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MINISTRY OF THE ENVIRONMENT, CLIMATE AND ENERGY

SLOVENIAN ENVIRONMENT AGENCY

Informative Inventory Report Slovenia 2023

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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

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Slovenian Environment Agency
Vojkova 1b
SI-1000 Ljubljana, Slovenia

Tel: +386 1 4784 000
Fax: +386 1 4784 052
E-mail: gp.arso@gov.si
Internet: www.arso.gov.si

Authors:

Overall responsibility	Martina Logar, D.Sc.
Summary, Introduction, Trends	Martina Logar, D.Sc.
Energy	Martina Logar, D.Sc.
Industrial processes and product use	Tajda Mekinda Majaron Martina Logar, D.Sc.
Agriculture	Jože Verbič, D.Sc. (Agricultural Institute of Slovenia) Žan Pečnik (Agricultural Institute of Slovenia) Martina Logar, D.Sc.
Waste	Martina Logar, D.Sc.
Recalculations, Improvements	Martina Logar, D.Sc.
Projections	Matjaž Česen (Jožef Stefan Institute)
Annexes, NFR Tables	Martina Logar, D.Sc. Tajda Mekinda Majaron Jože Verbič, D.Sc. (Agricultural Institute of Slovenia) Matjaž Česen (Jožef Stefan Institute)

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1. EXECUTIVE SUMMARY

1.1 Background information on emission inventories

This report is Slovenian Annual Emissions Informative Inventory Report (IIR) submitted 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. The report contains information on Slovenian inventories for all years from the base years (1980, 1987 or 1990) of the protocols to the year 2021.

The substances for which there are existing reporting obligations in the Convention and the Protocols include: SO_x (as SO_2), NO_x (as NO_2), NMVOC, CO, NH_3, TSP, PM_{10} and $PM_{2.5}$, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Dioxins/Furans (PCDD/DF), PAHs, HCB, PCB.

Substances for which emission reporting is obligatory:

- SO_x, which means all sulphur compounds expressed as sulphur dioxide (SO_2), including sulphur trioxide (SO_3), sulphuric acid (H_2SO_4), and reduced sulphur compounds, such as hydrogen sulphide (H_2S), mercaptans and dimethyl sulphides, etc.;
- NO_x, nitrogen oxides, which means nitric oxide and nitrogen dioxide, expressed as nitrogen dioxide (NO_2);
- NH_3, ammonia;
- NMVOCs, non-methane volatile organic compounds, which means all organic compounds of an anthropogenic nature, other than methane, that are capable of producing photochemical oxidants by reaction with nitrogen oxides in the presence of sunlight;
- CO, carbon monoxide;
- Particulate matter (PM), which is an air pollutant consisting of a mixture of particles suspended in the air. These particles differ in their physical properties (such as size and shape) and chemical composition. Particulate matter refers to:
    - $PM_{2.5}$, or particles with an aerodynamic diameter equal to or less than 2.5 micrometres (μm)
    - PM_{10}, or particles with an aerodynamic diameter equal to or less than 10 μm
- Cadmium (Cd) and its compounds;
- Lead (Pb) and its compounds;
- Mercury (Hg) and its compounds;
- Polycyclic aromatic hydrocarbons (PAHs). For the purposes of emission inventories, the following four indicator compounds shall be used: benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene;
- Dioxins and furans (PCDD/F), which are polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), tricyclic, aromatic compounds formed by two benzene rings, connected by two oxygen atoms in PCDD and by one oxygen atom in PCDF, and the hydrogen atoms of which may be replaced by up to eight chlorine atoms;
- Polychlorinated biphenyls (PCBs), which means aromatic compounds formed in such a manner that the hydrogen atoms on the biphenyl molecule (two benzene rings bonded together by a single carbon-carbon bond) may be replaced by up to 10 chlorine atoms;
- Hexachlorobenzene (HCB), Chemical Abstracts Service (CAS) Registry Number 118-74-1.

Substances for which emission reporting is encouraged include:

- Black carbon (BC), which means carbonaceous particulate matter that absorbs light;
- Total suspended particulate matter (TSP);
- Arsenic (As), Chromium (Cr), Copper (Cu), Nickel (Ni), Selenium (Se) and Zinc (Zn) and their compounds.

The annual emission inventory for Slovenia is reported in the new Nomenclature for Reporting (NFR) format as requested in the 2023 Guidelines for reporting emissions and projections data under the Convention. The document is a revised version of the 2014 Guidelines for reporting emission data under the Convention (ECE/EB.AIR/125), which itself is a revised version of the 2009 Guidelines for Reporting Emission data under the Convention (ECE/EB.AIR/97), which were approved by the Executive Body in 2008 (ECE/EB.AIR/96, para. 83 (b)). The 2023 Reporting Guidelines were adopted for application in 2024 and subsequent years. However, Parties are encouraged to provisionally apply the Guidelines in 2023. The guidelines for the implementation of the inventory of air pollutants contain prescribed methods for the calculation of emissions, providing a unified framework for reporting and documenting sources for all inventories. One of the main aims of this method is to ensure comparability of data gathered in individual states and that calls for a definition of at least a minimum scope of equal methods, criteria, and estimating procedures.

This report and NFR tables are available to the public on the EIONET central data repository:
http://cdr.eionet.europa.eu/si/un/clrtap/
http://cdr.eionet.europa.eu/si/eu/nec_revised/

1.2 National obligations

Slovenia's annual obligations under the UNECE Convention on Long-range Transboudary Air Pollution (CLRTAP) and its Protocols comprising the annual reporting of national emission data on SO_x (as SO_2), NO_x (as NO_2), NMVOC, NH_3, CO, TSP, PM_{10}, $PM_{2.5}$, BC as well as on the heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) and persistent organic pollutants (PAHs, PCB, Dioxins/Furans and HCB).

Slovenia had succeeded the LRTAP Convention from Yugoslavia in 1992 with the Act on succession notification (OJ of RS - International Contracts No 35/92, 17 July 1992).
Protocols that Slovenia ratified under LRTAP Convention are listed below:

- The 1984 Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP); Entered into force 28 January 1988 (Slovenia ratified the protocol in 6.7.1992).
- The 1985 Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent; Entered into force 2 September 1987.
- The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes; Entered into force 14 February 1991 (Slovenia ratified the protocol in 5.1.2006).
- The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes; Entered into force 29 September 1997.
- The 1994 Protocol on Further Reduction of Sulphur Emissions; Entered into force 5 August 1998 (Slovenia ratified the protocol in 7.5.1998).
- The 1998 Protocol on Heavy Metals; Entered into force on 29 December 2003 (Slovenia ratified the protocol in 9.2.2004).
- The 1998 Protocol on Persistent Organic Pollutants (POPs); Entered into force on 23 October 2003 (Slovenia ratified the protocol in 15.11.2005).
- The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; Entered into force on 17 May 2005 - Gothenburg Protocol. Guidance documents to Protocol adopted by decision 1999/1 (Slovenia ratified the protocol in 4.5.2004).

Slovenia has also obligations under European legislation, under the DIRECTIVE (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC.

The new Directive repeals and replaces Directive 2001/81/EC, the National Emission Ceilings Directive (NEC Directive) from the date of its transposition (30 June 2018) ensuring that the emission ceilings for 2010 set in that Directive shall apply until 2020. Directive 2016/2284 also transposes the reduction commitments for 2020 taken by the EU and its Member States under the revised Gothenburg Protocol and sets more ambitious reduction commitments for 2030 so as to cut the health impacts of air pollution by half compared with 2005.

Slovenia has obligations under the Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants and the Stockholm Convention on Persistent Organic Pollutants.

1.3 Responsible organization

Slovenian Environment Agency (SEA) is responsible for the annual preparation and submission to the UNECE-LRTAP Convention and European Commission of the annual Slovenian emissions report and the inventories in the NFR format in accordance with the guidelines. Slovenian Environment Agency is an independent part of the Ministry of the Environment, Climate and Energy, formerly the Ministry of Environment and Spatial Planning. There was a reorganization of the ministries in 2023, but the tasks and responsibilities of SEA stayed unchanged.

Slovenian Environment Agency participates in meetings under the UNECE Task Force on Emission Inventories and Projections and the related expert panels, where parties to the convention prepare the guidelines and methodologies on inventories.

1.4 Emission trends

1.4.1 Emission trends for main pollutants

The main part of the SO_x emission originates from combustion of fossil fuels, mainly coal and oil in public power plants and district heating plants. From 1980 to 2021, the total emission decreased by 98 %. The large reduction is largely due to installation of desulphurisation plant, use of fuels with lower content of sulphur in public power and district heating plants, introduction of liquid fuels with lower content of sulphur and substitution of high-sulphur solid and liquid fuels to low-sulphur fuels such as natural gas. Despite the large reduction of the SO_x emissions, these plants make up to 40 % of the total emission. Also emissions from industrial plants, combustion and process emissions are important source of national SO_x.

