	7.5	6.5	5.9	5.7	6.0	5.4	4.8	4.0	4.0	3.9	-90	-2.1	20.7	7.8
EU-28 (a)	**184**	**132**	**99**	**83**	**64**	**64**	**62**	**59**	**58**	**55**	**52**	**52**	**51**	**-72**	**-2.0**	**100**	**100**
EU-28 (b)	184	132	99	83	64	64	62	59	58	55	52	52	51				

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

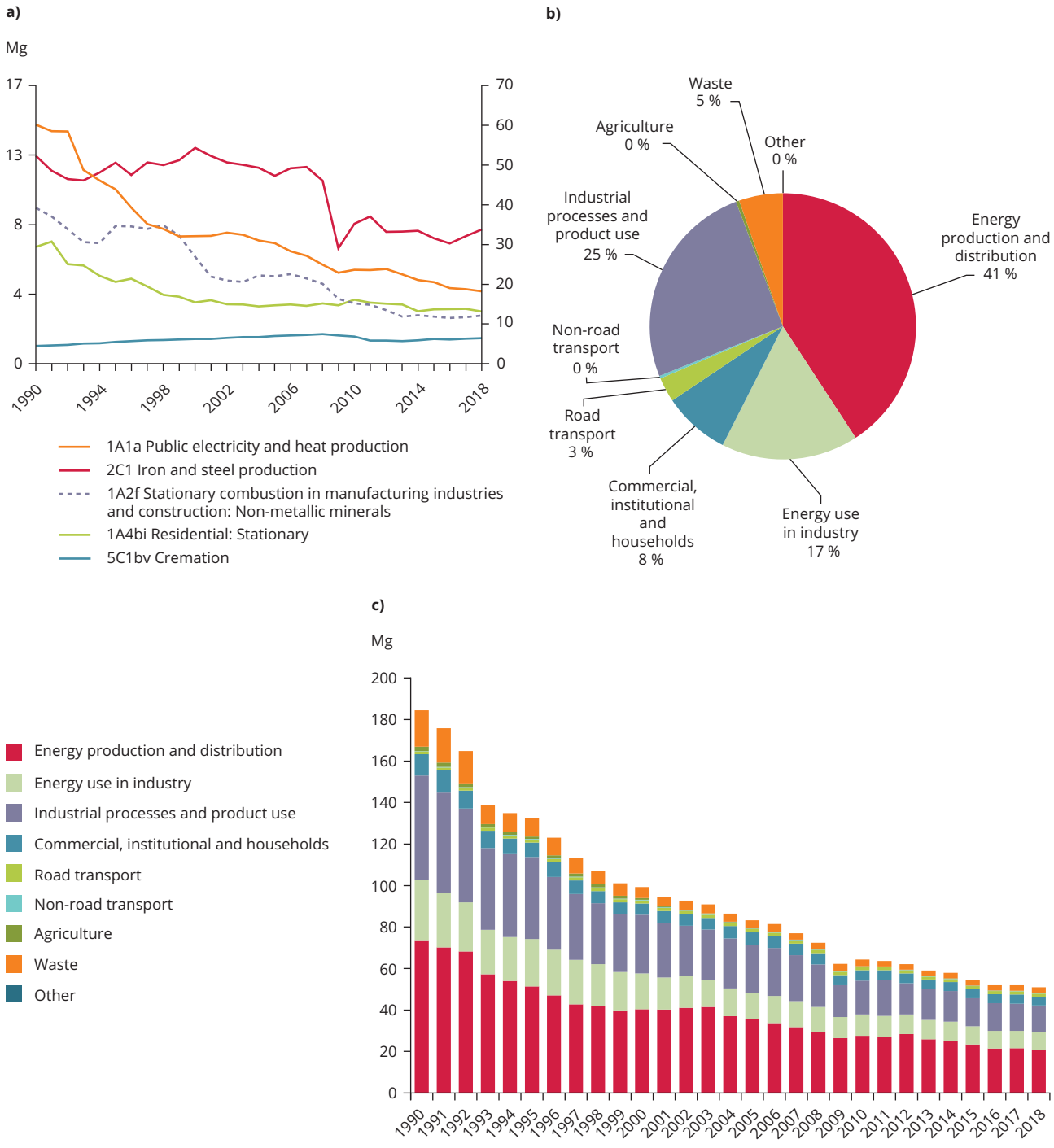
(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

Since 1990, the fall in Hg emissions in the industrial sector is mainly due to better emission controls on Hg cells and replacing them with diaphragm or membrane cells, and switching from coal to gas and other energy sources in many countries' power- and heat-generating sectors (EEA, 2019e).

Figure 3.14(b) shows the contribution made by each aggregated sector group to total EU emissions. For Hg, the principal emission sources are the energy sectors and the industrial processes and product use sector.

Figure 3.14 Hg emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions



Note: In Figure 3.14 (a), the right-hand axis shows values for '1A1a — Public electricity and heat production'.

3.15 Arsenic emission trends

Between 1990 and 2018, As emissions dropped by 79 % in the EU. Between 2017 and 2018, emissions fell by 1.7 % (Table 3.18), mainly because emissions slightly decreased in Estonia, Germany, Poland and the United Kingdom (countries ranked according to the size of their contributions to the absolute change). The EU Member States that contributed most (i.e. more than 10 %) to As emissions in 2018 were Italy, Poland and the United Kingdom (countries ranked according to their shares of the EU total). As Austria and Luxembourg did not provide emission data for As, the EU total is an underestimate.

Table 3.18 Member State contributions to EU emissions of As

Member State	As (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	6.4	6.1	3.6	3.0	1.8	1.6	1.4	1.3	1.0	1.1	0.9	0.8	0.9	-87	3.0	1.0	0.6
Bulgaria	25	15	7.5	16	3.5	4.1	3.0	2.9	4.4	3.0	3.6	3.7	3.5	-86	-5.7	4.0	2.6
Croatia	8.6	1.2	1.1	1.1	0.8	0.6	0.6	0.5	0.4	0.5	0.4	0.5	0.6	-94	6.9	1.4	0.4
Cyprus	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	-22	0.3	0.0	0.1
Czechia	69	17	3.8	2.0	1.7	1.5	1.4	1.6	1.3	1.5	1.4	1.5	1.3	-98	-15.2	11.1	1.0
Denmark	1.3	0.8	0.8	0.5	0.3	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.2	-82	-5.0	0.2	0.2
Estonia	19	10	8.7	9.3	11	11	9.7	11	10	7.8	9.0	9.5	8.7	-54	-9.3	3.0	6.5
Finland	35	5.2	4.4	3.0	3.4	3.0	2.6	2.8	2.7	2.5	2.6	2.4	2.4	-93	-1.3	5.6	1.8
France	17	17	15	12	7.5	6.3	6.0	6.3	5.4	5.3	5.4	5.2	5.3	-69	0.7	2.8	4.0
Germany	87	11	10	9.0	9.7	9.4	9.3	9.5	9.1	9.2	9.2	9.3	8.7	-90	-5.8	14.0	6.6
Greece	2.3	2.6	2.9	3.1	2.3	2.1	2.4	2.1	3.4	3.1	2.5	2.7	2.6	11	-2.7	0.4	2.0
Hungary	4.0	3.3	3.1	2.5	2.2	2.3	2.1	1.8	1.9	2.1	1.9	2.1	2.1	-49	-1.5	0.6	1.6
Ireland	1.6	1.7	1.7	1.5	1.2	1.2	1.3	1.2	1.2	1.3	1.3	1.2	1.1	-35	-9.5	0.3	0.8
Italy	37	27	46	40	45	46	45	44	45	46	38	47	48	30	3.0	5.9	36.2
Latvia	17	8.5	15	17	16	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	-99	-3.7	2.7	0.2
Lithuania	0.6	0.3	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-83	3.9	0.1	0.1
Luxembourg																0.0	0
Malta	0.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-98	35.9	0.0	0.0
Netherlands	1.3	0.9	0.9	1.3	0.6	1.0	0.8	0.7	0.7	0.7	0.7	0.5	0.3	-73	-35.6	0.2	0.3
Poland	145	72	31	19	18	18	18	18	18	18	17	17	17	-88	-2.7	23.3	12.8
Portugal	3.2	3.6	3.7	3.7	1.9	1.7	1.9	1.8	1.7	1.9	1.7	1.8	1.7	-48	-6.5	0.5	1.3
Romania	73	37	5.8	6.5	5.0	5.7	5.2	4.3	4.3	4.5	4.1	4.1	4.1	-94	0.5	11.7	3.1
Slovakia	3.8	3.2	3.2	3.2	3.1	2.9	2.9	3.0	2.9	2.9	3.0	3.1	3.0	-20	-1.8	0.6	2.3
Slovenia	0.9	0.8	0.8	0.9	0.8	0.9	0.8	0.8	0.6	0.6	0.7	0.7	0.7	-27	-2.3	0.1	0.5
Spain	10	9.4	9.8	9.2	5.2	5.9	5.9	5.0	5.1	5.3	4.7	5.2	4.9	-52	-6.2	1.6	3.7
Sweden	5.6	1.6	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.7	0.7	0.8	0.8	-87	-2.5	0.9	0.6
United Kingdom	49	36	25	19	17	17	17	18	18	17	16	15	15	-70	-2.9	7.9	11.0
EU-28 (a)	**622**	**293**	**206**	**183**	**159**	**144**	**140**	**139**	**138**	**135**	**126**	**135**	**133**	**-79**	**-1.7**	**100**	**100**
EU-28 (b)	622	293	206	183	159	144	140	139	138	135	126	135	133				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

3.16 Chromium emission trends

Between 1990 and 2018, Cr emissions dropped by 69 % in the EU. Between 2017 and 2018, emissions dropped by 1.5 % (see Table 3.19), mainly because of decreases in Germany, Finland, Estonia and Sweden (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Cr emissions were Germany and the United Kingdom (countries ranked according to their shares of the EU total). As Austria and Luxembourg did not provide emission data for Cr, the EU total is an underestimate.

Table 3.19 Member State contributions to EU emissions of Cr

Member State	Cr (Mg)													Change (%)		Share in EU–28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990–2018	2017–2018	1990	2018
Austria																0.0	0
Belgium	34	29	19	18	14	12	11	6.3	6.1	6.0	6.3	4.8	4.8	-86	-0.4	2.8	1.3
Bulgaria	21	10	7.6	9.9	5.4	5.8	5.5	5.3	5.7	6.4	6.8	7.1	6.7	-68	-5.7	1.8	1.8
Croatia	5.3	3.7	3.2	3.7	2.6	2.5	2.4	2.2	2.0	2.2	2.0	2.1	2.0	-62	-5.2	0.4	0.6
Cyprus	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	.2	-4	-0.5	0.0	0.0
Czechia	26	17	12	12	11	11	11	10	10	10	10	10	10.1	-61	1.2	2.2	2.8
Denmark	6.0	3.1	1.6	1.7	1.7	1.6	1.5	1.6	1.6	1.7	1.7	1.8	1.8	-70	1.1	0.5	0.5
Estonia	18	10	8.4	9.1	11	10	9.2	11	9.9	7.6	8.7	9.2	8.3	-55	-9.7	1.6	2.3
Finland	47	36	29	20	26	17	19	18	23	17	18	17	15	-68	-7.8	4.0	4.2
France	392	190	104	45	28	23	23	23	20	21	21	20	20	-95	-0.7	33.0	5.5
Germany	166	95	84	77	75	75	75	75	76	77	77	78	76	-54	-2.1	14.0	20.9
Greece	6.0	6.5	6.9	7.3	7.4	8.7	9.3	7.7	15	15	11	10	9.9	66	-4.2	0.5	2.7
Hungary	18	12	12	12	11	12	11	8.0	9.0	12	9.7	12	13	-29	1.1	1.5	3.5
Ireland	4.5	4.6	4.9	3.5	2.7	2.5	2.5	2.5	2.4	2.5	2.5	2.4	2.2	-50	-7.9	0.4	0.6
Italy	86	69	44	49	40	41	39	36	35	35	35	35	35	-59	0.5	7.3	9.6
Latvia	2.5	1.9	2.2	2.5	2.5	1.3	1.4	1.3	1.3	1.3	1.2	1.3	1.4	-45	3.3	0.2	0.4
Lithuania	3.2	1.6	1.3	1.3	1.0	1.0	1.1	1.0	5.6	5.5	5.3	4.8	4.9	52	0.2	0.3	1.3
Luxembourg																0.0	0.0
Malta	0.6	0.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-92	1.2	0.1	0.0
Netherlands	10	6.5	3.0	2.1	1.5	1.4	1.4	1.4	1.3	1.1	1.3	1.1	1.	-90	-14.7	0.8	0.3
Poland	56	51	38	37	39	38	38	36	36	36	36	36	36	-36	-1.6	4.7	9.8
Portugal	13	15	16	15	12	11	11	11	11	11	11	11	11	-18	0.4	1.1	3.0
Romania	25	19	16	19	13	12	12	11	11	12	12	12	12	-53	2.8	2.1	3.3
Slovakia	22	19	20	24	25	24	25	26	26	24	26	27	26	19	-1.5	1.9	7.2
Slovenia	1.3	1.3	1.2	1.5	1.5	1.5	1.5	1.5	1.3	1.3	1.4	1.4	1.4	2	-1.2	0.1	0.4
Spain	26	28	32	32	23	23	24	21	22	24	23	23	24	-8	1.1	2.2	6.4
Sweden	23	12	6.9	10	5.1	6.4	5.0	5.0	4.5	5.4	5.6	6.7	6.0	-74	-9.4	2.0	1.7
United Kingdom	173	127	87	50	35	35	35	36	37	36	36	36	36	-79	0.5	14.6	10.0
EU-28 (a)	**1 186**	**770**	**561**	**465**	**395**	**378**	**375**	**359**	**374**	**371**	**368**	**371**	**365**	**-69**	**-1.5**	**100**	**100**
EU-28 (b)	1 186	770	561	465	395	378	375	359	374	371	368	371	365				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

3.17 Copper emission trends

Between 1990 and 2018, Cu emissions in the EU decreased by 9.9 %. Between 2017 and 2018, they rose by 0.6 % (see Table 3.20), mainly because of increases in Italy, Poland, Denmark and Spain (countries ranked according to the size of their contributions to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Cu emissions were Germany, the United Kingdom, Poland and France (63.1 % of EU-28) (countries ranked according to their shares of the EU total). As Austria and Luxembourg did not provide emission data for Cu, the EU total is an underestimate.

Table 3.20 Member State contributions to EU emissions of Cu

Member State	Cu (Mg)													Change		Share in EU-28	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.00	0.00
Belgium	51	52	49	46	44	43	42	39	39	40	41	39	38	-25	-1.9	2.3	1.9
Bulgaria	108	77	58	101	23	24	24	23	24	26	26	28	29	-73	3.6	4.8	1.4
Croatia	7.5	6.3	7.7	9.7	8.4	8.2	7.8	8.7	8.2	8.6	8.8	9.6	9.5	26	-1.3	0.3	0.5
Cyprus	1.5	1.8	2.2	2.4	2.5	2.5	2.3	2.0	1.9	2.0	2.1	2.2	2.2	47	0.9	0.1	0.1
Czechia	32	26	21	26	24	24	24	24	25	26	26	26	26	-19	0.1	1.4	1.3
Denmark	33	37	40	42	43	43	41	41	41	43	42	43	44	36	4.1	1.4	2.2
Estonia	11	5.6	4.3	5.4	5.8	5.8	5.6	6.0	6.0	5.5	5.8	5.9	4.7	-57	-20.6	0.5	0.2
Finland	157	116	65	58	42	42	41	42	43	41	42	41	40	-74	-1.1	6.9	2.0
France	225	219	222	227	215	219	211	214	210	212	211	208	206	-8	-1.0	9.9	10.1
Germany	633	543	567	553	567	571	573	571	584	596	603	607	606	-4	-0.1	28.0	29.8
Greece	22	26	29	33	35	31	26	26	30	28	28	29	29	29	0.0	1.0	1.4
Hungary	18	14	16	21	21	20	19	18	20	22	23	24	25	37	4.3	0.8	1.2
Ireland	11	12	19	22	19	19	18	19	19	20	21	20	20	93	0.6	0.5	1.0
Italy	186	209	215	227	201	202	189	182	199	190	182	169	176	-5	4.6	8.2	8.7
Latvia	4.6	2.7	2.9	3.9	4.1	3.6	3.6	3.6	3.8	4.0	4.1	4.3	4.5	-3	3.0	0.2	0.2
Lithuania	9.7	4.9	4.3	5.2	5.7	5.6	5.5	5.5	5.4	5.3	5.2	4.7	4.7	-51	0.3	0.4	0.2
Luxembourg																0.0	0.0
Malta	0.6	0.7	0.8	0.0	1.1	1.0	0.7	0.8	0.8	0.8	0.8	1.0	1.1	88	4.2	0.0	0.1
Netherlands	16	18	19	19	22	21	20	20	20	17	17	19	17	6	-7.1	0.7	0.9
Poland	191	202	158	170	201	197	196	187	186	187	197	213	217	14	1.8	8.4	10.7
Portugal	27	33	43	45	36	33	30	30	30	30	30	30	30	13	-0.3	1.2	1.5
Romania	8.7	7.8	5.8	19	19	20	21	20	20	20	22	23	24	171	3.9	0.4	1.2
Slovakia	10	7.4	5.6	8.9	10	10	10	9.0	9.4	11	11	12	12	21	0.9	0.4	0.6
Slovenia	3.5	4.0	4.2	5.1	5.8	6.0	6.1	5.6	5.4	5.5	5.8	5.6	6.2	77	10.3	0.2	0.3
Spain	100	120	155	174	163	152	142	136	140	145	148	151	152	52	1.1	4.4	7.5
Sweden	65	51	45	37	38	38	38	38	38	39	39	40	41	-38	0.3	2.9	2.0
United Kingdom	328	301	294	284	267	269	262	262	268	268	268	270	269	-18	-0.4	14.5	13.2
EU-28 (a)	**2 259**	**2 098**	**2 053**	**2 145**	**2 025**	**2 010**	**1 960**	**1 933**	**1 977**	**1 994**	**2 009**	**2 024**	**2 036**	**-9.9**	**0.6**	**100**	**100**
EU-28 (b)	2 259	2 098	2 053	2 145	2 025	2 010	1 960	1 933	1 977	1 994	2 009	2 024	2 036				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

3.18 Nickel emission trends

Between 1990 and 2018, Ni emissions dropped by 74 % in the EU. Between 2017 and 2018, they decreased by 3.9 %, mainly because Germany, France, Poland and Spain (countries ranked according to the size of their contribution to the absolute change) reported decreases (see Table 3.21). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Ni emissions were Germany, the United Kingdom and Poland (countries ranked according to share of the EU total). As Austria and Luxembourg did not provide emission data for Ni, the EU total is an underestimate.

In Bulgaria, Ni emissions in 2000 and 2001 were much lower than in the years before and after, and declined again in 2008, because Ni emissions from primary Cu production fell (personal communication by Bulgaria in 2012).

Table 3.21 Member State contributions to EU emissions of Ni

Member State	Ni (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	77	72	36	28	10	9.3	6.7	5.2	4.9	5.0	4.9	4.0	3.6	-95	-9.2	3.5	0.6
Bulgaria	33	28	8.0	24	6.9	7.2	5.6	5.8	6.0	5.8	6.0	6.5	6.2	-81	-4.4	1.5	1.1
Croatia	17	14	13	14	7.7	6.8	6.0	4.7	3.8	4.5	4.2	4.3	3.5	-80	-18.7	0.8	0.6
Cyprus	5.9	7.3	9.9	12	7.1	8.9	9.4	5.1	5.1	5.2	5.6	5.5	5.6	-4	1.1	0.3	1.0
Czechia	55	28	14	12	8.0	7.1	6.1	5.5	5.5	5.3	5.0	5.4	5.1	-91	-5.6	2.5	0.9
Denmark	19	13	7.6	7.1	4.5	4.0	3.7	3.7	3.2	2.9	2.9	3.0	2.7	-86	-9.6	0.8	0.5
Estonia	27	10	6.5	6.4	6.6	6.5	5.7	6.5	6.1	4.7	5.4	5.7	5.0	-82	-11.8	1.2	0.9
Finland	78	47	35	26	23	20	19	17	17	16	16	15	14	-82	-4.3	3.5	2.5
France	276	218	178	142	82	66	57	51	48	43	40	35	29	-90	-17.8	12.5	5.0
Germany	341	211	168	179	156	144	141	137	130	137	147	163	155	-54	-4.7	15.4	27.2
Greece	42	47	50	55	60	56	59	50	34	40	34	32	31	-26	-2.7	1.9	5.4
Hungary	27	33	21	7.8	7.0	7.9	6.8	6.2	6.2	6.0	5.7	5.8	5.5	-79	-4.4	1.2	1.0
Ireland	22	27	34	27	14	11	10	9.5	8.4	8.3	8.4	8.2	8.2	-63	0.7	1.0	1.4
Italy	114	110	107	112	41	39	36	31	30	30	30	30	29	-74	-1.3	5.2	5.2
Latvia	15	8.5	6.8	6.4	5.9	0.6	1.1	0.5	0.5	0.5	0.5	0.5	0.6	-96	8.1	0.7	0.1
Lithuania	35	16	9.7	9.3	5.0	4.1	4.8	2.8	1.8	1.8	1.4	1.2	1.1	-97	-7.0	1.6	0.2
Luxembourg																0.0	0.0
Malta	8.3	13	17	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-100	-11.0	0.4	0.0
Netherlands	74	85	19	10	1.6	1.8	1.5	1.3	1.2	1.3	1.4	1.4	1.1	-99	-25.4	3.4	0.2
Poland	207	174	124	109	107	100	94	84	82	88	87	86	83	-60	-3.5	9.3	14.4
Portugal	112	117	108	107	48	41	36	30	25	26	25	25	24	-79	-3.5	5.1	4.2
Romania	111	63	33	23	12	13	12	10	8.9	8.6	6.9	8.9	8.3	-93	-6.9	5.0	1.4
Slovakia	3.6	3.1	2.1	2.7	3.3	3.2	2.9	2.6	2.6	3.0	3.2	3.1	3.1	-15	-1.1	0.2	0.5
Slovenia	2.6	2.2	2.4	2.3	2.1	2.0	1.8	1.8	1.4	1.4	1.6	1.5	1.5	-44	-0.1	0.1	0.3
Spain	159	185	187	161	83	71	57	43	37	36	37	41	40	-75	-2.3	7.2	7.0
Sweden	30	31	18	16	14	11	10	9.4	7.7	6.2	6.7	6.5	7.4	-75	12.6	1.3	1.3
United Kingdom	323	331	192	154	129	103	120	128	129	93	88	98	98	-70	0.3	14.6	17.1
EU-28 (a)	**2 214**	**1 895**	**1 406**	**1 253**	**846**	**745**	**713**	**652**	**605**	**579**	**574**	**595**	**572**	**-74**	**-3.9**	**100**	**100**
EU-28 (b)	2 214	1 895	1 406	1 253	846	745	713	652	605	579	574	595	572				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

3.19 Selenium emission trends

Between 1990 and 2018, Se emissions dropped by 41 % in the EU. However, between 2017 and 2018, they dropped by 0.7 % (see Table 3.22), mainly because of slight decreases in Bulgaria, Belgium, the United Kingdom and Greece (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Se emissions were Portugal, Czechia and Bulgaria (countries ranked according to their shares of the EU total). As Austria, Luxembourg and Poland did not provide emission data for Se, the EU total is an underestimate.

In 2005, Belgium reported high Se emissions in the category '2A3 — Glass production'. This was caused by one glass plant in Wallonia, which gives annual emissions based on measurements; the concentration of Se was very high in 2005 (personal communication by Belgium in 2014). Likewise, Belgium's high emissions in 2010 were mainly attributable to the operations of a particular company in Wallonia's glass industry (personal communication by Belgium in 2012).

Table 3.22 Member State contributions to EU emissions of Se

Member State	Se (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	5.2	6.4	6.5	27	12	4.0	3.6	3.6	4.3	4.1	3.7	3.7	2.9	-44	-22.0	1.9	1.8
Bulgaria	41	13	5.2	14	14	16	15	16	19	20	22	23	21	-49	-8.5	15.2	13.3
Croatia	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.4	0.3	0.4	0.4	0.4	-18	-0.4	0.2	0.2
Cyprus	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-33	-0.5	0.0	0.0
Czechia	33	29	28	30	26	25	24	23	22	22	22	22	23	-31	2.0	12.1	14.3
Denmark	4.2	3.9	2.3	1.4	1.3	1.0	0.7	1.0	0.9	0.7	0.7	0.6	0.5	-87	-9.8	1.6	0.3
Estonia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42	57.5	0.0	0.0
Finland	1.8	0.4	0.5	0.5	0.6	0.6	0.7	0.4	0.4	0.5	0.4	0.9	0.5	-74	-47.0	0.7	0.3
France	15	15	16	15	13	13	12	12	12	12	12	12	12	-20	-1.2	5.7	7.7
Germany	5.7	11	8.4	5.8	7.3	7.6	7.3	7.3	7.2	7.2	7.3	7.5	7.2	27	-3.5	2.1	4.5
Greece	14	14	16	17	15	15	16	14	13	11	8.9	9.9	9.5	-30	-4.2	5.0	6.0
Hungary	6.5	5.9	5.8	4.2	3.6	3.7	3.6	3.6	3.4	3.4	3.2	3.1	2.8	-57	-7.7	2.4	1.8
Ireland	8.7	6.5	5.1	4.6	4.0	3.8	4.0	4.0	3.6	3.8	3.5	3.1	2.8	-68	-9.7	3.2	1.8
Italy	10	11	12	12	11	12	11	11	11	12	11	11	11	10	0.5	3.8	7.0
Latvia	0.4	0.3	0.2	0.1	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	-61	-31.4	0.1	0.1
Lithuania	0.4	0.2	0.2	0.4	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	-71	11.1	0.1	0.1
Luxembourg																0.0	0.0
Malta	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	60	-57.7	0.0	0.0
Netherlands	0.4	0.3	0.5	2.6	1.5	0.8	0.8	0.5	0.8	1.0	0.6	0.2	0.2	-54	-10.4	0.1	0.1
Poland																0.0	0.0
Portugal	12	17	23	27	30	30	32	32	32	32	32	32	36	196	12.3	4.5	22.8
Romania	20	16	12	12	12	14	13	10	10	10	9.2	9.3	9.1	-54	-1.7	7.3	5.8
Slovakia	3.0	2.9	2.8	2.7	2.3	2.3	2.2	2.1	1.9	2.0	1.9	1.9	1.8	-40	-7.1	1.1	1.1
Slovenia	2.9	2.5	2.4	2.5	2.5	2.5	2.4	2.3	1.8	1.9	2.0	2.0	1.9	-33	-2.5	1.1	1.2
Spain	6.5	6.8	8.0	8.0	5.8	6.0	6.0	5.8	5.8	6.1	6.1	6.2	6.2	-4	0.1	2.4	3.9
Sweden	1.0	1.1	1.0	1.1	1.2	1.2	1.2	1.1	1.1	1.0	1.1	1.1	1.1	11	-0.5	0.4	0.7
United Kingdom	78	50	34	34	17	17	20	17	17	14	9.1	8.6	8.1	-90	-6.3	28.9	5.1
EU-28 (a)	**270**	**213**	**190**	**223**	**181**	**177**	**177**	**167**	**168**	**166**	**158**	**160**	**159**	**-41**	**-0.7**	**100**	**100**
EU-28 (b)	270	213	190	223	181	177	177	167	168	166	158	160	159				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

3.20 Zinc emission trends

Between 1990 and 2018, Zn emissions dropped by 47 % in the EU. However, between 2017 and 2018, they increased by 6.3 %, mainly because the Netherlands, Italy, Bulgaria and Portugal (countries ranked according to the size of their contribution to the absolute change) reported higher emissions (see Table 3.23). In 2018, the EU Member States contributing most (i.e. more than 10 %) to Zn emissions were Italy, France, the United Kingdom and Poland (countries ranked according to their shares of the EU total). As Austria and Luxembourg did not provide emission data for Zn, the EU total is an underestimate.

Ireland explained the decline in its emissions after 2000 by the closure of its only steel plant in 2001. From 1990 to 2001, metal production was the main determinant of the trend in Zn emissions. On average, it accounted for 54.9 % of national total emissions throughout that period (see Ireland's IIR p .53, listed in Appendix 5).

Table 3.23 Member State contributions to EU emissions of Zn

Member State	Zn (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	229	179	177	125	103	96	82	74	74	76	67	62	63	-72	1.6	2.9	1.5
Bulgaria	182	107	258	142	95	104	105	110	117	111	117	122	126	-31	3.2	2.3	3.0
Croatia	37	30	29	35	34	33	32	32	29	32	31	31	32	-13	2.3	0.5	0.8
Cyprus	3.2	3.9	4.9	5.8	4.0	4.5	4.3	2.8	2.8	2.8	3.0	3.1	3.1	-4	0.2	0.0	0.1
Czechia	101	76	62	65	57	55	51	46	46	45	41	41	42	-58	3.1	1.3	1.0
Denmark	72	65	55	59	63	60	57	58	57	61	63	65	66	-8	2.1	0.9	1.6
Estonia	106	63	49	52	62	60	54	62	57	46	52	55	49	-54	-10.8	1.3	1.2
Finland	679	403	127	116	130	126	128	124	132	119	127	120	119	-83	-1.0	8.5	2.8
France	2.166	1.373	979	569	512	501	508	493	478	488	495	489	486	-78	-0.6	27.2	11.4
Germany	475	269	281	260	290	277	292	300	283	291	292	298	293	-38	-1.7	6.0	6.9
Greece	48	51	53	53	51	52	52	46	49	47	42	42	42	-13	-0.3	0.6	1.0
Hungary	71	53	56	52	58	68	72	67	60	64	64	62	56	-21	-9.4	0.9	1.3
Ireland	53	48	54	25	20	19	19	19	20	20	20	20	20	-63	0.4	0.7	0.5
Italy	978	986	946	1028	921	986	944	886	868	862	881	924	940	-4	1.7	12.3	22.1
Latvia	30	28	26	31	28	25	30	26	26	24	24	26	27	-7	5.0	0.4	0.6
Lithuania	25	18	18	20	20	19	20	19	18	17	17	17	16	-36	-1.6	0.3	0.4
Luxembourg																0.0	0.0
Malta	0.4	0.5	0.6	1.6	2.3	2.4	2.4	2.0	2.0	1.3	1.0	0.6	0.4	5	-26.7	0.0	0.0
Netherlands	192	113	59	49	62	53	54	45	73	62	54	50	311	62	522.4	2.4	7.3
Poland	781	757	520	460	462	456	461	451	444	434	437	453	445	-43	-1.7	9.8	10.5
Portugal	65	69	76	77	73	73	73	72	73	73	73	74	77	19	3.6	0.8	1.8
Romania	122	98	103	125	120	111	113	107	107	107	108	109	108	-11	-0.6	1.5	2.5
Slovakia	39	36	39	52	57	55	58	59	57	51	57	59	57	44	-4.0	0.5	1.3
Slovenia	19	17	16	21	22	23	22	22	20	21	22	22	21	15	-1.3	0.2	0.5
Spain	274	247	318	326	326	332	281	332	278	316	312	311	312	14	0.3	3.4	7.3
Sweden	182	131	88	94	98	89	89	81	83	83	79	78	77	-58	-1.5	2.3	1.8
United Kingdom	1.034	996	664	528	474	455	429	465	469	477	446	463	460	-56	-0.8	13.0	10.8
EU-28 (a)	**7 965**	**6 217**	**5 056**	**4 368**	**4 145**	**4 135**	**4 030**	**4 003**	**3 923**	**3 933**	**3 926**	**3 998**	**4 250**	**-47**	**6.3**	**100**	**100**
EU-28 (b)	7 965	6 217	5 056	4 368	4 145	4 135	4 030	4 003	3 923	3 933	3 926	3 998	4 250				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

3.21 Dioxin and furan emission trends and key categories

Between 1990 and 2018, PCDD/F emissions dropped by 80 % in the EU. Between 2017 and 2018, the decrease was 1.4 % (see Table 3.24), mainly because Italy, Hungary, France and Germany (countries ranked according to the size of their contribution to the absolute change) reported lower emissions. In 2018, the Member State contributing most (i.e. more than 10 %) to PCDD/F emissions were Poland and Italy, with a joint contribution of 31.5 % of EU-28 emissions.

Cyprus explained that, from 1990 to 2018, its PCDD/F emissions decreased by 96.2 % because a clinical waste incineration plant was closed down in 2003 and all clinical waste is now sterilised (see Cyprus's IIR p. 55, listed in Appendix 5).

Czechia explained that the fall in emissions between 2007 and 2009 was due to the installation of new fabric filters in the Třinecké železárny sinter plant (personal communication by Czechia in 2018).

In France (1990-2012), the decrease in dioxin emissions resulted from regulations limiting emissions, especially in the fields of waste incineration, industrial energy processes (steel and metallurgy) and combustion in manufacturing (see France's IIR, listed in Appendix 5). The drop in dioxin emissions between 1995 and 2000 was due to improvements in sinter plants (personal communication by France in 2013).

Slovakia reported in its IIR that the emissions of PCDD/F dropped in 1999 because of the technological improvement of facilities that combust industrial waste as a fuel to produce energy. The moderate increase in 2005 was because many facilities did not comply with the stricter emission limits that came into force in 2006 and therefore used the last year of their operation to burn more waste. This was followed by a decrease in 2006. Since then, emissions have shown a slightly increasing trend as a result of waste management politics in Slovakia, which prefers the combustion of waste to its disposal to landfill. The main contributors are the sectors energy production (includes incineration of municipal waste with energy recovery) and waste incineration without energy recovery, which includes incineration of industrial and clinical waste (see Slovakia's IIR p. 40, listed in Appendix 5).

In Spain, the fall in PCDD/F emissions after 1995 was linked to the adaptation of municipal solid waste (MSW) incineration facilities with energy recovery (included under category '1A1a — Public electricity and heat production') to comply with the maximum levels imposed in legislation; it was also related to the implementation of particle and acid gas abatement techniques as from 1996 (personal communication by Spain in 2017).

The '5C1biii — Clinical waste incineration' category contributed most to the trend in PCDD/F emissions reported by Portugal. The dramatic drop in emissions between 2000 and 2005 was caused by the closing of 25 incinerators on its mainland; just one clinical waste incinerator has remained in operation since 2004. Other clinical waste receives alternative treatment or is sent abroad (see Portugal's IIR pp. 6-19, listed in Appendix 5).

The United Kingdom reported in its IIR that the strong decrease in PCDD/F emissions from 1990 to 1995 is associated with the rise in sales of unleaded petrol, particularly as a result of the greater use of cars fitted with three-way catalysts. Leaded petrol was then phased out of general sales at the end of 1999, giving rise to the large reduction in emissions (see the United Kingdom's IIR pp. 122/128, listed in Appendix 5).

The emissions reported by Greece for PCDD/F in the category '1A1a — Public electricity and heat production' are responsible for the strong decrease observed since 2009.

The emissions reported by Lithuania for PCDD/F in the category '5C1biii — Clinical waste incineration' are responsible for the peak in 2005.