The largest sources of emissions of NO_x are transport followed by combustion in energy industries. The road transport sector is the sector contributing the most to the emission of NO_x in 2021, 40 % of the Slovenian emissions of NO_x. The total emissions have decreased by 66 % from 1987 to 2021. The largest reduction of emissions has occurred in power plants and district heating plants due to the installation of low-NO_x burners and denitrifying units. The reductions in a road transport sector have been achieved as a result of fitting three-way catalysts to petrol fuelled vehicles.

Almost all atmospheric emissions of NH_3 result from agricultural activities (93 % in the year

2021). Only a minor part originates from small combustion and transport sector. Road transport sector has been increasing due to increasing use of catalyst cars. The total ammonia emission decreased by 26 % from 1986 to 2021. This is due to decreasing livestock population.

The emissions of NMVOC can be divided into two main groups: incomplete combustion and evaporation. They originate from many different sources. The main contributor of NMVOC in the year 2021 is industrial processes and product use, followed by small combustion and agriculture. Emissions of NMVOC have decreased from 1990 to 2021 by 54 %. The decline in emissions since 1990 has primarily been due to reductions achieved in the road transport sector due to the introduction of vehicle catalytic converters and carbon canisters on gasoline cars for evaporative emission control, driven by tighter vehicle emission standards, combined with limits on the maximum volatility of petrol as specified in fuel quality directives. The reductions in NMVOC emissions have been enhanced by the switching from petrol to diesel cars and changes in the solvents and product use sector as a result of the introduction of legislative measures limiting the use and emissions of solvents.

CO emissions have decreased between 1980 and 2021 by 71 %. CO is mainly emitted from incomplete combustion. Small combustion is responsible for the dominant share of the total CO emissions. Also transport contributes significantly to the total emission of this pollutant. Emission reduction of CO is mainly a result of introduction of vehicle meeting higher emission standards.

1.4.2 Emission trends for persistent organic pollutants (POPs), heavy metals (HM) and particulate matter (PM)

The persistent organic pollutants and heavy metals emission inventory has been reported for the years 1990-2021.

Persistent Organic Pollutants comprise:

- Polycyclic aromatic hydrocarbons (PAHs):
  - benzo(a)pyrene,
  - benzo(b)fluoranthene,
  - benzo(k)fluoranthene,
  - indeno(1,2,3-cd)pyrene
- Dioxins and furans (PCDD/PCDF or indicated as DF)
- Hexachlorobenzene (HCB)
- Polychlorinated Biphenyls (PCB)

The present emission inventory for PAH (polycyclic aromatic hydrocarbons) includes the four PAHs: benzo(a)pyrene, benzo(b)-fluoranthene, benzo(k)fluoranthene and indeno-(1,2,3-cd) pyrene. The most important source of the PAH emissions is combustion of wood in the residential sector. Small combustion sector contributed 80 % of the total emission in 2021. The PAH emission has decreased by 48 % from 1990 to 2021.

The major part of the dioxins and furans emissions owe to wood combustion in the residential sector, mainly in wood stoves and ovens without flue gas cleaning. Wood and other fuel combustion in small combustion sector accounts for 59 % of the national dioxin emission in 2021. Emissions of dioxins and furans have decreased between 1990 and 2021 by 33 %.

The most important source of HCB emissions is electricity and heat production. Among 1990 to 2021 the emission of HCB were decreased by 98 %. The reason for decrease of HCB emissions is termination of HCE use in aluminium production.

Far the most important sources of PCB in Slovenia in 2021 are industrial processes and product use with more than 99 % of the total national emissions. Emissions of PCB were reduced by 91 % in the period 1990-2021.

In general, the most important sources of heavy metal emissions are production processes, combustion of fossil fuels and non-industrial combustion and road transport. The heavy metal emissions have decreased substantially in recent years. The reductions span from 87 %, 6 % and 48 % for Pb, Cd and Hg, respectively from the year 1990 to 2021. The reason for the reduced emissions is mainly increased use of gas cleaning devices at power and district heating plants. The large reduction in the Pb emission is due to a gradual shift towards unleaded gasoline, the latter being essential for catalyst cars. Emissions of As, Cr, Cu, Ni, Se, Zn have been estimated for the first time in 2019 submission. Emissions of As, Ni, Se have decreased by 33, 52, 42 % respectively, from the year 1990 to 2021. Emissions of Cu, Cr and Zn have increased by 66, 3 and 6 % between 1990 and 2021.

The particulate matter emission inventory has been reported for the years 2000-2021. The inventory includes the total emission of particles TSP (Total Suspended Particles), emission of particles smaller than 10 µm (PM_{10}), emission of particles smaller than 2.5 µm ($PM_{2.5}$) and emissions of black carbon (BC). PM emissions from transport comprise exhaust emissions and non-exhaust emissions from brake and tyre wear and road abrasion. The largest particulate emission source is small combustion sector. Consumption of fuel, mostly wood in residential plants, contributes 73 % of $PM_{2.5}$ emissions, 53 % of PM_{10} emissions, 39 % of TSP emissions and 65 % of BC emissions to total PM emissions. $PM_{2.5}$ emissions decreased by 29 %, PM_{10} by 21 %, TSP by 20 % and BC by 35 % from 2000 to 2021.

1.5 General Assessment of Completeness

Pollutants

SO_x, NO_x, NMVOC, CO, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins/furans, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, HCB and PCB are covered by the Slovenian inventory.

Emissions of SO_x, NO_x, CO have been calculated for the period 1980-2021.

Emissions of NH_3 have been calculated for the period 1986-2021.

Emissions of NMVOC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins/furans, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, HCB and PCB have been calculated for the period 1990-2021.

Emissions of TSP, PM_{10}, $PM_{2.5}$, BC have been calculated for the period 2000-2021.

Geographic coverage

The geographic coverage is complete. No territory in Slovenia has been left uncovered by the inventory.

Notation keys

IE (included elsewhere):

There are a few categories marked with IE in 2021 because relevant data are not available on the reporting level but are included in other category. These sources are:

-1A4aii	Commercial/institutional: Mobile – emissions included into 1A3b Road transport
-1A4ci	Agriculture/Forestry/Fishing: Stationary - emissions included into 1A4bi Residential: Stationary
-1A5a	Other stationary (including military) - emissions included into 1A4ai Commercial/institutional: Stationary
-2A5c	Storage, handling and transport of mineral products - emissions included into 2A1 Cement production, 2A2 Lime production, 2A3 Glass production
-2C7d	Storage, handling and transport of metal products - emissions included into 2C1 Iron and steel production, 2C2 Ferroalloys production, 2C3 Aluminium production, 2C5 Lead production, 2C6 Zinc production, 2C7a Copper production

NE (not estimated):
Notation key NE was applied according to the tables with emission factors in EMEP/EEA Emission Inventory Guidebook, 2019. If in the tables is stated that emission factors for certain pollutants are not estimated, NE was used for particular pollutant and NFR sector.

NA (not applicable):
The activity or category exists but relevant emissions and removals are considered never to occur. Application of this notation key is dependent on availability of emission factors in EMEP/EEA Emission Inventory Guidebook, 2019.

NO (not occurring)
There are list of sectors marked with NO for the year 2021. NO is used when an activity or process does not exist within a country. No emissions originate from these sectors, since they did not exist in Slovenia in 2021. The highest number of source categories marked with NO is found in agriculture and industrial processes and product use sector, but there are some in waste and energy industries as well.

1A1b	Petroleum refining
1A3di(ii)	International inland waterways
1A3eii	Other
1B1b	Fugitive emission from solid fuels: Solid fuel transformation
1B1c	Other fugitive emissions from solid fuels
1B2ai	Fugitive emissions oil: Exploration, production, transport
1B2aiv	Fugitive emissions oil: Refining / storage
1B2d	Other fugitive emissions from energy production
2A6	Other mineral products (please specify in the IIR)
2B1	Ammonia production
2B2	Nitric acid production
2B3	Adipic acid production
2B5	Carbide production
2B7	Soda ash production

2B10b	Storage, handling and transport of chemical products
2C2	Ferroalloys production
2C4	Magnesium production
2C7b	Nickel production
2C7c	Other metal production (please specify in the IIR)
2H3	Other industrial processes
2J	Production of POPs
2L	Other production, consumption, storage, transportation or handling of bulk products
3B4a	Manure management – Buffalo
3B4f	Manure management - Mules and asses
3Da2b	Sewage sludge applied to soils
3F	Field burning of agricultural residues
3I	Agriculture other
5C1bi	Industrial waste incineration
5C1biv	Sewage sludge incineration
5C1bvi	Other waste incineration (please specify in the IIR)
5C2	Open burning of waste
5D3	Other wastewater handling
6A	Other (included in national total for entire territory)
6B	Other not included in national total of the entire territory (specify in the IIR)
11A	Volcanoes
11C	Other natural emissions (please specify in the IIR)

NR (not relevant)

NR is introduced where reporting of emissions is not strictly required by the different protocols. Emission inventory reporting for the main pollutants should cover all years from 1990 onwards if data are available. NR was used for particulate matter before the year 2000.

C (confidential)

Statistical low considering confidentiality is very strict in Slovenia. All data gathered by three or less reporting units is confidential. It is a good practise in national statistic that this boundary is even higher (five units). As Slovenia is a small country, almost all relevant categories from industrial processes sector and, to a lesser extent, from energy sector are also confidential. Nevertheless, no data in our report is marked with C. The confidentiality problem in activity data has been solved on individual level with each relevant plant. After 2005, verified reports from installations included in Emission Trading Scheme (ETS) have resolved this problem generally for most cases.

1.6 General uncertainty evaluation

The uncertainty assessment of national air emissions was performed in accordance with the methodology described in the EMEP/EEA air pollutant emission inventory guidebook 2019, Chapter 5 Uncertainties 2019.

The combined uncertainty was derived using the Tier 1 method. The uncertainty estimates are based on emission data for the base years and the last reporting year (2021), uncertainties of activity data and emission factors. Approach 1 uncertainty aggregation scheme was applied for

uncertainty estimation.
According to the 2022 in-depth EU NECD review recommendation uncertainty estimation for NO_x, SO_x, NMVOC, NH_3 and $PM_{2.5}$ have been performed.

The uncertainty estimates for activity data have been adopted from Slovenia's National Inventory Report 2022 (GHG emission inventory), expert judgment and information from EMEP/EEA air pollutant emission inventory guidebook 2019.

The uncertainty estimates for emission factors have been derived from EMEP/EEA air pollutant emission inventory guidebook 2019. The lower value of the default uncertainty range of 95 % confidence intervals for emission factors was used for all sources and pollutants where available. For some pollutants and source categories where no information on default uncertainty ranges is available expert judgments and data from other countries were applied. Information from Croatian and German IIR 2022 was used for the estimation of emission factors uncertainty.

Table 1.6.1 shows a summary of the uncertainty evaluation of total emissions in the year 2021 and the trend uncertainties by pollutant (NO_x and SO_x for 1980-2021, NH_3 for 1986-2021, NMVOC for 1990-2021, $PM_{2.5}$ for 2000-2021). Detailed calculation sheets and results of Slovenian uncertainty analyses are provided in Annex 3.

Table 1.6.1 The summary of the uncertainty evaluation and total emissions by pollutant in 2021

Pollutant	Total emissions in 2021	Combined uncertainty as % of total national emissions in 2021	Uncertainty introduced into the trend in total national emissions
	kt	%	%
SO_x	4,1	7,1	0,1
NO_x	25,8	9,6	2,2
NMVOC	30,1	13,8	4,4
NH_3	18,5	48,0	16,1
$PM_{2.5}$	10,1	37,6	8,4

2 INTRODUCTION

2.1 Institutional arrangements

In Slovenia, the institution responsible for emission inventories is the Slovenian Environment Agency. In accordance with its tasks and obligations to international institutions, the Slovenian Environment Agency is obligated to perform inventories of greenhouse gases (GHG) and air pollutants emissions within the specified time limit. Slovenian Environment Agency cooperates with numerous other institutions and administrative bodies that relay the necessary activity data and other necessary data for performing inventory each year.

The main source of data is the Statistical Office of the Republic of Slovenia (SORS). Slovenian Environment Agency obtains much of its data through other activities which it performs under the Environmental Protection Act. Emissions from Agriculture are calculated in cooperation with the Slovenian Agriculture Institute. Many data are obtained directly from factories. Inventory institutional arrangements and data sources are presented in Table 2.1.1.

Table 2.1.1 Inventory Institutional Arrangements and Data Sources

NFR category	NFR sub-category	Sources of data
NFR 1 A – Energy: Fuel Combustion	NFR 1A1 - Energy Industry	• Statistical Office of the Republic of Slovenia: Joint Questionnaires, Energy Balances, annual energy statistics • Slovenian Environment Agency: ETS data
	NFR 1A2 - Manufacturing Industries and Construction	• Statistical Office of the Republic of Slovenia: Joint Questionnaires, Energy Balances, annual energy statistics • Slovenian Environment Agency: ETS data
	NFR 1A3 – Transport	• Statistical Office of the Republic of Slovenia • Ministry of Infrastructure • Slovenian Infrastructure Agency • Slovenian Environment Agency • Slovenian Maritime Administration
	NFR 1A4 – Other Sectors	• Statistical Office of the Republic of Slovenia • Ministry of the Interior, Police • Ministry of Defence, Slovenian Armed Forces • The Fisheries Research Institute of Slovenia
NFR 1 B – Energy: Fugitive Emissions from Fuels		• Statistical Office of the Republic of Slovenia • Slovenian Environment Agency: ETS data
NFR 2 – Industrial Processes and Product use	NFR 2A – Mineral Products	• Slovenian Environment Agency: ETS data • Data obtained from factories • Slovenian Infrastructure Agency
	NFR 2B – Chemical Industry	• Statistical Office of the Republic of Slovenia • Slovenian Environment Agency: ETS data • Data obtained from factories
	NFR 2C – Metal Production	• Slovenian Environment Agency: ETS data • Data obtained from factories
	NFR 2D-2L Other Solvent and Product use	• Chemicals Office of the Republic of Slovenia • Statistical Office of the Republic of Slovenia • Slovenian Environment Agency
NFR 3 – Agriculture		• Agricultural Institute of Slovenia • Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection • Statistical Office of the Republic of Slovenia
NFR 5 – Waste		• Statistical Office of the Republic of Slovenia • Slovenian Environment Agency • Administration for Civil Protection and Disaster Relief of the Republic of Slovenia

2.2 Brief description of the process of inventory preparation, data collection, processing, data storage and archiving

Owing to the ever-increasing obligations of Slovenia with regard to reporting, the Slovenian Environment Agency has implemented a unified system of data collection for the purposes of GHG and air pollutants inventories, as well as secures reliable financing in accordance with the annual program of its work.

There was a reorganization of the ministries in 2023, but the tasks and responsibilities of Slovenian Environment Agency stayed unchanged. Slovenian Environment Agency is an independent part of the Ministry of the Environment, Climate and Energy, formerly the Ministry of Environment and Spatial Planning.

A Memorandum of Understanding has been concluded with the SORS to submit quality and verified data to the Slovenian Environment Agency in due time, because the time limits for GHG and air pollutants inventories and the national inventory report (NIR) and IIR have shortened with the entry of Slovenia into the EU. In view of this, an agreement has been reached with the participating institutions to shorten the time limits for submitting data. For reasons of complexity, attention was mostly focused on the Joint Questionnaires (JQ) of the SORS, on the basis of which the Statistical Office produces the Energy Balance of the Republic of Slovenia, where in the most important data on the energy sector are to be found. Data flow in the Slovenian Inventory System is presented in Figure 2.2.1.