'1A4bi — Residential: Stationary' and '2C1 — Iron and steel production' were the primary key categories for PCDD/F emissions, together making up 56 % of total PCDD/F emissions (see Figure 3.15(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2018 were in the second

Table 3.24 Member State contributions to EU emissions of PCDD/Fs

Member State	PCDD/Fs (g I-TEQ)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	125	58	50	36	41	38	39	40	37	38	37	37	34	-73	-7.5	1.4	1.8
Belgium	589	408	125	66	53	45	49	40	31	33	33	34	30	-95	-10.4	6.4	1.6
Bulgaria	117	139	156	155	64	73	63	65	55	55	53	55	55	-53	-0.6	1.3	2.9
Croatia	49	43	42	50	40	39	39	36	31	34	33	29	28	-43	-2.9	0.5	1.5
Cyprus	18	20	21	0.8	0.7	0.7	0.7	0.8	0.6	0.6	0.7	0.7	0.7	-96	1.7	0.2	0.0
Czechia	100	74	63	62	47	39	40	40	42	36	28	27	27	-73	2.4	1.1	1.5
Denmark	69	52	34	32	35	32	31	32	30	33	35	35	36	-48	3.3	0.7	1.9
Estonia	8.1	5.6	6.7	5.7	6.4	6.4	4.8	3.7	4.0	4.1	3.9	4.3	3.7	-54	-13.8	0.1	0.2
Finland	18	19	19	14	16	14	15	15	16	14	16	13	14	-21	7.1	0.2	0.8
France	1.782	1.723	557	236	140	131	119	123	117	115	103	101	97	-95	-3.8	19.3	5.2
Germany	815	344	267	155	139	134	133	133	125	127	125	124	121	-85	-3.0	8.8	6.4
Greece	69	70	75	78	42	47	45	39	40	30	27	30	29	-58	-0.7	0.8	1.6
Hungary	110	75	81	62	76	84	86	81	71	79	77	67	59	-46	-10.9	1.2	3.2
Ireland	60	42	32	29	27	24	24	23	21	22	19	18	20	-67	8.5	0.6	1.1
Italy	508	488	410	334	316	276	293	289	275	281	279	296	277	-45	-6.5	5.5	14.7
Latvia	30	34	31	35	23	24	27	22	21	18	17	20	19	-36	-2.7	0.3	1.0
Lithuania	26	20	21	33	22	22	22	21	20	19	18	19	19	-26	2.0	0.3	1.0
Luxembourg	43	34	6.1	2.2	2.4	2.3	1.7	1.6	1.8	1.4	2.3	2.0	1.4	-97	-31.3	0.5	0.1
Malta	0.2	0.2	0.2	0.2	7.8	1.0	3.8	4.2	4.0	3.6	3.4	3.3	3.2	1504	-5.1	0.0	0.2
Netherlands	752	78	44	42	47	46	39	39	37	36	36	36	35	-95	-1.8	8.1	1.9
Poland	387	454	313	368	386	344	350	330	303	300	309	306	316	-18	3.4	4.2	16.8
Portugal	552	549	352	66	49	51	53	48	48	48	49	51	55	-90	7.7	6.0	2.9
Romania	175	143	157	184	173	165	167	150	153	148	148	153	153	-13	-0.2	1.9	8.1
Slovakia	960	817	932	377	53	51	48	49	46	47	48	49	47	-95	-4.7	10.4	2.5
Slovenia	19	16	16	17	18	18	17	17	15	15	16	15	14	-24	-7.4	0.2	0.8
Spain	431	460	197	184	178	182	179	179	182	188	182	178	180	-58	1.2	4.7	9.6
Sweden	70	49	41	43	37	31	28	26	25	24	25	25	25	-65	-1.0	0.8	1.3
United Kingdom	1.359	792	346	256	218	208	211	210	195	192	182	178	179	-87	0.6	14.7	9.5
EU-28 (a)	**9 243**	**7 006**	**4 395**	**2 924**	**2 261**	**2 129**	**2 128**	**2 058**	**1 944**	**1 941**	**1 906**	**1 907**	**1 881**	**-80**	**-1.4**	**100**	**100**
EU-28 (b)	9 243	7 006	4 395	2 924	2 261	2 129	2 128	2 058	1 944	1 941	1 906	1 907	1 881				

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

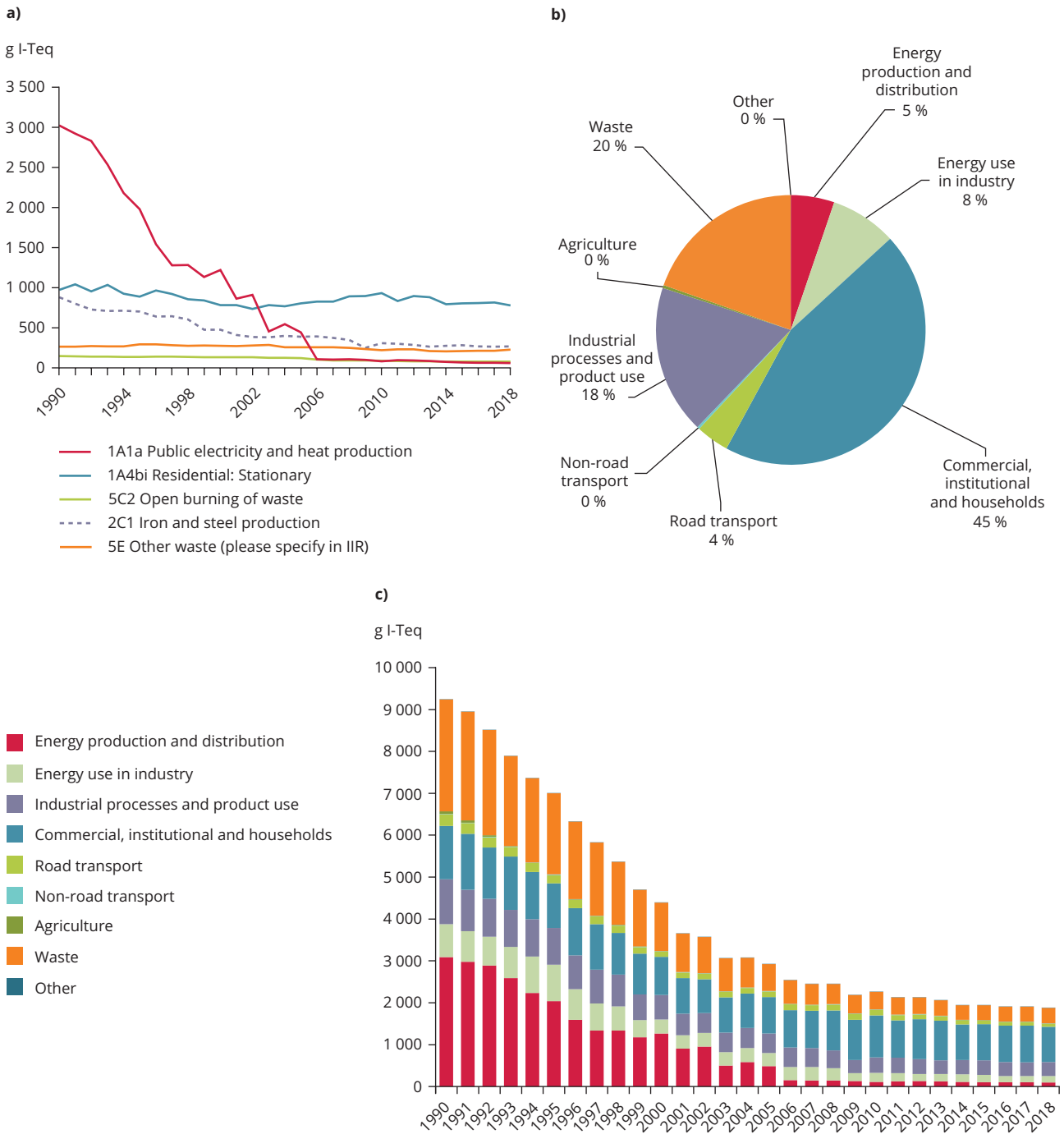
(b) Sum of sectors: differences arise when only national totals and no sectoral data are available.

I-Teq, international toxic equivalent.

most important, '2C1 — Iron and steel production' (69.6 % decrease), and the fourth most important, '5C2 — Open burning of waste' (48.2 % decrease).

Figure 3.15(b) shows the contribution made by each aggregated sector group to total EU emissions. The sector groups waste, commercial, institutional and households and energy production and distribution are significant sources of PCDD/Fs.

Figure 3.15 PCDD/F emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions



Note: I-Teq, international toxic equivalent.

3.22 Total polycyclic aromatic hydrocarbon emission trends and key categories

Between 1990 and 2018, total PAH emissions dropped by 49 % in the EU. However, between 2017 and 2018, they dropped by 7.6 % (see Table 3.25), mainly because Bulgaria, Italy, Hungary and Germany (countries ranked according to their shares of the EU total) reported lower emissions. In 2018, the EU Member States contributing most (i.e. more than 10 %) to total PAH emissions were Poland, Germany, Greece and Spain (countries ranked according to the percentage of their share in the EU total).

Belgium explained that the strong decrease in PAH emissions in 2000 was due to the installation in 1999 of dust-abatement technology in the pig-iron tapping installations in Wallonia (2C1) (personal communication by Belgium in 2018).

Bulgaria and Portugal reported high values in the category '2D3g — Chemical products' (asphalt blowing production) for the years 2000-2006, and 1990-2018, respectively. Spain reported that estimated total PAH emissions are mainly driven by '3F — Field burning of agricultural residues'. This activity and the related emissions have notably decreased because of this practice being gradually abandoned, driven by legislation to prevent forest fires and the entry into force of the EU common agricultural policy's conditionality rules and mitigation programmes for the reduction of field burning of agricultural waste, particularly between 1999 and 2003 (personal communication by Spain in 2017).

In 2018, '1A4bi — Residential: Stationary' and '3F — Field burning of agricultural residues ' were the principal key categories for these emissions, making up 75 % of total PAH emissions (see Figure 3.16(a)). Among the key categories, the largest change could be observed for in the most important, '1A4bi — Residential: Stationary (35.6 % decrease).

The data reported in 2020 by Portugal and Bulgaria mainly contribute to the total PAH emissions in the key category '2D3g — Chemical products' (asphalt blowing production).

The sudden drop in total PAH emissions in the category '3F — Field burning of agricultural residues' from 1999 to 2001 resembles the data reported by Spain.

Figure 3.16(b) shows the contribution made by each aggregated sector group to total EU emissions. The sector groups commercial, institutional and households sector group is a very significant source of total PAHs.

Table 3.25 Member State contributions to EU emissions of total PAHs

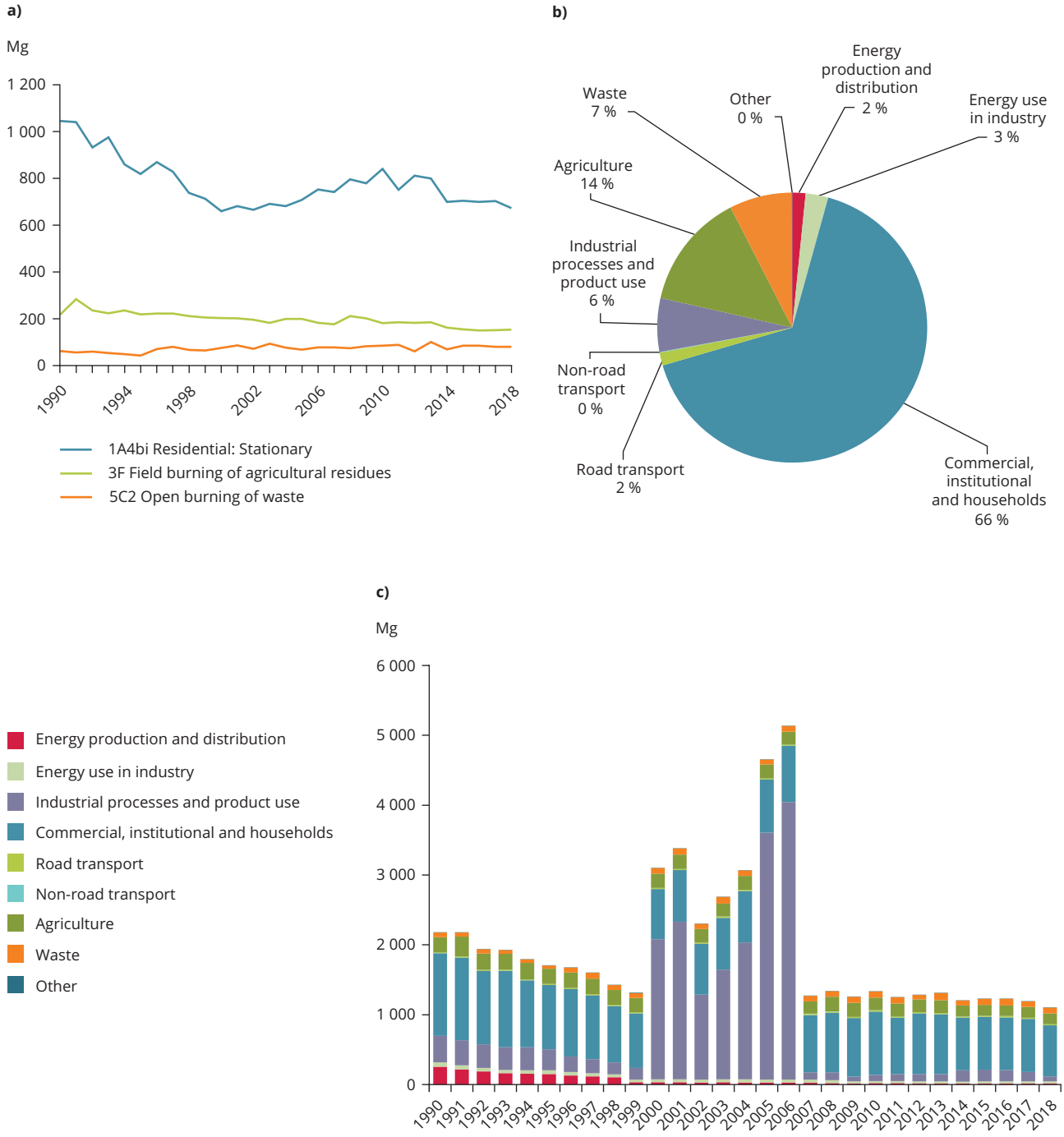
Member State	Total PAHs (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	19	11	8.5	7.2	8.1	7.4	7.7	7.9	7.0	7.3	7.3	7.4	6.8	-64	-8.1	0.9	0.6
Belgium	51	40	31	25	15	12	12	12	8.2	8.5	8.8	8.1	8.1	-84	-0.5	2.3	0.7
Bulgaria	111	109	1924	3452	32	44	52	55	110	116	112	82	15	-87	-81.9	5.1	1.3
Croatia	22	17	15	18	17	17	16	16	14	16	15	14	14	-36	-3.2	1.0	1.3
Cyprus	14	11	6.2	3.8	0.9	1.0	1.0	0.8	0.7	0.9	0.7	0.6	0.7	-95	13.1	0.6	0.1
Czechia	280	179	45	40	47	46	48	49	47	47	46	47	46	-84	-1.6	12.9	4.1
Denmark	13	13	11	11	8.2	7.4	7.1	7.2	6.6	7.4	7.6	7.5	7.5	-41	-0.7	0.6	0.7
Estonia	8.2	10	8.5	7.4	8.3	7.1	7.1	7.1	7.1	7.0	7.0	7.7	7.7	-6	0.0	0.4	0.7
Finland	7.1	7.7	7.7	8.7	11	9.7	10	9.8	10	9.5	10	10	10	40	-1.5	0.3	0.9
France	46	44	35	26	22	19	20	21	18	18	19	18	17	-62	-4.5	2.1	1.6
Germany	375	161	155	135	208	185	213	223	180	184	174	180	175	-53	-2.8	17.2	15.9
Greece	196	215	208	213	192	199	197	198	175	168	163	165	167	-15	1.1	9.0	15.1
Hungary	79	30	26	24	29	33	35	35	28	30	30	30	24	-69	-17.5	3.6	2.2
Ireland	48	31	22	20	19	17	17	18	16	15	14	13	13	-72	4.0	2.2	1.2
Italy	90	92	60	64	87	64	82	78	69	71	70	74	67	-26	-9.9	4.1	6.1
Latvia	18	17	16	13	10	10	11	9.2	8.9	7.3	7.2	7.9	8.2	-54	3.9	0.8	0.7
Lithuania	19	9.0	9.1	11	11	11	11	11	9.7	8.9	8.9	9.1	9.0	-53	-0.8	0.9	0.8
Luxembourg	4.6	2.3	0.7	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.7	0.6	0.7	-85	7.3	0.2	0.1
Malta	0.8	0.6	0.5	0.4	0.4	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.1	-87	-81.1	0.0	0.0
Netherlands	19.0	9.8	5.2	5.3	5.4	5.5	5.1	5.0	5.0	4.9	4.8	4.7	4.6	-76	-2.3	0.9	0.4
Poland	306	380	233	289	309	271	272	254	228	226	237	235	231	-24	-1.8	14.0	20.9
Portugal	24	23	22	19	15	15	14	14	14	14	14	15	16	-36	6.4	1.1	1.4
Romania	75	46	57	67	65	59	61	58	60	59	59	58	58	-23	0.6	3.5	5.3
Slovakia	44	25	24	29	27	26	27	26	22	23	23	23	21	-52	-10.5	2.0	1.9
Slovenia	8.1	5.9	5.1	6.0	6.1	6.1	5.9	6.0	5.0	5.3	5.4	5.2	4.8	-40	-7.4	0.4	0.4
Spain	138	108	134	126	147	150	120	159	128	146	154	141	141	2	-0.1	6.4	12.8
Sweden	17.7	17.6	13.9	15.6	9.8	9.7	9.0	8.7	8.2	8.0	8.0	8.0	7.0	-60	-11.8	0.8	0.6
United Kingdom	147	96	20	18	22	19	22	23	21	22	23	22	23	-84	4.5	6.7	2.1
EU-28 ([a])	**2 180**	**1 711**	**3 104**	**4 656**	**1 334**	**1 253**	**1 283**	**1 312**	**1 207**	**1 230**	**1 229**	**1 195**	**1 103**	**-49**	**-7.6**	**100**	**100**
EU-28 ([b])	2 180	1 711	3 104	4 656	1 334	1 253	1 283	1 312	1 207	1 230	1 229	1 195	1 103				

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

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

Figure 3.16 Total PAH emissions in the EU: (a) trend in emissions from the three most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions



3.23 Benzo(a)pyrene emission trends and key categories

Between 1990 and 2018, B(a)P emissions fell by 59 % in the EU. Between 2017 and 2018, they decreased by 21.1 % (see Table 3.26), mainly because emissions fell in Bulgaria, Italy, Hungary and Poland (countries ranked according to the size of their contributions to the absolute change). In 2018, the Member State contributing most (i.e. more than 10 %) to B(a)P emissions were Poland, Greece, Germany and Spain. As Austria and Spain did not provide sufficient data for B(a)P and gap filling was not possible, the EU total is an underestimate.

Bulgaria and Portugal reported high values in the category '2D3g — Chemical products' (asphalt blowing production) for the years 2000-2006 and 1990-2018, respectively.

In 1990, the large emissions of B(a)P in the United Kingdom were mostly from the agriculture sector due to field burning of residues. Following a ban on the practice of field burning in agriculture, emissions had fallen to zero by 1994. Emissions from the industrial processes and product use sector in 1990 are dominated by aluminium production and the process of anode baking. B(a)P emissions from this source have substantially declined since the mid-1990's, and anode baking no longer takes

Table 3.26 Member State contributions to EU emissions of B(a)P

Member State	Benzo(a)pyrene (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	15	12	9.6	7.7	5.3	4.7	4.0	3.9	2.6	2.7	2.8	2.6	2.6	-83	-0.9	2.3	0.9
Bulgaria	83	77	1 900	3 429	20	31	39	43	100	106	101	71	4.9	-94	-93.0	12.2	1.8
Croatia	7.0	5.7	5.1	6.3	6.0	5.7	5.6	5.5	4.8	5.4	5.2	5.0	4.8	-32	-3.7	1.0	1.7
Cyprus	2.4	1.9	1.1	0.7	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1	-95	10.1	0.3	0.0
Czechia	91	60	17	14	17	17	17	17	16	16	16	16	16	-83	-2.6	13.5	5.7
Denmark	3.5	3.6	3.0	3.1	2.5	2.2	2.2	2.2	2.0	2.2	2.3	2.3	2.2	-36	-1.1	0.5	0.8
Estonia	2.4	2.8	2.4	2.1	2.4	2.0	2.0	2.1	2.0	2.0	2.0	2.2	2.2	-5	0.1	0.4	0.8
Finland	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	21	-0.4	0.0	0.1
France	13	13	9.8	7.3	6.0	5.1	5.5	5.8	5.0	5.0	5.1	5.0	4.7	-63	-4.7	1.9	1.7
Germany	139	48	31	23	35	31	35	37	29	30	28	29	28	-80	-2.9	20.6	10.3
Greece	37	40	39	39	35	36	36	36	32	31	30	31	31	-16	0.9	5.4	11.3
Hungary	26	9.9	8.5	7.8	9.6	11	12	12	9.4	9.9	10	9.8	8.0	-69	-18.4	3.9	2.9
Ireland	14	8.6	6.1	5.6	5.2	4.9	4.7	5.1	4.4	4.3	4.0	3.6	3.7	-73	3.9	2.0	1.4
Italy	10	11	11	12	21	14	19	19	17	18	17	19	17	67	-10.2	1.5	6.1
Latvia	6.3	6.0	6.1	4.8	3.6	3.7	3.6	3.2	3.1	2.6	2.5	2.8	2.9	-54	3.8	0.9	1.1
Lithuania	6.4	3.1	3.2	3.6	3.8	3.8	3.8	3.7	3.4	3.1	3.2	3.2	3.2	-51	-0.9	0.9	1.2
Luxembourg	1.2	0.6	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	-85	10.2	0.2	0.1
Malta	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-96	-93.8	0.0	0.0
Netherlands	4.9	2.9	1.8	1.9	1.8	1.8	1.7	1.7	1.7	1.7	1.6	1.6	1.6	-68	-2.2	0.7	0.6
Poland	101	123	73	93	101	87	87	82	72	72	75	75	73	-27	-2.1	14.9	26.6
Portugal	8	7	6	5	4	4	4	4	4	4	4	4	5	-39	9.1	1.1	1.7
Romania	17	10	16	18	20	18	19	18	18	18	18	17	17	5	-0.2	2.5	6.4
Slovakia	15	8.3	7.7	9.4	8.8	8.4	8.7	8.1	6.6	7.1	7.3	7.1	6.2	-59	-12.8	2.2	2.3
Slovenia	2.8	2.2	2.0	2.4	2.5	2.5	2.4	2.5	2.0	2.2	2.2	2.1	1.9	-31	-8.9	0.4	0.7
Spain	30	25	27	26	30	30	26	31	26	29	32	28	28	-8	-1.0	4.5	10.1
Sweden	6.2	6.3	4.9	5.3	3.4	3.3	3.1	3.0	2.8	2.7	2.7	2.6	2.3	-64	-13.6	0.9	0.8
United Kingdom	35	23	6.9	6.0	7.8	6.8	7.8	8.2	7.2	7.8	7.9	7.7	8.1	-77	4.7	5.1	2.9
EU-28 (a)	**676**	**511**	**2 199**	**3 735**	**351**	**334**	**350**	**354**	**374**	**382**	**381**	**348**	**275**	**-59**	**-21.1**	**100**	**100**
EU-28 (b)	676	511	2 199	3 735	351	334	350	354	374	382	381	348	275				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

(b) Sum of sectors.

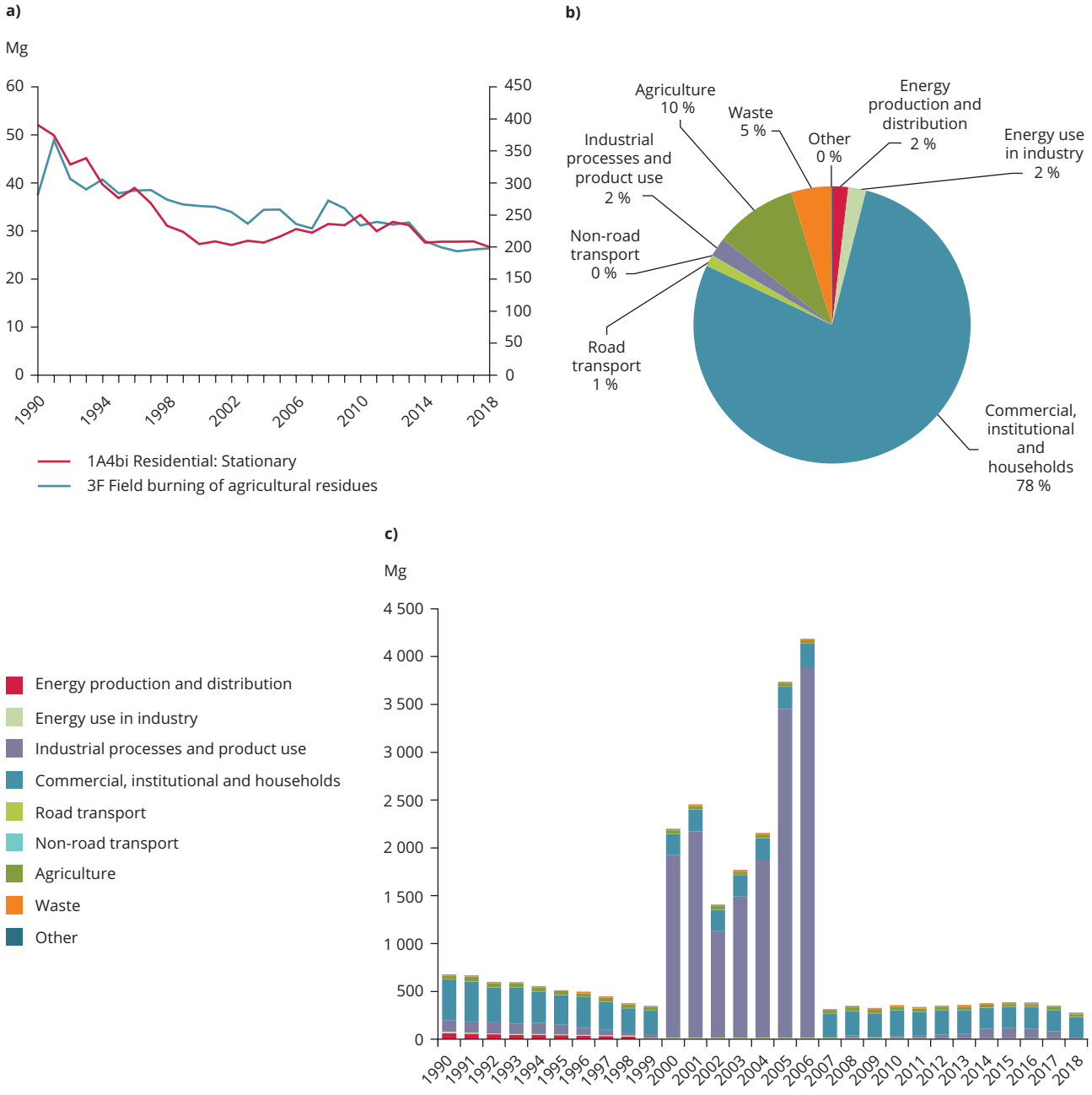
place in the United Kingdom, as a result of plant closures (see the United Kingdom's IIR p. 130, listed in Appendix 5).

'1A4bi — Residential: Stationary was the principal key category for B(a)P emissions, accounting for 73 % of the total. Among the key categories, the largest change could be observed for the most important key category, '1A4bi — Residential: Stationary' (48.8 % decrease) (see Figure 3.17(a)). Emissions from the second most important key category '3F—Field burning of agricultural residues' fell by 29.5 %.

The data reported in 2020 by Portugal and Bulgaria mainly contribute to B(a)P emissions in the key category '2D3g — Chemical products' (asphalt blowing production).

Figure 3.17(b) shows the contribution made by each aggregated sector group to total EU emissions. The commercial, institutional and households sector group is the chief source of B(a)P emissions.

Figure 3.17 B(a)P emissions in the EU: (a) trend in emissions from the two most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions



Note: In Figure 3.17(a), the right-hand axis shows values for '1A4bi — Residential Stationary'.

3.24 Benzo(b)fluoranthene emission trends

Between 1990 and 2018, B(b)F emissions fell by 48 % in the EU. Between 2017 and 2018, they dropped by 2.2 % (see Table 3.27), mainly because of a slight decrease in Italy, Hungary, Poland and Bulgaria (countries ranked according to the size of their contributions to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to B(b)F emissions were Poland, Greece and Spain (countries ranked according to their shares of the EU total). As Austria and Spain did not provide sufficient data for B(b)F and gap filling was not possible, the EU total is an underestimate.

Sweden explained that the marked decline in its B(b)F emissions between 2005 and 2010 was because of changes in aluminium production ('2C3 — Aluminium production'). Until 2008, aluminium production at the country's only operating plant (Kubikenborg Aluminium AB) was a key source of B(b)F emissions. In 2008, all the potlines in the plant that used Soderberg technology were shut down, which caused an abrupt decline in B(b)F emissions between 2008 and 2009 (personal communication by Sweden in 2017).

Table 3.27 Member State contributions to EU emissions of B(b)F

Member State	Benzo(b)fluoranthene (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	18	14	11	8.7	4.7	3.7	3.9	4.0	2.9	3.0	3.1	2.8	2.8	-84	-0.1	3.0	0.9
Bulgaria	10	7.8	5.5	6.0	5.9	6.7	6.7	6.1	5.2	5.2	5.6	5.7	5.0	-51	-12.7	1.7	1.6
Croatia	7.5	5.5	4.9	6.0	5.7	5.4	5.3	5.2	4.6	5.1	4.9	4.8	4.6	-39	-3.6	1.3	1.5
Cyprus	6.6	5.2	3.0	1.8	0.4	0.5	0.5	0.4	0.3	0.4	0.3	0.3	0.3	-95	14.1	1.1	0.1
Czechia	90	57	11	9.5	11	11	12	12	11	11	11	11	11	-88	-1.1	15.0	3.6
Denmark	3.1	3.2	2.7	2.9	2.3	2.1	2.1	2.1	2.0	2.2	2.4	2.4	2.4	-24	0.6	0.5	0.8
Estonia	2.7	2.8	2.5	2.3	2.6	2.2	2.2	2.2	2.3	2.3	2.3	2.6	2.6	-4	0.8	0.5	0.8
Finland	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	27	0.3	0.0	0.1
France	15	15	12	8.6	7.3	6.2	6.7	6.9	6.0	6.1	6.1	6.0	5.8	-62	-4.5	2.5	1.8
Germany	3.8	2.0	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.8	-52	-2.3	0.6	0.6
Greece	91	100	97	99	90	93	91	92	81	78	76	77	77	-15	1.1	15.2	24.8
Hungary	30	11	8.9	8.4	10	11	12	12	9.6	10	10	10	8.4	-72	-17.5	5.1	2.7
Ireland	20	13	9.5	8.7	8.1	7.4	7.2	7.6	6.6	6.4	6.0	5.5	5.7	-72	4.1	3.4	1.8
Italy	13	14	14	15	25	17	23	23	20	21	21	22	20	53	-11.8	2.1	6.3
Latvia	6.2	5.4	5.0	4.4	3.4	3.4	3.4	3.0	3.0	2.4	2.4	2.6	2.7	-56	3.9	1.0	0.9
Lithuania	7.5	3.3	3.2	3.7	3.9	3.9	3.9	3.9	3.6	3.3	3.3	3.4	3.3	-56	-0.6	1.3	1.1
Luxembourg	1.5	0.8	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.3	-81	5.2	0.2	0.1
Malta	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-33	-44.2	0.0	0.0
Netherlands	7.6	3.2	1.7	1.7	1.8	1.9	1.7	1.6	1.6	1.6	1.6	1.5	1.5	-80	-2.2	1.3	0.5
Poland	112	141	85	105	111	97	97	91	81	80	84	83	82	-27	-2.0	18.7	26.2
Portugal	7.0	6.3	5.8	4.9	3.8	3.9	3.8	3.8	3.8	3.7	3.7	3.9	4.0	-42	4.8	1.2	1.3
Romania	22	12	16	19	20	18	19	18	18	18	18	17	17	-22	0.1	3.7	5.6
Slovakia	12	7.2	7.1	8.5	7.8	7.5	7.8	7.4	6.3	6.6	6.7	6.8	6.0	-50	-10.5	2.0	1.9
Slovenia	2.6	1.7	1.3	1.5	1.5	1.4	1.4	1.4	1.2	1.3	1.3	1.2	1.2	-56	-5.9	0.4	0.4
Spain	42	32	36	32	38	39	31	41	33	37	40	36	36	-14	-0.4	6.9	11.5
Sweden	6.0	6.0	4.7	5.2	3.4	3.3	3.2	3.0	2.8	2.8	2.7	2.7	2.4	-61	-12.9	1.0	0.8
United Kingdom	61	40	5.6	5.5	6.8	5.8	6.8	7.3	6.5	7.0	7.1	7.0	7.3	-88	5.0	10.2	2.3
EU-28 ([a])	**600**	**510**	**356**	**371**	**377**	**353**	**353**	**357**	**315**	**317**	**321**	**319**	**312**	**-48**	**-2.2**	**100**	**100**
EU-28 ([b])	600	510	356	371	377	353	353	357	315	317	321	319	312				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

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

3.25 Benzo(k)fluoranthene emission trends

Between 1990 and 2018, B(k)F emissions in the EU decreased by 42 %. Between 2017 and 2018, they fell by 1.7 % (see Table 3.28), mainly in Italy, Hungary, Poland and Slovakia (countries ranked according to the size of their contributions to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to B(k)F emissions were Spain, Poland and Greece (countries ranked according to their shares of the EU total). As Austria and Spain did not provide sufficient data for B(k)F, and gap filling was not possible, the EU total is an underestimate.

Table 3.28 Member State contributions to EU emissions of B(k)F

Member State	Benzo(k)fluoranthene (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	10	7.8	6.0	4.7	2.4	2.0	1.9	1.9	1.3	1.3	1.4	1.3	1.3	-87	-0.1	3.3	0.7
Bulgaria	3.9	3.5	2.1	2.3	2.3	2.6	2.6	2.3	2.0	2.0	2.2	2.2	1.9	-50	-12.6	1.3	1.1
Croatia	2.8	2.1	1.9	2.3	2.2	2.1	2.0	2.0	1.7	2.0	1.9	1.8	1.7	-38	-3.7	0.9	1.0
Cyprus	2.8	2.2	1.3	0.8	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	-95	14.2	0.9	0.1
Czechia	50	32	7.6	6.6	7.6	7.6	7.8	8.0	7.5	7.5	7.3	7.4	7.3	-85	-2.1	16.4	4.1
Denmark	2.4	2.5	2.2	2.2	1.8	1.6	1.5	1.5	1.3	1.5	1.5	1.5	1.4	-40	-2.1	0.8	0.8
Estonia	1.5	1.8	1.5	1.3	1.4	1.2	1.2	1.3	1.2	1.2	1.2	1.3	1.3	-16	-0.5	0.5	0.7
Finland	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	18	0.5	0.0	0.1
France	9.4	9.1	7.2	5.5	4.5	3.9	4.2	4.3	3.8	3.8	3.8	3.7	3.5	-62	-4.9	3.1	2.0
Germany	2.1	1.2	1.2	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	-43	-2.4	0.7	0.7
Greece	39	43	42	43	39	40	40	40	35	34	33	33	34	-14	1.2	12.9	19.2
Hungary	12	4.5	3.6	3.4	3.9	4.5	4.6	4.7	3.8	4.0	4.1	4.1	3.4	-72	-16.5	4.0	1.9
Ireland	7.7	4.9	3.5	3.2	3.0	2.8	2.7	2.9	2.5	2.5	2.3	2.1	2.2	-72	3.9	2.6	1.2
Italy	6.0	6.7	6.8	7.6	12	7.7	11	10	9.2	9.7	9.5	10	9.1	50	-10.9	2.0	5.2
Latvia	2.4	2.1	2.0	1.7	1.3	1.3	1.3	1.2	1.1	0.9	0.9	1.0	1.0	-57	3.9	0.8	0.6
Lithuania	3.1	1.5	1.4	1.7	1.7	1.7	1.7	1.7	1.6	1.5	1.5	1.5	1.5	-53	-0.6	1.0	0.8
Luxembourg	1.0	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-88	4.9	0.3	0.1
Malta	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-91	-86.5	0.0	0.0
Netherlands	3.8	2.3	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	-79	-3.0	1.3	0.5
Poland	47	60	38	46	48	43	43	41	37	36	38	38	37	-22	-1.7	15.6	21.1
Portugal	3.0	2.7	2.6	2.3	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.8	2.0	-33	11.2	1.0	1.1
Romania	8.6	5.4	6.7	7.7	8.0	7.3	7.6	7.2	7.5	7.4	7.3	7.1	7.2	-17	0.3	2.8	4.1
Slovakia	7.0	3.9	4.0	4.9	4.6	4.4	4.5	4.3	3.7	3.9	4.0	4.0	3.6	-48	-8.8	2.3	2.1
Slovenia	1.6	1.2	1.1	1.3	1.4	1.4	1.3	1.4	1.1	1.2	1.2	1.2	1.1	-31	-8.5	0.5	0.6
Spain	42	28	46	41	52	55	38	61	42	52	54	49	49	17	-0.1	13.9	28.0
Sweden	2.9	2.9	2.3	2.9	1.2	1.2	1.1	1.1	1.0	1.0	1.0	1.0	0.8	-72	-13.5	1.0	0.5
United Kingdom	30	20	3.7	3.2	2.9	2.5	2.9	3.0	2.7	2.9	3.0	2.9	3.0	-90	4.0	10.0	1.7
EU-28 (a)	**303**	**253**	**195**	**197**	**206**	**197**	**184**	**205**	**171**	**181**	**183**	**178**	**175**	**-42**	**-1.7**	**100**	**100.0**
EU-28 (b)	303	253	195	197	206	197	184	205	171	181	183	178	175				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

(b) Sum of sectors.

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

Between 1990 and 2018, IP emissions fell by 44 % in the EU. Between 2017 and 2018, they decreased by 2.9 %, mainly because Italy, Hungary, Poland and Slovakia (countries ranked according to the size of their contributions to the absolute change) reported lower emissions (see Table 3.29). In 2018, the EU Member States contributing most (i.e. more than 10 %) to IP emissions were Poland and Greece (countries ranked according to their shares of the EU total). As Austria and Spain did not provide sufficient data for IP, and gap filling was not possible, the EU total is an underestimate.

Table 3.29 Member State contributions to EU emissions of IP

Member State	Indeno(1.2.3-cd)pyrene (Mg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria																0.0	0
Belgium	7.4	5.9	4.7	3.8	2.4	1.9	2.0	2.1	1.4	1.5	1.6	1.5	1.4	-81	-1.0	3.1	1.1
Bulgaria	3.5	4.0	2.5	2.8	3.0	3.3	3.3	3.1	2.8	2.7	2.9	3.0	2.7	-24	-9.4	1.5	2.0
Croatia	3.8	3.3	3.0	3.7	3.5	3.3	3.3	3.2	2.8	3.2	3.0	2.9	2.8	-27	-3.8	1.6	2.1
Cyprus	2.0	1.6	0.9	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-95	11.8	0.8	0.1
Czechia	49	31	10	9.4	11	11	12	12	12	12	11	12	12	-76	-0.4	20.6	8.7
Denmark	3.5	3.5	2.7	2.6	1.6	1.4	1.4	1.4	1.3	1.4	1.4	1.4	1.4	-60	-0.6	1.5	1.1
Estonia	1.6	2.6	2.2	1.7	1.9	1.6	1.6	1.6	1.5	1.5	1.5	1.6	1.6	0	-1.0	0.7	1.2
Finland	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	4	-0.4	0.0	0.1
France	8.1	7.8	6.3	4.8	4.1	3.5	3.8	3.9	3.4	3.5	3.5	3.4	3.3	-59	-3.9	3.4	2.5
Germany	1.5	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	-43	-2.7	0.6	0.6
Greece	28	31	30	31	28	29	29	29	26	25	24	24	24	-15	0.8	12.0	18.2
Hungary	11	4.6	4.6	4.2	5.4	6.3	6.6	6.7	5.5	5.7	5.8	5.6	4.7	-57	-16.9	4.6	3.5
Ireland	6.6	4.2	3.0	2.7	2.6	2.4	2.3	2.5	2.2	2.1	2.0	1.8	1.9	-72	4.0	2.8	1.4
Italy	7.1	7.8	7.8	8.5	14	9.3	13	13	11	12	12	13	11	56	-11.6	3.0	8.3
Latvia	2.9	3.1	3.1	2.6	2.0	2.0	2.0	1.7	1.7	1.4	1.3	1.5	1.5	-47	4.3	1.2	1.2
Lithuania	2.7	1.6	1.8	2.1	2.0	2.0	2.0	2.0	1.8	1.7	1.7	1.7	1.7	-38	-1.1	1.1	1.2
Luxembourg	0.9	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-87	10.4	0.4	0.1
Malta	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.0	-96	-94.1	0.1	0.0
Netherlands	2.6	1.4	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.7	-72	-1.6	1.1	0.6
Poland	39	50	31	38	41	36	36	34	30	30	31	31	31	-21	-2.0	16.3	23.0
Portugal	4.4	4.	3.6	3.1	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.4	2.6	-40	7.9	1.9	2.0
Romania	7.9	5.1	8.5	10	11	10	10	10	10	10	10	10	10	23	-0.3	3.3	7.3
Slovakia	7.6	4.1	3.5	4.1	3.8	3.6	3.8	3.5	2.7	3.0	3.1	3.0	2.6	-66	-15.3	3.2	1.9
Slovenia	0.8	0.5	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	-54	-6.0	0.3	0.3
Spain	12	11	9.1	8.6	9.4	9.4	9.3	9.2	9.3	9.3	11	9.3	9.3	-22	-0.3	5.0	7.0
Sweden	3.1	3.2	2.4	2.4	1.9	1.9	1.7	1.7	1.5	1.5	1.5	1.4	1.2	-59	-13.9	1.3	0.9
United Kingdom	20	13	4.1	3.7	4.8	4.1	4.7	4.9	4.3	4.5	4.6	4.5	4.7	-77	3.9	8.6	3.5
EU-28 ([a])	**238**	**205**	**148**	**152**	**159**	**147**	**153**	**150**	**136**	**136**	**138**	**137**	**133**	**-44**	**-2.9**	**100**	**100**
EU-28 ([b])	238	205	148	152	159	147	153	150	136	136	138	137	133				

Notes: Dark-blue shaded cells indicate that no emission values are available. See Appendix 1 for an explanation of the notation keys reported by EU Member States and the United Kingdom.