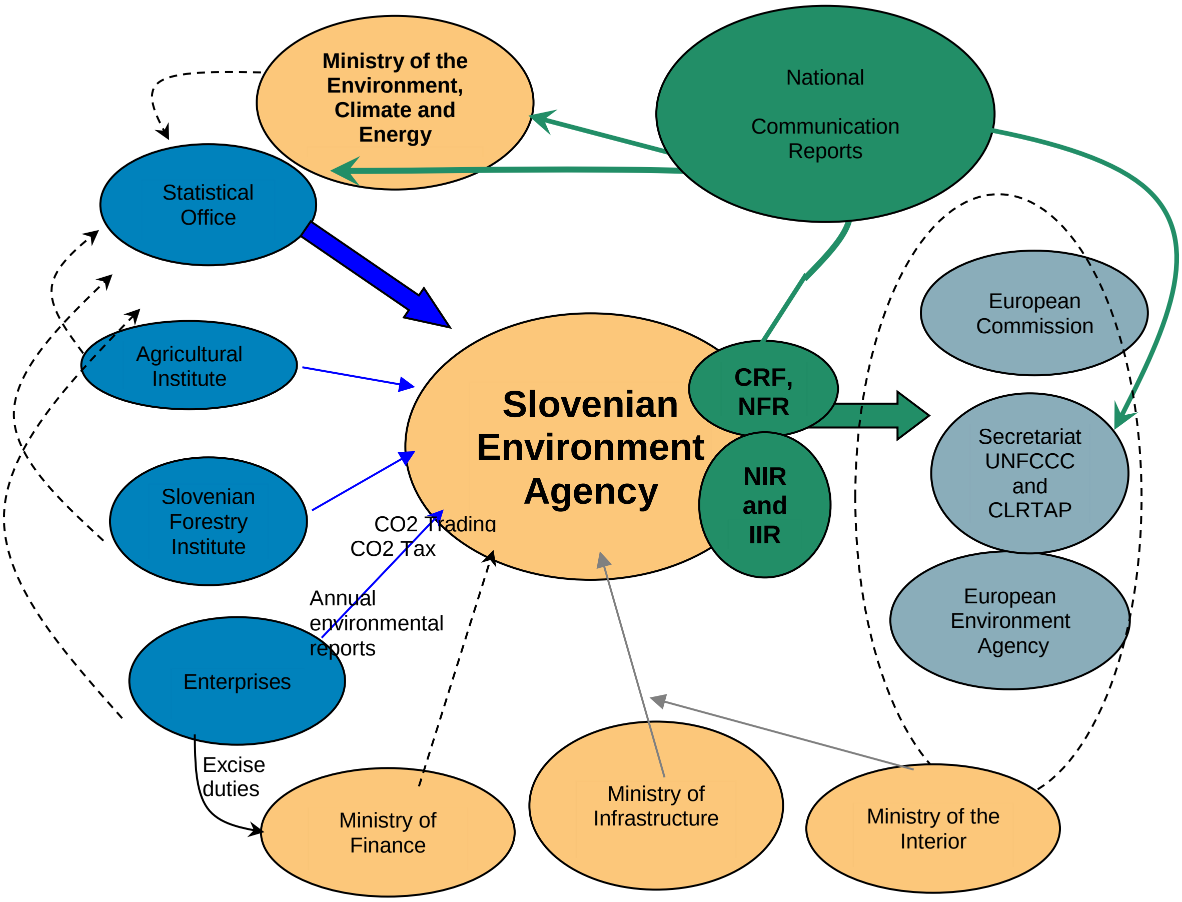

Figure 2.2.1 Data flow in the Slovenian Inventory System

The year 2003 presents the end of the process of harmonization of data collection among the Directorate of Energy, Ministry of Environment and Spatial Planning, and the SORS. An end was put to previous parallel double collecting of data. The competence of collecting data has, by law, passed to the SORS, which checks the data and eliminates potential reporting errors, and submits consolidated data to the Directorate of Energy, which has been publishing data until 2005 in its Energy Yearbook of the Republic of Slovenia. In terms of content, the data were identical to those submitted in the Joint Questionnaires to the International Energy Agency (IEA).

At the beginning of 2007, the agreement between SORS and the Slovenian Environment Agency came into force. Accordingly, all statistical data which are necessary for preparing emission inventories are available each year by October 30 at the latest. In exchange, European trading scheme (ETS) data and emission estimates are reported to the SORS within a defined time frame. In 2014 the new agreement has been signed which includes more data sets and updated time lines.

A process of inventory preparation is designed according to the PDCA-cycle (Plan – Do – Check – Act). This is a generally accepted model for pursuing a systematic quality work according to international standards, in order to ensure the maintenance and development of the quality system. This structure is in accordance with structures described in decision 19/CMP.1 and in the 2006 IPCC Guidelines. The system consists of inventory planning, inventory preparation, inventory quality checking and follow-up improvements which are integrated into the annual cycle and preparation.

Owing to the ever-increasing obligations of Slovenia with regard to reporting, the Slovenian Environment Agency has decided to implement a unified system of data collection for the purposes of making inventories, as well as secure reliable financing in accordance with the annual program of its work.

For submitting reports to different institutions, various report formats have been devised, since the same data are used to report to the United Nations Framework Convention on Climate Change (UNFCCC), European Environment Agency (EEA), European Commission (EC), and CLRTAP. All external reports of the Slovenian Environment Agency are prepared in accordance with ISO 9001 via the Agency's reporting service, which keeps inventories of reports. Parallel to this, emissions data are submitted to the SORS, which makes this data available in its publications and submits them to EUROSTAT and the IEA.

In 2006, we started to develop a joint database for air pollutants and GHGs. It already contains all activity data, emission factors and other parameters together with a description of sources from 1980 on for other pollutants, and from 1986 on for GHG emissions. At defined control points, QC procedures are included. New Nomenclature For Reporting (NFR) and Common Reporting Format (CRF) tables in 2015 required additional changes of the database. Constant improvement of the database is expected.

For each submission, databases and additional tools and submodels are frozen together with the resulting NFR reporting format. This material is placed on central agency's servers, which are subject to routine back-up services. Material which has been backed up is archived safely.

Figure 2.2.1 shows a schematic overview of the process of inventory preparation. The figure illustrates the process of inventory preparation from the first step of collecting external data to the last step, where the reporting schemes are generated for the UNFCCC and EU in the CRF format and to the United Nations Economic Commission for Europe/Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (CLRTAP - UNECE/EMEP) in the NFR format. For calculations and reporting the software tool is developed by Slovenian Environment Agency.

2.3 Brief description of methodologies and data sources used

Slovenia's air emission inventory is based on EMEP/EEA methodology. It has been developed under UNECE/EMEP Task Force on Emission Inventories and Projections (TFEIP) and the European Environment Agency. The basis of inventory is also 2006 IPCC Guidelines for National Greenhouse Gas Inventories. EMEP/EEA (formerly referred as CORINAIR - COoRdination of INformation on AIR emissions) is a European air emission inventory programme for national sector wise emission estimations, harmonized with the IPCC guidelines. To ensure estimates are as timely, consistent, transparent, accurate and comparable as possible, the inventory programme has developed calculation methodologies for most subsectors and software for storage and further data processing. The EMEP/EEA calculation principle is to calculate the emissions as activities multiplied by emission factors. Activities are numbers referring to a specific process generating emissions, while an emission factor is the mass of emissions per unit activity. Information on activities to carry out the EMEP/EEA inventory is largely based on official statistics. The most consistent emission factors have been used, either as national values or default factors proposed by international guidelines. The emission factors used for emission calculations were adopted from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019.

The activity data of consumed fuel energy were provided by SORS. Additional data on the energy use of some types of waste (waste tires, oils and solvents) were acquired from verified ETS reports. Data on fuel consumption in agriculture and forestry refer to mobile sources only, while the rest of the fuel consumption of these sub-sectors is included in the public and service sub-sector. Emissions in road transport were determined with the COPERT 5 model (version 5.6.1) using default EFs from the model.

Emissions from industrial processes and product use have been mostly determined on the basis of statistical data on production and consumption of raw materials and by applying country-specific emission factors. After 1997, the SORS partly changed the manner of collecting and presenting these data, and therefore most of the data were obtained directly from individual companies (plant communication data) and verified ETS reports.

Important source of data in Industrial processes and product use sector is REMIS database, established and handled by Slovenian Environmental Agency. These data represent plant specific values. REMIS database is obtained in compliance with Rules on initial measurements and operational monitoring of the emission of substances into the atmosphere from the stationary pollution sources and on the conditions for their implementation (OJ RS, No. 105/08 and 44/22 – ZVO-2). Each year all obligators must provide report on implementation of emission monitoring of substances into air. Annual emission report includes emissions of substances into air. These emissions data are direct measurements of emissions into air and reflect plant specific values.

Additional source of NMVOC data is HOS database. It is similar to REMIS database and it is established and handled by Slovenian Environmental Agency as well. Data in HOS database are obtained in compliance with Decree on limit values for atmospheric emissions of volatile organic compounds from installations using organic solvents (OJ RS, No. 35/15, 58/16, 54/21, 44/22 – ZVO-2 and 49/22) and Decree on the emission limit values of halogenated volatile organic compounds into the atmosphere from installations using organic solvents (OJ RS, No. 71/11, 44/22 – ZVO-2 and 49/22). Each year all VOC obligators must provide report about solvent management plan (mass balance) for previous year. Data on NMVOC from HOS database have been available since 2005.

Emissions from agriculture and waste sectors have been mostly determined on the basis of statistical data as well. Emission factors used have been mainly obtained from EMEP/EEA Emission Inventory Guidebook, 2019 and by applying country specific emission factors

Table 2.3.1 Summary report for methods and emission factors used

Categories	Method applied	Emission factors
1. Energy	M,T1,T2,T3	CS,D,M,PS
A. Fuel combustion	M,T1,T2,T3	CS,D,M,PS
1. Energy industries	T1,T2	CS,D,PS
2. Manufacturing industries and construction	T1,T2	D, PS
3. Transport	M,T1,T2,T3	M,CS,D
4. Small combustion and Non-road mobile sources and machinery	T1,T2	CS,D
B. Fugitive emissions from fuels	T1	D,CS
1. Solid fuels	T1	D,CS
2. Oil and natural gas	T1,T2	D
2. Industrial Processes	T1,T2	CS,D
A. Mineral industry	T1,T2	CS,D
B. Chemical industry	T1,T2	CS,D
C. Metal industry	T1,T2	CS,D
D.-L. Other solvent and product use	T1,T2	CS,D
3. Agriculture	T1,T2	CS,D
B. Manure management	T1,T2	CS,D
D. Crop production and agricultural soils	T1,T2	CS,D
5. Waste	T1,T2,D	CS,D
A. Solid waste Disposal on land	T2	D
B. Biological Treatment	T1	D
C. Incineration	T2	D
D. Waste water handling	T1	D
E. Other waste	T1	D

CS - Country Specific, T1 - Tier 1, T2 - Tier 2, T3 - Tier 3, M- Model, D – Default value, PS – plant specific

2.4 Key Categories

This chapter presents results of Slovenia's key source analysis. Key categories analysis is increasingly important in order to prioritize emission sources and identify where the implementation of improvements is most effective. We have assessed the most important sources (the sources making up 80% of the national total). The key sources for the 2021 and 2005 emissions and the corresponding percentages are listed in Table 2.4.1 and Table 2.4.2. The analysis of key source categories was performed on the basis of sectorial distribution and using the Tier 1 method and Approach 1. Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80 % of the total level.

Table 2.4.1 List of key sources (and their contribution to total amount) by pollutant for 2021

Component	Key categories (Sorted from high to low from left to right)											Total (%)
SOx	1A1a	1A2f	2B10a	1A4bi	2C3							83,1
	39,6%	15,9%	12,5%	9,3%	5,7%							
NOx	1A3bi	1A1a	1A3bii	1A4cii	1A3biii	1A4bi	1A2f	3Da1	1A2gvii			81,8
	24,4%	12,7%	8,5%	8,3%	7,2%	6,7%	5,7%	4,5%	3,8%			
NH3	3Da2a	3B1b	3B1a	3Da1	1A4bi							84,1
	39,4%	18,2%	12,8%	7,9%	5,7%							
NMVOC	1A4bi	2D3a	2D3g	2D3d	3B1b	3Da2a	1A3bi	3B1a	1A4cii	1A3bv	2H2	82,9

	19,3%	14,6%	8,5%	8,1%	7,3%	5,7%	4,7%	4,4%	4,3%	3,1%	2,9%	
CO	1A4bi	1A3bi	1A4cii									82,8
	66,1%	12,8%	3,9%									
TSP	1A4bi	2A5b	1A3bvi	2A5a								81,1
	38,6%	36,1%	3,3%	3,0%								
PM10	1A4bi	2A5b	1A3bvi	1A2gviii								80,9
	53,0%	21,8%	3,6%	2,5%								
PM2.5	1A4bi	1A2gviii	2A5b	1A3bvi								81,9
	72,7%	3,4%	3,1%	2,7%								
BC	1A4bi	1A4cii	1A3bi	1A2gviii								84,9
	64,1%	7,5%	7,4%	5,9%								
Pb	1A3bvi	2C1	1A1a	1A4bi								84,6
	33,4%	31,6%	10,5%	9,1%								
Hg	1A2f	2C1	1A1a	5C1bv	1A4bi							83,0
	26,5%	18,0%	16,4%	15,9%	6,1%							
Cd	1A4bi	2C1	1A1a	1A2gviii								83,6
	42,6%	23,6%	12,0%	5,3%								
As	1A1a											84,7
	84,7%											
Se	1A1a											92,2
	92,2%											
Cr	1A3bvi	1A4bi	1A1a									84,4
	39,9%	24,9%	19,6%									
Cu	1A3bvi											94,9
	94,9%											
Ni	2C1	1A1a	1A4ai	1A3bvi								86,6
	34,0%	27,0%	17,8%	7,7%								
Zn	1A4bi	1A3bvi	2C1									82,5
	45,7%	25,2%	11,6%									
Dioxins/Furans	1A4bi	5E	2C1									88,6
	59,1%	15,2%	14,4%									
PAH	1A4bi											80,3
	80,3%											
HCB	1A1a	1A4bi										81,3
	60,8%	20,5%										
PCB	2K											94,4
	94,4%											

Table 2.4.2 List of key sources (and their contribution to total amount) by pollutant for 2005

Component	**Key categories Sorted from high to low from left to right**												**Total**
SOx	1A1a												80,4%
	80,4%												
NOx	1A1a	1A3biii	1A3bi	1A4cii	1A4bi	1A4ai	1A2gviii						81,1%

	22,9%	21,3%	14,7%	8,4%	5,2%	5,1%	3,4%						
NH3	3Da2a	3B1b	3B1a	3B3	3Da1								81,0%
	36,4%	13,8%	11,5%	11,0%	8,4%								
NMVOC	1A4bi	2D3d	2D3g	1A3bi	2D3a	3B1b	3Da2a	1A4cii	3B1a	1B1a	1A3bv	1B2av	81,1%
	18,5%	12,1%	10,0%	9,7%	8,7%	4,0%	3,7%	3,6%	3,1%	3,0%	2,2%	2,2%	
CO	1A4bi	1A3bi	2C3										86,7%
	50,5%	27,6%	8,6%										
TSP	1A4bi	2A5b	2A2	1A1a	2A5a	1A2d							81,0%
	41,1%	27,8%	5,0%	2,9%	2,1%	2,1%							
PM10	1A4bi	2A5b	1A1a	1A2d	1A4cii	2A2							80,8%
	56,9%	12,0%	3,4%	2,8%	2,8%	2,8%							
PM2.5	1A4bi	1A4cii	1A2d	1A1a									80,8%
	70,6%	3,5%	3,5%	3,2%									
BC	1A4bi	1A4cii	1A3bi	1A3biii									80,0%
	56,0%	10,3%	7,6%	6,1%									
Pb	1A3bvi	2C1	1A1a	2G	1A4bi	1A2d							82,8%
	23,7%	22,8%	12,0%	10,5%	9,3%	4,5%							
Hg	1A1a	1A2f	2C1	5C1bv	1A2d								81,1%
	28,1%	23,2%	13,3%	8,3%	8,1%								
Cd	1A4bi	2C1	1A1a	1A2d									80,9%
	43,8%	17,5%	14,4%	5,2%									
As	1A1a												86,8%
	86,8%												
Se	1A1a												95,1%
	95,1%												
Cr	1A3bvi	1A4bi	1A1a										80,3%
	29,7%	26,3%	24,3%										
Cu	1A3bvi												90,0%
	90,0%												
Ni	1A4ai	1A1a	2C1										86,4%
	45,6%	23,3%	17,5%										
Zn	1A4bi	1A3bvi	2C1	1A2d									84,7%
	50,1%	18,4%	9,1%	7,0%									
Dioksin/ Furans	1A4bi	5E	2C1										84,5%
	64,8%	10,9%	8,8%										
PAH	1A4bi												82,3%
	82,3%												
HCB	1A1a	3Df											81,6%
	43,0%	38,6%											
PCB	2K												98,4%
	98,4%												

2.5 Quality assurance, quality control and verification plan

In 2014, Slovenia developed and implemented a Quality Assurance and Quality Control plan. At the end of 2013, a QA/QC manager at the inventory agency was designated. It has been commonly used in preparation of GHG and air pollutant inventories.

Quality Control (QC) is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. The QC system is designed to:
- provide routine and consistent checks to ensure data integrity, correctness and completeness;
- identify and address errors and omissions;
- document and archive inventory material and record all QC activities.

The final part of this system is incorporated in an Oracle database (ISEE – "Emission inventory" information system). ISEE enables and ensures that all necessary built-in QA/QC checks have been performed before data and emission estimates are entered in the reporting format tables. It also keeps a record of all changes made to data in the database.

As all calculations are performed in the database with software generated for this purpose, no human errors are expected. But for QA/QC purpose all emissions are also calculated in the old way in Excel spreadsheets. Both estimates were then compared and all differences were carefully investigated and corrected.

The main purpose of ISEE is:
- to enable collection and archiving of activity data, emission factors and other parameters including descriptions of sources from 1980 on for air pollutants, and from 1986 on for GHG emissions,
- to calculate GHG and air pollutants emissions,
- to automatically fill in reporting tables.

During development of the database, the following QC was performed:

<u>Check of methodological and data changes resulting in recalculations</u>
- check for temporal consistency in time series input data for each source category
- check for consistency in the algorithm/method used for calculations throughout the time series.

<u>Completeness checks</u>
- confirm that estimates are reported for all source categories and for all years from the appropriate base year to the period of the current inventory
- check that known data gaps that result in incomplete source category emissions estimates are documented
- compare estimates to previous estimates: for each source category, current inventory estimates should be compared to previous estimates. If there are significant changes or departures from expected trends, recheck estimates and explain any differences.

<u>Check of activity data, emission factors and other parameters</u>
- cross-check all input data from each source category for transcription errors
- check that units are properly labelled in calculation sheets
- check that units are correctly carried through from beginning to end in calculations
- check that conversion factors are correct
- check that temporal and spatial adjustment factors are used correctly.

Check of emissions estimates

For the entire period 1980–2016, emissions are also calculated in the old way using Excel spreadsheets and in the database using built-in formulas. Both estimates were compared and all differences carefully investigated.