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

([a]) Sum of national totals, as reported by EU Member States and the United Kingdom.

([b]) Sum of sectors.

3.27 Hexachlorobenzene emission trends and key categories

Between 1990 and 2018, HCB emissions fell by 97 % in the EU. However, between 2017 and 2018, they decreased by 14.9 % (see Table 3.30), mainly in Belgium, Germany, Austria and Finland (countries ranked according to the size of their contribution to the absolute change). In 2018, the EU Member States contributing most (i.e. more than 10 %) to HCB emissions were the United Kingdom, Austria, Finland and France (countries ranked according to their shares of the EU total).

Austria explained that the increase in HCB emissions from 2012 to 2014 reflects the data reported in the category '1A2f — Stationary combustion in manufacturing industries and construction: Non-metallic minerals'. Due to unintentional releases in 2012, 2013 and 2014, emissions rose to a very high level: HCB-contaminated material (lime) was co-incinerated in a cement plant at temperatures that were too low to destroy the HCB. Thus, the sharp 74.2 % decrease in emissions between 2014 and 2015 marked a return to usual levels. (see Austria's IIR p.14, listed in Appendix 5).

The peak in HCB emissions (the increase between 1990 and 1995 and the decrease between 1995 and 1999) reported by Belgium was mainly due to higher amounts of burned sludge (personal communication by Belgium in 2017). The strong decline in HCB emissions from 1999 to 2000 was because the sewage sludge incineration sector used a lower emission factor from 2000 onwards (personal communication by Belgium in 2016).

Czechia explained that the increase from 2009 to 2010 was due to implementation of new statistical data on hardcoal consumption, and the rise between 2011 and 2012 was linked to higher hard-coal consumption (personal communication by Czechia in 2018).

The data reported by Finland shows a 266 % increase from 2015 to 2016 followed by a fall in HCB emissions. This was mainly caused by emissions from the category '2B10a — Chemical industry: Other'. The emission trend reported by Finland is dominated by fluctuations in the industrial processes and product use sector and may be overestimated for the other sources because of the highly uncertain methods (see Finland's IIR p.147, listed in Appendix 5).

France reported a pronounced drop in HCB emissions between 1990 and 1995. The decrease in the category '1Ab2 — Stationary combustion in manufacturing industries and construction: Non-ferrous metals' was mainly due to the aluminium industry, which used chlorine to refine aluminium by eliminating magnesium traces. Until the early 1990s, it used hexachloroethane (HCE) as a core source, which resulted in HCB emissions, the main HCB source in the national inventory. In 1993, France banned HCE in secondary aluminium refining, as a result of which this industry no longer emits HCB (personal communication by France in 2015).

Ireland reported a marked decrease in HCB emissions between 1995 and 2000. HCB emissions from '2C2 — Ferroalloys production' dominated the inventory for the period up to and including 1996, contributing 40 kg per year. However, this is no longer a source of HCB emissions in Ireland due to the banning of HCE-based cover gas use (HCB was present as a contaminant in such cover gases) (see Ireland's IIR p.94, listed in Appendix 5).

In Germany, the drop in HCB emissions from 2001 to2002 was mainly attributed to data reported in the category '2C3 — Aluminium production'. Values up to 2001 were reported, after which the notation key 'NA' (not applicable) was used.

Portugal's HCB emissions reported in 2020 mainly come from the metal industry/aluminium production (2C3), energy industries (1A1) and waste-incineration sources (5C) (see Portugal's IIR, listed in Appendix 5).

Slovakia explained that HCB emissions are connected to using energy from industrial waste. The general declining trend until 2013, with several jumps in 2003, 2005 and 2008, resulted from tightening legislation on waste-incineration plants. Since 2014, emissions have increased because of a greater use of biomass waste as a fuel compared with other fuels in industry (see Slovakia's IIR, listed in Appendix 5).

Spain stated in its 2020 IIR that the sudden reduction in HCB emissions between 2005 and 2006 and the further drop from 2008 to 2010 was due to a new regulation in line with the framework of the Stockholm Convention on Persistent Organic Pollutants. The previous fluctuations reflect variations in the productions of POPs in Spain (see Spain's IIR p.261, listed in Appendix 5).

The United Kingdom explained that the largest source of HCB emissions for the years 1990-1998 was the use of HCE as a degassing agent in secondary aluminium smelting reported in the '2C3 — Aluminium production' category. A specific regulation controlling the use of HCE reduced emissions from this sector to zero from 1999 onwards, resulting in an overall sharp drop in HCB emissions between 1998 and 1999 (personal communication by the United Kingdom in 2017).

Table 3.30 Member State contributions to EU emissions of HCB

Member State	HCB (kg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	86	58	43	38	43	39	64	144	144	37	38	39	36	-58	-9.6	1.0	15.9
Belgium	40	115	21	19	13	28	17	6.2	6.6	4.7	4.0	34	4.8	-88	-85.8	0.5	2.2
Bulgaria	1.8	1.8	1.8	2.0	2.4	2.4	2.1	1.8	1.9	1.9	1.7	1.8	1.6	-15	-10.8	0.0	0.7
Croatia	7.1	6.4	2.0	0.5	0.9	0.8	0.9	0.8	0.6	0.4	0.5	0.5	0.6	-92	21.5	0.1	0.3
Cyprus	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-42	-1.8	0.0	0.0
Czechia	106	44	19	14	22	19	25	22	22	23	22	22	21	-80	-4.0	1.3	9.4
Denmark	13	11	5.6	3.7	2.8	2.6	2.4	2.6	2.4	2.2	2.4	2.4	2.5	-81	2.1	0.2	1.1
Estonia	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	62	2.5	0.0	0.1
Finland	36	36	39	32	8.9	26	9.5	17	22	16	60	34	32	-10	-4.6	0.4	14.3
France	1 196	70	44	11	21	18	18	19	21	24	26	24	24	-98	0.0	14.5	10.6
Germany	2 897	2 118	2 883	14	10	10	9.1	9.6	14	13	15	18	12	-99.6	-32.8	35.2	5.3
Greece	21	22	25	27	12	12	11	9.4	10	3.1	2.7	3.3	3.3	-84	1.4	0.3	1.5
Hungary	7.2	5.5	5.7	2.7	1.7	2.0	2.2	2.3	2.6	2.6	2.6	2.6	2.3	-69	-14.4	0.1	1.0
Ireland	48	48	7.9	2.7	2.7	2.7	2.8	2.8	2.7	2.7	2.7	2.7	2.6	-95	-5.1	0.6	1.1
Italy	67	55	30	24	20	20	20	11	11	11	11	11	10	-85	-3.4	0.8	4.5
Latvia	5.7	0.3	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	-91	2.5	0.1	0.2
Lithuania	11.0	4.7	1.9	2	1	0.9	0.7	0.7	0.3	0.4	0.4	0.4	0.4	-96	7.3	0.1	0.2
Luxembourg	0.4	1.3	0.6	0.5	0.6	0.6	0.4	0.4	0.4	0.5	0.5	0.4	0.5	11	6.7	0.0	0.2
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	> 100	5.9	0.0	0.0
Netherlands	45	1.2	1.5	1.6	2.4	2.5	2.7	2.8	2.9	3.3	3.4	3.3	3.1	-93	-5.4	0.5	1.4
Poland	3.9	4.3	3.4	3.7	4.6	4.1	4.2	3.9	3.6	3.6	3.7	3.7	3.7	-4	1.1	0.0	1.7
Portugal	59	74	101	1	1	1	1	1	2	2	2	2	2	-96	18.6	0.7	1.1
Romania	2.6	2.7	2.4	2.7	2.7	3.1	3.0	2.4	2.3	2.3	2.2	2.4	2.2	-17	-8.0	0.0	1.0
Slovakia	13	4.9	4.5	3.2	3.1	3.2	3.2	3.3	2.9	3.2	3.3	3.8	3.3	-74	-13.0	0.2	1.5
Slovenia	21	18	19	0.9	1.3	0.8	0.8	0.8	0.7	0.6	0.6	0.5	0.6	-97	2.6	0.3	0.3
Spain	381	207	192	136	12	12	11	7.7	12	10	12	12	13	-97	4.4	4.6	5.7
Sweden	16	17	11	4.5	6.6	4.2	3.7	4.2	3.4	3.8	2.7	3.0	2.7	-83	-10.1	0.2	1.2
United Kingdom	3 155	4 131	81	72	34	25	24	20	24	28	34	37	40	-99	7.6	38.3	17.7
EU-28 (a)	**8 241**	**7 056**	**3 546**	**420**	**231**	**241**	**240**	**298**	**316**	**200**	**254**	**264**	**225**	**-97**	**-14.9**	**100**	**100**
EU-28 (b)	8 241	7 056	3 546	420	231	241	240	298	316	200	254	264	225				

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

(b) Sum of sectors.

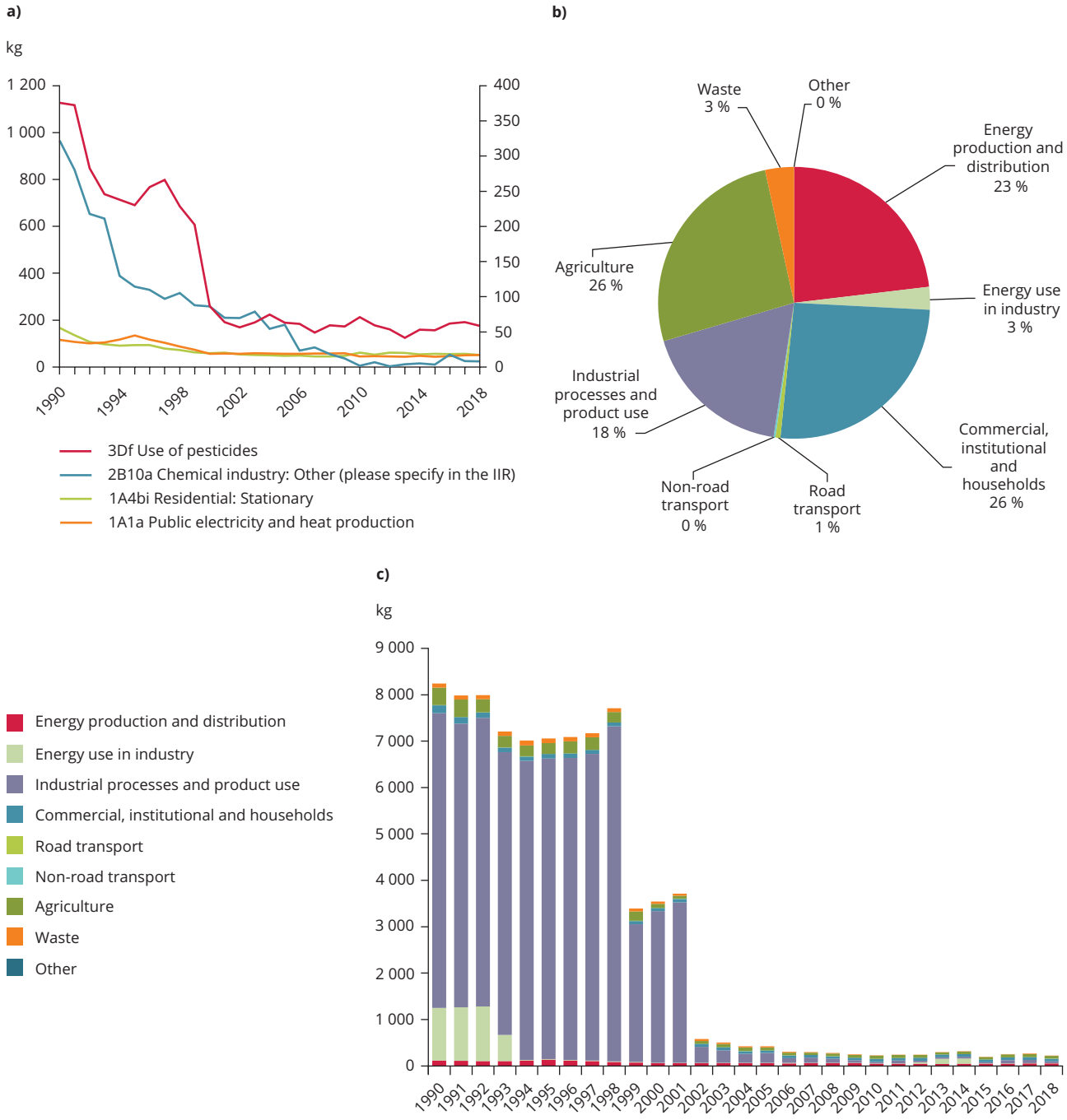
In 2018, '3Df — Use of pesticides, '1A4bi — Residential: Stationary' and '1A1a — Public electricity and heat production' were the chief key categories for HCB emissions, together accounting for 72 % of the total (see Figure 3.18(a)). Among the top five key categories, the highest relative reductions in emissions between 1990 and 2018 were in the most important '3Df — Use of pesticides' (84.4 % decrease) and in the fourth most important '2B10a — Chemical industry: Other' (97.5% decrease) category.

Figure 3.18(b) shows the contribution made by each aggregated sector group to total EU emissions.

For HCB, the primary emission sources are the commercial, institutional and households and agriculture sector groups.

The drop in HCB emissions from 1998 to 1999, shown in Figure 3.18 (a) and Figure 3.18(c), is because of a considerable reduction reported by the United Kingdom in the category '2C3 — Aluminium production' (see explanation above). Furthermore, the notation key 'NA' has been used from 1999 onwards. The drop between 2001 and 2002, in the same category, is caused by reductions reported by Germany.

Figure 3.18 HCB emissions in the EU: (a) trend in emissions from the five most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions



Note: In Figure 3.18(a), the right-hand axis shows values for '3Df — Use of pesticides'.

3.28 Polychlorinated biphenyl emission trends and key categories

Between 1990 and 2018, PCB emissions dropped by 85 % in the EU. Between 2017 and 2018, they fell by 2.3 %, mainly because of reductions reported by the United Kingdom, Germany, Austria and Poland (countries ranked according to the size of their contributions to the absolute change (see Table 3.31). In 2018, the EU Member States contributing most (i.e. more than 10 %) to PCB emissions were the United Kingdom, Croatia and Germany (countries ranked according to their shares of the EU total).

Belgium stated that PCB emissions reported in the category '2A1 — Cement production' from one of its plants were very high in 2010 and 2011 because of the use of an alternative raw material containing high concentrations of PCBs. Having removed this raw material at the end of 2011, emissions decreased significantly (see Belgium's IIR p.119, listed in Appendix 5).

The emissions reported by Greece for PCB in the category '2C5 — Lead production' are responsible for the strong increases observed from 2007 to 2008 and from 2017 to 2018.

In 2003, the emission peak in Ireland (not shown in Table 3.31) was caused by an increase in household waste reported in the category '5E — Other waste' (see Ireland's IIR p.157, listed in Appendix 5).

Lithuania explained that the high PCB emissions in 2005 occurred because emissions from electrical transformer oil were estimated (personal communication by Lithuania in 2017).

Portugal's total PCBs is strongly linked to the development of emissions in the category '2C1 — Iron and steel production', which means that this category is also a main driver for the drop in emissions from 2000 to 2002.

The United Kingdom explained that the strong decrease in PCB emissions between 1995 and 2000 came from measures to end the use of PCBs in capacitors and dielectric fluid transformers, etc., resulting in a sharp drop in activity data between 1999 and 2000 (personal communication by the United Kingdom in 2017).

'2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' was the chief key category for PCB emissions, making up 42 % of the total. Among the top four key categories, the highest relative reductions in emissions between 1990 and 2018 were in the principal most important, '2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' (90.2 % decrease), the second most important, '2C1 — Iron and steel production' (63.0 % decrease) and in the third most important key category, '1A1a — Public electricity and heat production' (62.1 % decrease) (see Figure 3.19(a)).

The large decrease in emissions from '2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' between 1999 and 2001 is due to reductions reported by the United Kingdom (see explanation above).

The strong drop in PCB emissions between 2000 and 2002 in '2C1 — Iron and steel production' is mainly caused by data reported from Portugal. This can be explained by significant changes in the only integrated iron and steel plant operating in Portugal, in particular the end of coke and sinter production and the closure and dismantling of the blast furnace (see Portugal's IIR pp. 3-48/56, listed in Appendix 5). The decrease from 2008 to 2009 can be explained by the economic recession, which negatively affected production volumes.

Figure 3.19(b) shows the contribution made by each aggregated sector group to total EU emissions. For PCBs, the most significant emission source is the industrial processes and product use sector group.

Table 3.31 Member State contributions to EU emissions of PCBs

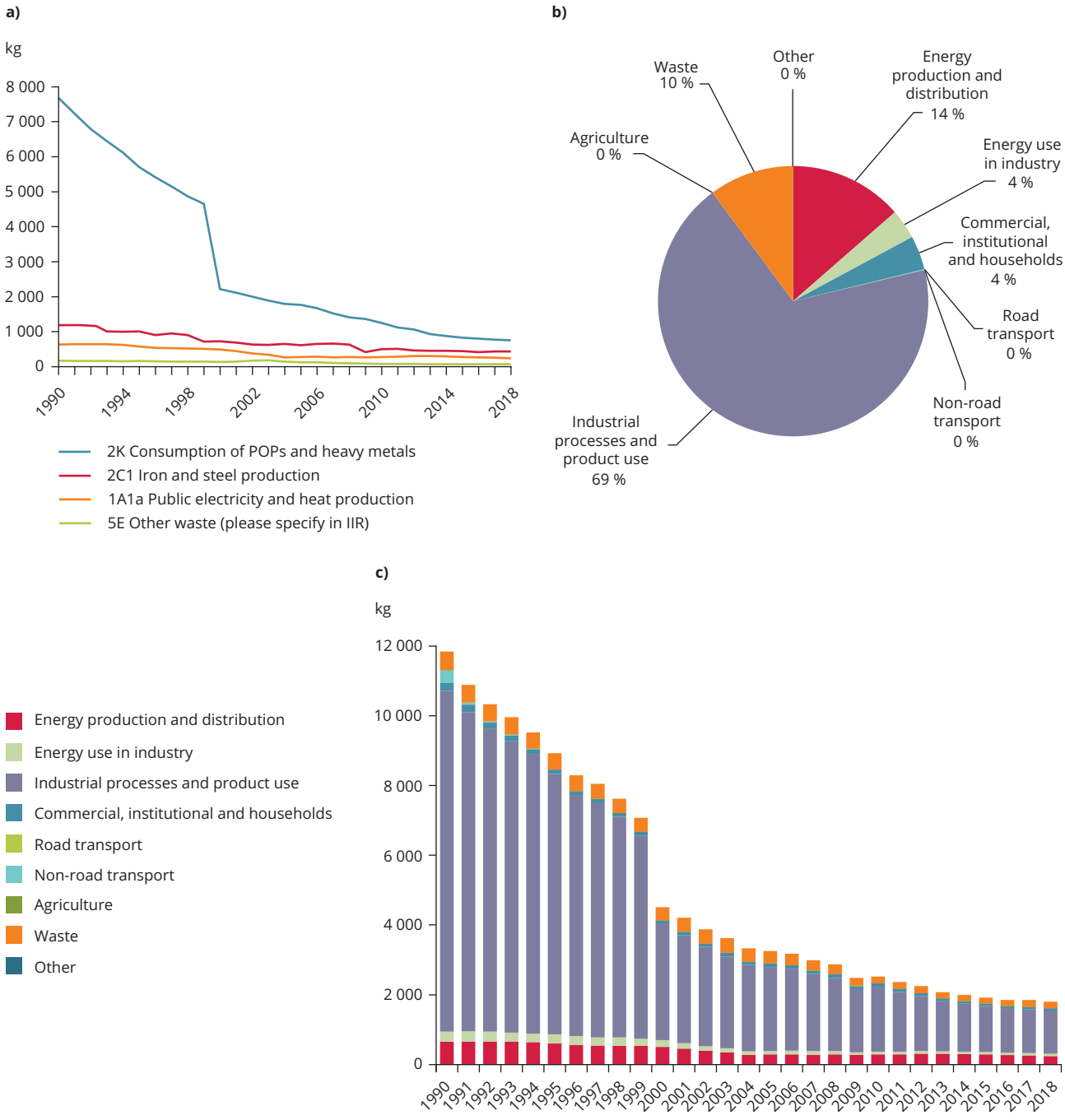
Member State	PCB (kg)													Change (%)		Share in EU-28 (%)	
	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	1990-2018	2017-2018	1990	2018
Austria	47	29	30	35	35	35	35	37	37	36	35	38	32	-32	-16.0	0.4	1.8
Belgium	98	82	87	69	95	57	9.4	5.1	11	3.0	5.7	2.8	5.5	-94	96.3	0.8	0.3
Bulgaria	14	16	11	10	4.3	5.0	4.7	4.1	3.1	3.0	3.1	3.8	3.5	-75	-8.2	0.1	0.2
Croatia	483	468	441	436	434	433	431	430	429	425	422	415	412	-15	-0.8	4.1	22.8
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	-5.9	0.0	0.0
Czechia	3.7	2.8	2.1	2.0	1.8	1.8	1.7	1.7	1.7	1.8	1.8	1.7	1.7	-53	0.1	0.0	0.1
Denmark	2.9	2.9	2.3	1.2	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-82	-0.7	0.0	0.0
Estonia	8.4	4.1	2.6	3.5	4.2	3.6	3.5	3.9	4.2	4.2	4.2	5.0	5.1	-39	1.2	0.1	0.3
Finland	29	29	30	31	28	28	25	23	25	24	26	26	26	-8	1.9	0.2	1.5
France	180	154	99	68	55	47	51	51	43	42	41	42	39	-78	-8.5	1.5	2.2
Germany	1 735	1 483	948	196	236	235	227	230	230	231	230	228	213	-88	-6.7	14.7	11.8
Greece	9.2	8.9	7.9	19	32	32	30	29	29	29	30	31	38	> 100	23.0	0.1	2.1
Hungary	385	12	9.9	11	8.9	9.6	8.8	7.1	7.4	11	9.8	8.5	8.7	-98	2.3	3.2	0.5
Ireland	39	33	30	32	12	10	9.4	7.6	7.0	8.9	6.4	6.9	7.9	-80	14.6	0.3	0.4
Italy	152	163	152	174	128	133	134	119	116	109	114	117	116	-23	-0.4	1.3	6.4
Latvia	4.3	1.1	0.4	0.6	0.4	0.8	2.4	0.7	0.3	0.2	0.2	0.2	0.2	-96	-0.1	0.0	0.0
Lithuania	6.1	1.8	0.8	37	10	1.7	1.4	1.6	1.4	1.3	1.4	1.5	1.5	-75	2.0	0.1	0.1
Luxembourg	40	36	11	12	19	26	9.1	4.3	5.1	3.1	3.8	3.7	2.1	-95	-42.6	0.3	0.1
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	> 100	-2.6	0.0	0.0
Netherlands	39	22	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	-99	-9.9	0.3	0.0
Poland	206	190	180	173	165	180	183	185	181	182	176	182	178	-14	-2.4	1.7	9.9
Portugal	1 064	860	794	670	323	251	262	140	105	86	84	96	92	-91	-4.0	9.0	5.1
Romania	62	39	28	38	21	20	18	17	18	20	20	19	20	-68	6.0	0.5	1.1
Slovakia	18	16	17	19	17	16	17	17	17	16	16	17	17	-5	-1.0	0.2	1.0
Slovenia	415	290	213	135	76	51	44	41	41	39	39	36	36	-91	-0.1	3.5	2.0
Spain	26	40	33	36	34	30	28	27	27	27	25	26	27	1	1.6	0.2	1.5
Sweden	9.2	9.6	9.8	9.5	9.2	9.8	8.8	8.5	9.0	9.1	9.2	9.5	9.4	2	-1.1	0.1	0.5
United Kingdom	6 763	4 933	1 366	1 040	769	747	710	681	647	611	549	528	512	-92	-2.9	57.1	28.4
EU-28 (a)	**11 839**	**8 927**	**4 509**	**3 257**	**2 518**	**2 366**	**2 254**	**2 075**	**1 996**	**1 922**	**1 852**	**1 846**	**1 804**	**-85**	**-2.3**	**100**	**100**
EU-28 (b)	11 839	8 927	4 509	3 257	2 518	2 366	2 254	2 075	1 996	1 922	1 852	1 846	1 804				

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

(a) Sum of national totals, as reported by EU Member States and the United Kingdom.

(b) Sum of sectors.

Figure 3.19 **PCB emissions from key categories in the EU: (a) trend in emissions from the four most important key categories, 1990-2018; (b) share by sector group, 2018; (c) sectoral trends in emissions**



4 Sectoral analysis and emission trends for key pollutants

Chapter 4 sets out emission trends in and detailed methodologies for the key pollutants, aggregated into the following main sector groups:

- energy production and distribution;
- energy use in industry;
- industrial processes and product use;
- commercial, institutional and households;
- road transport;
- non-road transport;
- agriculture;
- waste.

Appendix 4 of this report provides a conversion chart showing how the aggregated sector groups include the individual nomenclature for reporting (NFR) source categories (see Table A4.1). Box 4.1 gives some general explanations relevant to the figures in this chapter.

Table 4.2 and the subsequent tables provide information on the relative and absolute difference between reported emissions from 2019 and 2020. Big changes in absolute terms originate from the fact that EU Member States provided certain data for the first time (e.g. Finland, Italy and Spain for individual polycyclic aromatic hydrocarbons —PAHs) and carried out major recalculations (e.g. Spain for dioxins). Detailed information can be found in Section 5.1.

4.1 Sectoral analysis and emission trends for energy production and distribution

The energy production and distribution sector grouping comprises emissions from a number of activities that employ fuel combustion to produce energy products and electricity, for instance. It is a primary source of many pollutants, especially sulphur oxides (SO_X) and mercury (Hg). Despite considerable previous reductions, this sector group contributes 51 % of the total EU emissions of SO_X as well as 40 % of Hg emissions.

The sector is a significant source of SO_X, Hg, hexachlorobenzene (HCB), cadmium (Cd), nitrogen oxides (NO_X), and polychlorinated biphenyls (PCBs). Countries are ranked according to the size of the absolute values that they reported. In 2018, Poland, Germany and Spain contributed most (in absolute terms) to the emissions of SO_X for this sector. Germany, Poland and Spain reported the highest emissions of Hg in the same year. In addition, in 2018, Germany, the United Kingdom and Poland contributed most to NO_X emissions. The United Kingdom reported the highest emissions of HCB, and Poland, Germany and the United Kingdom primarily accounted for PCB emissions in this sector in 2018.

For emissions of the main pollutants (see Figure 4.1), between 1990 and 2018, the highest absolute and relative reduction within this aggregated sector was for SO_X (94 %). Between 1990 and 2018, NO_X and non-methane volatile organic compounds (NMVOC) emissions dropped by 73 % and 71 %, respectively. Emissions of particulate matter with a diameter of

Box 4.1 Explanations of the figures in this chapter

- The Convention on Long-range Transboundary Air Pollution (LRTAP Convention) formally requests Parties to report emissions of particulate matter (PM) for 2000 and thereafter. The figures in this chapter show only data from 2000 onwards.
- The figures showing indexed values (in percentages) use 1990 as the index year (1990 = 100 %), with the exception of PM with a diameter of 10 µm or less (PM_{10}) and PM with a diameter of 2.5 µm or less ($PM_{2.5}$), for which the index year is 2000 (2000 = 100 %).

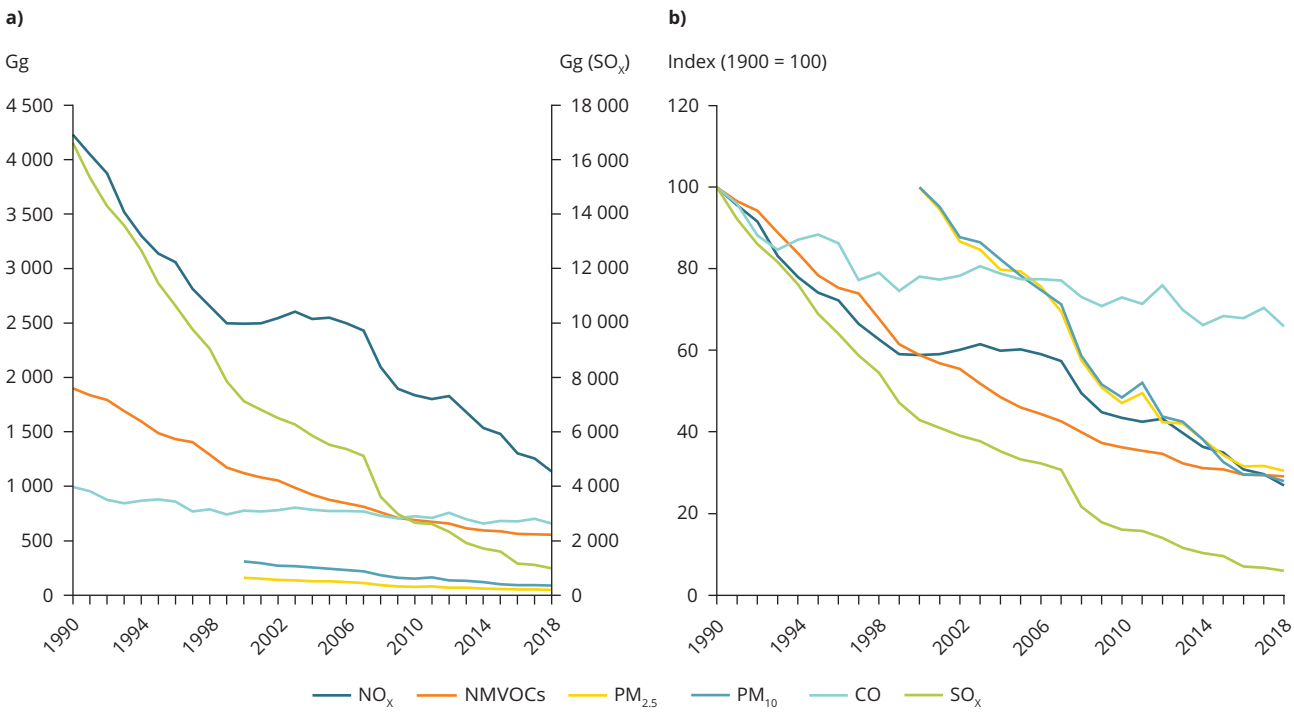
2.5 µm or less ($PM_{2.5}$) and particulate matter with a diameter of 10 µm or less (PM_{10}) emissions have decreased notably since 2000: $PM_{2.5}$ by 70 % and PM_{10} by 72 %. In addition, benzo(a)pyrene (B(a)P) emissions fell significantly by 92 % from 1990 to 2018.

The significant reduction in NO_X emissions between 2007 and 2008 was mainly because of decreases reported by Spain in the category '1A1a — Public electricity and heat production'. The United Kingdom noted that, since 1988, electricity generators have adopted a programme of progressively fitting low-NO_X burners to their 500 MWe (megawatt electric) or larger coal-fired units, and since 2007 a programme of fitting over-fire-air burners has further reduced NO_X emissions from the sector. Since 1990, greater use of nuclear generation and the introduction of combined cycle gas turbine (CCGT) plants burning natural gas, replacing older coal stations, have further reduced NO_X emissions (see the United Kingdom's informative inventory report — IIR — p .131, listed in Appendix 5). Furthermore, emission reductions reported for the same category in Spain are mainly responsible for the strong decline in SO_X emissions in the same year. Spain explained that the dramatic drop in both NO_X and SO_X emissions in 2008 was due to the closure of the country's main brown coal mine in 2007. In addition, the necessary retrofitting in 2008 of the adjacent thermal power plant and the introduction of abatement techniques reduced NO_X and SO_X emissions during this period (see Spain's IIR p. 82, listed in Appendix 5).

The declining trend in SO_X emissions between 1990 and 2018 mainly reflects data from the United Kingdom, Germany and Poland in the category '1A1a — Public electricity and heat production'. Since 1990, several measures have been combined to reduce emissions from these main emitting sources: switching fuel in energy-related sectors away from high-sulphur solid and liquid fuels to low-sulphur fuels such as natural gas; fitting flue gas desulphurisation (FGD) abatement technology in industrial facilities; and the introduction of EU directives relating to the sulphur content of certain liquid fuels (EEA, 2019c).

In 2012, the peak in CO emissions was due to reported increases between 2011 and 2012 from Italy and Estonia in the category '1A1c — Manufacture of solid fuels and other energy industries'. The United Kingdom and Germany reported a steep increase in the category '1A1a — Public electricity and heat production' in 2012. Furthermore, between 2012 and 2013, Croatia, Portugal and especially France reported reductions in the category '1B2aiv — Fugitive emissions oil: Refining/storage', and Italy reported decreases in the categories '1A1a — Public electricity and heat

Figure 4.1 EU emission trends in the energy production and distribution sector for NO_X, NMVOCs, $PM_{2.5}$, PM_{10}, CO and SO_X between 1990 (2000) and 2018



Note: In the left-hand panel, the right-hand axis shows values for SO_X.

Figure 4.2 **EU emission trends in the energy production and distribution sector group: (a) HMs (Pb, Cd and Hg) and (b) POPs (PCDD/Fs, PCBs and HCB) between 1990 and 2018**

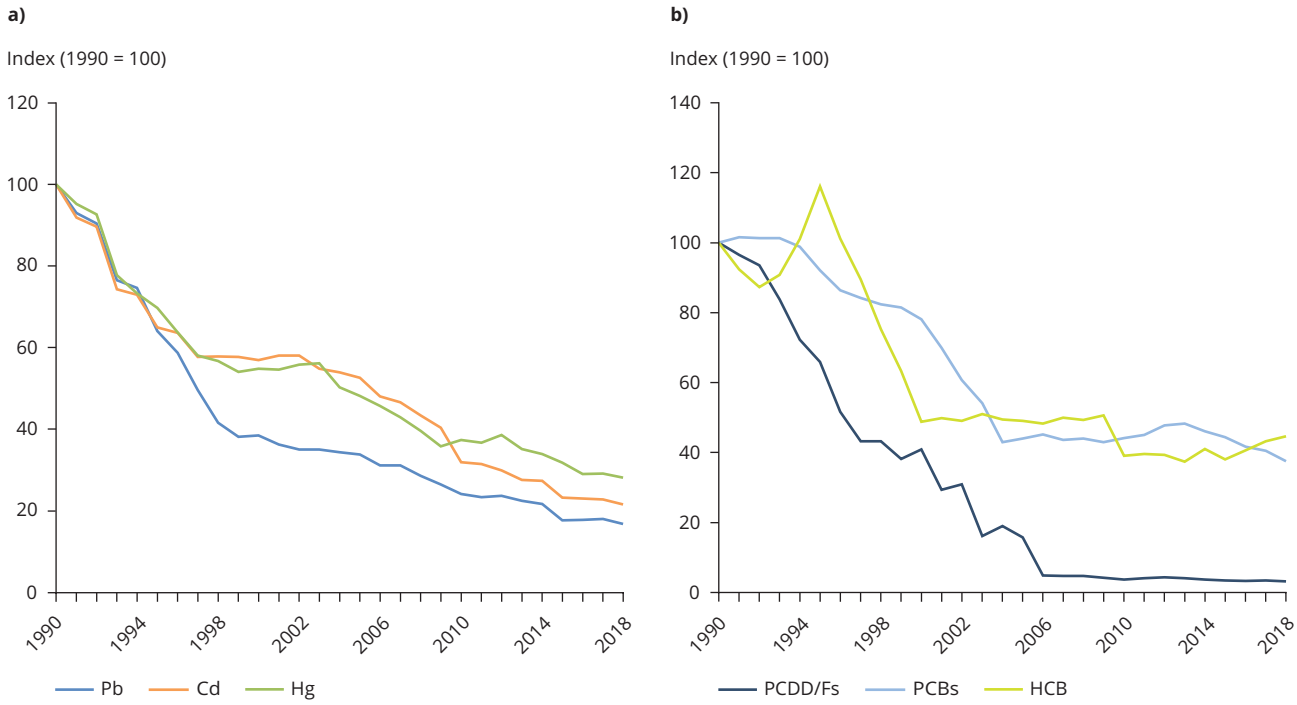


Table 4.1 **Number of EU Member States reporting notation keys within the key categories of the energy production and distribution sector group**

Key categories		NA	NO	NR	NE
NMVOC	1B1a	4	8	0	6
	1B2aiv	0	5	0	0
SO_x	1A1b	0	6	0	0
	1B2aiv	1	5	0	1
Cd	1A1b	0	6	0	1
HCB	1A1a	1	0	0	0
PCB	1A1a	1	0	0	0

Note: Only those key categories where notation keys are reported are considered.

production' and '1A1c — Manufacture of solid fuels and other energy industries'. France explained that carbon monoxide (CO) emissions were mainly caused by the regeneration of catalytic crackers. In 2013, a plant was equipped with a CO boiler and, since then, emissions have fallen (see France's IIR p.721, listed in Appendix 5).

In 2011, peaks in $PM_{2.5}$ and PM_{10} emissions arose from high emission values reported by Estonia in the category '1A1a — Public electricity and heat production'. The Member State explained that the significant growth of $PM_{2.5}$ emissions in 2011 was due to a 34 % increase in electricity production at the Balti Power Plant (Eesti Energia Narva Elektrijaamad) which resulted from the incorrect operation of electric precipitators in two of the plant's power units (see Estonia's IIR p. 46, listed in Appendix 5).

Of the three main heavy metals (HMs), lead (Pb) shows the highest reduction in relative terms (83 %) (see Figure 4.2(a)).

For emissions of persistent organic pollutants (POPs), the highest relative reduction was in polychlorinated

dibenzodioxins/dibenzofurans (PCDD/Fs) (97 %) (see Figure 4.2(b)). The peak in hexachlorobenzene (HCB) emissions in 1995 reflects high emission values reported by Belgium in the category '1A1a — Public electricity and heat production'. The Member State explained that these high HCB emissions were the result of higher levels of sludge burning in Flanders in 1995 (personal communication by Belgium in 2017). HCB emission data reported by the United Kingdom for the category '1A1a — Public electricity and heat production' also show that there has been a rising trend in recent years. The United Kingdom stated that the HCB emissions were the result of burning municipal solid waste and that more emissions reflect changes in quantities of waste burnt (see the United Kingdom's IIR p. 131, listed in Appendix 5).

Table 4.1 indicates the number of EU Member States reporting the notation keys 'NA' (not applicable), 'NO' (not occurring), 'NR' (not relevant) and 'NE' (not estimated) within the key categories. Table 4.2 shows the recalculations within the energy production and distribution sector group. For explanations of EU recalculations, see Section 5.1.

4.2 Sectoral analysis and emission trends for energy use in industry sector

The energy use in industry sector is a significant source of HMs and SO_x. According to the size of the absolute values reported, Italy, Bulgaria and France

Table 4.2 (a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions for the energy production and distribution sector group

a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	1	3	4	6	6	7	7	7	6	6	6	6	5	5	6	6
NMVOCs	5	7	8	10	9	9	9	8	8	8	9	9	9	9	9	7
SO_x	2	3	6	8	8	8	10	10	6	4	4	4	3	3	3	3
NH_3	-11	-9	-7	-6	-7	-10	-10	-11	-10	-10	-11	-9	-10	-9	-8	-2
TSPs	0	4	3	4	4	4	4	4	5	4	6	5	5	7	8	11
CO	-7	2	4	5	4	5	5	5	2	1	2	0	-1	-1	-2	-1
Pb	9	16	38	37	32	34	37	40	16	17	14	13	15	2	2	4
Cd	12	21	36	38	40	45	47	55	21	23	23	21	24	8	7	9
Hg	0	1	2	2	3	4	2	2	1	0	0	0	0	-1	-4	1
As	-2	0	2	1	1	1	1	1	1	1	1	1	1	1	1	2
Cr	0	0	0	1	1	1	1	1	1	1	1	1	1	2	1	1
Cu	0	0	-1	0	1	0	0	0	0	0	0	0	1	0	0	3
Ni	0	-2	-3	-3	-3	-3	-3	-3	-3	-2	-1	0	0	0	-1	11
Se	-6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5
Zn	0	0	-1	1	2	1	1	1	1	1	1	1	1	1	1	1
PCDD/Fs	-5	-13	-13	-61	-86	-87	-86	-88	-89	-88	-88	-87	-88	-88	-86	-85
B(a)P	-14	-19	-49	-43	-44	-46	-50	-41	-43	-41	-44	-46	-48	-51	-51	-50
B(b)F	-1	-3	-16	-12	-10	-11	-17	-18	-11	-11	-10	-7	-7	-10	-10	-8
B(k)F	-7	-10	-35	-31	-31	-33	-41	-42	-37	-37	-37	-37	-39	-42	-42	-41
IP	-12	-16	-50	-45	-49	-49	-56	-55	-53	-53	-53	-53	-54	-56	-57	-55
Total PAHs	-9	-12	-33	-35	-38	-40	-44	-43	-46	-47	-47	-45	-45	-46	-46	-45
HCB	19	18	72	77	70	72	69	67	26	25	24	23	23	4	4	5
PCBs	-14	-17	-17	-25	-24	-23	-22	-21	-20	-20	-20	-19	-19	-19	-17	-18
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			0	0	0	0	-1	-1	-1	-1	0	0	-1	-1	-1	1
PM_{10}			2	2	2	1	2	1	1	1	2	2	2	2	3	5
BC			1	7	4	4	3	4	3	2	2	1	-1	-2	-2	4

Note: As, arsenic; BC, black carbon; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd) pyrene; NH_3, ammonia; Ni, nickel; PCBs, polychlorinated biphenyls; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

Table 4.2 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions for the energy production and distribution sector group

b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	22	85	105	150	142	152	145	131	100	97	106	90	80	77	69	70
NMVOCs	Gg	99	104	80	77	72	65	60	54	50	51	57	53	49	47	47	37
SO_x	Gg	277	364	397	432	401	389	328	281	156	102	81	69	55	50	39	34
NH_3	Gg	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0
TSPs	Gg	3	30	14	14	13	13	12	10	10	10	11	10	9	10	11	14
CO	Gg	-75	17	28	34	33	37	37	32	12	9	15	1	-4	-6	-10	-4
Pb	Mg	59	60	72	63	52	54	53	51	23	23	20	18	19	3	3	5
Cd	Mg	4	5	6	6	6	6	6	6	2	3	2	2	2	1	1	1
Hg	Mg	0	1	1	1	1	1	1	0	0	0	0	0	0	0	-1	0
As	Mg	-3	0	1	1	1	0	1	0	0	0	0	0	0	0	0	1
Cr	Mg	-1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1
Cu	Mg	-1	0	-1	0	1	0	0	0	0	0	0	0	0	0	0	2
Ni	Mg	-1	-19	-21	-16	-15	-16	-14	-12	-10	-7	-3	-1	0	0	-3	22
Se	Mg	-8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3
Zn	Mg	0	1	-4	4	7	4	4	3	4	4	4	4	3	3	2	2
PCDD/Fs	g I-Teq	-171	-300	-195	-748	-927	-965	-931	-921	-909	-905	-949	-850	-809	-780	-623	-579
B(a)P	Mg	-10	-10	-7	-6	-6	-6	-6	-4	-5	-5	-5	-5	-5	-5	-5	-5
B(b)F	Mg	-1	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	-1	-1	-1
B(k)F	Mg	-3	-3	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
IP	Mg	-4	-4	-3	-2	-3	-3	-3	-2	-3	-3	-2	-3	-3	-3	-3	-3
Total PAHs	Mg	-25	-21	-17	-16	-18	-18	-18	-13	-18	-18	-17	-16	-15	-15	-15	-15
HCB	kg	19	21	24	25	23	24	23	24	9	9	9	8	9	2	2	2
PCBs	kg	-105	-127	-105	-95	-95	-85	-82	-75	-70	-75	-80	-72	-69	-69	-57	-58
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			0	0	0	-1	-1	-1	-1	-1	0	0	0	0	0	0
PM_{10}	Gg			5	4	3	3	3	2	2	2	3	2	2	2	2	4
BC	Gg			0	1	0	0	0	0	0	0	0	0	0	0	0	0

contributed most to Pb emissions in this sector in 2018. For Cd, Italy, Poland and the United Kingdom reported the highest emissions, while Italy and France contributed most to Hg emissions. In addition, in 2018, Poland, France and Spain contributed most to SO_X emissions.

Energy use (fuel combustion) in industry is a significant source of many pollutants. For the main ones, the highest absolute and relative reduction (89 %) between 1990 and 2018 was for SO_X (see Figure 4.3).

The strong decrease in CO emissions between 2008 and 2009 resulted from emission reductions reported by several countries, especially France, Italy and Belgium, in the main category, '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel', and may have been caused by the economic crisis.

The negative peak in $PM_{2.5}$ and PM_{10} emissions in 2009 was due to data reported by several countries and might also have been caused by the economic crisis. In 2015, data reported by Estonia and Spain in the category '1A2gviii — Stationary combustion in manufacturing industries and construction: Other' was the main reason for the increase in $PM_{2.5}$ and PM_{10} emissions. The increase from 2016 to 2017

was mainly caused by higher emissions reported by Estonia, Poland and the United Kingdom. Estonia and the United Kingdom reported higher emissions for the category '1A2gviii — Stationary combustion in manufacturing industries and construction: Other', while Poland's reported value for the category '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel' was higher in 2017 than in 2018 and previous years.

The trend in black carbon (BC) emissions mainly followed the data reported by the United Kingdom in the category '1A2gviii — Stationary combustion in manufacturing industries and construction: Other'.

Of the three HMs, Cd shows the biggest reduction in relative terms (77 % decrease) (see Figure 4.4(a)).

Pb emissions fell abruptly between 1996 and 1997, peaked in 2008, decreased considerably between 2008 and 2009, and increased between 2013 and 2014. This pattern was mainly the result of Bulgaria's data for the category '1A2b — Stationary combustion in manufacturing industries and construction: Non-ferrous metals', accentuated by drops in Pb emissions in the categories '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel' and '1A2b — Stationary combustion in manufacturing industries and construction: Non-ferrous metals' reported by Italy from 1996 to 1997 and between 2008 and 2009.

The increase in Hg emissions between 1994 and 1995 can be linked to higher emissions reported by Spain for the category '1A2f — Stationary combustion in manufacturing industries and construction: Non-metallic minerals'. Stationary combustion in non-metallic minerals manufacturing industries (1A2f) accounted for 16 % of total Hg emissions in 1990 but reduced its emissions by 71 % in 2018. This reduction resulted from the implementation of abatement techniques in thermal power plants and the shift from coal power plants to combined cycle gas turbine plants (see Spain's IIR p.82, listed in Appendix 5). The strong decline in Hg emissions between 2008 and 2009 was due to reductions reported by several countries, especially Italy and Romania in the category '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel', and may have been caused by the economic crisis in 2009.

The high Cd emissions from 1995 to 1997 mainly reflect the high levels reported by Bulgaria and Italy in the category '1A2b — Stationary combustion in manufacturing industries and construction: Non-ferrous metals'. The drop in Cd emissions between 2008 and 2009 was caused by reductions noted by several countries, in particular Italy, Bulgaria and

Figure 4.3 EU emission trends in the energy use in industry sector group for NO_X, SO_X, $PM_{2.5}$, PM_{10}, CO and BC between 1990 (2000) and 2018

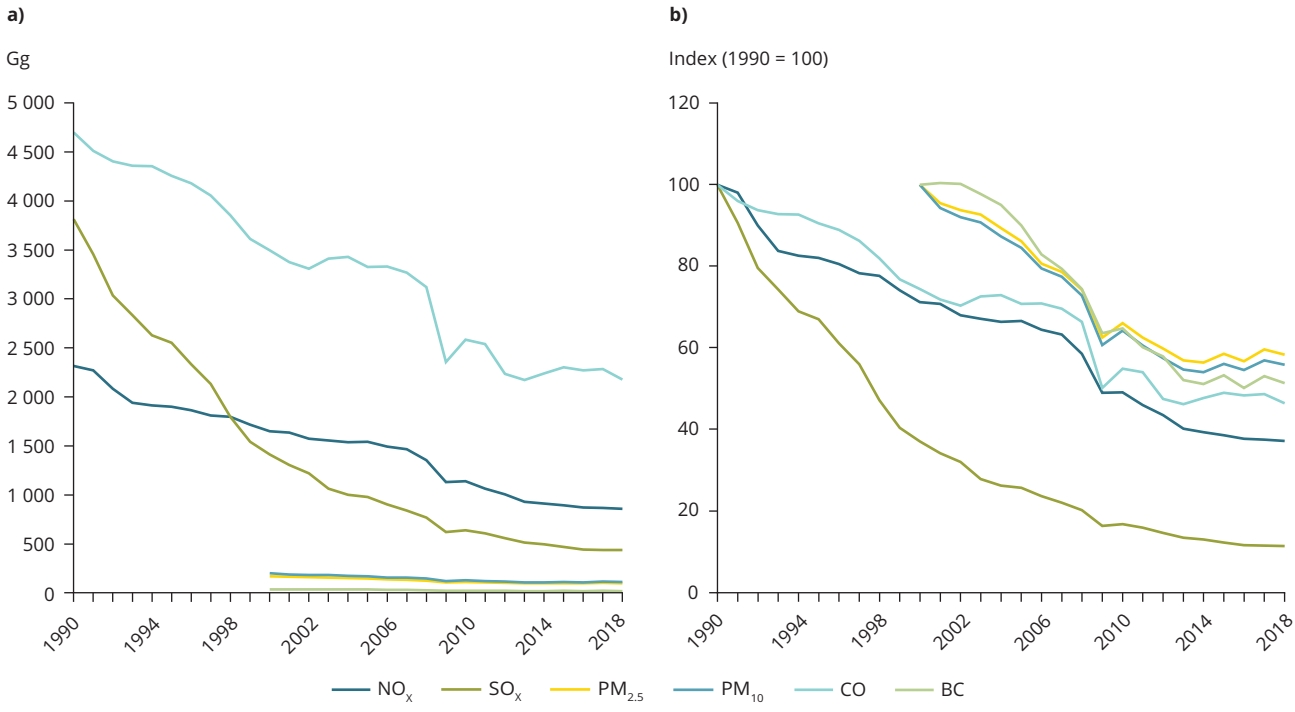
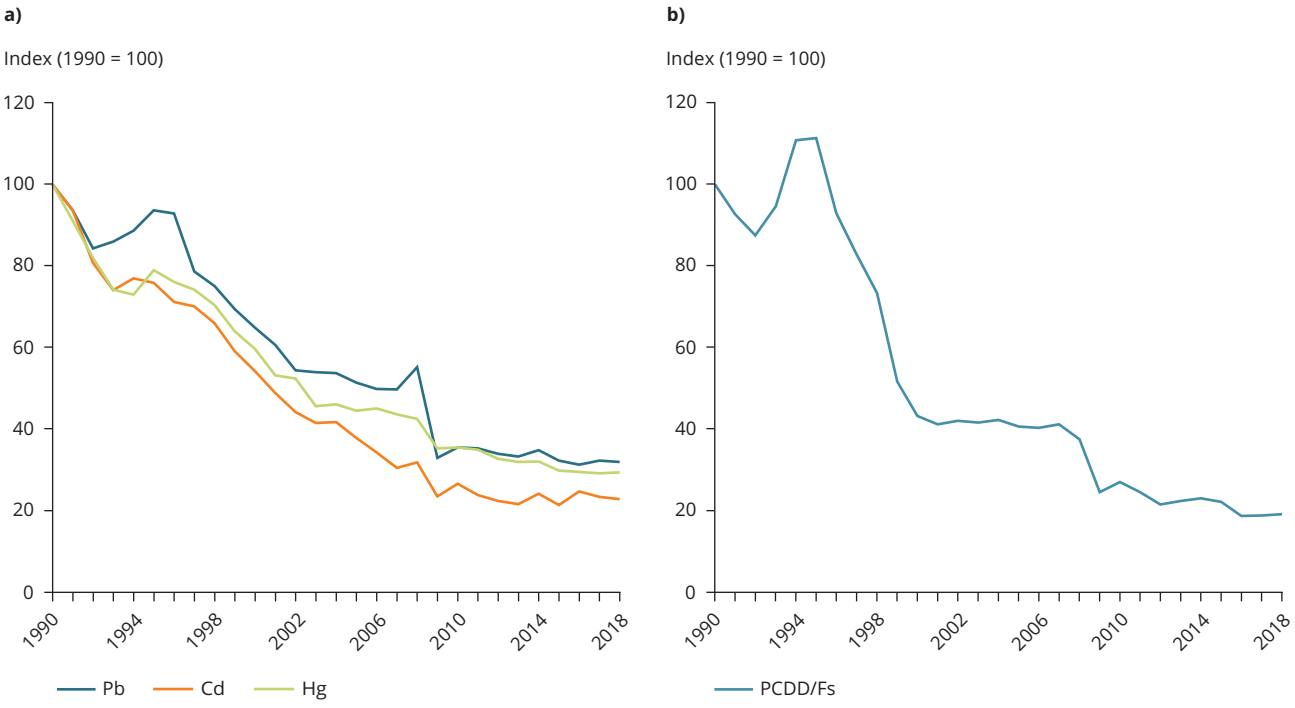


Figure 4.4 **EU emission trends in the energy use in industry sector group: (a) HMs (Pb, Cd and Hg) and (b) POPs (PCDD/Fs) between 1990 and 2018**



France in the category '1A2f — Stationary combustion in manufacturing industries and construction: Non-metallic minerals' and Italy in the category '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel' category.

Among the POPs, PCDD/Fs are key pollutants in the energy use in industry sector group. HCB registered the largest reduction, compared with 1990 values, of 99 % up to 2018. Figure 4.4(b) presents trends for these pollutants.

The trend in PCDD/F emissions from 1990 until 2000 was mainly attributable to the data reported by France, with peaks from 1994 to 1998 in the categories '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel' and '1A2b — Stationary combustion in manufacturing industries and construction: Non-ferrous metals'. The sudden drop in PCDD/F emissions from 2008 to 2009 was due to data reported by several countries, especially Italy, Czechia, Belgium and Bulgaria, mainly in the category '1A2a — Stationary combustion in manufacturing industries and construction: Iron and steel', and may have been caused by the economic crisis.

Table 4.3 presents the number of EU Member States reporting the notation keys 'NA', 'NO', 'NR' and 'NE' within the key categories. Table 4.4 shows the recalculations within the energy use in industry sector group. For explanations of EU recalculations, see Section 5.1.

4.3 Sectoral analysis and emission trends for the industrial processes and product use sector

The industrial processes and product use sector grouping refers to emissions from industrial sources other than those arising from fuel combustion within the industrial sector. This is the primary sector group for PCB, NMVOC, Pb, Cd, HCB and Hg emissions, as well as a significant source of total PAHs which make significant contributions to PM, CO and PCDD/F emissions. Countries are ranked according to the size of the absolute values they reported. Greece and Slovakia reported the largest contributions to B(a)P emissions. Spain, Germany and Italy reported the largest contributions to total PAH emissions. The United Kingdom, Italy and Germany contributed most to PCB emissions in this sector in 2018. Of all the countries that reported data, Germany, the United Kingdom and Italy contributed most to NMVOC emissions. For HCB emissions, the largest contributions were reported by Finland, Austria and Belgium. For Pb, the greatest contributions came from Poland, Germany and Italy. The EU Cd emission value is mainly driven by data

Table 4.3 Number of EU Member States reporting notation keys within the key categories of the energy use in industry sector group

Key categories		NA	NO	NR	NE
NO_x	1A2f	0	1	0	0
	1A2gviii	0	1	0	0
SO_x	1A2a	0	2	0	0
	1A2c	0	1	0	0
	1A2f	0	1	0	0
	1A2gviii	0	1	0	0
$PM_{2.5}$	1A2f	0	1	0	0
	1A2gviii	0	1	0	0
PM_{10}	1A2f	0	1	0	0
	1A2gviii	0	1	0	0
CO	1A2a	0	2	0	0
	1A2f	0	1	0	0
	1A2gvii	0	1	0	0
Pb	1A2a	0	2	0	1
	1A2b	0	2	0	0
	1A2f	0	1	0	0
Cd	1A2a	0	2	0	1
	1A2d	2	1	0	1
	1A2f	0	1	0	0
	1A2gviii	0	1	0	1
Hg	1A2a	0	2	0	1
	1A2b	1	2	0	1
	1A2d	2	1	0	0
	1A2f	0	1	0	0
	1A2gviii	0	1	0	0
PCDD/Fs	1A2b	1	2	0	1

Note: Only those key categories where notation keys are reported are considered.

reported by Germany, Poland and Spain. Figure 4.5 shows previous trends in emissions of the relevant main pollutants.

Data from France and Germany for the category '2C1 — Iron and steel production' have a great influence on the trend in CO emissions. In France, CO emissions from the 2C1 category have fluctuated over the years, depending on the amount of blast furnace gas that has been produced, reused or flared. These amounts depend on the operating conditions and how feasible it is for iron and steel or colliery plants to reuse the gas being produced continuously by blast furnaces. This may fluctuate a great deal from one year to another, resulting in peaks (1995, 2004 and 2010) or troughs (1992, 2001 and 2009) (personal communication by France in 2013). The negative peak in 2009 was also influenced by the data reported by several countries, mainly Belgium, France, Germany and the United Kingdom, in the category '2C1 — Iron and steel production'. Spain stated that the sharp drop in CO emissions in 2008 in this category was linked to the economic downturn (see Spain's IIR p. 96, listed in Appendix 5). The CO emission peak in 2013 followed that reported by Belgium in the '2A2 — Lime production' category. Belgium reported that the sudden increase in 2013 was due to a plant where lime production was taking place without oxygen (reducing atmosphere) (see Belgium's IIR p. 45, listed in Appendix 5).

The fall in SO_X emissions from 1990 to 1991, the increase from 1999 to 2000 and the decrease from 2008 to 2009 mainly reflect emission data reported by Germany for several categories. The drop in SO_X

emissions from 1990 to 1991 resulted from reductions in the categories '2H1 — Pulp and paper industry', '2B10a — Chemical industry: Other' and '2C1 — Iron and steel production'. The increase in SO_X emissions from 1999 to 2000 and the decrease from 2008 to 2009 mainly reflect data reported in the category '2C1 — Iron and steel production'. Germany explained that all the categories showed a reduction in SO_X emissions between 1990 and 2018 because of West Germany's stricter regulations, which applied to the new German *Länder* following German reunification; the fuel mix was changed from sulphur-rich solid fuels to liquid and gaseous fuels (see Germany's IIR, listed in Appendix 5). The drop in SO_X emissions from 1995 to 1996 was due to reductions in the category '2B10a — Chemical industry: Other' reported by Italy.

In 2009, many countries reported a fall in PM_{10} emissions, such as Greece, Denmark, France, Belgium and Spain. In 2015, Bulgaria reported a peak in PM_{10} emissions in the category '2D3b — Road paving with asphalt'.

Despite considerable reductions since 1990, the industrial processes and product use sector continues to contribute significantly to total EU emissions of HMs. Figure 4.6(a) presents previous emission trends for these pollutants. Pb shows the

Table 4.4 (a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions for the energy use in industry sector group

a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	2	3	4	5	5	4	5	5	4	2	3	3	3	2	2	2
NMVOCs	3	6	2	4	4	4	5	6	6	5	6	5	6	5	6	6
SO_x	1	3	5	9	8	6	4	3	1	-3	-1	-1	-3	-4	-4	-6
NH_3	-14	-24	-24	-18	-19	-19	-16	-18	-19	-23	-23	-26	-26	-23	-26	-27
TSPs	-2	-3	-3	-2	-1	-2	-2	-1	0	-2	-2	-4	-5	-4	-5	-6
CO	-8	-2	-3	-2	-1	-2	-2	0	0	0	0	-1	-1	-1	-1	-2
Pb	-4	-4	-5	-5	-6	-3	-3	-2	-3	-4	-4	-4	-6	-6	-6	-7
Cd	-20	-33	-33	-35	-36	-41	-37	-36	-36	-35	-35	-41	-39	-41	-33	-40
Hg	-10	-9	-15	-9	-12	-10	-13	-1	-2	-3	-3	-4	-6	-5	-5	-7
As	-2	-1	-2	-1	-1	-1	-1	0	0	0	-1	-1	-1	-1	-1	-1
Cr	-3	-2	-1	0	0	0	0	1	1	0	-1	0	-1	-1	-1	-3
Cu	-5	-5	-6	-5	-5	-1	-1	0	0	-1	-2	-2	-3	-3	-3	-5
Ni	-2	-1	-1	-1	-2	-1	-2	-1	-1	-7	-4	0	-1	0	-3	-11
Se	-2	-3	-3	-3	-2	0	0	0	0	0	0	0	0	0	0	0
Zn	-5	-3	-3	-1	-2	-1	0	2	1	1	0	1	0	-1	-1	-3
PCDD/Fs	-22	-17	-21	-6	-6	-4	-10	-4	-2	-4	-5	-7	-8	-8	-18	-24
B(a)P	22	32	37	39	38	40	43	46	46	56	58	52	45	43	43	48
B(b)F	22	28	30	32	31	33	35	36	39	47	48	44	37	37	36	40
B(k)F	19	30	28	31	29	30	32	33	33	39	40	35	29	28	27	30
IP	24	34	35	37	35	39	41	43	45	51	54	50	43	43	43	46
Total PAHs	6	3	7	6	7	6	8	11	10	11	13	11	9	8	7	7
HCB	0	-10	-13	-11	-11	-9	-16	-8	-5	-9	-2	-1	-1	-14	-22	-29
PCBs	-11	-11	-13	-18	-18	-17	-15	-5	-10	-16	-14	-18	-20	-21	-24	-29
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			-4	-3	-2	-3	-3	-1	-1	-3	-2	-4	-5	-5	-5	-7
PM_{10}			-3	-2	-2	-2	-2	-1	-1	-2	-2	-4	-5	-5	-5	-7
BC			0	-2	-1	0	-1	-1	0	-1	1	1	2	3	3	1

Note: As, arsenic; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd)pyrene; NH_3, ammonia; Ni, nickel; PCBs, polychlorinated biphenyls; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

Table 4.4 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions for the energy use in industry sector group

(b)

		Absolute difference																
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	54	60	65	67	66	62	60	55	46	26	31	28	24	21	19	18
NMVOCs	Gg	6	13	5	7	8	7	9	9	10	9	9	8	8	8	9	10
SO_x	Gg	54	70	70	83	70	49	28	18	6	-20	-6	-8	-17	-18	-16	-27
NH_3	Gg	-2	-3	-3	-3	-3	-3	-3	-3	-3	-4	-4	-4	-4	-4	-5	-5
TSPs	Gg	-12	-10	-8	-4	-2	-4	-4	-1	-1	-4	-3	-5	-7	-6	-7	-9
CO	Gg	-435	-99	-111	-51	-47	-65	-58	0	8	-7	-9	-14	-20	-19	-18	-39
Pb	Mg	-38	-31	-30	-25	-25	-14	-13	-7	-9	-12	-12	-13	-17	-17	-18	-20
Cd	Mg	-11	-16	-11	-9	-8	-9	-8	-6	-6	-5	-5	-6	-7	-6	-5	-7
Hg	Mg	-3	-2	-3	-1	-2	-1	-2	0	0	0	0	0	-1	0	0	-1
As	Mg	-1	-1	-1	0	-1	-1	-1	0	0	0	0	0	0	0	0	-1
Cr	Mg	-3	-2	0	0	0	0	0	0	0	0	0	0	-1	0	-1	-1
Cu	Mg	-14	-10	-9	-8	-8	-1	-1	0	0	-1	-1	-1	-2	-2	-2	-4
Ni	Mg	-13	-7	-4	-3	-4	-3	-3	-2	-2	-10	-6	0	-1	0	-3	-10
Se	Mg	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0
Zn	Mg	-67	-42	-30	-10	-14	-5	1	10	9	5	3	6	1	-5	-4	-17
PCDD/Fs	g I-Teq	-223	-183	-88	-22	-21	-12	-32	-8	-3	-9	-9	-13	-16	-16	-33	-47
B(a)P	Mg	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2
B(b)F	Mg	4	4	3	4	4	4	4	3	3	3	3	3	2	2	2	3
B(k)F	Mg	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IP	Mg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total PAHs	Mg	3	2	3	3	3	2	3	3	3	3	3	3	2	2	2	2
HCB	kg	-2	-1	-1	-1	-1	-1	-2	-1	0	-1	-1	-1	-1	-1	-2	-3
PCBs	kg	-37	-32	-28	-22	-21	-21	-18	-4	-9	-14	-12	-15	-16	-17	-22	-26
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			-7	-4	-3	-4	-3	-1	-1	-3	-2	-4	-5	-5	-6	-7
PM_{10}	Gg			-7	-4	-2	-4	-3	-1	-1	-3	-3	-4	-6	-5	-6	-8
BC	Gg			0	-1	0	0	0	0	0	0	0	0	0	1	1	0

highest relative reduction in emissions between 1990 and 2018 (77 %).

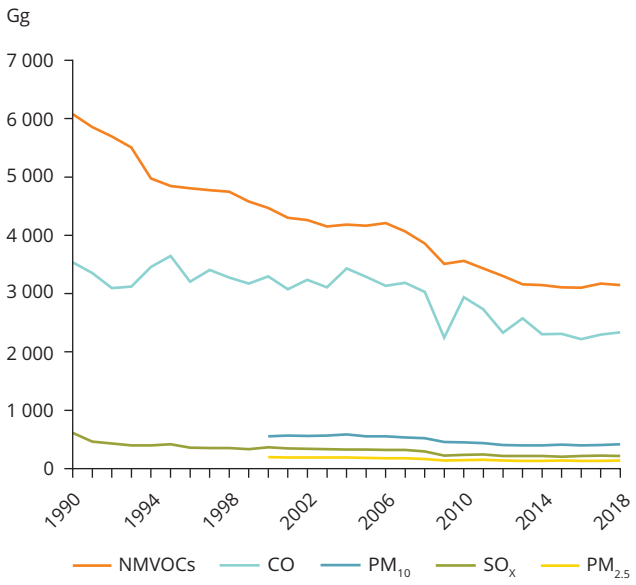
The trend in Cd emissions between 1990 and 2007 mainly reflects data reported by Germany in the category '2C1 — Iron and steel' and '2C7a — Copper production'.

The decrease in Pb emissions between 2008 and 2009 was mainly caused by reductions in the category '2C1 — Iron and steel production' in several countries, such as Belgium, Latvia, Italy, Poland and Germany, presumably due to the economic crisis in 2009. The reduction in Pb emissions between 2010 and 2011 reflected the significant drop in emissions reported by Latvia in the category '2C1 — Iron and steel production' resulting from a change in the type of furnace used in metal production. Overall, between 2010 and 2011, Latvia's total Pb emissions (national total) fell by 97.4 % (see Latvia's IIR p. 28 f., listed in Appendix 5).

Among the POPs, HCB recorded the highest relative reduction (99 %) between 1990 and 2018 (Figure 4.6(b)).

The considerable change in HCB emissions mainly resulted from an increase in '2C3 — Aluminium production' in the United Kingdom until 1998; from 1999 onwards, the United Kingdom has reported the

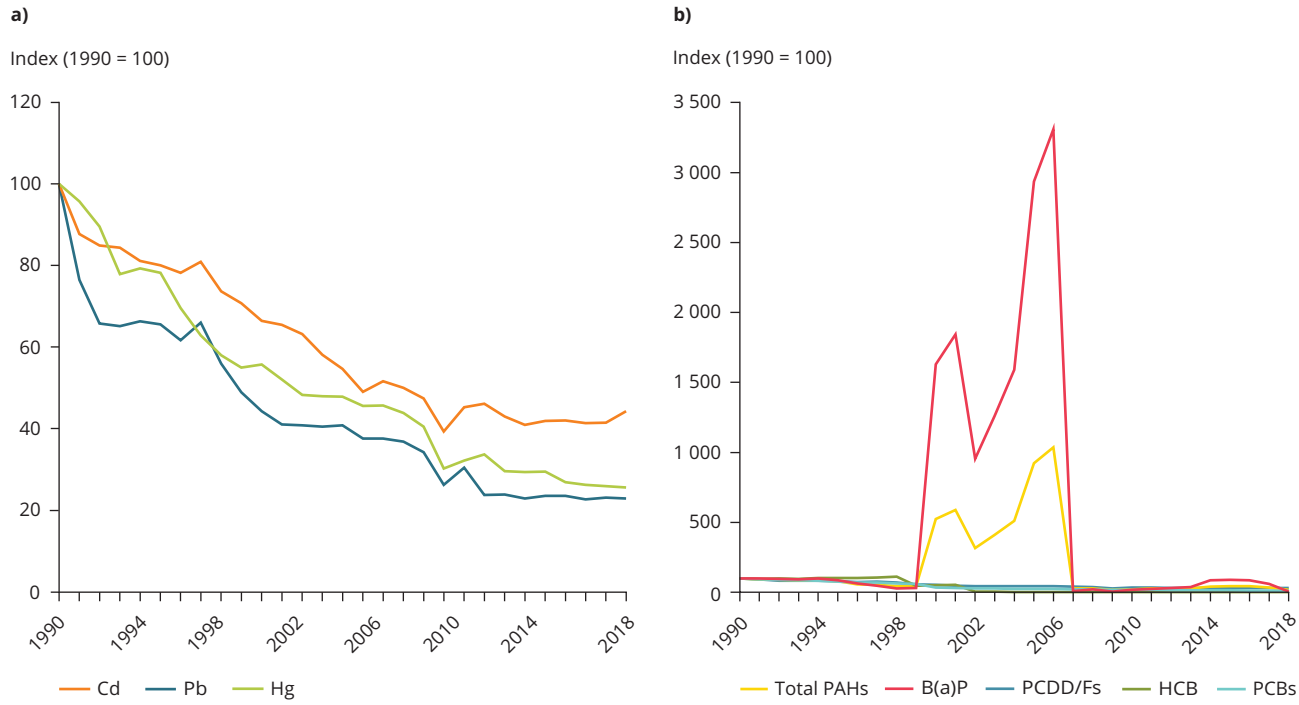
Figure 4.5 **EU emission trends in the industrial processes and product use sector group for NMVOCs, SO_X, $PM_{2.5}$, PM_{10} and CO between 1990 (2000) and 2018**



notation key 'NA'. In the United Kingdom, the largest source of HCB emissions for the years 1990-1998 was the use of hexachloroethane (HCE) as a degassing agent in secondary aluminium smelting. Specific regulations controlling the use of HCE resulted in zero emissions from this sector from 1999 onwards and thus an overall sharp fall in HCB emissions between 1998 and 1999 (personal communication by the United Kingdom in 2017). Since 2002, Germany has reported the notation key 'NA' in this category. The country's secondary aluminium production has been prohibited by law since 2002, resulting in an omission of the source for HCB (see Germany's IIR, listed in Appendix 5).

The steep drop in PCBs from 1999 to 2000 resulted from lower emissions from the category '2K — Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)' reported by the United Kingdom. It explained that there was a sharp fall in PCB emissions generated by capacitors between 1999 and 2000 (personal communication by the United Kingdom in 2017).

Figure 4.6 **EU emission trends in the industrial processes and product use sector group: (a) HMs (Pb, Cd, Hg) and (b) POPs (PCDD/Fs, total PAHs, B(a)P, HCB, PCBs) between 1990 and 2018**



Note: Data from Austria for B(a)P could not be gap filled, as the country did not report values for any year. To enable the presentation of provisional EU emission trends, the emissions have been aggregated without including data from this Member State.

Changes in the total emissions of PAHs follow the data reported by Bulgaria in the category '2D3g — Chemical products' and shows a significant drop from 2006 to 2007.

Table 4.5 presents the number of EU Member States reporting the notation keys 'NA', 'NO', 'NR' and 'NE' within the key categories. Table 4.6 shows the recalculations within the industrial processes and product use sector group. For explanations of EU recalculations, see Section 5.1.

Table 4.5 Number of EU Member States reporting notation keys within the key categories of the industrial processes and product use sector group

Key categories		NA	NO	NR	NE
NMVOC	2B10a	0	6	0	0
	2D3d	0	0	0	1
	2D3e	0	1	0	1
	2D3g	0	0	0	1
	2D3h	0	0	0	1
	2D3i	1	0	0	0
SO_x	2B10a	1	5	0	2
$PM_{2.5}$	2A5b	0	0	0	3
	2C1	0	4	0	0
PM_{10}	2A5a	0	0	0	4
	2A5b	0	0	0	4
	2C1	0	4	0	0
	2D3b	0	0	0	4
	2L	7	14	0	1
CO	2C1	0	4	0	2
Pb	2A3	1	3	0	0
	2C1	0	4	0	0
	2C5	0	9	0	0
Cd	2A3	1	3	0	0
	2C1	1	4	0	0
	2C6	1	12	0	1
	2C7a	1	10	0	1
Hg	2A1	7	1	0	5
	2C1	1	4	0	0
	2C6	3	12	0	1
PCDD/Fs	2C1	1	4	0	1
HCB	2B10a	14	5	0	7
PCB	2C1	1	4	0	0
	2K	8	7	0	5

Note: Only those key categories where notation keys are reported are considered.

Table 4.6 **(a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions for the industrial processes and product use sector group**

(a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	-10	-7	-6	-7	-15	-12	-12	-10	-11	-15	-12	-13	-14	-15	-16	-3
NMVOCs	0	1	2	4	3	3	3	3	2	2	2	1	1	1	1	0
SO_x	-8	-3	0	1	0	0	-1	-2	-2	-3	-4	-4	-4	-5	-5	-5
NH_3	-27	-25	-31	-31	-27	-24	-27	-32	-29	-26	-29	-31	-31	-37	-35	-37
TSPs	3	5	4	3	3	3	4	4	4	5	4	3	3	3	4	4
CO	-6	-1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Pb	34	21	2	2	3	2	3	4	3	3	4	5	4	4	3	4
Cd	-8	-13	-13	-10	-9	5	6	7	7	7	7	6	6	8	8	8
Hg	-22	-4	-3	-2	-1	-1	-2	-4	-4	-3	-6	-7	-7	-7	-7	-9
As	46	75	24	-29	-31	-29	-31	-29	-33	-47	-43	-31	-47	-51	-56	-54
Cr	-8	1	6	15	15	16	15	22	20	20	21	24	24	23	24	21
Cu	-13	-4	4	0	-2	-2	-2	1	-3	-4	-3	1	-2	-5	-5	-5
Ni	11	10	-5	-9	-8	-8	-8	-8	-8	-8	-8	-10	-10	-9	-11	-9
Se	-8	-11	-7	-7	-10	-10	-12	-11	-14	-15	-15	-13	-13	-16	-18	-20
Zn	-9	-9	-12	-12	-12	-13	-13	-14	-13	-14	-14	-15	-16	-16	-15	-15
PCDD/Fs	3	0	1	1	1	2	0	0	0	0	0	1	1	1	1	1
B(a)P	-78	-90	-35	-30	-26	-99	-98	-99	-98	-94	-89	-83	-69	-74	-76	-84
B(b)F	10	14	85	65	61	27	52	84	100	103	85	85	85	87	89	80
B(k)F	10	13	48	40	37	19	36	89	100	106	85	84	84	85	87	78
IP	14	20	119	83	86	31	60	27	36	40	34	37	37	38	40	31
Total PAHs	-52	-75	-34	-30	-26	-92	-90	-94	-91	-83	-74	-66	-56	-64	-66	-74
HCB	0	0	0	-33	-55	-44	-58	-62	-79	-65	-80	-79	-71	-77	-41	-44
PCBs	-16	-24	-41	0	0	0	0	1	1	1	1	1	1	1	1	1
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			-3	-5	-5	-4	-5	-6	-5	-6	-6	-7	-7	-6	-6	-6
PM_{10}			2	1	1	2	3	2	2	3	2	1	1	1	2	2
BC			19	14	15	16	17	14	24	18	22	20	17	19	19	10

Note: As, arsenic; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd)pyrene; NH_3, ammonia; Ni, nickel; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

Table 4.6 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions for the industrial processes and product use sector group

(b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	-40	-22	-18	-19	-41	-31	-30	-21	-25	-35	-26	-29	-30	-34	-34	-5
NMVOCs	Gg	27	66	79	146	137	125	113	111	76	77	52	31	35	35	23	9
SO_x	Gg	-54	-14	0	2	1	-1	-3	-4	-6	-7	-9	-10	-9	-11	-10	-12
NH_3	Gg	-32	-24	-26	-27	-22	-18	-19	-21	-20	-19	-20	-21	-22	-29	-26	-29
TSPs	Gg	48	76	57	47	48	49	66	60	54	65	51	35	37	39	47	51
CO	Gg	-234	-20	17	52	54	53	47	42	46	48	49	48	49	52	49	48
Pb	Mg	665	300	17	21	25	21	23	26	21	19	24	31	26	22	20	24
Cd	Mg	-5	-7	-6	-3	-3	1	2	2	2	2	2	1	2	2	2	2
Hg	Mg	-14	-2	-1	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1
As	Mg	108	56	11	-17	-20	-19	-19	-14	-18	-19	-16	-10	-20	-24	-27	-25
Cr	Mg	-59	4	14	22	24	23	21	20	22	20	21	22	23	22	22	21
Cu	Mg	-54	-16	11	0	-7	-6	-5	3	-8	-11	-7	3	-6	-12	-13	-13
Ni	Mg	30	17	-7	-10	-9	-9	-8	-6	-7	-7	-7	-8	-8	-8	-9	-7
Se	Mg	-4	-6	-4	-6	-7	-7	-8	-7	-10	-9	-9	-7	-8	-10	-11	-13
Zn	Mg	-373	-296	-267	-186	-203	-216	-211	-172	-186	-205	-212	-201	-226	-223	-205	-212
PCDD/Fs	g I-Teq	32	-4	4	3	3	8	1	0	0	0	1	5	4	3	4	2
B(a)P	Mg	-426	-898	-1 036	-1 495	-1 381	-1 255	-1 006	-1 149	-894	-508	-317	-212	-219	-309	-330	-362
B(b)F	Mg	6	6	6	4	4	2	3	2	2	3	2	2	2	2	2	2
B(k)F	Mg	3	3	3	3	3	1	2	2	2	3	2	2	2	2	2	2
IP	Mg	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0
Total PAHs	Mg	-422	-903	-1 035	-1 481	-1 366	-1 245	-996	-1135	-879	-493	-302	-199	-206	-296	-317	-380
HCB	kg	1	1	1	-106	-122	-89	-117	-95	-110	-112	-128	-111	-82	-86	-47	-57
PCBs	kg	-1 809	-2 359	-2 354	8	8	9	8	10	12	11	12	12	11	10	9	10
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			-6	-10	-9	-7	-9	-9	-8	-10	-9	-11	-10	-9	-9	-9
PM_{10}	Gg			10	7	7	9	13	11	9	13	9	4	4	5	7	7
BC	Gg			1	1	1	1	1	1	1	1	1	1	0	1	0	0

4.4 Sectoral analysis and emission trends for the commercial, institutional and households sector

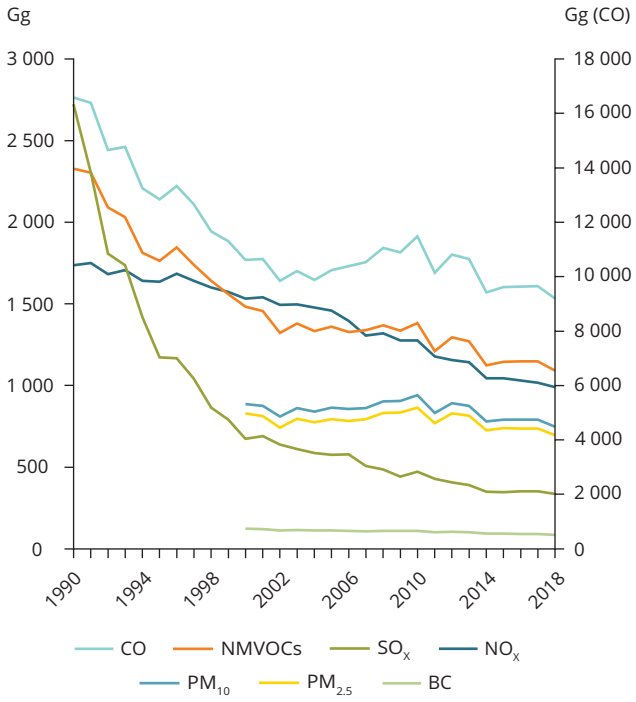
As indicated in Chapter 2, fuel combustion in commercial and institutional facilities and households makes a significant contribution to the total emissions of many pollutants.