The reasons for differences were the following:

- formulas for calculation of emissions were not correct
- data field was not properly labelled
- data relationship was not correct
- emissions data were not correctly aggregated from lower reporting levels to higher reporting levels.

All errors were corrected and the accuracy of emissions calculations on all levels is now assured.

QA/QC checks not performed in the database:

Preparation of IIR

- check that all chapters from annotated IIR are included in the IIR
- check that AD, EF and other numerical information mentioned in the text is correct
- check all AD data is presented in the tables in the IIR
- check all EF and other parameters used in the tables in the IIR
- check all graphs for accuracy and presence in the whole period
- check all titles for tables and pictures
- check that all Annexes to the IIR are included and updated

Documentation and archiving

All inventory data are now stored in a joint database. Supporting data and references are stored in electronic form and/or hard copy form. Inventory submissions are stored mostly in electronic form at various locations and on various media (network server, random-access memory, computer hard disk). Access to files is limited in accordance with the security policy. Backup copies on the server are made at regular intervals in accordance with the requirements of the information system. All relevant data from external institutions are also stored at the SEA.

QA/QC checks of documentation and archiving procedures:

- check that inventory data, supporting data and inventory records are archived and stored to facilitate detailed review
- check that all supporting documentation on QA/QC procedures is archived
- check that results of QC analysis and uncertainty estimates are archived
- check that there is detailed internal documentation to support the estimates and enable duplication of emissions estimates.
- check that documentation of the database is adequate and archived.
- check that bibliographical data references are properly cited in the internal documentation and archived.
- check that inventory improvements plan is updated ad archived.

In 2006, an additional quality control check point was introduced by forwarding the assessment of verified emission reports from installations included in the National Allocation Plan to the SORS. The role of SORS is to compare data from installations included in the EU-ETS with data from their reporting system and to propose corrective measures, if necessary. The outcome of data consistency checks is used as preliminary information for the Ministry of the Environment and Spatial Planning to perform on-site inspections. The use of (EU) ETS data is described in more detail in the relevant chapter on Energy and Industrial Processes sectors.

Quality assurance (QA)
Quality assurance generally consists of independent third-party review activities to ensure that the inventory represents the best possible estimates of emissions and removals, and to support the effectiveness of the QC program. In the past we have performed only one peer review. In 2006, we received many useful comments from the team preparing our fourth National Communication Report. Although the comments were not presented as an official report, we accepted many of the suggestions and corrected a number of errors. We are planning a sectorial review of our inventory on a yearly basis – one sector per year. In May 2009, a peer review of the Slovenian inventory was performed for the energy sector.

SORS is our main data provider. In 2005, the European Statistics Code of Practice was adopted, bringing considerable changes to the SORS QA/QC system. The main pillars (factors) of quality are defined and thoroughly described in the Medium-term Programme of Statistical Surveys 2008–2012 (http://www.stat.si/doc/drzstat/SPSR-ang.pdf). The strategic directions from the Medium-term Programme of Statistical Surveys are presented in detail at http://www.stat.si/doc/drzstat/kakovost/TQMStrategy_2006_eng.doc in the Total Quality Management Strategy 2006–2008.

Official consideration and approval of the inventory

Before the inventory is reported to the EU, EEA, CLRTAP or UNFCCC Secretariat, it goes through an approval process. The institution designated for approval is the Ministry of the Environment, Climate and Energy.

Public Availability of the Inventory

The inventories are publically available on the web. Every submission is accompanied with a short description in Slovenian language. The estimates are presented in a more simple way suitable for general public. Air pollutant emissions are also presented as indicators.

Web page address:
http://okolje.arso.gov.si/onesnazevanje_zraka/vsebine/onesnazevala-zraka
https://www.gov.si/teme/zmanjsevanje-onesnazevanja-zraka/

2.6 Description and interpretation of emission trends by gas

2.6.1 Emission Trends for Main Pollutants

Emission trends for main pollutants (SO_x, NO_x, NH_3, NMVOC and CO) from years 1980 for SO_x, NO_x, CO, 1986 for NH_3 and 1990 for NMVOC to 2021 are represented in Table 2.6.1.1. Emissions decreases are: SO_x (98 %), NO_x (64 %), NH_3 (26 %), NMVOC (54 %) and CO (71 %).

Table 2.6.1.1 National total emissions and emission trends

Year	Emissions (kt)				
	SO_x	NO_x	NH_3	NMVOC	CO
1980	242,5	72,3			303,7
1981	262,9	72,2			291,9
1982	263,0	69,8			276,6
1983	278,7	69,0			266,2
1984	255,3	68,1			278,1
1985	248,3	69,2			297,1
1986	254,1	75,0	24,9		316,7
1987	231,8	76,6	24,9		333,5
1988	218,3	75,2	24,5		296,1
1989	219,0	75,0	24,0		289,8
1990	202,9	75,2	23,8	65,1	290,1
1991	187,7	69,5	22,4	62,6	276,0
1992	193,6	68,5	23,3	61,4	272,2
1993	191,3	73,3	21,8	61,9	287,3
1994	185,0	76,0	21,8	62,7	279,9
1995	124,7	75,2	21,9	62,7	280,2
1996	116,0	77,2	21,2	66,0	289,3
1997	120,1	77,7	21,1	62,6	264,9
1998	110,2	68,4	21,4	58,4	232,7
1999	96,3	60,9	21,4	55,6	215,3
2000	93,1	58,6	22,2	54,8	203,3
2001	63,3	59,3	22,2	55,3	214,6
2002	62,8	58,5	22,8	51,4	182,1
2003	59,8	55,3	21,5	50,9	183,8
2004	50,5	53,9	20,1	48,8	171,7
2005	39,7	55,1	20,7	48,1	181,8
2006	16,6	55,2	20,6	46,0	160,6
2007	14,1	53,9	21,3	46,0	166,3
2008	11,7	58,2	20,1	43,9	158,2
2009	9,9	48,5	20,5	40,4	142,0
2010	10,3	47,7	19,8	39,6	142,5
2011	11,3	47,0	19,1	37,1	139,4
2012	10,5	45,5	18,9	35,6	133,3
2013	9,7	42,8	18,7	34,8	132,8
2014	7,8	38,8	18,6	32,2	113,7
2015	5,6	35,1	19,1	32,6	121,3
2016	4,8	34,6	19,3	32,9	120,6
2017	5,1	34,1	18,9	32,5	115,5
2018	5,0	32,7	18,8	32,2	105,1
2019	4,5	29,6	18,6	31,4	97,5

2020	4,0	25,5	18,5	30,8	87,5
2021	4,1	25,8	18,5	30,1	87,2
Reduction trend (%)	***-98 %***	***-64 %***	***-26 %***	***-54 %***	***-71 %***

SO_x Emissions

National SO_x emissions steadily decreased from the year 1980, when total amount was 242,5 kt to 4,1 kt in 2021. Emissions have decreased by 98 % between 1980 and 2021. The reduction in emissions since 1980 has been achieved as a result of a combination of measures, including fuel-switching in energy-related sectors away from high-sulphur solid and liquid fuels to low-sulphur fuels such as natural gas, the fitting of flue gas desulphurisation abatement technology in thermal power plants and industrial facilities and the impact of European Union directives relating to the sulphur content of certain liquid fuels.

The highest drop of emission was occurred in electricity and heat production. Important factor of lower emissions from thermal power plants was introduction of flue gas desulphurization device and gas turbines in power cogeneration plants. In 1995, SO_2 emissions fell considerably, mostly due to the operation of the device for the desulphurization of flue gases in unit 4 of the Šoštanj Thermal Power Plant. In the 2001 and 2005, SO_2 emissions again fell considerably, due to the operation of the device for the desulphurization of flue gases (FGD) in unit 5 of the Šoštanj Thermal Power Plant (2001) and Thermal Power Plant Trbovlje (2005).

The 2010 national emission ceiling for SO_x in Slovenia is 27 kt regarding Gothenburg Protocol and DIRECTIVE 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants. Slovenia has reduced national SO_x emissions below the level of the 2010. Total emissions of SO_x were in the year 2021, 85 % below the national emission ceiling.

The 2012 revision of the Gothenburg Protocol to the UNECE LRTAP Convention and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants set emission reduction targets for SO_x based on 2005 emission totals, to be met by countries in or before 2020. Reduction of emissions has to be 63 % compared to 2005 emissions. Emissions for Slovenia in 2021 were below a linear target path to its 2020 target by 90 % of its 2005 emission totals.

Slovenia in 2021 fulfilled all requirements under 2nd Sulphur Protocol.

Sulphur dioxide is emitted when fuels containing sulphur are combusted. It is a pollutant which contributes to acid deposition which in turn can lead to changes occurring in soil and water quality. The subsequent impacts of acid deposition can be significant, including adverse effects on aquatic ecosystems in rivers and lakes and damage to forests, crops and other vegetation. SO_x emissions also aggravate asthma conditions and can reduce lung function and inflame the respiratory tract, and contribute as a secondary particulate pollutant to formation of particulate matter in the atmosphere, an important air pollutant in terms of its adverse impact on human health. Further, the formation of sulphate particles in the atmosphere after their release results in reflection of solar radiation, which leads to net cooling of the atmosphere.