The commercial, institutional and households sector is the primary sector group for $PM_{2.5}$, CO, total PAHs and PM_{10}, as well as an important sector group for PCDD/F, B(a)P, HCB, Cd, SO_X, NMVOC and PCB emissions. Countries are ranked according to the size of the absolute values that they reported. For primary $PM_{2.5}$, Italy, Romania, Poland and France reported the highest emissions. Poland, Italy and France contributed most to CO emissions. Poland, Italy and Romania emitted the largest proportion of PM_{10} in 2018.

Of the main pollutants, once again the highest relative reduction between 1990 and 2018 for the sector grouping was for SO_X (88 % decrease). In contrast, PM emissions have changed little since 2000 (see Figure 4.7).

The drop in CO emissions between 1990 and 1992 reflects data from Germany in the categories '1A4ai — Commercial/institutional: Stationary' and '1A4bi — Residential: Stationary'. The Member State explained that the main driver of the CO emission trends was declining lignite consumption. Since 1990, fuel use has changed from solid fuels, causing high CO emissions, to gaseous fuels, producing much lower emissions (see Germany's IIR, listed in Appendix 5). The increase

Figure 4.7 **EU emission trends in the commercial, institutional and households sector group for NO_X, NMVOCs, SO_X, $PM_{2.5}$, PM_{10}, BC and CO between 1990 (2000) and 2018**

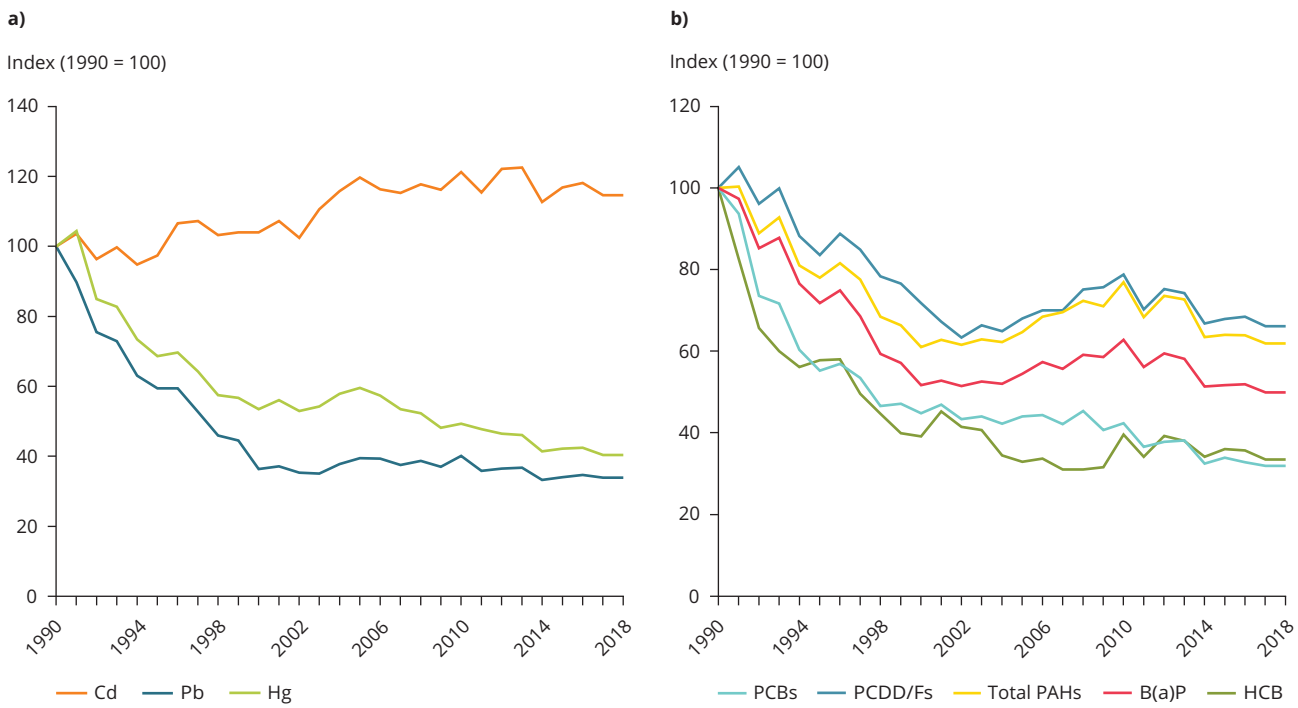


Note: The right-hand axis shows values for CO.

in CO emissions from 1992 to 1993 reflects data from Poland in the category '1A4bi — Residential: Stationary'. The peak in 1996 reflects data from France and Poland in the same category. Low CO emissions in 2002 and the decreases in 2011 and 2014 reflect data from Italy and France for the category '1A4bi — Residential: Stationary'.

Lower SO_X and NMVOC emissions between 1990 and 1992 were the result of reductions in these air pollutants in Germany. The Member State explained that lower SO_X emissions resulted from the fuel switch from coal (especially lignite with a high emission factor) to natural gas (with a lower emission factor). From 2008 onwards, a further reduction in sulphur dioxide (SO_2) emissions can be explained by the increasing use of fuel oil with low sulphur content. The main reason behind the NMVOC emissions reported by Germany concerns less lignite consumption. In the residential sector, the emission trend is also affected by the increasing use of firewood with high emission factors, which counteracts the reduction in SO_2 emissions. Since 1990, fuel use has changed from solid fuels causing high NMVOC emissions to gaseous fuels producing much lower emissions (see Germany's IIR, listed in Appendix 5). The data reported by Poland, Germany and France in the category '1A4bi — Residential: Stationary' were the main cause of the dip in NMVOC emissions in 2010.

Figure 4.8 **EU emission trends in the commercial, institutional and households sector group: (a) HMs (Pb, Cd and Hg) and (b) POPs (PCDD/Fs, total PAHs, B(a)P, HCB and PCBs) between 1990 and 2018**



Notes: Data from Austria for B(a)P could not be gap filled, as the country did not report values for any year. To enable the presentation of provisional EU emission trends, the emissions have been aggregated without including data from this Member State.

Of the three HMs in the commercial, institutional and households sector, Pb shows the largest reduction, both absolutely and relatively (66 % decrease) (see Figure 4.8(a)).

The trend in Cd emissions largely reflects data from Romania und the United Kingdom, whereas Poland and Germany contribute most to the Pb emission trend. The Cd emissions mainly relate to the category '1A4bi — Residential: Stationary' category in Romania. As regards

Table 4.7 Number of EU Member States reporting notation keys within the key categories of the commercial, institutional and households sector group

	Key categories	NA	NO	NR	NE
CO	1A4bii	0	2	0	0

Note: Only those key categories where notation keys are reported are considered.

Table 4.8 (a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions for the commercial, institutional and households sector group

(a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	1	3	3	3	4	4	4	3	2	2	1	0	0	0	-1	0
NMVOCs	1	2	2	2	2	3	3	2	1	2	3	2	2	1	1	1
SO_x	1	-3	-4	-1	-1	-3	-3	-4	-4	-5	-5	-6	-6	-6	-6	-6
NH_3	0	4	3	4	3	4	3	3	3	4	3	2	3	2	2	2
TSPs	2	2	1	0	1	1	1	0	-1	0	0	0	0	0	-1	-1
CO	-3	1	1	1	2	2	3	1	1	1	3	2	1	1	0	0
Pb	0	3	6	3	-1	-16	-17	-19	-20	-18	-20	-21	-25	-25	-28	-27
Cd	-4	-5	-3	-3	-5	-12	-14	-17	-14	-11	-11	-12	-14	-14	-16	-16
Hg	-7	-11	-13	-12	-17	-28	-31	-33	-32	-29	-27	-30	-33	-34	-36	-37
As	-5	-6	-5	-6	-6	-7	-7	-8	-5	-4	-4	-3	-4	-3	-3	-3
Cr	0	1	2	1	0	-4	-5	-7	-4	-3	-2	-3	-4	-5	-7	-6
Cu	-2	-1	-1	-1	-1	-4	-4	-7	-2	-2	-2	-2	-3	-3	-4	-3
Ni	1	0	0	-1	-6	-14	-22	-34	1	1	0	0	0	0	-1	0
Se	20	-2	-3	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1
Zn	1	4	4	2	3	1	2	0	-1	0	3	2	1	0	-2	-1
PCDD/Fs	11	15	13	20	20	17	18	17	17	17	17	15	15	15	16	16
B(a)P	39	60	49	63	70	70	72	66	62	54	61	56	54	53	51	54
B(b)F	75	86	66	78	84	106	84	82	79	65	68	64	63	63	64	66
B(k)F	42	29	22	26	28	29	120	116	114	96	101	95	94	94	97	99
IP	19	13	17	16	17	19	20	18	15	9	12	11	10	11	10	12
Total PAHs	27	31	20	25	28	30	34	27	26	24	29	25	23	20	17	19
HCB	5	0	-1	5	7	7	5	1	6	6	6	-1	0	0	-1	-1
PCBs	-70	-83	-77	-79	-81	-81	-80	-83	-83	-84	-83	-83	-84	-84	-85	-84
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			1	1	2	2	2	1	0	1	2	1	1	1	0	0
PM_{10}			1	0	1	1	1	0	-1	0	0	0	0	0	-1	-1
BC			-5	-6	-5	-5	-4	-5	-5	-5	-5	-5	-6	-6	-7	-8

Note: As, arsenic; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd)pyrene; NH_3, ammonia; Ni, nickel; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

Table 4.8 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions for the commercial, institutional and households sector group

(b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	18	40	48	46	50	46	47	36	25	25	9	5	2	0	-8	-3
NMVOCs	Gg	19	31	29	27	31	33	34	23	18	21	43	23	19	14	6	10
SO_x	Gg	31	-38	-31	-7	-7	-17	-13	-17	-20	-24	-23	-27	-24	-24	-24	-23
NH_3	Gg	0	3	2	3	3	3	2	2	2	3	3	2	2	2	2	2
TSPs	Gg	26	21	6	4	5	8	6	-1	-11	-4	2	-3	-2	-3	-9	-7
CO	Gg	-449	156	108	71	175	235	290	130	91	127	325	188	110	66	-26	-1
Pb	Mg	0	8	9	5	-2	-30	-33	-36	-42	-33	-38	-41	-46	-48	-55	-54
Cd	Mg	0	0	0	0	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Hg	Mg	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-3
As	Mg	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0
Cr	Mg	0	1	1	0	0	-2	-2	-3	-2	-2	-1	-1	-2	-2	-3	-3
Cu	Mg	-2	-1	0	-1	-1	-3	-4	-6	-2	-2	-2	-2	-2	-2	-3	-2
Ni	Mg	2	0	1	-1	-9	-21	-33	-52	1	1	0	0	0	0	-1	0
Se	Mg	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zn	Mg	5	21	20	14	15	7	12	0	-4	1	17	15	4	1	-11	-4
PCDD/Fs	g I-Teq	121	139	105	142	151	131	144	141	148	128	137	125	112	114	119	122
B(a)P	Mg	121	116	73	90	101	99	106	100	103	84	97	90	77	77	75	78
B(b)F	Mg	129	124	78	95	103	125	104	102	105	84	90	84	74	75	77	78
B(k)F	Mg	39	27	16	20	22	21	54	53	55	46	49	46	41	41	42	43
IP	Mg	24	15	15	15	16	17	19	18	15	9	13	11	9	10	9	11
Total PAHs	Mg	249	219	122	153	179	191	216	179	185	154	194	173	138	127	109	121
HCB	kg	9	0	-1	3	4	3	3	1	4	3	4	-1	0	0	-1	0
PCBs	kg	-537	-614	-336	-391	-430	-416	-429	-445	-473	-431	-437	-432	-398	-397	-422	-415
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			12	12	14	16	15	10	2	7	13	8	9	7	2	3
PM_{10}	Gg			5	3	4	7	5	0	-10	-3	3	-2	-1	-2	-8	-6
BC	Gg			-6	-7	-5	-5	-5	-5	-6	-6	-5	-6	-6	-6	-7	-7

the positive trend in Cd emissions in 2008, Romania also reported an increase in the category '1A4bi — Residential: Stationary'.

The fall in Pb emissions from 1990 to 1992 is the result of emission reductions reported by several countries, especially Germany and Italy, which reduced their emissions considerably in the categories '1A5b — Other, mobile (including military, land based and recreational boats)' and '1A4cii — Agriculture/forestry/fishing: Off-road vehicles and other machinery'. The peak in Pb emissions in 2010 relates to Poland's emission data in the category '1A4bi — Residential: Stationary'.

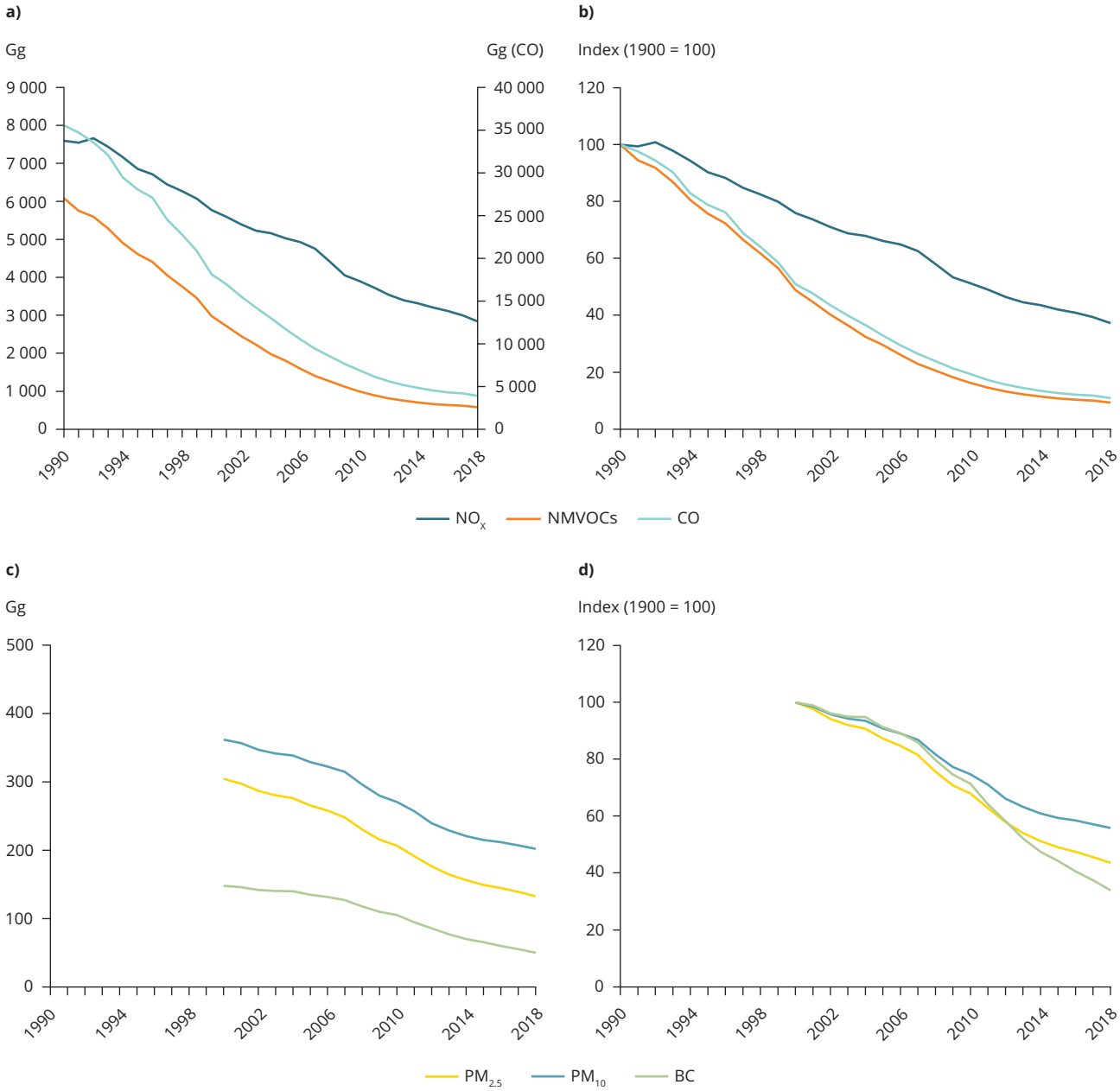
The development of the trend in Hg emissions largely reflects data from Czechia, Poland, Germany, Italy and the United Kingdom reported for the category '1A4bi — Residential: Stationary'. The Hg peak in 1991 reflects data from France for the category '1A4bi — Residential: Stationary'.

Among the POPs relevant to the commercial, institutional and households sector, the highest absolute and relative reduction occurred for PCB (68 %) (see Figure 4.8(b)).

The trend in PCB emissions largely reflects data from Germany, Italy and France for the category '1A4bi — Residential: Stationary'. Furthermore, the HCB trend largely reflects data from Austria and Czechia for the category '1A4bi — Residential: Stationary'.

The trend in total emissions of PAHs between 1990 and 2000 largely reflects data from Czechia, Germany and Poland in the category '1A4bi — Residential: Stationary'.

Figure 4.9 **EU emission trends in the road transport sector group for NO_x, NMVOCs, $PM_{2.5}$, PM_{10}, BC and CO between 1990 (2000) and 2018**



Note: In the left-hand panel, Figure (a), the right-hand axis shows values for CO.

The strong decline in total PAHs and B(a)P from 1990 to 1992 and the peaks in 2010 and 2013 reflect data reported by Germany in the '1A4bi' category. Emissions from Poland reported in the same category caused the peak in total PAHs and B(a)P total emissions in 1993.

Table 4.7 presents the number of EU Member States reporting the notation keys 'NA', 'NO', 'NR' and 'NE' within the key categories. Table 4.8 shows the recalculations within the commercial, institutional and households sector group. For explanations of EU recalculations, see Section 5.1.

4.5 Sectoral analysis and emission trends for the road transport sector

Together, the individual NFR sources that make up the road transport sector group contribute considerably to the emissions of several pollutants, including NO_X, CO, Pb, $PM_{2.5}$, PM_{10} and NMVOCs. Figure 4.9 and Figure 4.10 show the previous emission trends for these pollutants in this sector.

Countries are ranked according to the size of the absolute values that they reported. Germany, France and Italy contributed most (in absolute terms) to NO_X, $PM_{2.5}$ and PM_{10} emissions in the road transport sector in 2018. For CO, Germany, Poland and Italy reported the highest emissions. France, Germany and the United Kingdom contributed most to Pb emissions, and Italy, Germany and Poland contributed most to NMVOC emissions in this sector in 2018.

The main HM for the road transport sector is Pb, which shows a high relative reduction in emissions (99 % decrease) between 1990 and 2018 (see Figure 4.10(a)). However, in recent years, little progress has been made in further reducing emissions from road transport, and over the last 3 years total Pb emissions have actually increased slightly. The promotion of unleaded petrol in the EU and other EEA member countries, by means of a combination of fiscal and regulatory measures, has been a success story. For example, EU Member States have completely phased out the use of leaded petrol. Directive 98/70/EC relating to the quality of petrol and diesel fuels (EU, 1998) regulated that objective. Nevertheless, the road transport sector remains a key source of Pb, contributing around 16 % of total Pb emissions in the EU.

PCDD/Fs are the most important POPs in the road transport sector group. Figure 4.10(b) shows past emission trends for this group of pollutants, with a 73 % reduction from 1990 to 2018.

The trend in emissions of PCDD/Fs mainly reflects data reported by the United Kingdom in the category '1A3bi — Road transport: Passenger cars'. The United Kingdom reported that the emissions were associated with compounds previously added to leaded petrol. From 1990 onwards, sales of unleaded petrol rose,

Figure 4.10 EU emission trends in the road transport sector group: (a) the priority HM Pb and (b) PCBs and PCDD/Fs between 1990 and 2018

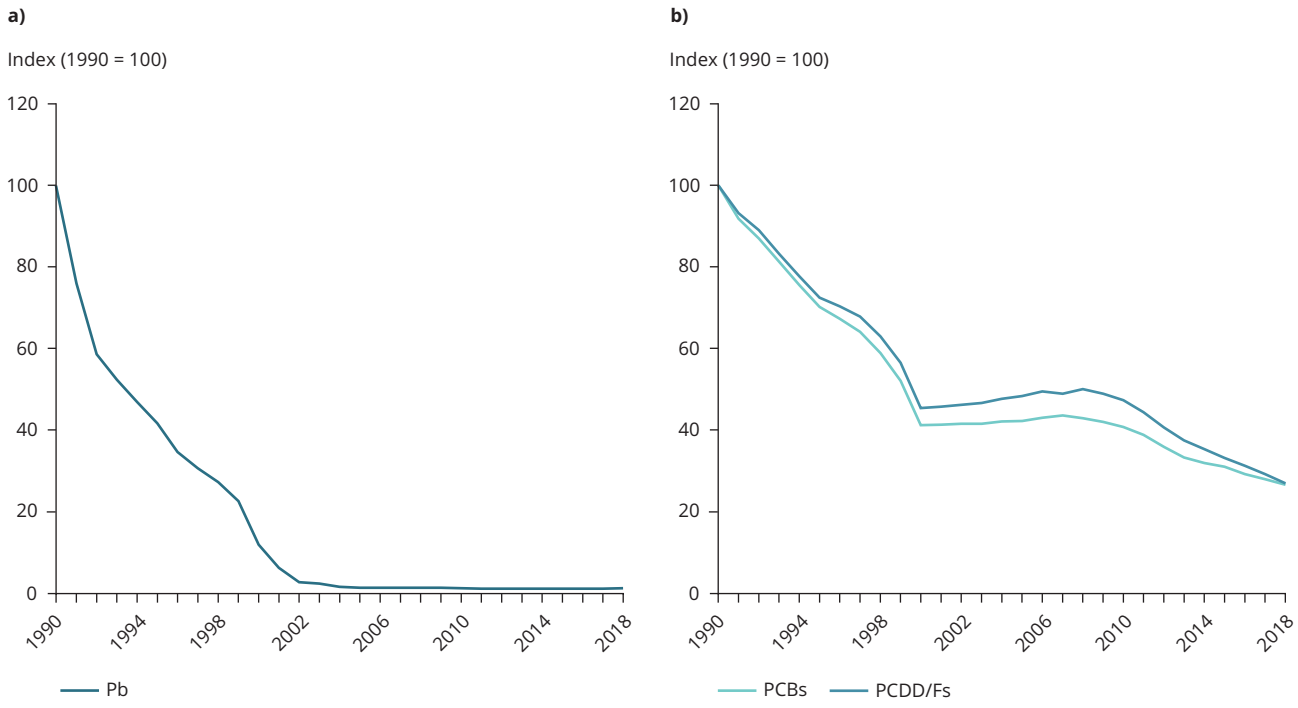


Table 4.9 Number of EU Member States reporting notation keys within the key categories of the road transport sector group

Key categories		NA	NO	NR	NE
$PM_{2.5}$	1A3bvi	0	0	0	1
	1A3bvii	0	0	0	1
PM_{10}	1A3bvi	0	0	0	1
	1A3bvii	0	0	0	1
Pb	1A3bvi	0	0	0	2
Hg	1A3bi	0	0	0	1
PCDD/Fs	1A3bi	0	0	0	1

Note: Only those key categories where notation keys are reported are considered.

Table 4.10 (a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions for the road transport sector group

(a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	3	4	3	5	6	6	7	7	6	6	6	6	6	6	6	6
NMVOCs	10	9	8	9	9	9	9	10	9	9	7	9	9	9	8	8
SO_x	7	7	9	6	7	9	11	9	2	3	3	2	2	2	2	2
NH_3	57	9	4	3	2	2	1	1	1	0	-1	-1	-1	-1	-2	-2
TSPs	3	3	1	0	0	0	-1	-1	-2	-2	-3	-2	-2	-3	-2	-3
CO	4	6	7	6	8	8	9	9	9	10	9	10	12	13	12	13
Pb	-3	-2	-4	-27	-17	-17	-18	-18	-18	-24	-24	-21	-20	-24	-25	-26
Cd	-15	-15	-16	-16	-16	-16	-16	-16	-17	-17	-18	-18	-18	-18	-18	-18
Hg	-6	-7	-7	-7	-7	-7	-7	-7	-7	-7	-8	-8	-8	-8	-8	-8
As	5	4	4	4	4	4	4	5	4	4	4	5	5	4	4	4
Cr	-13	-16	-16	-13	-14	-14	-14	-13	-14	-14	-14	-14	-12	-12	-13	-14
Cu	-55	-57	-57	-55	-55	-55	-55	-55	-56	-56	-57	-57	-57	-57	-57	-58
Ni	-8	-12	-13	-12	-12	-12	-12	-12	-12	-12	-13	-13	-13	-14	-14	-14
Se	-50	-51	-51	-49	-50	-50	-50	-50	-51	-51	-52	-52	-52	-53	-53	-53
Zn	-66	-68	-68	-66	-66	-66	-67	-67	-67	-68	-68	-68	-68	-68	-68	-68
PCDD/Fs	6	12	24	24	23	23	23	23	22	21	19	19	18	17	16	15
B(a)P	-15	-6	5	11	11	13	14	14	14	15	13	14	14	15	15	15
B(b)F	-7	-2	5	10	11	12	12	12	12	12	12	12	12	12	13	13
B(k)F	-6	0	6	11	12	13	13	13	13	13	13	13	13	13	13	13
IP	-2	3	8	11	11	12	13	14	14	13	12	13	12	13	13	14
Total PAHs	-29	-29	-30	-32	-33	-34	-33	-34	-33	-33	-33	-33	-33	-33	-33	-33
HCB	5	11	4	1	0	0	0	0	-1	-1	-1	-1	-1	-1	0	-1
PCBs	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			2	0	1	1	0	-1	-1	-1	-2	-2	-2	-2	-2	-3
PM_{10}			1	0	0	0	-1	-1	-2	-2	-3	-2	-2	-3	-3	-3
BC			1	-1	0	-1	-1	-2	-3	-3	-3	-4	-4	-4	-5	-4

Note: As, arsenic; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd)pyrene; NH_3, ammonia; Ni, nickel; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

Table 4.10 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions for the road transport sector group

(b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	209	249	155	218	274	275	269	259	231	213	204	197	191	176	178	163
NMVOCs	Gg	569	371	227	154	126	112	105	98	81	71	56	59	57	52	45	44
SO_x	Gg	42	32	11	1	2	2	2	1	0	0	0	0	0	0	0	0
NH_3	Gg	7	5	4	3	2	2	1	1	1	0	0	0	-1	-1	-1	-1
TSPs	Gg	14	13	6	-1	0	-1	-4	-5	-8	-8	-8	-7	-7	-8	-7	-8
CO	Gg	1 279	1 594	1 111	683	772	687	674	651	570	556	467	450	508	514	477	470
Pb	Mg	-494	-126	-87	-96	-53	-53	-54	-54	-54	-70	-69	-59	-58	-69	-73	-76
Cd	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hg	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
As	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cr	Mg	-6	-8	-9	-9	-9	-9	-9	-8	-9	-9	-9	-9	-8	-9	-9	-10
Cu	Mg	-1 268	-1 495	-1 651	-1 669	-1 701	-1 718	-1 711	-1 672	-1 713	-1 753	-1 741	-1 750	-1 777	-1 812	-1 858	-1 887
Ni	Mg	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Se	Mg	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Zn	Mg	-1 257	-1 483	-1 632	-1 654	-1 683	-1 708	-1 700	-1 669	-1 705	-1 741	-1 729	-1 738	-1 771	-1 805	-1 846	-1 869
PCDD/Fs	g I-Teq	16	21	24	26	26	25	26	25	23	21	18	17	15	13	12	11
B(a)P	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B(b)F	Mg	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
B(k)F	Mg	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	0
IP	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total PAHs	Mg	-5	-6	-7	-8	-9	-9	-9	-9	-8	-8	-8	-8	-8	-8	-8	-9
HCB	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PCBs	kg	-90	-22	-23	-27	-28	-29	-28	-25	-26	-27	-25	-24	-26	-26	-28	-29
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			6	1	3	1	0	-1	-3	-3	-3	-3	-3	-4	-3	-4
PM_{10}	Gg			5	-1	1	0	-3	-4	-6	-5	-6	-6	-6	-6	-6	-7
BC	Gg			2	-1	0	-1	-2	-2	-3	-3	-3	-3	-3	-2	-3	-3

particularly as a result of greater use of cars fitted with three-way catalysts. Leaded petrol was then phased out of general sales at the end of 1999, giving rise to the large reduction in emissions. Consequently, PCDD/F emissions fell in line with Pb emissions from the road transport sector (see the United Kingdom's IIR p. 122, listed in Appendix 5).

The steep drop in PCB emissions from 1990 to 1999 was mainly caused by data reported by the United Kingdom and Germany in the '1A3bi — Road transport: Passenger car' category.

Table 4.9 presents the number of EU Member States reporting the notation keys 'NA', 'NO', 'NR' and 'NE' within the key categories. Table 4.10 shows the recalculations within the road transport sector group. For explanations of EU recalculations, see Section 5.1.

4.6 Sectoral analysis and emission trends for the non-road transport sector

In this report, emissions from international/domestic aviation and shipping are reported as a simple sum of the emissions from each of the EU Member States. Accordingly, emissions from international/domestic aviation and shipping are not divided into those occurring within the EU and those that cross its geographical boundaries. However, since the guidelines (UNECE, 2014a) define international emissions as those that start in one country and finish in another, the reporting matches the guidelines.

Within the non-road transport sector group, NO_X is a major pollutant. The countries are ranked according to the size of the absolute values that they reported. The United Kingdom, Italy and Spain contributed most (in absolute terms) to emissions of NO_X. Italy, the United Kingdom and Spain accounted for most of the SO_X emissions, and France, Italy and the United Kingdom contributed most to CO emissions in 2018.

The increases in NO_X and SO_X emissions reflect data reported by Spain from 2016 to 2018 in the category '1A3dii — National navigation (shipping)'. The 115 % increase in SO_X in this category and during this period is the result of more domestic navigation (see Spain's IIR p. 165, listed in Appendix 5).

BC emissions reported by Italy, Portugal and Greece have shown an increasing trend over the last few years. Greece's emissions reported in the category '1A3dii — National navigation (shipping)'and Portugal's '1A3ai(i) — International aviation LTO (civil)' emissions were responsible for this trend.

As the non-road transport sector group does not contribute very much to HM and POP emissions, trends in pollutants from these two groups of substances are not shown (see Figure 4.11).

Table 4.11 shows the recalculations within the non-road transport sector group. For explanations of EU recalculations, see Section 5.1.

Figure 4.11 EU emission trends in the non-road transport sector group for SO_X, CO, $PM_{2.5}$, NO_X and BC between 1990 (2000) and 2018

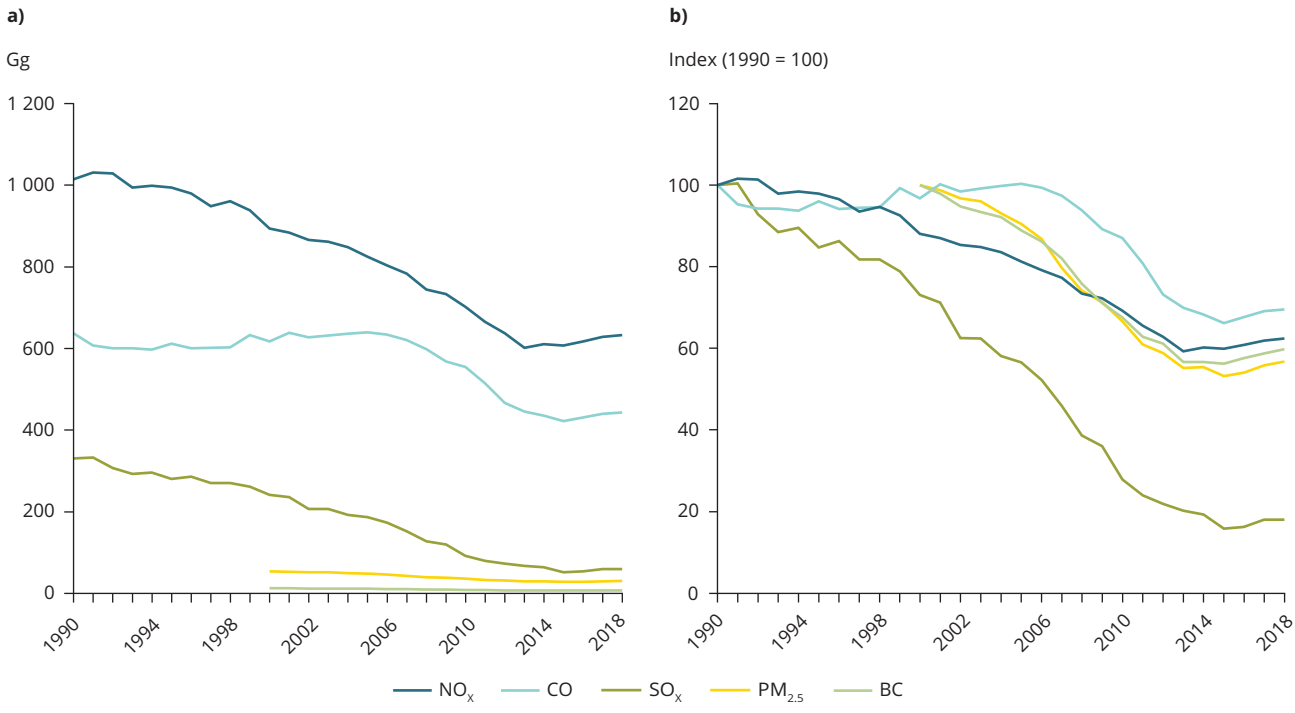


Table 4.11 (a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions for the non-road transport sector group

(a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	3	3	3	2	3	3	3	5	3	2	3	3	4	4	5	2
NMVOCs	0	1	1	1	1	1	1	1	0	-1	0	-1	0	1	1	1
SO_x	6	3	2	1	1	1	1	0	0	-1	1	1	1	-1	0	0
NH_3	402	204	58	27	35	29	29	16	-9	0	6	11	7	2	8	11
TSPs	1	1	0	-2	-2	-2	-2	-4	-3	-4	-3	-3	-3	-3	-4	-4
CO	11	12	5	7	8	9	8	8	8	9	8	8	9	10	11	12
Pb	4	4	1	6	2	2	6	7	7	8	8	8	9	8	4	6
Cd	1	1	1	2	1	1	1	1	2	1	3	4	3	3	3	-1
Hg	2	0	-1	0	-1	0	-1	-1	0	0	1	1	1	0	0	-3
As	14	7	7	2	3	3	3	1	1	2	3	4	4	3	4	4
Cr	5	3	1	0	1	0	0	0	0	0	0	0	0	0	0	-2
Cu	0	0	0	0	0	-1	-2	-2	-3	-3	-4	-5	-5	-6	-6	-8
Ni	3	-1	0	-2	-1	-1	-1	-3	-2	-3	-2	-3	-2	-3	-3	-4
Se	5	1	2	1	1	1	1	0	0	1	1	1	1	0	0	0
Zn	0	2	1	0	0	0	0	0	1	1	1	1	1	1	1	0
PCDD/Fs	3	3	3	2	2	2	3	2	3	3	3	3	3	3	3	3
B(a)P	-7	-4	0	0	-1	0	-1	-5	-3	-3	-3	-4	-5	-5	-6	-8
B(b)F	18	26	23	26	23	22	18	16	18	15	16	13	14	14	15	15
B(k)F	3	4	4	3	3	3	3	2	3	3	3	3	3	2	2	0
IP	23	30	24	28	30	30	25	23	24	21	23	18	22	21	23	24
Total PAHs	-1	1	1	1	1	1	1	0	0	0	1	0	0	0	0	-2
HCB	9	6	4	2	2	2	2	2	2	3	4	5	4	4	5	3
PCBs	6 958	-38	-36	-38	-37	-38	-41	-39	-44	-47	-48	-50	-50	-52	-51	-49
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			-1	-3	-3	-3	-3	-5	-5	-5	-5	-5	-5	-5	-5	-6
PM_{10}			-1	-2	-2	-2	-2	-4	-4	-4	-4	-4	-4	-4	-4	-5
BC			-4	-6	-6	-6	-7	-10	-10	-11	-11	-11	-11	-11	-11	-12

Note: As, arsenic; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd)pyrene; NH_3, ammonia; Ni, nickel; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

Table 4.11 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions for the non-road transport sector group

(b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	31	29	27	17	20	19	19	38	17	14	17	20	23	26	27	15
NMVOCs	Gg	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0
SO_x	Gg	20	7	5	2	2	2	1	0	0	0	1	1	1	0	0	0
NH_3	Gg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSPs	Gg	1	1	0	-1	-1	-1	-1	-2	-2	-2	-2	-1	-1	-1	-1	-2
CO	Gg	62	65	31	45	47	53	46	42	40	40	36	35	35	39	44	48
Pb	Mg	6	2	0	1	0	0	1	1	1	1	1	1	1	1	1	1
Cd	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hg	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
As	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cr	Mg	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Cu	Mg	0	0	0	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-15
Ni	Mg	4	-2	0	-2	-1	-1	-1	-4	-3	-3	-2	-2	-2	-3	-3	-4
Se	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zn	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PCDD/Fs	g I-Teq	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B(a)P	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B(b)F	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B(k)F	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IP	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total PAHs	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HCB	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PCBs	kg	357	-2	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-1	-2	-2	-2
PM_{10}	Gg			0	-1	-1	-1	-1	-2	-2	-2	-2	-2	-1	-2	-2	-2
BC	Gg			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

4.7 Sectoral analysis and emission trends for the agriculture sector

This sector group is responsible for the vast majority of ammonia (NH_3) emissions in the EU — namely 93 %. With regard to the size of the absolute values that the countries reported, Germany, France and Spain contributed most to NH_3 emissions in 2018.

Agricultural emissions of NH_3 have fallen by 27 % since 1990 (see Figure 4.12). However, between 2014 and 2018, NH_3 emissions rose slightly by 0.6 %.

In addition, the agriculture sector produces considerable emissions of NMVOCs, PM_{10} and NO_X. The drop in emissions of NMVOCs between 1990 and 1991 reflects data reported by Germany, mainly in categories '3B1b — Manure management — Non-dairy cattle' and '3B1a — Manure management — Dairy cattle'.

During the period 2000-2016, PM_{10} emissions fell slightly by just 10.4 %. Data reported by Spain in the category '3F — Field burning of agricultural residues' reflects the decline in PM_{10} emissions in 2001.

As regards POPs, the agriculture sector contributes considerably to emissions of total PAHs and HCB. Figure 4.13 shows previous emission trends for these pollutants.

The trend in emissions of total PAHs largely reflects data that Spain reported for the category

Figure 4.12 **EU emission trends in the agriculture sector group for NH_3, PM_{10}, NMVOCs and NO_X between 1990 (2000) and 2018**

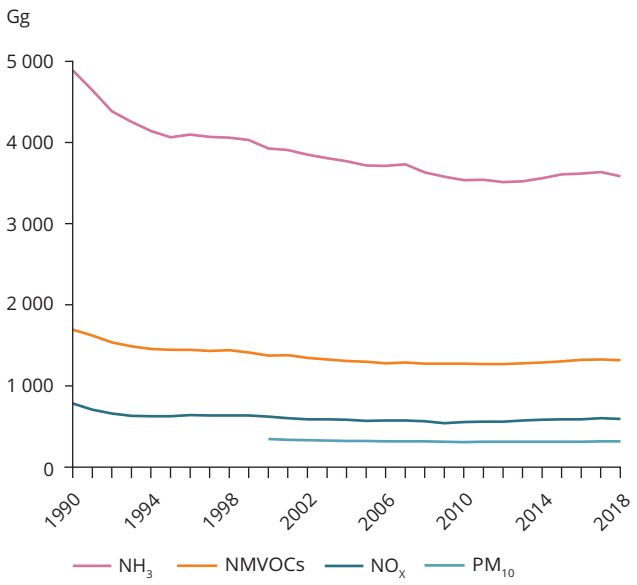


Figure 4.13 **EU emission trends in the agriculture sector group for total PAHs between 1990 and 2018**

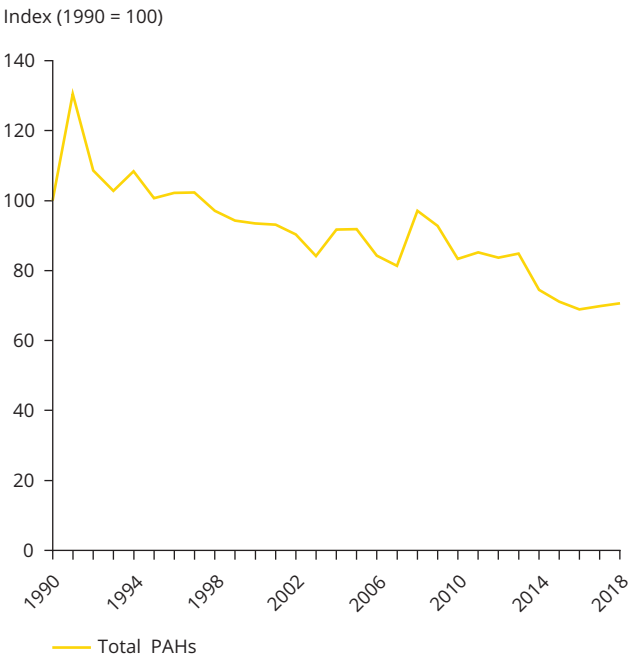


Table 4.12 **Number of EU Member States reporting notation keys within the key categories of the agriculture sector group**

Key categories		NA	NO	NR	NE
NO_x	3Da1	0	0	0	1
	3Da2a	1	0	0	1
NMVOC	3Da2a	12	1	0	2
NH_3	3Da3	0	1	0	0
Total PAHs	3F	0	13	0	1
HCB	3Df	4	4	0	3
B(a)P	3F	0	13	1	1

Note: Only those key categories where notation keys are reported are considered.

'3F — Field burning of agricultural residues'. The Member State explained that high emissions of total PAHs fell significantly, particularly between 1999 and 2003, due to a gradual reduction in the field burning of agricultural residues. This practice has been restricted by a combination of legislation aimed at preventing forest fires, the fact that the EU's common agricultural policy's conditionality rules entered into force and national mitigation programmes aimed at reducing the field burning of agricultural waste (personal communication by Spain in 2017).

Table 4.12 presents the number of EU Member States reporting the notation keys 'NA', 'NO', 'NR' and 'NE' within the key categories. Table 4.13 shows the recalculations within the agriculture sector group. For explanations of EU recalculations, see Section 5.1.

Table 4.13 (a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions (relative data, percentage of EU national totals) for the agriculture sector group

(a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	9	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6
NMVOCs	20	20	19	18	18	17	17	17	18	18	18	18	18	18	18	18
SO_x	19	4	46	60	39	39	42	37	35	44	37	38	42	44	41	43
NH_3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSPs	7	4	1	0	0	0	0	0	0	0	0	0	0	0	0	1
CO	17	4	39	39	27	26	28	25	24	30	26	26	29	30	28	29
Pb	37	-2	15	5	1	0	-1	-1	-1	1	0	0	3	3	2	4
Cd	52	-3	31	18	5	2	-1	-3	-1	6	2	1	10	13	9	15
Hg	47	-2	25	18	5	2	-1	-2	-1	6	2	1	10	13	9	15
As	20	8	26	29	27	27	23	25	24	25	25	24	26	28	30	29
Cr	21	1	36	34	24	21	17	15	17	23	20	18	27	30	30	32
Cu	19	0	29	21	13	12	10	9	10	14	12	11	17	19	18	20
Ni	21	0	37	35	23	19	16	13	15	22	18	16	27	30	30	33
Se	20	2	31	27	20	19	16	15	16	20	18	17	22	25	25	26
Zn	7	0	6	2	2	2	2	2	1	2	2	2	3	2	-29	2
PCDD/Fs	3	2	11	6	6	5	5	5	5	6	6	6	6	7	8	7
B(a)P	-86	-48	-53	-47	-48	-52	-44	-45	-46	-48	-52	-49	-52	-54	-51	-48
B(b)F	-86	-37	-39	-38	-39	-40	-34	-35	-36	-37	-40	-37	-41	-43	-40	-37
B(k)F	-86	-40	-43	-39	-41	-42	-37	-38	-40	-40	-43	-41	-44	-46	-44	-41
IP	-86	-41	-45	-41	-42	-44	-38	-39	-40	-41	-45	-42	-46	-47	-45	-42
Total PAHs	-95	-91	-80	-11	-7	-14	16	8	-3	-6	-15	-6	-23	-23	-16	-15
HCB	35	75	54	13	15	16	42	59	90	110	123	141	134	142	133	141
PCBs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			11	4	2	1	0	0	0	2	1	1	2	2	2	3
PM_{10}			3	1	1	1	1	1	1	1	1	1	1	1	1	2
BC			16	6	3	1	0	0	0	2	1	0	4	4	3	5

Note: As, arsenic; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd)pyrene; Ni, nickel; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

Table 4.13 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions (relative data, percentage of EU national totals) for the agriculture sector group

(b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	68	40	39	36	34	34	34	30	33	32	30	30	31	31	31	31
NMVOCs	Gg	284	239	219	197	193	192	189	186	195	194	194	197	201	201	205	206
SO_x	Gg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
NH_3	Gg	37	-12	-8	-8	-2	0	2	-8	6	7	-3	7	3	5	-5	1
TSPs	Gg	69	38	11	4	4	1	0	1	1	2	1	2	1	2	3	9
CO	Gg	142	19	109	50	35	31	34	31	29	37	33	31	37	38	32	35
Pb	Mg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cd	Mg	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hg	Mg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
As	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cr	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cu	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ni	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Se	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zn	Mg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	-4	0
PCDD/Fs	g I-Teq	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
B(a)P	Mg	-239	-34	-40	-30	-29	-33	-29	-28	-26	-29	-34	-31	-31	-31	-27	-24
B(b)F	Mg	-640	-62	-63	-57	-55	-56	-53	-51	-49	-51	-57	-52	-54	-55	-48	-43
B(k)F	Mg	-275	-30	-31	-26	-26	-27	-25	-25	-24	-26	-28	-26	-26	-27	-24	-22
IP	Mg	-200	-23	-24	-20	-19	-21	-19	-19	-18	-19	-22	-20	-20	-20	-18	-16
Total PAHs	Mg	-4 157	-22 40	-800	-24	-14	-28	29	15	-5	-12	-33	-13	-47	-47	-28	-26
HCB	kg	98	99	31	7	8	7	18	21	34	31	29	24	30	31	35	37
PCBs	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			7	2	1	0	0	0	0	1	0	0	1	1	1	1
PM_{10}	Gg			10	4	4	3	2	2	2	3	2	3	3	3	4	5
BC	Gg			1	0	0	0	0	0	0	0	0	0	0	0	0	0

4.8 Sectoral analysis and emission trends for the waste sector

This sector group is a primary source of PCDD/Fs and a significant source of certain pollutants, including HCB, Hg and PCBs. Figure 4.14 shows the previous emission trends for these pollutants.

Between 1990 and 2006, the decline in PCB emissions mainly reflects the data reported by the United Kingdom in the categories '5C2 — Open burning of waste' and '5E — Other waste', and from 2008 onwards it mainly reflects the PCB emissions reported by Portugal in the category '5C1bi — Industrial waste incineration'. PCB emissions reported by this Member State correspond closely to the amount of waste burnt in industrial incineration plants. Portugal explained that the fluctuations in the results from industrial waste incineration arose, at least partially, from variations in fluxes in other treatments (landfilling, shipping abroad and recycling) as a consequence of the annual waste market demand (see Portugal's IIR pp. 6-19, listed in Appendix 5). The slight increase in 1993 reflects the data reported by France in the category '5C1bii — Hazardous waste incineration'.

The trend in PCDD/F emissions reported by Portugal from 1990 until 2001 contributed most to the drop observed in the category '5C1biii — Clinical waste incineration'. In its IIR, Portugal stated that 25 incinerators had been closed in recent years on its mainland, with just one clinical waste incinerator

Figure 4.14 **EU emission trends in the waste sector group for the HM Hg, POPs (PCDD/Fs, PCBs, HCB, B(a)P) and $PM_{2.5}$ and PM_{10} between 1990 and 2018**

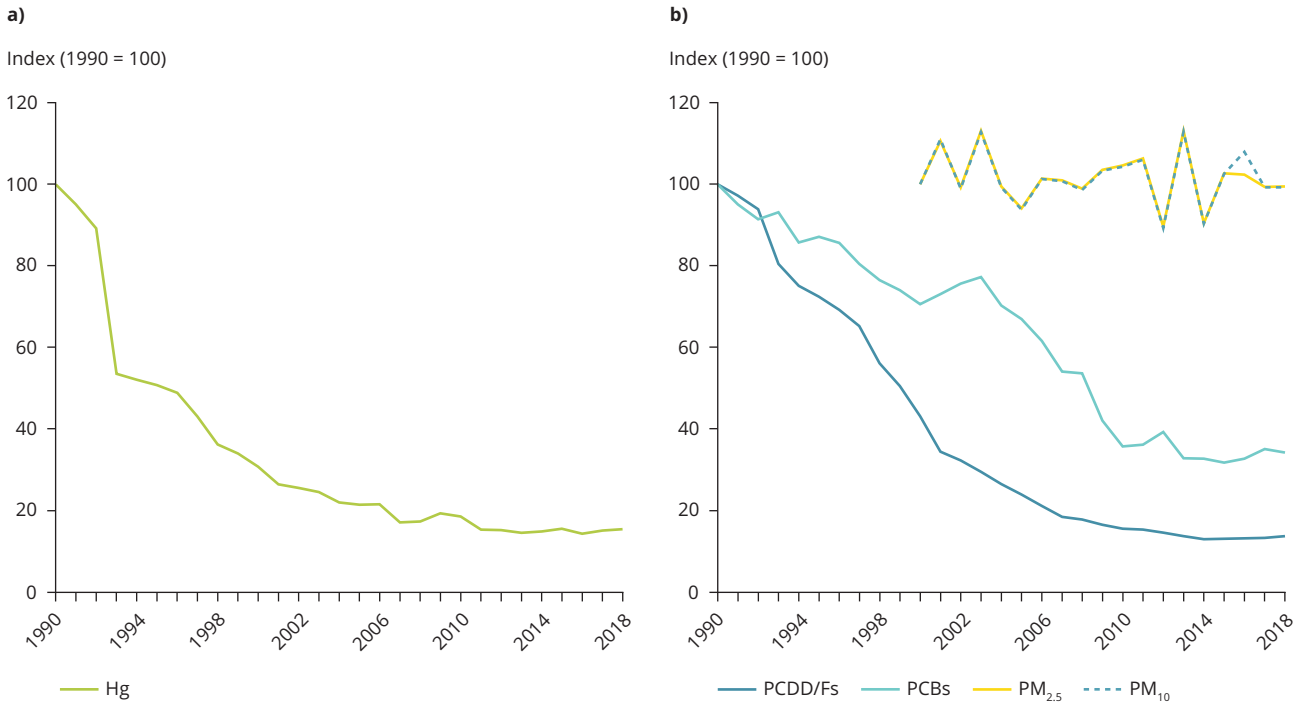


Table 4.14 **Number of EU Member States reporting notation keys within the key categories of the waste sector group**

Key categories		NA	NO	NR	NE
$PM_{2.5}$	5C2	0	12	0	2
PM_{10}	5C2	0	12	0	2
CO	5C2	0	11	0	2
Hg	5C1bv	0	0	0	2
PCDD/Fs	5C2	0	12	0	1
	5E	0	0	0	1
Total PAH	5C2	0	12	0	2
PCB	5E	4	1	0	20

Note: Only those key categories where notation keys are reported are considered.

remaining in operation since 2004. Other clinical waste receives alternative treatment or is sent abroad (see Portugal's IIR pp. 6-19, listed in Appendix 5).

From 2008 onwards, the PCDD/F emission trend reflected data from Slovakia and Hungary in the categories '5C1biii — Clinical waste incineration' and '5E — Other waste', respectively. The upwards trend from 2013 to 2018 was caused by data reported by Poland in the category '5E — Other waste'.

The decrease in HCB emissions between 1990 and 2005 largely reflected data from France for the category '5C1biv — Sewage sludge incineration'. However, high HCB emissions between 1993 and 1997 were also influenced by data reported by Belgium under the same category. This Member State commented that this category has disappeared as a key source of HCB because nearly all incineration plants now have energy recuperation, and emissions are allocated to the category '1A1a — Public electricity

Table 4.15 (a) Relative difference (relative data, percentage of EU national totals) between reported emissions when comparing the EU's 2019 and 2020 submissions for the waste sector group

(a)

	Relative difference (%)															
Pollutant	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	47	23	93	81	114	121	108	134	139	148	81	178	102	142	137	129
NMVOCs	29	33	30	21	19	19	19	23	26	29	28	35	36	37	39	36
SO_x	4	5	19	16	22	27	25	29	41	43	27	52	34	44	39	46
NH_3	-2	-4	-4	-6	-5	-4	-6	-5	-11	-7	-5	-5	-4	-4	-3	-2
TSPs	22	25	24	17	29	29	25	31	34	37	15	47	22	35	30	29
CO	50	28	102	83	116	117	106	129	138	147	82	177	101	140	136	128
Pb	0	2	21	33	28	32	25	17	22	27	12	29	26	41	36	47
Cd	2	1	14	17	17	21	16	13	17	21	11	27	15	24	20	26
Hg	1	1	1	-3	-10	-11	-13	-19	-17	-18	-12	-12	-18	-14	-22	-21
As	-11	-2	3	3	4	4	4	4	4	4	3	4	3	4	4	4
Cr	0	-1	-2	-1	-1	-3	-4	-3	-3	-3	-4	-4	-4	-3	-3	-3
Cu	2	1	2	3	-1	-4	-7	-9	-6	-4	-6	-1	-9	-5	-8	-1
Ni	0	-1	0	-1	-5	-5	-9	-11	-14	-15	-13	-18	-16	-12	-5	-5
Se	101	115	190	207	240	237	230	242	245	251	181	248	185	239	222	214
Zn	47	53	113	111	135	132	123	128	136	147	102	171	110	152	140	139
PCDD/Fs	8	7	8	-8	-25	-25	-28	-57	-43	-41	-34	-35	-59	-55	-58	-64
B(a)P	189	119	266	235	351	380	336	384	426	451	291	502	322	422	532	400
B(b)F	207	135	300	266	381	407	355	409	447	467	303	522	333	438	477	414
B(k)F	553	347	784	682	1 044	1 145	968	1 088	1 212	1 256	802	1.360	861	1 154	1 183	1 096
IP	-3	-2	-1	-1	-1	-1	-1	-1	0	0	-1	-1	-1	-1	199	0
Total PAHs	86	35	131	108	160	167	149	182	196	208	115	246	138	196	140	178
HCB	0	0	0	-2	-21	-29	-41	-26	-36	-56	-64	-66	-66	-64	-36	-31
PCBs	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0
			2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$			27	20	33	33	29	37	40	43	19	54	27	41	38	33
PM_{10}			27	19	32	32	29	36	39	42	18	53	26	40	35	32
BC			92	75	107	108	98	121	130	138	74	167	91	130	123	114

Note: As, arsenic; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cr, chromium; Cu, copper; IP, indeno(1,2,3-cd)pyrene; Ni, nickel; Se, selenium; TSPs, total suspended particulates; Zn, zinc.

and heat production' (see Belgium's IIR p. 24, listed in Appendix 5). The trend in HCB emissions from 2005 onwards reflects data reported by Italy in the category '5C1biv — Sewage sludge incineration'. It is important to point out that clinical waste incineration is the major source of Italy's HCB emissions (88.6 % of the national total) (see Italy's IIR, listed in Appendix 5).

The United Kingdom contributed most to reducing Hg emissions in the category '5C1a — Municipal waste incineration' from 1992 to 1993. This is because of better controls introduced for waste incineration. In addition, there was a general decline in ferrous and non-ferrous metal production, while the use of coal as a fuel in all sectors declined (see the United Kingdom's IIR p. 126, listed in Appendix 5).

Table 4.15 (b) Absolute difference between reported emissions when comparing the EU's 2019 and 2020 submissions for the waste sector group

(b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	14	6	21	17	24	24	22	26	27	29	16	35	20	28	27	25
NMVOCs	Gg	30	33	30	20	19	18	18	21	22	23	23	26	25	26	26	24
SO_x	Gg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NH_3	Gg	-2	-3	-3	-4	-3	-3	-3	-3	-6	-4	-3	-2	-2	-2	-2	-1
TSPs	Gg	14	16	15	11	17	18	15	19	20	22	9	28	13	21	19	17
CO	Gg	155	76	268	222	302	303	278	333	349	369	206	442	251	351	343	319
Pb	Mg	1	2	6	5	4	4	3	3	3	4	2	4	3	5	4	6
Cd	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hg	Mg	0	0	0	0	0	0	0	-1	-1	-1	0	0	-1	0	-1	-1
As	Mg	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cr	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cu	Mg	0	0	0	0	0	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	0
Ni	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Se	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zn	Mg	87	77	132	128	148	144	139	151	155	161	109	178	113	152	144	142
PCDD/Fs	g I-Teq	200	131	85	-53	-184	-161	-183	-593	-314	-287	-202	-202	-502	-434	-483	-636
B(a)P	Mg	7	4	9	8	10	10	9	10	11	11	7	13	9	11	14	10
B(b)F	Mg	13	8	17	15	18	18	17	20	20	21	14	24	16	20	23	19
B(k)F	Mg	29	18	37	33	41	40	38	43	45	47	31	54	35	45	47	42
IP	Mg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Total PAHs	Mg	30	12	44	36	50	50	46	55	58	61	34	73	41	58	57	53
HCB	kg	0	0	0	0	-5	-6	-8	-3	-4	-9	-14	-14	-14	-13	-4	-3
PCBs	kg	-1	-1	-1	-3	-3	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			14	11	17	17	15	19	20	22	10	27	13	21	19	17
PM_{10}	Gg			15	11	18	18	16	20	21	23	10	28	13	21	20	17
BC	Gg			10	8	12	12	11	13	14	14	8	17	9	14	13	12

The cause of the peak in PM_{10} emissions in 2016 is data reported by Spain in the category '5E — Other waste'. The slight increase in Spain's PM_{10} emissions resulted from accidental fires (see Spain's IIR p. 360, listed in Appendix 5).

Table 4.14 presents the number of EU Member States reporting the notation keys 'NA', 'NO', 'NR' and 'NE' within the key categories. Table 4.15 shows the recalculations within the waste sector group. For explanations of EU recalculations, see Section 5.1.

5 Recalculations and implemented or planned improvements

5.1 Recalculations

Recalculations are changes made to previous emission estimates (for one or more years) to eliminate errors, consider additional factors and incorporate new data. The Inventory guidebook (EMEP/EEA, 2019) stipulates that it is good practice to change or refine data and/or methods when:

- available data have changed;
- the method previously used is not consistent with good practice for a certain category;
- an emission source category has become a key category;
- the method previously used does not reflect mitigation activities transparently;
- the capacity (resources) for inventory preparation has increased;
- new inventory methods become available;
- the correction of errors is necessary.

It is important to identify inventory recalculations and to understand their origin in order to evaluate officially reported emission data properly. EU Member States often do not document why they report different numbers compared with the previous year.

5.1.1 Recalculations of the EU inventory

Table 5.1 compares total emissions from the EU according to the submissions in 2019 with those in 2020.

Details of recalculations that influenced the EU recalculations are given below. In some cases, recalculations reflect changes in gap filling (see also Section 1.4.5) rather than 'true' recalculations by the countries themselves. Often, high recalculations for EU Member States have been compensated for by recalculations for other EU Member States, and therefore EU recalculations are only moderate.

Recalculations for PMs, TSPs and BC: The highest recalculations for $PM_{2.5}$, PM_{10}, BC and TSPs, reducing emissions and relevant for the EU recalculations, were carried out by France ($PM_{2.5}$, PM_{10}, TSPs) and Poland ($PM_{2.5}$, PM_{10}, BC).On the other hand, recalculations from Germany (PM_{10}, TSP), Spain ($PM_{2.5}$, PM_{10}, BC, TSP) and Poland (TSP) led to an increase in EU emissions.

Recalculations for the main pollutants and carbon monoxide (CO). Recalculations for nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), sulphur oxides (SO_X) and CO that are relevant for the EU recalculations were done by several countries (see also Table 5.2).

Recalculations for PMs, TSPs and BC: The highest recalculations for $PM_{2.5}$, PM_{10}, BC and TSPs, reducing emissions and relevant for the EU recalculations, were carried out by France ($PM_{2.5}$, PM_{10}, TSPs) and Poland ($PM_{2.5}$, PM_{10}, BC).On the other hand, recalculations from Germany (PM_{10}, TSP), Spain ($PM_{2.5}$, PM_{10}, BC, TSP) and Poland (TSP) led to an increase in EU emissions.

Recalculations for heavy metals (HMs). Recalculations carried out by Germany, Poland, Spain, Slovakia, Romania, Italy, the United Kingdom and several other countries are relevant for the EU recalculations for HMs (see also Table 5.2).

For **lead (Pb)**, Romania carried out significant recalculations with a positive impact (1990-1998) that were relevant for the EU recalculations in the category '2C1 — Iron and steel production', which were counterbalanced by recalculations with a negative impact from Germany (1990), the Netherlands (1990-1991, previously reported now filled with the notation key NE from 1990-2018), and Hungary (1992) in the category 1A3bi — Road transport: Passenger cars'. Germany explained in its informative inventory report (IIR that the reason for recalculations was a fundamental revision of its TREMOD (Transport Emission Model) model (see Germany's IIR, listed in Appendix 5). Romania explained that it estimated emissions of Pb from the category '2C1 — Iron and steel production' for the first 4 years, 1990-1994, and for the years 1995-1999 activity data were changed, because new sources were taken into account (see Romania's IIR, listed in Appendix 5).

Several countries are responsible for the EU recalculation trends for **cadmium (Cd)**, **mercury (Hg)**, **arsenic (As)**, **chromium (Cr)**, **nickel (Ni)** and **selenium (Se)** emissions (see also Table 5.2).

The EU recalculation trend for **copper (Cu)** mainly represents recalculated data reported by Germany for the category '1A3bvi — Road transport: Automobile tyre and brake wear' for the years 1990-2017. Germany stated in its IIR that recalculations were carried out because of a shift towards the default emission factor for HM emissions from tyre and break wear, as provided in the Inventory guidebook (EMEP/EEA, 2019), as well as the revision of the TREMOD model (see Germany's IIR, listed in Appendix 5).

For **zinc (Zn)**, significant recalculations influencing the EU results (that had a negative impact) were carried out by Germany and Poland in the categories '1A3bvi — Road transport: Automobile tyre and brake wear' and '2C1 — Iron and steel production', respectively. Germany stated in its IIR that recalculations were carried out because of a shift towards the default emission factor for HM emissions from tyre and break wear, as provided in the Inventory guidebook (EMEP/EEA, 2019), as well as the revision of the TREMOD model (see Germany's IIR, listed in Appendix 5). In Poland's IIR, it is stated that emissions from the production of Zn and Pb were split into primary and secondary production, which led to recalculations (see Poland's IIR, listed in Appendix 5).

Table 5.1 Comparison of data submitted in 2019 and 2020 by EU Member States: (a) relative data, percentage of EU national total

(a)

		Relative difference (%)															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	0	1	1	1	1	2	2	2	1	1	2	2	1	1	1	1
NMVOCs	Gg	4	4	4	4	4	4	4	4	3	4	4	3	3	3	3	3
SO_x	Gg	-1	-1	-1	-1	-1	-2	-2	-3	-2	-3	-3	-3	-4	-4	-5	-6
NH_3	Gg	0	-1	-1	-1	-1	0	-1	-1	-1	0	-1	-1	-1	-1	-1	-1
TSPs	Gg	2	3	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO	Gg	-1	2	1	1	2	2	2	3	2	3	3	3	3	3	3	2
Pb	Mg	1	2	0	-1	0	-1	-1	-1	-3	-4	-5	-4	-5	-7	-8	-8
Cd	Mg	-4	-12	-9	-7	-7	-3	-3	-1	-6	-4	-4	-7	-7	-8	-7	-9
Hg	Mg	-9	-3	-4	-2	-3	-4	-6	-6	-6	-5	-5	-6	-7	-8	-10	-9
As	Mg	19	23	6	-9	-10	-9	-10	-8	-10	-12	-10	-7	-13	-15	-18	-16
Cr	Mg	-5	-1	1	3	3	3	2	3	3	3	3	4	4	3	3	2
Cu	Mg	-37	-42	-45	-44	-44	-44	-45	-45	-46	-47	-47	-48	-48	-48	-48	-49
Ni	Mg	1	-1	-2	-3	-3	-5	-6	-8	-3	-4	-3	-2	-2	-2	-3	0
Se	Mg	-4	-3	-3	-3	-4	-4	-4	-4	-6	-5	-5	-5	-5	-6	-7	-7
Zn	Mg	-17	-22	-26	-28	-28	-29	-29	-31	-29	-30	-31	-30	-32	-32	-33	-33
PCDD/Fs	g I-Teq	0	-3	-1	-18	-27	-28	-28	-38	-32	-33	-32	-31	-38	-36	-34	-37
B(a)P	Mg	-45	-62	-31	-28	-24	-79	-73	-77	-70	-57	-42	-29	-31	-40	-42	-46
B(b)F	Mg	-45	18	13	19	24	32	24	25	27	20	17	21	15	16	21	23
B(k)F	Mg	-40	7	15	17	24	22	50	57	61	54	40	58	42	50	58	57
IP	Mg	-43	-4	-6	-3	-2	-3	0	-1	-2	-7	-6	-6	-8	-8	-5	-4
Total PAHs	Mg	-66	-63	-35	-22	-19	-45	-35	-42	-33	-20	-9	1	-7	-13	-14	-18
HCB	kg	2	2	2	-15	-23	-17	-23	-18	-23	-24	-30	-24	-15	-25	-6	-8
PCBs	kg	-16	-26	-39	-14	-15	-15	-16	-18	-18	-19	-19	-20	-20	-21	-22	-22
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			1	1	1	1	1	1	0	1	1	1	0	1	0	0
PM_{10}	Gg			2	1	1	1	1	1	1	1	1	1	0	1	1	1
BC	Gg			2	0	2	2	1	2	2	2	0	4	0	3	2	1

Note: As, arsenic; BC, black carbon; B(a)P, benzo(b)pyrene; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cd, cadmium; CO, carbon monoxides; Cr, chromium; Cu, copper; HCB, hexachlorobenzene; Hg, mercury; IP, indeno(1,2,3-cd)pyrene; NH_3, ammonia; Ni, nickel; NMVOCs, non-methane volatile organic compounds; NO_x, nitrogen oxides; PAHs, polycyclic aromatic hydrocarbon; Pb, lead; PCBs, polychlorinated biphenyls; PCDD/Fs, polychlorinated dibenzodioxins/dibenzofurans; $PM_{2.5}$, particulate matter with a diameter of 2.5 µm or less; PM_{10}, particulate matter with a diameter of 10 µm or less; Se, selenium; SO_x, sulphur oxides; TSPs, total suspended particulates; Zn, zinc.

Table 5.1 Comparison of data submitted in 2019 and 2020 by EU Member States: (b) absolute data

(b)

		Absolute difference															
Pollutant	**Unit**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
NO_x	Gg	62	166	89	127	164	173	178	180	136	106	144	134	104	92	77	65
NMVOCs	Gg	774	614	423	400	359	334	329	316	275	278	268	238	237	226	215	193
SO_x	Gg	- 146	- 106	- 122	- 86	- 88	- 114	- 121	- 136	- 95	- 119	- 99	- 102	- 107	- 114	- 119	- 133
NH_3	Gg	8	- 34	- 33	- 37	- 25	- 20	- 20	- 33	- 22	- 17	- 28	- 20	- 24	- 29	- 37	- 34
TSPs	Gg	163	185	100	74	84	82	91	82	65	81	63	58	42	53	56	66
CO	Gg	- 732	803	539	329	569	496	659	625	582	669	576	734	519	615	502	469
Pb	Mg	200	215	- 13	- 26	0	- 18	- 19	- 15	- 57	- 68	- 72	- 60	- 72	- 104	- 119	- 116
Cd	Mg	- 7	- 19	- 10	- 6	- 6	- 3	- 2	- 1	- 4	- 2	- 3	- 5	- 5	- 6	- 5	- 6
Hg	Mg	- 18	- 4	- 4	- 2	- 3	- 3	- 5	- 4	- 4	- 3	- 4	- 4	- 5	- 5	- 5	- 5
As	Mg	101	55	11	- 17	- 20	- 19	- 19	- 14	- 18	- 19	- 16	- 10	- 20	- 24	- 27	- 25
Cr	Mg	- 67	- 4	6	14	15	12	10	9	12	9	12	12	13	11	10	6
Cu	Mg	-1 338	-1 521	-1 649	-1 676	-1 717	-1 731	-1 725	-1 680	-1 729	-1 773	-1 758	-1 757	-1 797	-1 839	-1 888	-1 919
Ni	Mg	21	- 13	- 32	- 34	- 41	- 52	- 62	- 78	- 22	- 28	- 19	- 13	- 14	- 13	- 20	- 2
Se	Mg	- 11	- 8	- 6	- 8	- 9	- 8	- 9	- 7	- 11	- 10	- 10	- 8	- 9	- 11	- 12	- 12
Zn	Mg	-1 603	-1 723	-1 781	-1 704	-1 731	-1 775	-1 755	-1 677	-1 727	-1 775	-1 808	-1 735	-1 875	-1 877	-1 925	-1 958
PCDD/Fs	g I-Teq	- 22	- 194	- 63	- 650	- 952	- 974	- 973	-1 355	-1 054	-1 051	-1 003	- 918	-1 195	-1 099	-1 004	-1 126
B(a)P	Mg	- 545	- 819	- 999	-1 430	-1 302	-1 183	- 923	-1 069	- 809	- 444	- 249	- 143	- 167	- 256	- 271	- 301
B(b)F	Mg	- 489	79	40	60	74	93	75	75	81	59	52	61	41	45	56	60
B(k)F	Mg	- 205	17	25	29	39	36	69	73	78	69	53	76	51	61	67	65
IP	Mg	- 176	- 8	- 9	- 5	- 3	- 4	- 1	- 2	- 4	- 11	- 10	- 10	- 12	- 11	- 8	- 6
Total PAHs	Mg	-4 326	-2 937	-1 691	-1 338	-1 175	-1 057	- 730	- 905	- 665	- 313	- 130	14	- 94	- 179	- 200	- 254
HCB	kg	125	119	53	- 73	- 93	- 62	- 83	- 53	- 68	- 78	- 100	- 94	- 57	- 68	- 16	- 24
PCBs	kg	-2 222	-3 157	-2 846	- 531	- 569	- 547	- 552	- 541	- 570	- 539	- 545	- 534	- 501	- 504	- 523	- 520
				2000	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
$PM_{2.5}$	Gg			25	9	21	22	16	15	7	11	8	16	2	9	3	0
PM_{10}	Gg			42	24	33	35	32	28	16	27	17	23	9	17	13	12
BC	Gg			7	0	6	6	4	5	5	6	0	9	1	5	4	2

Recalculations for persistent organic pollutants (POPs). For **dioxin** emissions, several countries carried out recalculations that affected the EU results. By far the highest recalculations (resulting in a negative impact) for all years were identified in Greece as a result of data being available for this year's submission, as opposed to gap-filled data in previous years. Until 2005, recalculations carried out by Slovakia for the categories '1A1a — Public electricity and heat production' and '5C1biii — Clinical waste incineration' counteracted EU recalculations with a positive impact. Slovakia explained in its IIR that the activity data for '5C1biii — Clinical waste incineration' were recalculated, because the amount of waste considered as incinerated was added and also the methodology was slightly improved by adding new data. Furthermore, Slovakia stated that recalculations were carried out to improve accuracy and completeness. For the category '1A1a — Public electricity and heat production', the Member State stated that the guidebook's emission factor, instead of a country-specific one, had been used. Furthermore, a change in the categorisation of fuels led to recalculations (see Slovakia's IIR, listed in Appendix 5).

The highest recalculations resulting in a negative impact for **total polycyclic aromatic hydrocarbon (PAH)** emissions were carried out by Spain from 1990 to 1999 in the category '3F — Field burning of agricultural residues'. In its IIR, Spain mentioned that, following the recommendation of the expert review team (ERT), it recalculated emissions using the new emission factors provided in the Inventory guidebook (EMEP/EEA, 2019) (see Spain's IIR, listed in Appendix 5).

For **hexachlorobenzene (HCB)** emissions, the biggest recalculations affecting the EU's national total (resulting in a positive impact), especially for the years 1990-1995, were carried out by Spain in the category '3Df — Use of pesticides', which now includes values instead of the notation key 'NA' (not applicable). In its IIR, Spain mentioned that, following the recommendation of the ERT, it recalculated emissions because of the update to the calculation method, in line with the 2019 Inventory guidebook (EMEP/EEA, 2019) (see Spain's IIR, listed in Appendix 5).

The EU recalculation trend for **polychlorinated biphenyls (PCBs)** is mainly driven by recalculated data reported by Portugal (which had a negative impact, 1990-2001) and Poland (which had a negative impact, 1990-2017) in the categories '2C1 — Iron and steel production' and '1A4bi — Residential: Stationary', respectively. Portugal stated in its IIR that recommendations from the Convention on Long-range Transboundary Air Pollution (LRTAP Convention) and the United Nations Framework Convention on Climate Change (UNFCCC) reviews led to major methodological changes (revised activity data and new data), followed by significant recalculations (see Portugal's IIR p. 272, listed in Appendix 5). In its IIR, Poland explained that a domestic expert had been commissioned to compile country-specific emission factors for solid fuels (hard coal, brown coal, wood, waste wood and coal). Following this development, all emission factors for PCBs were revised and used for the recalculations (see Poland's IIR, listed in Appendix 5).

5.1.2 EU Member States' recalculations

Under the revised reporting guidelines (UNECE, 2014a), all countries should submit explanatory IIRs that include details addressing any recalculations made. Some EU Member States provide very detailed explanations for their recalculations of parts of the time series or the whole time series (e.g. methodological improvements, revisions of emission factors, reallocations, revisions of activity data and corrections of errors).

Austria provided detailed information concerning its recalculations, which were carried out because of revisions, new estimates, updates of activity data, updated models, improvements in methodologies and emission factors (see Austria's IIR p. 443, listed in Appendix 5).

Belgium provided detailed information on its recalculations for its individual regions (Brussels, Flanders and Walloon) for the sectors energy, industrial processes and product use, agriculture and waste. The main reasons for recalculations at the sectoral level were the application of emission factors from the Inventory guidebook (EMEP/EEA, 2019), the availability of new data (e.g. mobility data) and the application of new approaches (see Belgium's IIR p. 179f., listed in Appendix 5).