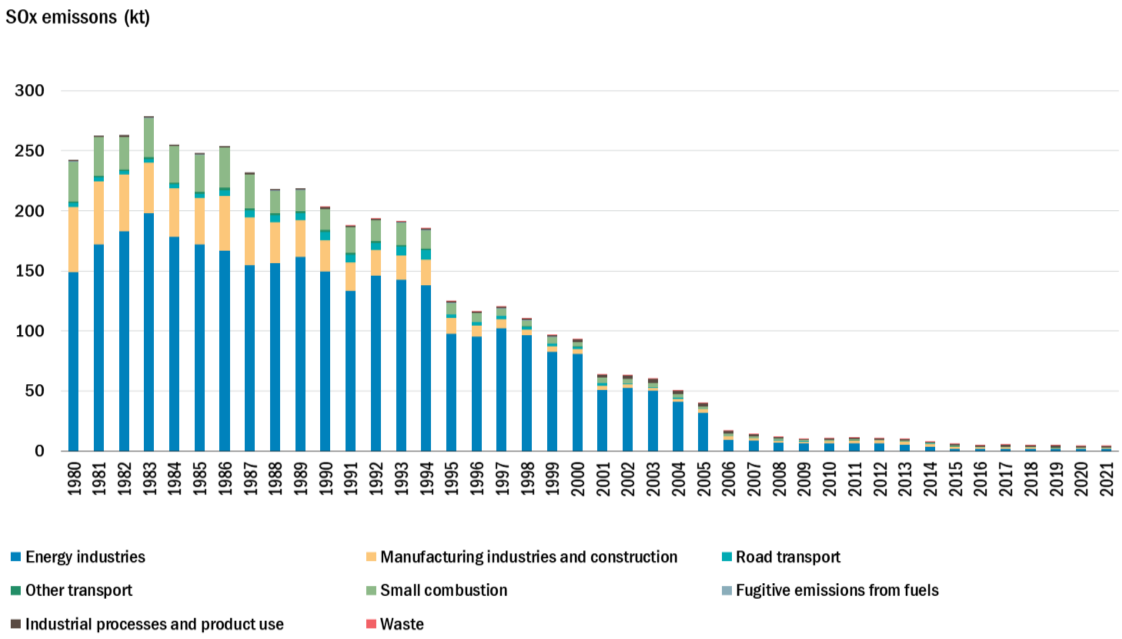

Figure 2.6.1.1 SO_x emissions in Slovenia for the period 1980 – 2021

In 2021, the most significant sector source of SO_x emissions was energy industries (40 % of total emissions), followed by emissions occurring in the industrial processes and product use (25 %) and from manufacturing industries and construction (22 %).

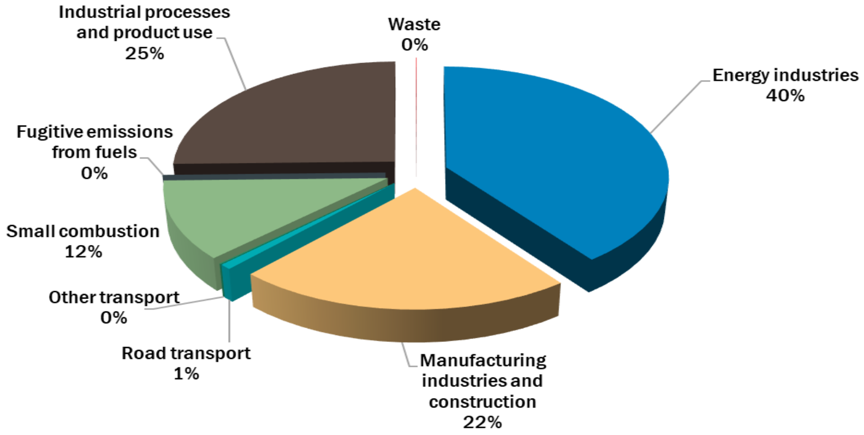

Figure 2.6.1.2 Individual sectors contribution of SO_x emissions for 2021

NO_X Emissions

Total national NO_x emissions in Slovenia decreased from 76,6 kt in 1987 to 25,8 kt in the year 2021. Emissions were reduced by 66 %. Despite the base year for NO_x is 1987 emissions have been calculated from 1980 onwards due to availability of activity data for the whole period. Emissions were reduced by 64 % in the period 1980-2021. The largest reduction of emissions since 1980 has occurred in the electricity/energy production sector as a result of measures such as the introduction of combustion modification technologies (such as use of low NO_X burners), implementation of flue-gas abatement techniques (NO_x scrubbers and selective catalytic and non-catalytic reduction techniques) and fuel-switching from coal to gas. These reductions have been achieved also in the road transport sector despite the general increase in activity within this sector since the early 1990s and have primarily been achieved as a result of fitting three-way catalysts to petrol fuelled vehicles.

Target value for NO_x according to Gothenburg Protocol and DIRECTIVE 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants for year 2010 is 45 kt NO_x. Slovenia met that target value in 2021, emissions were 43 % below national ceiling value.

The 2012 revision of the Gothenburg Protocol to the UNECE LRTAP Convention and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants set emission reduction targets for NO_x based on 2005 emission totals, to be met by countries in or before 2020. Reduction of emissions has to be 39 % compared to 2005 emissions. Emissions for Slovenia in 2021 were below a linear target path to its 2020 target by 53 % of its 2005 emission totals.

Slovenia in 2021 fulfilled requirements under NO_x Protocol.

NO_x contributes to acid deposition and eutrophication of soil and water. The subsequent impacts of acid deposition can be significant, including adverse effects on aquatic ecosystems in rivers and lakes and damage to forests, crops and other vegetation. Eutrophication can lead to severe reductions in water quality with subsequent impacts including decreased biodiversity, changes in species composition and dominance, and toxicity effects. NO_x is associated with adverse effects on human health, as at high concentrations it can cause inflammation of the airways and reduced lung function, increasing susceptibility to respiratory infection. It also contributes to the formation of secondary particulate aerosols and tropospheric ozone in the atmosphere, both of which are important air pollutants due to their adverse impacts on human health and other climate effects.

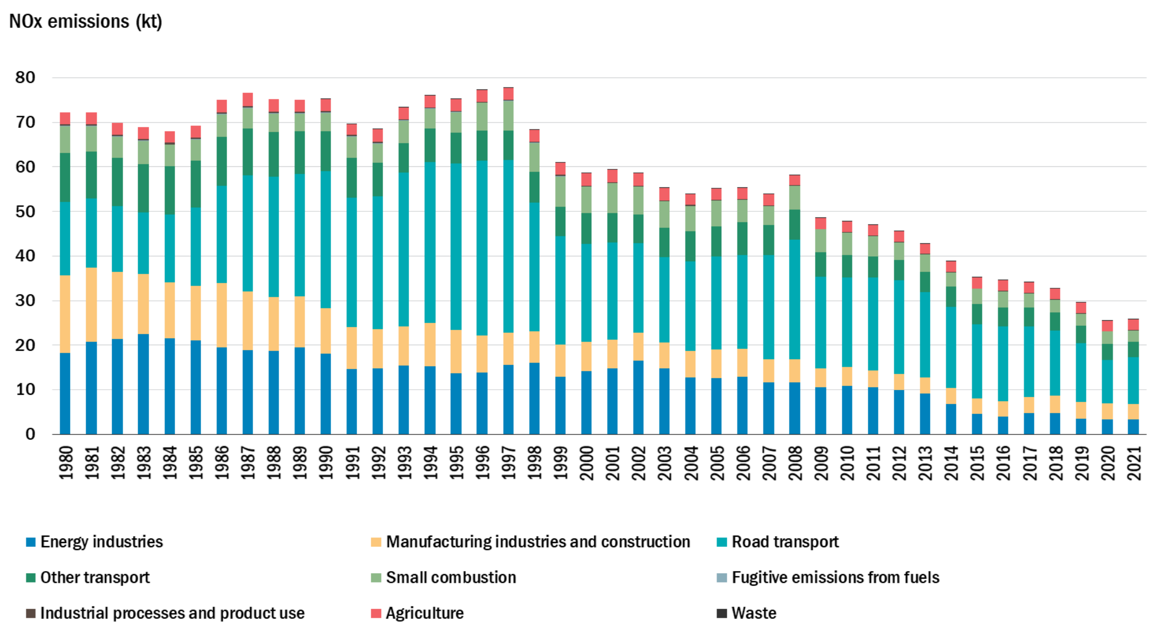

Figure 2.6.1.3 NO_x emissions in Slovenia for the period 1980 – 2021

In 2021, the most significant sources of NO_x emissions were the road transport (40 %). Other transport sectors contributed 14 %. Manufacturing of fuel in industries and construction contributed 14 % as well.