Bulgaria reported that it had made recalculations in several sectors — such as 1A3a, 1A3b, 1A3dii, 1A4bi, 2B2, 2D3a, 2D3i, 2G, 2B, 3Da, 3F and 5A — for 2018, in line with recommendations from the technical expert review team (TERT) in 2018 and 2019 (see Bulgaria's IIR p. 118, listed in Appendix 5).

Croatia provided detailed information on its recalculations for all pollutants. The main reasons for the recalculations included the availability of new information, the implementation of higher-tier methods, changed methodology and the correction of inconsistencies in the time series. Table ES4-1 in Croatia's IIR provides an overview of the recalculations (see Croatia's IIR, listed in Appendix 5).

Cyprus stated that it had made some methodological improvements to the national emission inventory. This resulted in recalculations of the time series from 1990 to 2017 in accordance with methodologies proposed in the Inventory guidebook (EMEP/EEA, 2019) and suggestions from TERT 2017, 2018 and 2019. Another reason for recalculations concerned the availability of new activities (see Cyprus's IIR p. 135, listed in Appendix 5).

Czechia stated that recalculations were carried out because of updated data and the introduction of the computer programme to calculate emissions from road transport version 5 (COPERT V) model. Recalculations were realised in several sectors, such as 1A3b, 1A3bvi, 1A3bvii, 1A2gvii, 1A4 and1A5bi (see Czechia's IIR p. 96 f., listed in Appendix 5).

Denmark provided detailed information on its recalculations within the sectoral chapters, having put considerable work into improving the inventory. The submission includes recalculated inventories for the whole time series. The reasons for recalculation were changes in methodology, updated activity data, new data, correction of errors and updated emission factors (see Denmark's IIR p. 435, listed in Appendix 5).

Estonia provided detailed information on its recalculations for the period 1990-2017. The reasons for the recalculations were the correction of activity data, emission factors and other data, newly available and additionally calculated data, new methodologies, more detailed allocation of data and more detailed calculation methods (see Estonia's IIR p. 21, listed in Appendix 5).

Table 5.2 Recalculations by EU Member States (gap-filled inventory) that have a significant impact on the EU recalculations

Pollutant	EU countries making significant recalculations	
	Countries for which recalculations had a 'negative' effect	Countries for which recalculations had a 'positive' effect
NO_x	RO 1990-1994, 2017; ; BG 1990-2016; DE 1999-2002; IT 2008-2017; PL 2017; UK 1995-2012; ES 1995, 2005	DE 1994, 1995, 2004-2017; EL 1990-2017; IT 1990-2006; BE 1991-1998; ES 2013; AT 2010-2017
NMVOCs	RO 1990, 1991, 1995, 2005-2007; PT 1992-2017; IT 1990-1996; BG 1992-1998; UK 1992, 1993, 1995, 2006-2017; LT 1992-2006; SE 2001-2006, 2017; AT 2013-2017; ES 2007-2009; HU 2008-2017	DE 1990-2017; PL 1990-2017; EL 1990-2017; CZ 1990-2017
SO_x	PL 1990-2017; EL 1990-2017; SK 1990-1993; RO 1992, 1994, 2017, FR 2011, MT 2000-2004	RO 1990, 1993, 1995-2003; SE 1991-2015; UK 1994-1997, 2001, 2002, 2006-2011, 2015-2017; DE 1991-2009; ES 2008-2010, 2012; SK 1996-1999, 2017; LT 1992; BE 2005, 2015-2017; IE 2009-2013; MT 2017
NH_3	ES 1990-2017; HU 1990-2017; SK 1990-1996; RO 1994; UK 2010	RO 1990, 1991, 1995-2017; EL 1990-2017; CZ 1996, 2001-2007, 2010, 2011, 2013-2017; LT 1990-2017; BE 1992-2012; DE 1991-2004; SK 2016, 2017
$PM_{2.5}$	FR 2000-2017; PL 2000-2017; DK 2000-2017; LT 2005-2017	ES 2000-2017; EL 2000-2017; HR 2009-2017; LV 2000-2009; DE 2000-2002, 2007, 2008, 2012, 2013; IT 2005-2010
PM_{10}	FR 2000-2017; PL 2000-2006; DK 2006, 2007	ES 2000-2017; DE 2000-2009, 2012-2014; EL 2000-2009, 2011-2017; IT 2000-2017; HR 2010-2017
TSPs	FR 2000-2017; HU 2017	DE 2000-2017; PL 2000-2017; ES 2000-2017;IT 2000-2011; UK 2017; HR 2017; RO 2012; DK 2008
BC	PL 2000-2017; DK 2000-2017; FR 2007-2016; IT 2005, 2014, 2015	ES 2000-2017; DE 2000-2014; FR 2000-2002
CO	RO 1990-1994; PL 1995-1999, 2003-2017; IT 1990-2004, 2015, 2016; EL 1998, 2000, 2007, 2009, 2010; BE 2000-2008; AT 2003-2004; FR 2008-2017; NL 2008-2009	DE 1990-2017; ES 1990-2017
Pb	HR 1993-2005; DE 1990-2017; IT 2007-2017; NL 1990-1996; HU 1992-1998; SK 2003-2006, 2016; CY 1999-2017	RO 1990-1999; EL 1998-2014, 2017; PL 1990-2000; AT 2010-2017; FR 2015-2017; IT 2001-2007; ES 2010; UK 2016; BG 2015-2017; SK 2013
Cd	PL 1990-2017; PT 1990-2017; SK 1990-2006; IT 2008-2017	EL 1990-2017; ES 1990, 1991, 1993, 1994, 1996-2003, 2010-2017; UK 1990-1992; SK 2010-2017
Hg	SK 1990-2008; IT 2007-2017; PT 1991-2017; PL 1994-2017; FR 2017; EL 2009-2011, 2014-2016	RO: 1990, 1995, 2000-2011; EL 1992-2007; SK 2009-2016; ES 1990-1991, 1993, 1996-1999, 2012, 2014-2017; UK 1990-1992, 1996, 2016-2017
As	SK 1990-2017; ES 1999, 2000; UK 2000	PL 1990-2017; DE 2002-2017; RO 1990-1999; IT 2003-2006
Cr	DE 1993-2017; PL 1990-2017; SK 1990-1993; EL 2017; IT 2007-2017, NL 1996-2018	SK 1994-2017; ES 1990-2017; RO 1990, 1991, 1995-1997; BE 1994
Cu	DE 1990-2017	BE 1990-2017; IT 2003-2016; PL 2008-2017; FI 1990-2017; FR 1999-2008; HU 1990-2017; BG 1990-2017
Ni	ES 1990-2015; SK 1990-2017; IT 2006-2009; FR 2011; UK 2017; PL 1994, 1997-2005, 2012-2017	RO 1990-1993, 1995-1999, 2001-2003; SE 1994, 2000-2014; FR 2013-2017; BE 2005-2010; IT 2004-2005, 2010-2011; DE 2017; PL 1990-1992;
Se	SK 1990-2017; RO 1990-1994; DE 1990-2017; UK 2017;	EL 2017; ES 2007-2017; IT 1990-2016; BE 1990-2013; UK 1990-2007
Zn	DE 1990-2017; PL 1990-2017	ES 1990-2017; IT 1990-2017; RO 1990; EL 2012
PCDD/Fs	EL 1990-2017; UK 1993	SK 1990-2005; PL 1990-2017; DK 2015-2017; DE 2008; NL 2007-2017; BG 2016-2017; HR 2015-2017
B(a)P	PT 1990-2007; UK 1990-1993;	PL 1990-2017; ES 1990-2017; IT 1998-2017; SK 1990
B(b)F	PT 1990-2017; UK 1990-1993	PL 1990-2017; ES 1990-2017; IT 1998-2017
B(k)F	PT 1990-2017; UK 1990-1993; PL 2000-2004; RO 1994, 2000, 2007	ES 1990-2017; PL 1990-1996, 2008-2017; IT 1994, 1995, 1998-2000, 2005-2017
IP	UK 1990-1993; PT 1990-2017; PL 1993-2017; RO 2000, 2001	IT 1990-2017; ES 1990-2017; SK 1990-2017; EL 2017; BE 1990-1992
Total PAHs	PT 1990-2007; ES 1990-2000; UK 1990-1992;	EL 1990-2017;PL 1990-2017; DE 2012-2013
HCB	PT 2003-2017; BE 1994-2002; AT 1998-2002; 1990-1993; PL 1994-1996, 1998-1999; RO 1994	EL 1990-2014; ES 1990-2004, 2010-2017; FR 2008-2017; IT 1990-1998; IE 2000-2004
PCBs	PL 1990-2017; PT 1990-2001; IT 2001-2017	UK 1990-2017; HU 1990-1994; SK 2002-2017; DE 2007-2010, 2012-2015; NL 1990-1999; FR 1999-2001, 2003, 2006, 2007, 2010; ES 2012

Notes: EU countries making significant recalculations are listed in descending order, reflecting the impact on recalculated emissions for the EU as a whole.Recalculations concern the gap-filled inventory.

B(a)P, benzo(b)pyrene; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; IP, indeno(1,2,3-cd)pyrene; NH_3, ammonia; PCDD/Fs, polychlorinated dibenzodioxins/dibenzofurans.

Finland provided detailed information on its recalculations, which were carried out for several reasons, such as the addition of new sources and emissions, updates following the information in the Inventory guidebook (EMEP/EEA, 2019) and correction of errors (see Finland's IIR, listed in Appendix 5).

France stated that recalculations were due to an update of activity data, methodological improvements, correction of errors and the availability of new information and a new methodology (see France's IIR, listed in Appendix 5).

Germany provided detailed information on its recalculations, which were carried out for several reasons, namely the revision of activity data, an update and revision of the entire German emission inventory model, newly implemented emission factors, revision of emission factors, and reallocation of activity data and emissions (see Germany's IIR, listed in Appendix 5).

Greece did not make any recalculations (see Greece's IIR p. 139, listed in Appendix 5).

Hungary provided information on recalculations in the sector-specific chapters. These were mainly carried out because of methodological changes, the use of the new COPERT model and the revision of activity data, as well as the availability of updated fuel consumption data (see Hungary's IIR, listed in Appendix 5).

Ireland provided information on recalculations in the sector-specific chapters. These were mainly related to updated activity data, as well as revised emission factors, calculation procedures and methodology (see Ireland's IIR, listed in Appendix 5).

Italy stated in the IIR that recalculations were mainly due to updated emission factors, the addition of new categories, the upgrade to the new COPERT model, revised estimates and new estimates (see Italy's IIR, listed in Appendix 5).

Latvia provided detailed information on recalculations that were carried out because of updated activity data and emission factors, as well as the implementation of sector-specific research results, and following recommendations from the TERT (see Latvia's IIR, listed in Appendix 5).

Lithuania stated that it had recalculated emissions based on improved data and enhanced methodology and to correct errors (see Lithuania's IIR p. 30, listed in Appendix 5).

Luxembourg presented its main revisions and recalculations in table 305 in its IIR (p. 430). The reasons for the recalculations were updated activity data, methodology and emission factors and correcting errors (see Luxembourg's IIR, listed in Appendix 5).

The **Netherlands** provided detailed information on the recalculations carried out. The main reasons for these were the inclusion and calculation of new emission sources (see the Netherlands' IIR p. 159, listed in Appendix 5).

Poland reported that recalculations were carried out mainly because of updated activity data, revised methodologies, updated emission factors in line with the Inventory guidebook (EMEP/EEA, 2019), new emission sources not estimated previously and an update to the latest version of the COPERT V software (see Poland's IIR p. 133, listed in Appendix 5).

Portugal provided detailed information on its recalculations. Since the last submission, recalculations have been mainly carried out because of revised data/emission factors/estimates, error correction and the implementation of emission factors from the Inventory guidebook (EMEP/EEA, 2019) (see Portugal's IIR pp. 8-17, listed in Appendix 5).

Romania noted that, following the review of the emission inventory, recalculations of emissions were carried out based on improved activity data, updated statistics, new sources, the application of a higher-tier level, an update to the latest version of COPERT V and new estimates (see Romania's IIR p. 274, listed in Appendix 5).

Slovakia provided detailed information and tables on its recalculations. The main reasons were new estimates, the implementation of a higher-tier method, error correction and new/improved methodology (see Slovakia's IIR p. 381, listed in Appendix 5).

Slovenia provided detailed information on its recalculations, which were carried out because of error correction, first-time reporting of emissions, new activity data, improved data and the implementation of emission factors from the Inventory guidebook (EMEP/EEA, 2019). Many of these recalculations were carried out following recommendations from the TERT (see Slovenia's IIR p. 281, listed in Appendix 5).

Spain provided very detailed information on its recalculations, the main reasons for which were revision of data sources, error correction and methodology changes (see Spain's IIR p. 22, listed in Appendix 5).

Sweden provided detailed information on its recalculations. The reasons were the revision and

updating of emission factors and activity data, reallocation of emissions, availability of new data, updated emission inventory models and correction of emissions (see Sweden's IIR p. 265, listed in Appendix 5).

The **United Kingdom** provided detailed information on recalculations made since its last LRTAP Convention submission. The reasons were improved emission estimates, new or additional data sources, the use of updated emission factors, revision/reallocation of data and methodological changes (see the United Kingdom's IIR p. 324, listed in Appendix 5).

The annual European Monitoring and Evaluation Programme (EMEP) inventory review report (EMEP, forthcoming) presents a summary of the individual recalculations reported by EU Member States and the United Kingdom. This yearly report will be available on the Centre on Emission Inventories and Projections (CEIP) website in July 2020 (EMEP CEIP, 2020c).

5.1.3 Changes in EU Member States' emission inventories due to improvements based on the review

In addition, EMEP CEIP has the task of reviewing the submitted emissions to help Parties improve their national inventories (EMEP CEIP, 2020b; EMEP, forthcoming). These yearly reviews should help EU Member States compile their individual emission estimates and submit their improved inventories together with their IIRs.

The stage 1 review — an automated test — is held every year to assess timeliness, completeness and format. The stage 2 review assesses recalculations, key category analysis (KCA), inventory comparison, trends and time series. Stage 3 is an in-depth review by experts nominated by the Parties. Each year, the plan is for two teams to review 10 Parties' inventories.

In 2019, EMEP CEIP reviewed Albania, Georgia, Norway, Russia, Serbia and Turkey, resulting in individual country-specific reports (EMEP CEIP, 2020c). In 2020, the EU, Iceland, Kyrgyzstan, North Macedonia and Switzerland will be reviewed in the scope of the stage 3 review.

5.1.4 Improvements planned at EU level

The EEA and the European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution (ETC/ATNI) have noted that the main future challenge for EU Member States remains improving the quality of data submissions in order to deliver more complete and timelier United Nations Economic Commission for Europe (UNECE) LRTAP Convention emission inventories. Improvements cannot be implemented at the EU level alone; the EU Member States themselves must also develop and prioritise reliable and timely inventory reporting systems.

- Further progress **concerning the completeness** of reporting. Although clear progress has been made in recent years on making reporting complete, a full set of emission inventory data for air pollutants is still not available for all EU Member States, as noted earlier in this report. In addition, for certain pollutants (including PM, HMs and POPs), data could not be fully gap filled, because some EU Member States had not reported emission values in any year; this is especially the case for pollutants where reporting is not obligatory (see Figure 1.5 and Figure 1.6).

- **Updating of emission data** by EU Member States, including for previous years. The ETC/ATNI has also identified a problem with gap filling by using data submitted several years ago. In a number of cases, because countries have not since submitted corrected or updated data sets, the EU inventory unavoidably includes inconsistencies. Therefore, the quality of the EU's inventory will be enhanced if the consistency and completeness of EU Member States' submissions improve. Such improvements would help reliable trend analysis to inform policy. Since 2017, emission inventory reviews have been conducted related to the National Emission Ceilings (NEC) Directive (EU, 2016b). The results of the review of these processes should also improve the quality of the LRTAP submissions.

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

- **Reducing the need for gap filling**. This is achievable if the EU Member States report complete time series as far as possible, and if they have already provided the data in earlier submissions under the LRTAP Convention. Current gap-filling procedures first use submissions received in the current reporting years under various reporting mechanisms and then use older LRTAP submissions. However, because of the review of processes under the NEC Directive, it is expected that the

completeness of submissions (under the NEC Directive and LRTAP Convention) will improve.

- **More explanatory information** on trends and recalculations would be possible only if the IIRs included such information. Thus, countries are encouraged to provide it.
- Further research on **outliers in EU Member States' emission data** to help ensure that they reflect real emissions. A comparison of Member State contributions to the EU total reveals extraordinarily high proportions in some instances. Future investigation could determine whether these high proportions reflect actual emissions or are attributable to incomplete reporting (or underestimates) by other EU Member States.
- More attention to **data quality**. In several submissions from EU Member States and as a result of the gap-filling procedure, values of BC exceed $PM_{2.5}$ values, values of $PM_{2.5}$ exceed PM_{10} values, or values of PM_{10} exceed TSP values — which should be impossible. Changes in the gap-filling procedure and improved Member State emission data should resolve these problems.

5.2 Improvements implemented

The joint EMEP/EEA annual review of inventory data helps to improve the EU Member States' and the United Kingdom's inventories. The review of data reported under the LRTAP Convention is held jointly with the review of data reported by the EU Member States and the United Kingdom under the NEC Directive. Since 2009, there has been a centralised stage 3 review process under the LRTAP Convention review process (EMEP CEIP, 2020b). Two teams of emission experts perform the reviews. EU Member States and the United Kingdom are encouraged to nominate reviewers for the EMEP roster of emission review experts; nomination process details are available on the CEIP website. In 2017, the EU emission inventory report (1990-2015) under the UNECE LRTAP Convention (EEA, 2017) was reviewed (UNECE/CEIP, 2017). The findings (EEA, 2017) and their implementation are summarised in Table 5.3, while Table 5.4 shows the findings that have not been or cannot be implemented.

5.2.1 Improvements in response to the stage 3 review of the EU inventory in 2017

Table 5.3 lists the status of improvements implemented in response to the stage 3 review by an ERT in 2017.

5.2.2 Further improvements undertaken in 2020

- Restructuring Section 1.5 (reporting) to enable a better overview of the reporting situation.
- Inclusion of Section 1.5.5 in the reporting of condensable components from $PM_{2.5}$ and PM_{10}.
- More focus on BC: extended description of BC in the trend section (Section 3) and BC was included in the sector analysis of Section 4.
- Again, explanations on unusual trends, peaks and troughs were improved.
- Manual corrections for PM_{10}, $PM_{2.5}$ and BC improved the gap-filled inventory.
- Specification of the share of gap-filled data in the total inventory.

5.2.3 Improvements at Member State level

Improvements at Member State level also automatically improve the EU inventory. For this reason, it is of interest to note which countries have planned to improve their inventories. Table 5.5 provides an overview of these, but it is not easy to gain a systematic overview of the overall situation, as EU Member States and the United Kingdom provide varying amounts of information.

The updated reporting guidelines (UNECE, 2014a) request that Parties to the LRTAP Convention provide emission data using the NFR14 format. All of the EU Member States that submitted data used the new template.

Table 5.3 EU stage 3 review results 2017 and improvements implemented

Review findings (2017)			
Topic	**Finding**	**Implemented**	**Comment**
	Transparency		
Gap-filling procedure	More detailed information at the sectoral level	Partly	Already given in Annex D
Notation keys	The ERT encourages the EU to create a summary for each subsector on how many EU Member States reported emissions and how many used notation keys; the ERT encourages the addition of an explanation in the IIR about the use of notation key 'NE'	Yes	Analysis given in Annex K
Under-reporting	The IIR sections 'General assessment of completeness' and 'Underestimations' and the graphs present a somewhat misleading picture of the level of under-reporting in the EU inventories; the ERT strongly encourages the EU to revise and expand these sections of the IIR	Yes	Analysis changed (see Section 1.9)
Key categories	The ERT encourages the EU to include information on reported/not-reported sectors and pollutants for the key categories for each year and each Member State	Partly	Analysis included in Chapter 4
Member State comparisons	The ERT encourages the EU to conduct a more detailed analysis of the Annex D information to identify and communicate potential outliers and inconsistencies between EU Member States in their methods and emission factor selection	Partly	Inconsistency checks were made (compare Section 1.7) and communicated to the EU Member States; comparisons between EU Member States were not made, as such checks would require considerable effort and the time-frame is limited
Member State comparisons	The IIR could contain more information on the consistency of reporting across countries and could indicate the number of countries not providing estimates for each nomenclature for reporting (NFR) category	Partly	Analysis included in Chapter 4; see also Annex K
Sector descriptions	The ERT encourages the EU to continue improving the transparency of the inventory by including more information and detail in sector and subsector descriptions and an explanation of emission trends	Partly	Sectoral emission trends are described to the greatest possible extent in Chapter 4
Notation keys	The EU data inventory uses the notation keys 'NE' and 'NR'; the ERT recommends improving the use of notation keys in the inventory	Ongoing	In 2020, 12 % of submitted data in the EU inventory contained the notation key 'NR' or 'NE'. To improve the completeness of data reporting, including the use of notation keys such as 'NE' and the use of tier 1 methods, the European Commission conducted a comprehensive review of emission inventories submitted by the EU Member States during the first reporting round under the new NEC Directive in 2017 and since then has conducted yearly reviews under the NEC Directive. The emissions inventory expert reviewers are required to check the appropriate use of notation keys and methods for key sources. Where used inappropriately, technical corrections of EU Member States' inventories are made. EU Member States must subsequently include these corrections in their national inventories, which will ensure improved completeness and consistency in future years
Key categories	More detailed information to highlight key data and information deficiencies in EU Member States' submissions, including (1) data gaps for key categories; (2) outlier level and trend emission data from EU Member States for key categories; and (3) identifying where lower-tier methods are used by EU Member States that contribute significantly to the reported EU total for a key category	No	Such checks would mean considerable effort; such an analysis is not feasible within the limited time-frame
Key categories	The ERT encourages the EU to summarise information about methodologies used by the different EU Member States for specific pollutants for the key categories	Ongoing	The EU is making efforts to compile information on methodologies used by EU Member States for key categories. It is planned to use this information to encourage improved submissions in future.
Activity data	No activity data are provided; the ERT recommends further enhancing the gap-filling procedure to finally provide activity data at EU level: for example, gap filling by utilising data from Eurostat statistics or data from another country (e.g. with a similar population, gross domestic product or other indicator), which could be an interim solution to overcome any difficulties	Ongoing	The EU is making efforts to improve the reporting of activity data by EU Member States, by establishing the annual NEC Directive review in order to provide activity data for the EU LRTAP submission. The EU is currently evaluating if gap filling for certain subcategories is possible by using Eurostat data

Table 5.3 EU stage 3 review results 2017 and improvements implemented (cont.)

Review findings (2017)			
Topic	**Finding**	**Implemented**	**Comment**
	Completeness		
Gap-filling procedure	Further improvement in the gap-filling procedures, such as the development of more manual interventions The ERT encourages the EU to strengthen its quality assurance (QA)/quality control (QC) of the gap-filling procedures to minimise the risk of (1) under-reporting in the EU submission; and (2) the gap-filling process itself introducing implausible step changes in the reported trends	Yes	Manual changes have been conducted (compare Section 1.4.5)
Assessment after gap filling	It would be useful to include details at the level of individual NFR categories (assessment of the significance of the remaining gaps after gap filling) for the sectors	Partly	Analysis included in Chapter 4; see also Annex K
Completeness assessment	The ERT encourages the EU to provide sector-specific assessments of completeness	Partly	Analysis included in Chapter 4; see also Annex K
EU-level inventory improvement programme	The ERT recommends developing the EU-level inventory improvement programme, which should include actions at the EU level to target improvements in the completeness of reporting from the EU Member States; the ERT encourages the EU to include more detailed information about QA/QC procedures used by EU Member States	Ongoing	The EU has made efforts to improve the reporting of emissions by EU Member States. Since 2017, annual reviews of NEC Directive data have been undertaken to consequently improve the submissions of EU Member States. In addition, general issues such as the reporting of uncertainties and completeness of inventories are raised during the annual Task Force on Emission Inventories and Projections (TFEIP) meeting
Relation between pollutants and sectors	The ERT encourages the EU to implement procedures to assess the relation between different pollutants and sectors	No	As the inventory is an aggregation of Member State inventories, this is not an easy task and would require too much effort given the limited time-frame
Gridded data, large point sources (LPSs) and projections	The ERT recommends that the EU provides a full assessment of gridded data, LPSs and projections submitted by EU Member States in its future submissions	Yes	Data are already available via the CEIP and Central Database Repository (CDR) websites; there is a huge amount of data and there is no need to provide such large annexes when data are readily available on these websites
	Consistency		
Recalculations	The main recalculations are explained in the IIR of each Member State; the ERT encourages the EU to also explain the rest of the recalculations, including their implications for the trends, and in particular to explain recalculations resulting from changes in the EU gap-filling method	Partly	Recalculations and their implications for trends are explained to the greatest possible extent, including recalculations that are caused by the gap-filling procedure (compare Section 5.1)
Sector-specific recalculations	The ERT encourages the EU to provide sector-specific recalculation information wherever possible (similar to that in Table 5.1)	Yes	Analysis included in Chapter 4
Time series checks	The ERT encourages the EU to conduct time series consistency checks on Member State submissions	Yes	Time series checks have already been performed for many years
	Comparability		
Consistent reporting	The ERT encourages the EU to continue its efforts to develop more consistent reporting (regarding allocations to specific NFR sectors) by EU Member States	Partly	Checks on the allocations to specific NFR sectors would require considerable effort; such an analysis is not feasible within the limited time-frame
Notation keys	There are many instances where some countries report emissions for a particular NFR category and pollutant, while other countries use the notation key 'NA'(not applicable); the ERT believes it would be immensely useful for this type of issue to be highlighted in the IIR at the level of individual NFR categories: it would highlight issues in EU Member States' inventories that could then be addressed by those countries	Yes	Analysis included in Annex K; see also Section 1.9

Table 5.3 EU stage 3 review results 2017 and improvements implemented (cont.)

Review findings (2017)			
Topic	**Finding**	**Implemented**	**Comment**
	Accuracy		
Emission basis	The EU inventory for road transport was based on a mixture of fuel sold and fuel used (one Member State)	Yes	The whole EU inventory is now based on fuel sold (compare Section 1.4.4)
Gap-filling procedure	In some cases, the gap-filling procedure does not generate a reliable representation of the emissions from the source categories	Yes	The gap-filling procedure for the EU inventory is described in the EU IIR (Chapter 1.4.5 of the report). In addition, Annex D to the EU inventory provides detailed information on the gap-filling procedure, including data sources. As described in the IIR (Chapter 1.4.5), data are — in addition to the unified gap-filling procedure — manually quality checked to ensure accuracy of the inventory
Uncertainty analysis	The EU clarified that uncertainty analysis is in the improvement plan for the near future, since, under the new NEC Directive, EU Member States will provide information on uncertainties; it is therefore planned to assess and evaluate if the uncertainty analysis for the EU can be generated	Ongoing	The EU performed an assessment in 2017 of whether an uncertainty analysis can be generated. The pollutants considered and the assumptions behind the uncertainty analysis vary across EU Member States; because so few provide an uncertainty estimate, the overall uncertainty of the EU LRTAP inventory cannot be estimated (Chapter 1.8) The EU is making efforts to require an uncertainty analysis from EU Member States to provide an accurate uncertainty analysis in future submissions
Uncertainty linked to gap filling	The ERT recommends that the EU assesses the impact of the gap-filling procedure on inventory uncertainty, e.g. assessment of uncertainties linked to the EU gap-filling process and its combination with EU Member States' inventory uncertainties	Ongoing	The EU is making efforts to require an uncertainty analysis from EU Member States to provide an accurate uncertainty analysis in future submissions

Table 5.4 Overview of improvements planned at Member State level

Member State	Improvements planned
Austria	Required methodological changes and planned improvements are presented in the respective sectoral chapters (Appendix 5 p. 455, Austria's IIR)
Belgium	Belgium's IIR lists planned improvements in Sections 8.1-8.4 and in the corresponding sector analysis chapters (Appendix 5p. 179f., Belgium's IIR)
Bulgaria	Planned improvements: • application of higher-tier method for estimating emissions; • incorporation of the Emissions Trading Scheme (ETS) and the European Pollutant Release and Transfer Register (E-PRTR) databases into the emission inventory in NFR sector 1 energy and NFR sector 2 industrial processes and other solvents and product use; • incorporation of data provided by branch business associations; • revision of activity data in NFR sector 3 agriculture, in line with agro-statistical data from the Ministry of Agriculture and Food; • improving the accuracy of the estimates; • improving transparency, completeness and consistency, including recalculations of time series and comparability of the national emission inventory (Appendix 5, Bulgaria's IIR p. 118)
Croatia	Table ES6-1 in Croatia's IIR details planned improvements, including calculation methodologies, recalculations, updating of emission factors and collection of new data (Appendix 5, Croatia's IIR p. 18)
Cyprus	Cyprus reports improvements in the categories anaerobic treatment and sewage connection (Appendix 5, Cyprus's IIR p. 136)
Czechia	Improvements are planned for the sectors road transport, energy, industrial processes and product use, and agriculture. Alongside other improvements Czechia plans to introduce new emission data and include open recommendations for the sector 3B. Further planned improvements are stated in the respective sectoral chapters (Appendix 5, Czechia's IIR p.104)
Denmark	The relevant sectoral chapters describe planned sector-specific improvements; priority will be given to key categories with a significant impact on the national total emissions (Appendix 5, Denmark's IIR p. 438)
Estonia	Estonia's IIR lists planned source-specific improvements; checking POP emissions from the energy sector and waste incineration, correcting activity data and emission factors in energy industries and comprehensively checking activity data and emissions in the waste sector are priorities for future inventory improvements (Appendix 5, Estonia's IIR p. 24)
Finland	Table 1.03 in Finland's IIR sets out sector-specific improvement needs, and the sectoral chapters describe the planned source-specific improvements (Appendix 5, Finland's IIR p. 24)
France	Some planned and ongoing improvements are mentioned in the French IIR: • conducting research to improve accuracy, especially for key categories; • establishing measures to determine uncertainties; • reducing the number of unconsidered or poorly determined pollutants — there are still plans to improve the estimation of emissions from heating boilers in the residential sector, which could strongly influence NO_x emissions; • introducing further splits for energy consumption in the industry sector; • updating the methodology for estimating emissions from wood combustion in various sectors (excluding industry sector); • improving existing methods to reduce NH_3 emissions; • strengthening all activities for better QA and QC of the system, especially towards the implementation of procedures and tools, cooperation with experts from different fields and maintaining the ISO 9001 certification system (Appendix 5, France's IIR)
Germany	Germany is planning to prioritise improvements based on the results of the uncertainty analysis; planned improvements for the source category stationary combustion category include revision of 2004-2011 biogas and liquid biomass activities to improve the consistency of the time series, new measurements and revision of emission factors for POPs, HMs, SO_2, CO and NH_3; for the mobile combustion category, planned improvements include the implementation of new emissions, as well as the validation and revision of the approach for abrasive emissions from railways; Germany lists the revision of emission factors within refinery processes as a planned improvement in the fugitives category, collects activity data for titanium dioxide production and calculates these emissions in the category of industrial processes (Appendix 5, Germany's IIR)
Greece	Greece plans recalculations of and improvements to the inventory that are associated with key categories (Appendix 5, Greece's IIR p. 139)
Hungary	Hungary plans to further improve the coordination with E-PRTR reporting and the reporting process and to execute a quantitative uncertainty analysis; another planned improvement is better QA/QC (Appendix 5, Hungary's IIR p. 229)
Ireland	In the sectoral chapters of Ireland's IIR, the planned source-specific improvements have been compiled (Appendix 5, Ireland's IIR)
Italy	Italy's IIR lists certain areas for improvement. For the energy and industrial processes and product use sectors harmonisation of information, as well as detection of data discrepancies and potential errors shall be carried out. For the agriculture and waste sectors new information, emission factors and activity data shall be implemented. Furthermore for $PM_{2.5}$ and BC an update of emission factors is planned in line with the Inventory guidebook (EMEP/EEA 2019). (Appendix 5, Italy's IIR p. 198)
Latvia	For the energy sector, planned improvements include the developing tier 2 calculation methodology, and the industrial processes and product use sector plans to review data for the year 2018 to get more precise data; planned improvements in the agriculture sector include the continued quantification and preparation of detailed documentation of abatement strategies for ammonia emissions to allow their inclusion in the inventory and to provide more detailed statistical data with the potential to report emissions of manure digestate application (Appendix 5, Latvia's IIR p. 151)
Lithuania	There are no source-specific planned improvements listed in the IIR, but the country sees a necessity for inventory improvements in the future and a priority in the estimation of KCA categories using a tier 2 or higher approach (Appendix 5, Lithuania's IIR)

Member State	Improvements planned
Luxembourg	The IIR lists planned improvements (Luxembourg's IIR, p. 452); they mainly concern updating the methodology, activity data and emission factors, as well as notation key correction, reallocation of emissions and new emission sources (Appendix 5, Luxembourg's IIR)
Malta	No IIR available
Netherlands	The remaining actions in the recommendations, issued in the NEC Directive review in 2019, will be prioritised, and are planned for implementation in the 2020 and 2021 inventories; some planned source-specific improvements are described in the sectoral chapters of the Netherlands' IIR (Appendix 5, the Netherland's IIR p. 159)
Poland	The planned improvement programme focuses on the following: gathering additional activity data to verify the trends for 1990-2018 and developing the methodology further by applying higher-tier methods for the estimation methodology (Appendix 5, Poland's IIR p. 134)
Portugal	Each source-specific section presents a detailed explanation of the planned sectoral improvements (Appendix 5, Portugal's IIR)
Romania	Romania is planning improvements, which include an update of the emission factors and calculations according to the Inventory guidebook (EMEP/EEA 2019). In addition, it has focused on gathering additional activity data to include new emission sources, a correlation with other reporting and better QA/QC actions (Appendix 5, Romania's IIR p. 275)
Slovakia	A general and sectoral uncertainty analysis is one of Slovakia's main future goals; it plans a total change in approach to most of the categories in the sectors energy and industrial processes and product use, and to move the KCA from the current tier 1 methodology to tier 2 Several sector-specific chapters also provide information on planned improvements (Appendix 5, Slovakia's IIR)
Slovenia	Planned improvements relate to the transport and solvents and product use categories; the main aims are to estimate new emissions, use a new model for emission calculation from road transport, find the correct emission factors and use improved data from the Slovenian HOS database; a detailed list of the planned improvements can be found in Slovenia's IIR (Appendix 5, Slovenia's IIR p. 287)
Spain	The principal areas for improvement are: • harmonising the inventory with other registries and inventories (e.g. E-PRTR, EU ETS); • completing the implementation of the EMEP/EEA Inventory guidebook 2019; • continuing the development of the inventory quality management tool — new modules and functionalities are expected to be included in future editions; • continuing to develop the external audit. Detailed information on planned improvements is included in section 8.4 of the IIR, as well as in the sectoral chapters (Appendix 5, Spain's IIR p. 27)
Sweden	For a number of sectors, planned improvements will be decided after the finalisation of the submission, as part of the national QA/QC plan; other than that, there is no information about planned improvements (Appendix 5, Sweden's IIR p. 265)
United Kingdom	A number of improvements to the inventory are planned and described in detail in the relevant sector chapters; planned improvements are relevant for the sectors energy, industrial processes and product use, agriculture, waste and other (Appendix 5, the United Kingdom's IIR)

Note: Grey text indicates those countries that did not submit an IIR in 2020.

Units, symbols, abbreviations and acronyms

As	Arsenic
B(a)P	Benzo(a)pyrene
B(b)F	Benzo(b)fluoranthene
BC	Black carbon
B(k)F	Benzo(k)fluoranthene
CCGT	Combined cycle gas turbine
Cd	Cadmium
CDR	Central Data Repository
CEIP	Centre on Emission Inventories and Projections
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
COPERT	Computer programme to calculate emissions from road transport
Cr	Chromium
Cu	Copper
DG	Directorate-General
EEA	European Environment Agency
EEA-5	Non-EU EEA member countries (Iceland, Liechtenstein, Norway, Switzerland and Turkey)
Eionet	European Environment Information and Observation Network
EMEP	European Monitoring and Evaluation Programme (cooperative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe)
EPER	European Pollutant Emission Register
E-PRTR	European Pollutant Release and Transfer Register
ERT	Expert review team

ETC	European Topic Centre (of the EEA)
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation (of the EEA)
ETC/ATNI	European Topic Centre on Air Pollution, Transport, Noise and Industrial Pollution (of the EEA)
ETS	Emissions Trading Scheme
EU	European Union
FGD	Flue gas desulphurisation
Gg	1 gigagram = 10^9 g = 1 kilotonne (kt)
GHG	Greenhouse gas
GNFR	Gridding nomenclature for reporting/UNECE nomenclature for reporting of air HCB Hexachlorobenzene
HCE	Hexachloroethane
HFC	Hydrofluorocarbon
Hg	Mercury
HM	Heavy metal
IE	Included elsewhere
IIR	Informative inventory report
IP	Indeno(1,2,3-cd)pyrene
I-Teq	International toxic equivalent
KCA	Key category analysis
kg	1 kilogram = 10^3 g (gram)
LPS	Large point source
LRTAP	Long-range Transboundary Air Pollution; (UNECE) Convention on LRTAP
LTO	Landing/take-off
Mg	1 megagram = 10^6 g = 1 tonne (t)
MMR	Monitoring Mechanism Regulation
MSW	Municipal solid waste
MWe	Megawatt electric
NA	Not applicable
N_2O	Nitrous oxide

NE	Not estimated
NEC Directive	National Emission reduction Directive (2016/2284/EU)
NFR	Nomenclature for reporting/UNECE nomenclature for reporting of air pollutants
NFR14	Current format for reporting of air pollutants (Nomenclature for reporting)
NH_3	Ammonia
Ni	Nickel
NMVOC	Non-methane volatile organic compound
NO	Not occurring
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides
NR	Not relevant
O_3	Ozone
PAH	Polycyclic aromatic hydrocarbon
Pb	Lead
PCB	Polychlorinated biphenyl
PCDD/F	Polychlorinated dibenzodioxin/dibenzofuran
PFC	Perfluorocarbon
PM	Particulate matter
$PM_{2.5}$	Fine particulate matter with a diameter of 2.5 µm or less
PM_{10}	Particulate matter with a diameter of 10 µm or less
POP	Persistent organic pollutant
QA	Quality assurance
QC	Quality control
SCR	Selective catalytic reduction
Se	Selenium
SNCR	Selective non-catalytic reduction
SO_2	Sulphur dioxide
SO_X	Sulphur oxides
t	1 tonne (metric) = 1 megagram (Mg) = 10^6 g

TERT	Technical Expert Review Team
TFEIP	Task Force on Emission Inventories and Projections
TREMOD	Transport Emission Model
TSP	Total suspended particulate
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile organic compound
WM	With measures (projections)
WaM	With additional measures (projections)
Zn	Zinc

Key category source sector abbreviations referred to in the main text

1A1a	Public electricity and heat production
1A1b	Petroleum refining
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals
1A2gvii	Mobile combustion in manufacturing industries and construction
1A2gviii	Stationary combustion in manufacturing industries and construction: Other
1A3bi	Road transport: Passenger cars
1A3bii	Road transport: Light duty vehicles
1A3biii	Road transport: Heavy duty vehicles and buses
1A3biv	Road transport: Mopeds and motorcycles
1A3bv	Road transport: Gasoline evaporation
1A3bvi	Road transport: Automobile tyre and brake wear
1A3bvii	Road transport: Automobile road abrasion
1A3dii	National navigation (shipping)

1A4ai	Commercial/institutional: Stationary
1A4bi	Residential: Stationary
1A4bii	Residential: Household and gardening (mobile)
1A4ci	Agriculture/forestry/fishing: Stationary
1A4cii	Agriculture/forestry/fishing: Off-road vehicles and other machinery
1B2aiv	Fugitive emissions oil: Refining/storage
1B2av	Distribution of oil products
2A1	Cement production
2A3	Glass production
2A5a	Quarrying and mining of minerals other than coal
2A5b	Construction and demolition
2B10a	Chemical industry: Other
2C1	Iron and steel production
2C3	Aluminium production
2C6	Zinc production
2C7a	Copper production
2D3a	Domestic solvent use including fungicides
2D3b	Road paving with asphalt
2D3d	Coating applications
2D3e	Degreasing
2D3g	Chemical products
2D3h	Printing
2D3i	Other solvent use
2G	Other product use
2H2	Food and beverages industry
2K	Consumption of POPs and heavy metals
2L	Other production, consumption, storage, transportation or handling of bulk products
3B1a	Manure management — Dairy cattle
3B1b	Manure management — Non-dairy cattle

3B3	Manure management — Swine
3B4gi	Manure management — Laying hens
3B4gii	Manure management — Broilers
3Da1	Inorganic N-fertilisers (includes also urea application)
3Da2a	Animal manure applied to soils
3Da3	Urine and dung deposited by grazing animals
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural p.
3De	Cultivated crops
3Df	Use of pesticides
3F	Field burning of agricultural residues
5C1bi	Industrial waste incineration
5C1biii	Clinical waste incineration
5C1bv	Cremation
5C2	Open burning of waste
5E	Other waste

Country codes

AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czechia
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland

FR	France
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom

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Appendix 1 Notation keys

Where there are methodological or data gaps in the inventories, information on these gaps should be presented in a transparent manner. Parties should clearly indicate the sources that they have not considered in their inventories — although the Inventory guidebook (EMEP/EEA, 2019) includes them — and explain the reason for excluding them. Similarly, each Party should indicate if it has excluded part of its territory and explain why. In addition, each Party should use the notations presented below to fill the blanks in all the tables in the nomenclature for reporting (NFR) inventory. This approach helps in assessing how complete the emission data reports are. The notations are as follows ([17]).

NO 'Not occurring' means an emission source or process does not exist in a country.

NE 'Not estimated' means emissions occur but have not been estimated or reported. Where an inventory uses 'NE', the Party should indicate why it could not estimate emissions.

NA 'Not applicable' means that a source exists but relevant emissions are considered never to occur.

IE 'Included elsewhere' is for emissions that are estimated and included in the inventory but are not presented separately for the relevant source. Where it uses 'IE', the Party should indicate where the inventory includes the emissions from the displaced source category and should give the reasons for deviating from the expected category.

C 'Confidential' is for aggregated emissions that the inventory includes elsewhere because reporting at a disaggregated level could lead to the disclosure of confidential information. Where an inventory uses 'C', it should make reference to the protocol provision that authorises it.

NR 'Not relevant' eases reporting where different protocols do not strictly require details of the emissions. 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, for example, some Parties do not need to report emissions of non-methane volatile organic compounds (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 it has used to estimate them.

([17]) Further explanation and guidance concerning the use of these notation codes are in the European Monitoring and Evaluation Programme (EMEP) emission-reporting guidelines (UNECE, 2014a).

Appendix 2 LRTAP Convention emission-reporting programme for 2020

Emission data should be submitted to the EMEP Centre on Emission Inventories and Projections (CEIP) by **15 February 2020**. Informative inventory reports (IIRs) should reach the centre no later than **15 March 2020**. Table A2.1 summarises information in the revised emission-reporting guidelines (UNECE, 2014a).

Reporting format

Each Party should use the reporting format in Annex IV of the reporting guidelines (UNECE, 2014a) for its annual submissions. It should submit the information to the CEIP formally, preferably in electronic format, and notify the United Nations Economic Commission for Europe (UNECE) secretariat. The reporting format, including the NFR, is standardised for reporting estimates of emissions. It includes activity data, projected activity data, projected emissions and other relevant information. The reporting format aims to facilitate electronic submissions by making it easier to process emission information and prepare useful documentation about technical analysis and synthesis.

The new NFR19 format covers:

- national annual emissions and national annual sector emissions (Annex I).

The NFR14 format covers:

- total and aggregated sector emissions for reporting emissions of nitrogen oxides (NO_X), NMVOCs, sulphur oxides (SO_X), ammonia (NH_3), particulate matter (PM), black carbon (BC), carbon monoxide (CO), lead (Pb), cadmium (Cd), mercury (Hg), polychlorinated dibenzodioxins/dibenzofurans (PCDD/Fs), polycyclic aromatic hydrocarbons (PAHs), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs) for the EMEP 0.1 ° × 0.1 ° grid cell and from large point sources (LPSs) (Annexes V and VI);
- for 2020, 2025, 2030, 2040 and 2050, projected activity data and projected national total emissions of NO_X, NMVOCs, sulphur and NH_3, which Parties are to report for the source categories listed in Annex IV (A- with measures — WM; B-WM; A- with additional measures — WaM; B-WaM).

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

Description of contents	Pollutant(s)	Reporting years (a)
Yearly: minimum (and additional)		
A. National total emissions		
1. Main pollutants	NO_x, NMVOCs, SO_x, NH_3, CO	1990-2018
2. Particulate matter (b)	$PM_{2.5}$, PM_{10} (TSPs, BC)	2000-2018
3. Heavy metals (b)	Pb, Cd, Hg, (As, Cr, Cu, Ni, Se, Zn)	1990-2018
4. Persistent organic pollutants (b)	PCDD/Fs, total PAHs, PCBs, HCB (PAHs: B(a)P, B(b)F, B(k)F, IP)	1990-2018
B. Emissions by NFR source category		
1. Main pollutants	NO_x, NMVOCs, SO_x, NH_3, CO	1990-2018
2. Particulate matter (b)	$PM_{2.5}$, PM_{10}, (TSPs, BC)	2000-2018
3. Heavy metals (b)	Pb, Cd, Hg, (As, Cr, Cu, Ni, Se, Zn)	1990-2018
4. Persistent organic pollutants (b)	PCDD/Fs, total PAHs, PCBs, HCB (PAHs: B(a)P, B(b)F, B(k)F, IP)	1990-2018
C. Activity data	NO_x, NMVOCs, SO_x, NH_3, CO	1990-2018
4-yearly: minimum reporting (from 2017 to the next reporting year: 2021)		
D. Gridded data in the EMEP 0.1 ° × 0.1 ° long/lat grid — sector emissions (GNFR14) (c) and national totals (optional)	NO_x, NMVOCs, SO_x, NH_3, CO, $PM_{2.5}$, PM_{10}, Pb, Cd, Hg, PCDD/Fs, PAHs, HCB, PCBs	2015 (1990, 1995, 2000, 2005, 2010 if not previously reported)
E. Emissions from LPSs	NO_x, NMVOCs, SO_x, NH_3, CO, $PM_{2.5}$, PM_{10}, Pb, Cd, Hg, PCDD/Fs, PAHs, HCB, PCBs	2015 (1990, 1995, 2000, 2005, 2010 if not previously reported)
F. Projected emissions and projected activity data		
1. National total emission projections	NO_x, NMVOCs, SO_x, NH_3, $PM_{2.5}$, BC	2020, 2025, 2030, where available 2040 and 2050
2. Emission projections by NFR14	NO_x, NMVOCs, SO_x, NH_3, $PM_{2.5}$, BC	2020, 2025, 2030, where available 2040 and 2050
3. Projected activity data by NFR14		2020, 2025, 2030, where available 2040 and 2050
5-yearly: additional reporting for review and assessment purposes		
Volatile organic compound (VOC) speciation/height distribution/temporal distribution		Parties are encouraged to review the information used for modelling at http://www.ceip.at/ms/ceip_home1/ceip_home/webdab_emepdatabase/emissions_emepmodels/ (accessed 20 March 2020)
Land-use data/Hg breakdown		
Percentage of toxic congeners of PCDD/F emissions		
Pre-1990 emissions of PAHs, HCB, PCDD/Fs and PCBs		
Information on natural emissions		

Notes: (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 (i.e. the second-last before the current year) should be reported.

(b) Parties report the pollutants listed in brackets voluntarily.

(c) Gap-filled NFR14.

As, arsenic; BC, black carbon; B(a)P, benzo(a)pyrene; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cd, cadmium; CO, carbon monoxide; Cr, chromium; Cu, copper; GNFR14, gridding nomenclature for reporting; HCB, hexachlorobenzene; Hg, mercury; IP, indeno(1,2,3-cd)pyrene; NO_x, nitrogen oxides; NH_3, ammonia; Ni, nickel; LPSs, large point sources; Pb, lead; PAHs, polycyclic aromatic hydrocarbons; PCBs, polychlorinated biphenyls; PCDD/Fs, polychlorinated dibenzodioxins/dibenzofurans; $PM_{2.5}$, particulate matter with a diameter of 2.5 µm or less; PM_{10}, particulate matter with a diameter of 10 µm or less; Se, selenium; SO_x, sulphur oxides; TSPs, total suspended particulates; Zn, zinc.

Table A2.2 European Union: country groupings

EU-9 refers to the nine EU Member States up to 31 December 1980: Belgium (BE), Denmark (DK), France (FR), Germany (DE), Ireland (IE), Italy (IT), Luxembourg (LU), the Netherlands (NL) and the United Kingdom (UK)
EU-12 refers to the 12 EU Member States from 1 January 1981 to 31 December 1994: the EU-9 plus Greece (EL), Portugal (PT) and Spain (ES)
EU-15 refers to the 15 EU Member States from 1 January 1995 to 30 April 2003: the EU-12 plus Austria (AT), Finland (FI) and Sweden (SE)
EU-27 refers to the 27 EU Member States from 1 May 2003 to 30 June 2013: the EU-15 plus Bulgaria (BG), Cyprus (CY), Czechia (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Malta (MT), Poland (PL), Romania (RO), Slovakia (SK) and Slovenia (SI)
EU-28 refers to the 28 EU Member States from 1 July 2013: the EU-27 plus Croatia (HR); The United Kingdom (UK) left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020. This report refers for 2018 to the air pollutant emission totals of the EU-27 plus the totals of the United Kingdom, i.e. the EU-28.

Appendix 3 Status of reporting and timeliness

Table A3.1 EU Member State and United Kingdom inventory submissions 2020: date received by the EEA, years covered and information provided (as of 06 May 2020)

Country	Reporting date and format									Comments
Member State	Submission Date*	Resubmission Date	Adjustment Date (Information or Annex submission)	Projection submission Date	Grid submission Date	LPS submission Date	Date of additional information	Date of IIR	NFR template version	
Austria	14.02.2020							12/03/2020	NFR2019-1	
Belgium	14.02.2020	11.03.2020 15.03.2020	14.02.2020 10.03.2020 15.03.2020					15/03/2020	NFR2019-1	
Bulgaria	14.02.2020	17.03.2020			17.03.2020			16/03/2020	NFR2019-1	
Croatia	14.02.2020							03/03/2020	NFR2019-1	
Cyprus	14.02.2020							13/03/2020	NFR2019-1	
Czechia	14.02.2020(a)	15.04.2020	14.02.2020			28.02.2020		13.03.2020 07.04.2020	NFR2019-1	(a) Annex III
Denmark	14.02.2020		14.02.2020					15/03/2020	NFR2019-1	
Estonia	13.02.2020	13.03.2020			28.02.2020			13/03/2020	NFR2019-1	
Finland	14.02.2020	13.03.2020	14.02.2020 21.02.2020	13.03.2020 17.03.2020	29.04.2020	29.04.2020		13/03/2020	NFR2019-1	
France	14.02.2020	13.03.2020	14.02.2020					13/03/2020	NFR2019-1	
Germany	12.02.2020	12.03.2020	12.02.2020					12/03/2020	NFR2019-1	
Greece	12.02.2020							17/02/2020	NFR2019-1	
Hungary	17.02.2020	10.03.2020 18.03.2020	10.03.2020					18/03/2020	NFR2019-1	
Ireland	14.02.2020			17.04.2020				13/03/2020	NFR2019-1	
Italy	25.02.2020	12.03.2020			21.03.2020	21.03.2020		21.03.2020	NFR2019-1	
Latvia	14.02.2020	13.03.2020						13/03/2020	NFR2019-1	
Lithuania	15.02.2020	17.02.2020 19.02.2020 21.02.2020 25.02.2020			13.02.2020	12.02.2020		13/03/2020	NFR2019-1	
Luxembourg	13.02.2020	13.03.2020	13.02.2020					13/03/2020	NFR2019-1	
Malta	17.02.2020	01.04.2020		03.03.2020	29.04.2020				NFR2019-1	
Netherlands	16.02.2020	16.03.2020	16.02.2020 28.02.2020 15.03.2020					15/03/2020	NFR2019-1	
Poland	12.02.2020	09.04.2020			27.04.2020			12.03.2020 09.04.2020	NFR2019-1	
Portugal	12.02.2020	13.02.2020 13.03.2020 07.04.2020						13.03.2020 08.04.2020	NFR2019-1	
Romania	14.02.2020	13.03.2020				06.03.2020		13/03/2020	NFR2019-1	
Slovakia	12.02.2020	13.03.2020						13/03/2020	NFR2019-1	
Slovenia	06.02.2020	13.03.2020						13/03/2020	NFR2019-1	

Table A3.1 EU Member State and United Kingdom inventory submissions 2020: date received by the EEA, years covered and information provided (as of 06 May 2020) (cont.)

Country	Reporting date and format									Comments
Member State	**Submission Date***	**Resubmission Date**	**Adjustment Date (Information or Annex submission)**	**Projection submission Date**	**Grid submission Date**	**LPS submission Date**	**Date of additional information**	**Date of IIR**	**NFR template version**	
Spain	17.01.2020	07.02.2020 12.03.2020	07.02.2020		28.04.2020	28.04.2020		12/03/2020	NFR2019-1	
Sweden	30.01.2020							02/03/2020	NFR2019-1	
United Kingdom	14.02.2020	13.03.2020	14.02.2020	13.03.2020				13/03/2020	NFR2019-1	

Notes: Dates in red indicate that data were submitted after the formal deadline for submissions (submissions 15 February; resubmissions 15 March; projections 15 March; IIR 15 March).

([a]) Refers to the first submission of inventory data to the Central Data Repository (CDR); submission of other data are possible at later dates.

The United Kingdom left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020.

Table A3.2 EU Member State and United Kingdom submissions of 2018 data (as of 06 May 2020)

Country	Years reported									Comments
Member State	**SO_2, NO_x, CO, NH_3, NMVOC**	**Cd, Hg, Pb**	**additional HM**	**$PM_{2.5}$, PM_{10}**	**TSP**	**BC**	**POPs: PAH, DIOX, HCB, PCB**	**Additional PAHs: BaP, BbF, BkF, IP**	**Activity data**	
Austria	1990-2018	1990-2018	-	1990, 1995, 2000-2018	1990, 1995, 2000-2018	-	1990-2018	-	1990-2018	
Belgium	1990-2018	1990-2018	1990-2018	2000-2018	2000-2018	2000-2018	1990-2018	1990-2018	1990-2018	
Bulgaria	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Croatia	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Cyprus	1990-2018	1990-2018	1990-2018	2000-2018	2000-2018	2000-2018	1990-2018	1990-2018	1990-2018	
Czechia	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Denmark	1985-2018(a)	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1980-2018	(a) SO_x: 1980-2017
Estonia	1990-2018	1990-2018	1990-2018	2000-2018	1990-2018	2000-2018	1990-2018	1990-2018	1990-2018	
Finland	1980-2018(a)	1990-2018(b)	1990-2018(c)	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	(a) CO:1990-2017, NMVOC: 1987-2017 (b) Pb also 1984 (c) Se only 1991
France	1980-2018(a)	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1980-2017	(a) NMVOC: 1988-2017
Germany	1990-2018	1990-2018	1990-2018	1995-2018	1990-2018	2000-2018	1990-2018	1990-2018	1990-2018	
Greece	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Hungary	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Ireland	1990-2018(a)	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	(a) NO_x, NMVOC, SO_x: also 1987
Italy	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Latvia	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Lithuania	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Luxembourg	1990-2018	1990-2018	-	1990-2018	1990-2018	-	1990-2018	1990-2018	1990-2018	
Malta	2005-2018	2005-2018	2005-2018	2005-2018	2005-2018	2005-2018	2005-2018	2005-2018	2005-2018	
Netherlands	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Poland	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Portugal	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Romania	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Slovakia	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	
Slovenia	1980-2018(a)	1990-2018	1990-2018	2000-2018	2000-2018	2000-2018	1990-2018	1990-2018	1990-2018	(a) NMVOC: 1990-2018, NH_3: 1986-2018
Spain	1990-2018	1990-2018	1990-2018	2000-2018	2000-2018	2000-2018	1990-2018	1990-2018	1990-2018	
Sweden	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	2000-2018	1990-2018	1990-2018	1990-2018	
United Kingdom	1990-2018	1990-2018	1990-2018	1990-2018	1990-2018	2000-2018	1990-2018	1990-2018	1990-2018	

Notes: Years in red indicate that time series reporting is incomplete.

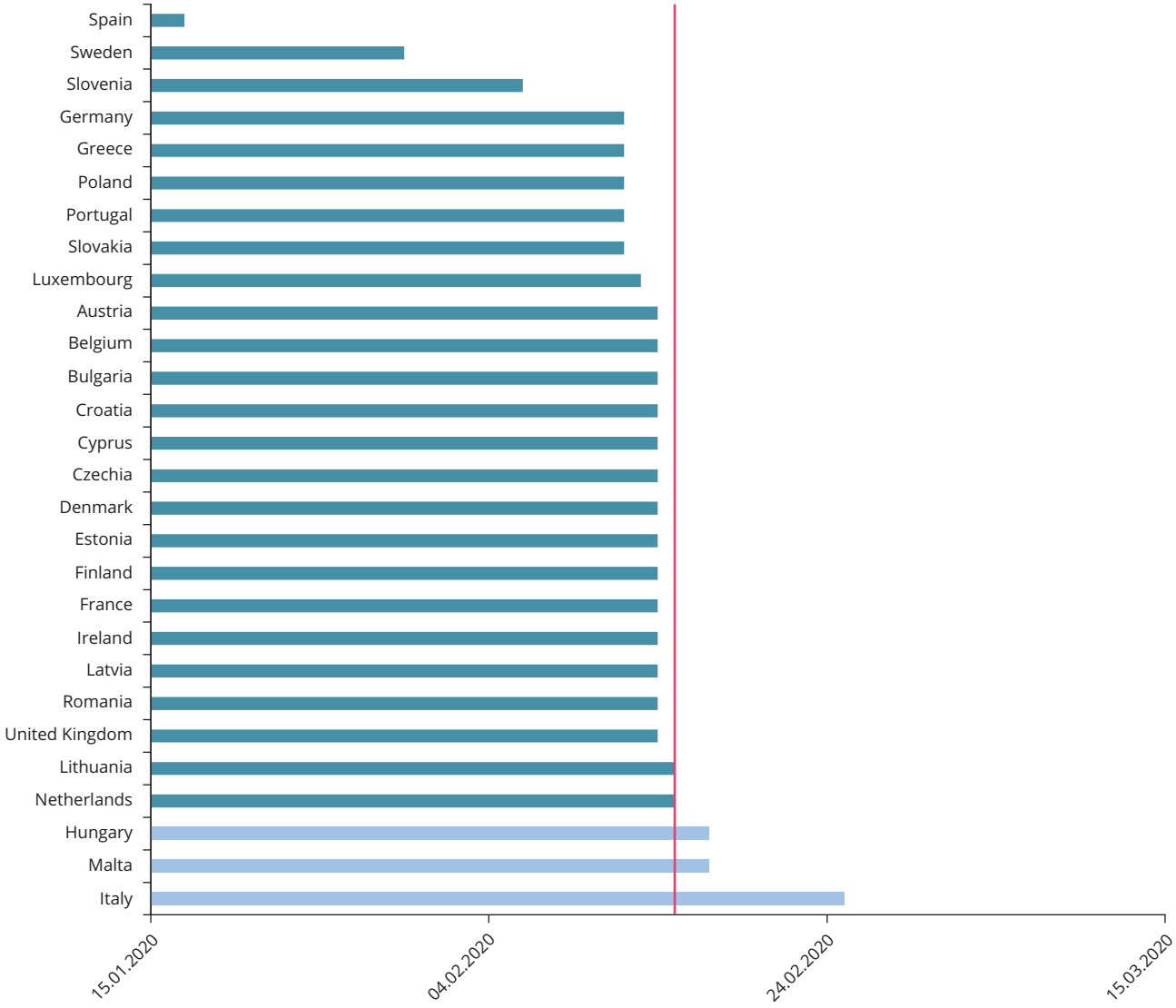
Reporting of additional heavy metals (HMs) is not mandatory.

EU Member States do not have to report total suspended particulates (TSPs) if they report PM emissions.

BC, black carbon; B(a)P, benzo(a)pyrene; B(b)F, benzo(b)fluoranthene; B(k)F, benzo(k)fluoranthene; Cd, cadmium; IP, indeno(1,2,3-cd) pyrene; $PM_{2.5}$, PM with a diameter of 2.5 µm or less; PM_{10}, PM with a diameter of 10 µm or less; POPs, persistent organic pollutants; Se, selenium; SO_2, sulphur dioxide.

The United Kingdom left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020.

Figure A3.1 Dates of first data submissions received from EU Member States and the United Kingdom (as of 25 February 2020)



Note: The United Kingdom left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020.

Appendix 4 Conversion chart for aggregated sector groups

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

- energy production and distribution;
- energy use in industry;
- industrial processes and product use;
- commercial, institutional and households;
- road transport;
- non-road transport;
- agriculture;
- waste.

Table A4.1 provides a conversion chart showing which of the individual NFR source categories appeared in each of the aggregated sector groups.

Table A4.1 Conversion chart for aggregated sector groups

NFR code	Full name	EEA aggregated sector name
1A1a	Public electricity and heat production	Energy production and distribution
1A1b	Petroleum refining	Energy production and distribution
1A1c	Manufacture of solid fuels and other energy industries	Energy production and distribution
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Energy use in industry
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Energy use in industry
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Energy use in industry
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, paper and print	Energy use in industry
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Energy use in industry
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Energy use in industry
1A2gvii	Mobile combustion in manufacturing industries and construction	Energy use in industry
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Energy use in industry
1A3ai(i)	International aviation LTO (civil)	Non-road transport
1A3aii(i)	Domestic aviation LTO (civil)	Non-road transport
1A3bi	Road transport: Passenger cars	Road transport
1A3bii	Road transport: Light duty vehicles	Road transport
1A3biii	Road transport: Heavy duty vehicles and buses	Road transport
1A3biv	Road transport: Mopeds and motorcycles	Road transport
1A3bv	Road transport: Gasoline evaporation	Road transport
1A3bvi	Road transport: Automobile tyre and brake wear	Road transport
1A3bvii	Road transport: Automobile road abrasion	Road transport
1A3c	Railways	Non-road transport
1A3di(ii)	International inland waterways	Non-road transport
1A3dii	National navigation (shipping)	Non-road transport
1A3ei	Pipeline transport	Non-road transport
1A3eii	Other	Non-road transport
1A4ai	Commercial/institutional: Stationary	Commercial, institutional and households
1A4aii	Commercial/institutional: Mobile	Commercial, institutional and households
1A4bi	Residential: Stationary	Commercial, institutional and households

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

NFR code	Full name	EEA aggregated sector name
1A4bii	Residential: Household and gardening (mobile)	Commercial, institutional and households
1A4ci	Agriculture/forestry/fishing: Stationary	Commercial, institutional and households
1A4cii	Agriculture/forestry/fishing: Off-road vehicles and other machinery	Commercial, institutional and households
1A4ciii	Agriculture/forestry/fishing: National fishing	Non-road transport
1A5a	Other stationary (including military)	Commercial, institutional and households
1A5b	Other, mobile (including military, land-based and recreational boats)	Commercial, institutional and households
1B1a	Fugitive emission from solid fuels: Coal mining and handling	Energy production and distribution
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	Energy production and distribution
1B1c	Other fugitive emissions from solid fuels	Energy production and distribution
1B2ai	Fugitive emissions oil: Exploration, production, transport	Energy production and distribution
1B2aiv	Fugitive emissions oil: Refining/storage	Energy production and distribution
1B2av	Distribution of oil products	Energy production and distribution
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	Energy production and distribution
1B2c	Venting and flaring (oil, gas, combined oil and gas)	Energy production and distribution
1B2d	Other fugitive emissions from energy production	Energy production and distribution
2A1	Cement production	Industrial processes and product use
2A2	Lime production	Industrial processes and product use
2A3	Glass production	Industrial processes and product use
2A5a	Quarrying and mining of minerals other than coal	Industrial processes and product use
2A5b	Construction and demolition	Industrial processes and product use
2A5c	Storage, handling and transport of mineral products	Industrial processes and product use
2A6	Other mineral products	Industrial processes and product use
2B1	Ammonia production	Industrial processes and product use
2B2	Nitric acid production	Industrial processes and product use
2B3	Adipic acid production	Industrial processes and product use
2B5	Carbide production	Industrial processes and product use
2B6	Titanium dioxide production	Industrial processes and product use
2B7	Soda ash production	Industrial processes and product use
2B10a	Chemical industry: Other	Industrial processes and product use
2B10b	Storage, handling and transport of chemical products	Industrial processes and product use
2C1	Iron and steel production	Industrial processes and product use
2C2	Ferroalloys production	Industrial processes and product use
2C3	Aluminium production	Industrial processes and product use
2C4	Magnesium production	Industrial processes and product use
2C5	Lead production	Industrial processes and product use
2C6	Zinc production	Industrial processes and product use
2C7a	Copper production	Industrial processes and product use
2C7b	Nickel production	Industrial processes and product use
2C7c	Other metal production	Industrial processes and product use
2C7d	Storage, handling and transport of metal products	Industrial processes and product use
2D3a	Domestic solvent use including fungicides	Industrial processes and product use
2D3b	Road paving with asphalt	Industrial processes and product use
2D3c	Asphalt roofing	Industrial processes and product use
2D3d	Coating applications	Industrial processes and product use
2D3e	Degreasing	Industrial processes and product use
2D3f	Dry cleaning	Industrial processes and product use
2D3g	Chemical products	Industrial processes and product use
2D3h	Printing	Industrial processes and product use
2D3i	Other solvent use	Industrial processes and product use
2G	Other product use	Industrial processes and product use

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

NFR code	Full name	EEA aggregated sector name
2H1	Pulp and paper industry	Industrial processes and product use
2H2	Food and beverages industry	Industrial processes and product use
2H3	Other industrial processes	Industrial processes and product use
2I	Wood processing	Industrial processes and product use
2J	Production of POPs	Industrial processes and product use
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	Industrial processes and product use
2L	Other production, consumption, storage, transportation or handling of bulk products	Industrial processes and product use
3B1a	Manure management — Dairy cattle	Agriculture
3B1b	Manure management — Non-dairy cattle	Agriculture
3B2	Manure management — Sheep	Agriculture
3B3	Manure management — Swine	Agriculture
3B4a	Manure management — Buffalo	Agriculture
3B4d	Manure management — Goats	Agriculture
3B4e	Manure management — Horses	Agriculture
3B4f	Manure management — Mules and asses	Agriculture
3B4gi	Manure management — Laying hens	Agriculture
3B4gii	Manure management — Broilers	Agriculture
3B4giii	Manure management — Turkeys	Agriculture
3B4giv	Manure management — Other poultry	Agriculture
3B4h	Manure management — Other animals	Agriculture
3Da1	Inorganic N-fertilisers (includes also urea application)	Agriculture
3Da2a	Animal manure applied to soils	Agriculture
3Da2b	Sewage sludge applied to soils	Agriculture
3Da2c	Other organic fertilisers applied to soils (including compost)	Agriculture
3Da3	Urine and dung deposited by grazing animals	Agriculture
3Da4	Crop residues applied to soils	Agriculture
3Db	Indirect emissions from managed soils	Agriculture
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	Agriculture
3Dd	Off-farm storage, handling and transport of bulk agricultural products	Agriculture
3De	Cultivated crops	Agriculture
3Df	Use of pesticides	Agriculture
3F	Field burning of agricultural residues	Agriculture
3I	Agriculture other	Agriculture
5A	Biological treatment of waste — Solid waste disposal on land	Waste
5B1	Biological treatment of waste — Composting	Waste
5B2	Biological treatment of waste — Anaerobic digestion at biogas facilities	Waste
5C1a	Municipal waste incineration	Waste
5C1bi	Industrial waste incineration	Waste
5C1bii	Hazardous waste incineration	Waste
5C1biii	Clinical waste incineration	Waste
5C1biv	Sewage sludge incineration	Waste
5C1bv	Cremation	Waste
5C1bvi	Other waste incineration	Waste
5C2	Open burning of waste	Waste
5D1	Domestic waste water handling	Waste
5D2	Industrial waste water handling	Waste
5D3	Other waste water handling	Waste
5E	Other waste	Waste
6A	Other (included in national total for entire territory)	Other

Note: LTO, landing/take-off; POPs, persistent organic pollutants.

Appendix 5 EU Member State and United Kingdom informative inventory reports (IIRs)

Table A5.1 List of submitted IIRs including source and date of submission (as of 06 May 2020)

Country code	Title of IIR	Source	Date of submission
AT	Austria's Informative Inventory Report (IIR) 2020. Submission under the UNECE Convention on Long-range Transboundary Air Pollution and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants	https://cdr.eionet.europa.eu/at/un/clrtap/iir/envxjgdaq	12.3.2020
BE	Informative Inventory Report about Belgium's air emissions submitted under the Convention on Long-range Transboundary Air Pollution LRTAP and the National Emission Ceilings Directive NECD. March 2020	http://cdr.eionet.europa.eu/be/un/clrtap/iir/envxm4kcw	15.3.2020
BG	Bulgaria's Informative Inventory Report 2020 (IIR). Submission under the UNECE Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/bg/un/clrtap/iir/envxm9l7g	16.3.2020
CY	Cyprus Informative Inventory Report 2018	https://cdr.eionet.europa.eu/cy/un/clrtap/iir/envxmtn_q	13.3.2020
CZ	Czech Informative Inventory Report 2020. Submission under the UNECE Convention on Long-range Transboundary Air Pollution	https://cdr.eionet.europa.eu/cz/un/clrtap/iir/envxj0lvw	13.3.2020
	Czech Informative Inventory Report 2020. Submission under the UNECE Convention on Long-range Transboundary Air Pollution	https://cdr.eionet.europa.eu/cz/un/clrtap/iir/envxj0lvw	07.4.2020
DE	German Informative Inventory Report 2020	http://iir-de.wikidot.com	No submission
DK	Annual Danish Informative Inventory Report to UNECE. Emission inventories from the base year of the protocols to year 2018	http://cdr.eionet.europa.eu/dk/un/clrtap/iir/envxm3v0a	15.3.2020
EE	Estonian Informative Inventory Report 1990-2018. Submitted under the Convention on Long-Range Transboundary Air Pollution. Tallinn 2020	http://cdr.eionet.europa.eu/ee/un/clrtap/iir/envxmtq3g	13.3.2020
EL	Greece's Informative Inventory Report (IIR) 2020. Submission under the UNECE Convention on Long-range Transboundary Air Pollution and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants	https://cdr.eionet.europa.eu/gr/un/clrtap/iir/envxkp8zg	17.2.2020
ES	Spain — March 2020. Edition 2020 (1990-2018). Informative Inventory Report. Submission to the Secretariat of the Geneva Convention and EMEP Programme	https://cdr.eionet.europa.eu/es/un/clrtap/iir/envxmo0tw	12.3.2020
FI	Finland's Informative Inventory Report 2020. Air Pollutant Emissions 1980-2018 under the UNECE CLRTAP and the EU NECD. Part I — General A. March 2020 Draft	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
	Finland's Informative Inventory Report 2020. Air Pollutant Emissions 1980-2018 under the UNECE CLRTAP and the EU NECD. Part 1B — General. March 2020	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
	Finland's Informative Inventory Report 2020. Air Pollutant Emissions 1980-2018 under the UNECE CLRTAP and the EU NECD. Part 2 — Energy. March 2020	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
	Finland's Informative Inventory Report 2020. under the UNECE CLRTAP and the EU NECD. Air Pollutant Emissions 1980-2018. Part 3 — Transport. March 2020	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
	Finland's Informative Inventory Report 2020. Air Pollutant Emissions 1980-2018 under the UNECE CLRTAP and the EU NECD. Part 4 — IPPU. March 2020	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
	Finland's Informative Inventory Report 2020. Air Pollutant Emissions 1980-2018 under the UNECE CLRTAP and the EU NECD. Part 5 — Agriculture	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
	Finland's Informative Inventory Report 2020. Air Pollutant Emissions 1980-2018 under the UNECE CLRTAP and the EU NECD. Part 6 — Waste	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
	Finland's Informative Inventory Report 2020. Air Pollutant Emissions 1980-2018 under the UNECE CLRTAP and the EU NECD. Part 7 — Annexes. March 2020	https://cdr.eionet.europa.eu/fi/un/clrtap/iir/envxmqea	13.3.2020
FR	Inventaire des émissions de polluants atmosphériques en France au titre de la convention sur la pollution atmosphérique transfrontalière à longue distance et de la directive Européenne concernant la réduction des émissions nationales de certains polluants atmosphériques. CEE — NU/NFR & NEC. Mars 2020	https://cdr.eionet.europa.eu/fr/un/clrtap/iir/envxmu48w	13.3.2020
HR	Republic of Croatia 2020 — Informative Inventory Report (1990-2018). Submission under the Convention on Long-range Transboundary Air Pollution (CLRTAP) and National Emission Ceilings Directive (NECD 2016/2284/EU)	https://cdr.eionet.europa.eu/hr/un/clrtap/iir/envxl4h1a	3.3.2020

Table A5.1 List of submitted IIRs including source and date of submission (as of 06 May 2020) (cont.)

Country code	Title of IIR	Source	Date of submission
HU	Informative Inventory Report — Hungary 2018	https://cdr.eionet.europa.eu/hu/un/clrtap/inventories/envxnjb5a	18.3.2020
IE	Ireland Informative Inventory Report 2020. Air Pollutant Emissions in Ireland 1990-2018 reported to the Secretariat of the UN/ECE Convention on Long-range Transboundary Air Pollution and to the European Union	https://cdr.eionet.europa.eu/ie/un/clrtap/iir/envxmuzha	13.3.2020
IT	Italian Emission Inventory 1990-2018 — Informative Inventory Report 2020	https://cdr.eionet.europa.eu/it/un/clrtap/iir/envxnycg	21.3.2020
LT	Lithuanian Pollutants Emission Inventory for period 1990-2018	https://cdr.eionet.europa.eu/lt/un/clrtap/iir/envxmt0uq	13.3.2020
LU	Luxembourg's Informative Inventory Report 1990-2018. Submission under the UNECE Convention on Long-Range Transboundary Air Pollution	https://cdr.eionet.europa.eu/lu/eu/nec_revised/iir/envxmtetg	13.3.2020
LV	2020. Latvia's Informative Inventory Report. Submitted under the Convention on Long-Range Transboundary Air Pollution	https://cdr.eionet.europa.eu/lv/un/clrtap/iir/envxmt3za	13.3.2020
MT	Informative Inventory Report for Malta 2017	https://cdr.eionet.europa.eu/mt/un/clrtap/iir/envxc06ca/	14.11.2019
NL	Informative Inventory Report 2020. Emissions of transboundary air pollutants in the Netherlands 1990-2018	https://cdr.eionet.europa.eu/nl/un/clrtap/iir/envxm6ouw	15.3.2020
PL	Poland's Informative Inventory Report 2020. Submission under the UNECE CLRTAP and NEC Directive. Air pollutant emissions in Poland 1990-2018. Warsaw 2020	https://cdr.eionet.europa.eu/pl/un/clrtap/iir/envxmocpa	12.3.2020
	Poland's Informative Inventory Report 2020. Submission under the UNECE CLRTAP and NEC Directive. Air pollutant emissions in Poland 1990–2018. Warsaw 2020	https://cdr.eionet.europa.eu/pl/un/clrtap/iir/envxo7duw	09.4.2020
PT	National Informative Inventory Report — Portugal 2020. Submission under the NEC Directive (EU) 2016/2284 and the UNECE Convention on Long-Range Transboundary Air Pollution	https://cdr.eionet.europa.eu/pt/un/clrtap/iir/envxmvblg	13.3.2020
	National Informative Inventory Report. 2020. Portugal. Submission under the NEC Directive (EU) 2016/2284 and the UNECE Convention on Long-Range Transboundary Air Pollution	https://cdr.eionet.europa.eu/pt/un/clrtap/iir/envxo4cmg	08.4.2020
RO	Romania's Informative Inventory Report 2020. Submission under the UNECE Convention on Long Range Transboundary Air Pollution	https://cdr.eionet.europa.eu/ro/un/clrtap/iir/envxmt7_g	13.3.2020
SE	Informative Inventory Report Sweden 2020. Submitted under the Convention on Long-range Transboundary Air Pollution	http://cdr.eionet.europa.eu/se/un/clrtap/iir/envxlkhza	2.3.2020
SI	Slovenian Informative Inventory Report 2020. Submission under the UNECE Convention on Long-Range Transboundary Air Pollution and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants	https://cdr.eionet.europa.eu/si/un/clrtap/iir/envxmoqtw	13.3.2020
SK	Slovak Republic. Informative Inventory Report 2020. Submission under the LRTAP Convention and under the NEC Directive	https://cdr.eionet.europa.eu/sk/un/clrtap/iir/envxms3lw	13.3.2020
UK	UK Informative Inventory Report (1990 to 2018)	https://cdr.eionet.europa.eu/gb/un/clrtap/iir/envxmo4kq	13.3.2020

Note: LRTAP, Long-range Transboundary Air Pollution.

The United Kingdom left the EU on February 1, 2020, but applies EU law until the end of the transition period, December 31, 2020.

European Environment Agency

**European Union emission inventory report 1990-2018
under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)**

2020 — 156 pp. — 21 x 29.7 cm

ISBN 978-92-9480-237-8
doi:10.2800/233574

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TH-AL-20-013-EN-N
doi:10.2800/233574

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