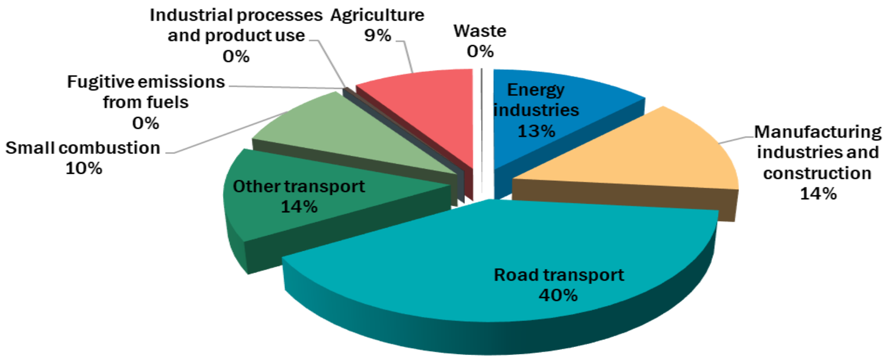

Figure 2.6.1.4 Individual sectors contribution of NO_x emissions for 2021

NMVOC Emissions

National emissions of non-methane volatile organic compounds (NMVOCs) have decreased by 54 % since 1990. From the year 1990 when total amount was 65,1 kt, NMVOC emissions steadily decreased to 30,1 kt in 2021. The most significant sources of NMVOC emissions in 2021 were industrial processes and product use sector (36 %). The decline in emissions since 1990 has primarily been due to reductions achieved in the road transport sector due to the introduction of vehicle catalytic converters and carbon canisters on gasoline cars for evaporative emission control, driven by tighter vehicle emission standards, combined with limits on the maximum volatility of petrol that can be sold in EU Member States, as specified in fuel quality directives. The reductions in NMVOC emissions have been enhanced by the switching from petrol to diesel cars in some EU countries, and changes in the solvent and product use subsector as a result of the introduction of legislative measures limiting the use and emissions of solvents.

Slovenia has reduced emissions since 1990 in line with its obligations under the 2001/81/EC National Emission Ceilings Directive (NECD) and Gothenburg protocol. Emissions of NMVOC were well below respective ceiling. Emissions in 2021 were 25 % below national ceiling value (40 kt NMVOC).

The 2012 revision of the Gothenburg Protocol to the UNECE LRTAP Convention and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants set emission reduction targets for NMVOC based on 2005 emission totals, to be met by countries in or before 2020. Reduction of emissions has to be 23 % compared to 2005 emissions. Emissions for Slovenia in 2021 were below a linear target path to its 2020 target by 37 % of its 2005 emission totals.

Non-methane volatile organic compounds (NMVOCs) are a collection of organic compounds that differ widely in their chemical composition but display similar behaviour in the atmosphere. NMVOCs are emitted into the atmosphere from a large number of sources including combustion activities, solvent use and production processes. Biogenic NMVOC are emitted by vegetation, with amounts dependent on the species and on temperature. NMVOCs contribute to the formation of ground-level (tropospheric) ozone, and certain species such as benzene and 1,3 butadiene are directly hazardous to human health. Quantifying the emissions of total NMVOC provides an indicator of the emissions of the most hazardous NMVOCs.

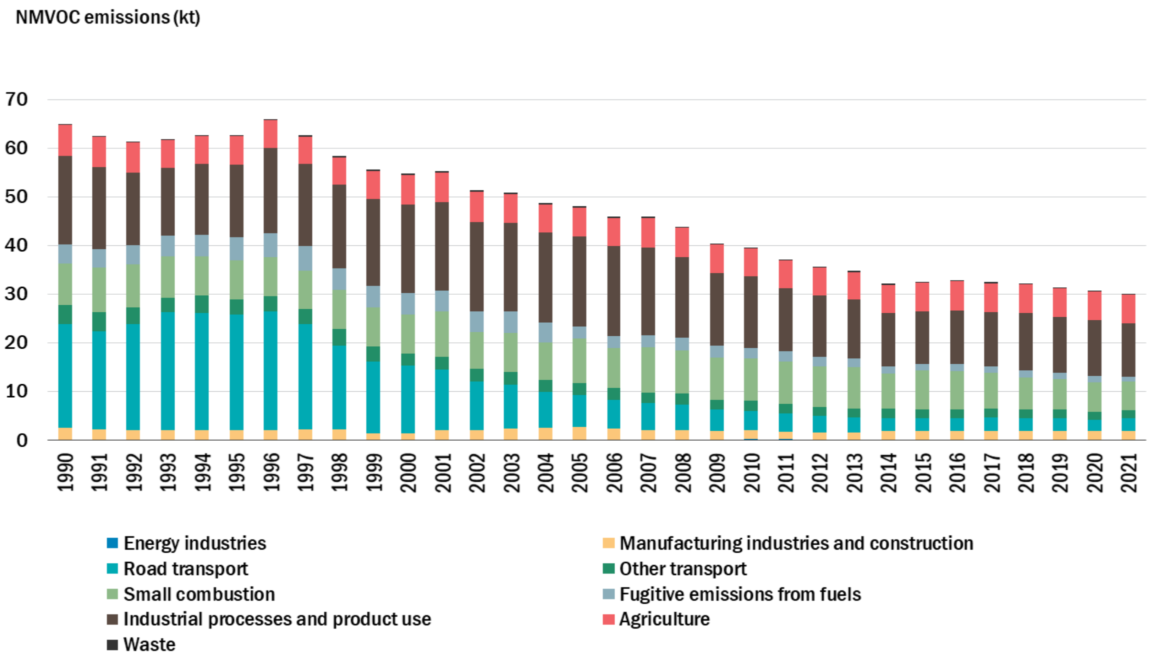

Figure 2.6.1.5 NMVOC emissions in Slovenia for the period 1990 – 2021

The main sources of NMVOC emissions in the year 2021 are industrial process and product use sector (36 %). Small combustion contributed 20 % to total NMVOC emissions and agriculture activities 20 % as well.

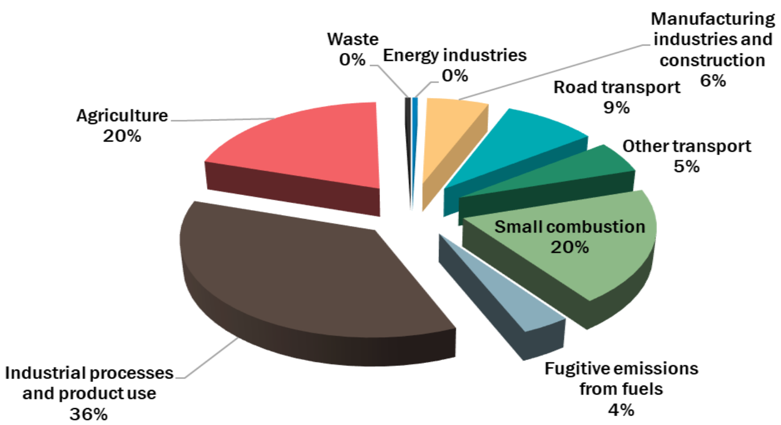

Figure 2.6.1.6 Individual sectors contribution of NMVOC emissions for 2021

NH_3 Emissions

National emissions of NH_3 have declined by 26 % between the years 1986 (24,9 kt) and 2021 (18,5 kt). Agriculture was responsible for 93 % of NH_3 emissions in 2021. The reduction in emissions within the agricultural sector is primarily due to a reduction in livestock numbers (especially cattle), changes in the handling and management of organic manures and from the decreased use of nitrogenous fertilisers. The reductions achieved in the agricultural sector have been marginally offset by the increase in annual emissions over this period in the road-transport sector.

Total NH_3 emissions in 2021 were below the level of the respective 2010 ceiling (20 kt NH_3). Emissions were 8 % lower than target value set in 2001/81/EC National Emission Ceilings Directive and Gothenburg protocol.

The 2012 revision of the Gothenburg Protocol to the UNECE LRTAP Convention and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants set emission reduction targets for NH_3 based on 2005 emission totals, to be met by countries in or before 2020. Reduction of emissions has to be 1 % compared to 2005 emissions. Emissions for Slovenia in 2021 were below a linear target path to its 2020 target by 11 % of its 2005 emission totals.

NH_3 contributes to acid deposition and eutrophication. The subsequent impacts of acid deposition can be significant, including adverse effects on aquatic ecosystems in rivers and lakes and damage to forests, crops and other vegetation. Eutrophication can lead to severe reductions in water quality with subsequent impacts including decreased biodiversity, changes in species composition and dominance, and toxicity effects. NH_3 also contributes to the formation of secondary particulate aerosols, an important air pollutant due to its adverse impacts on human health.

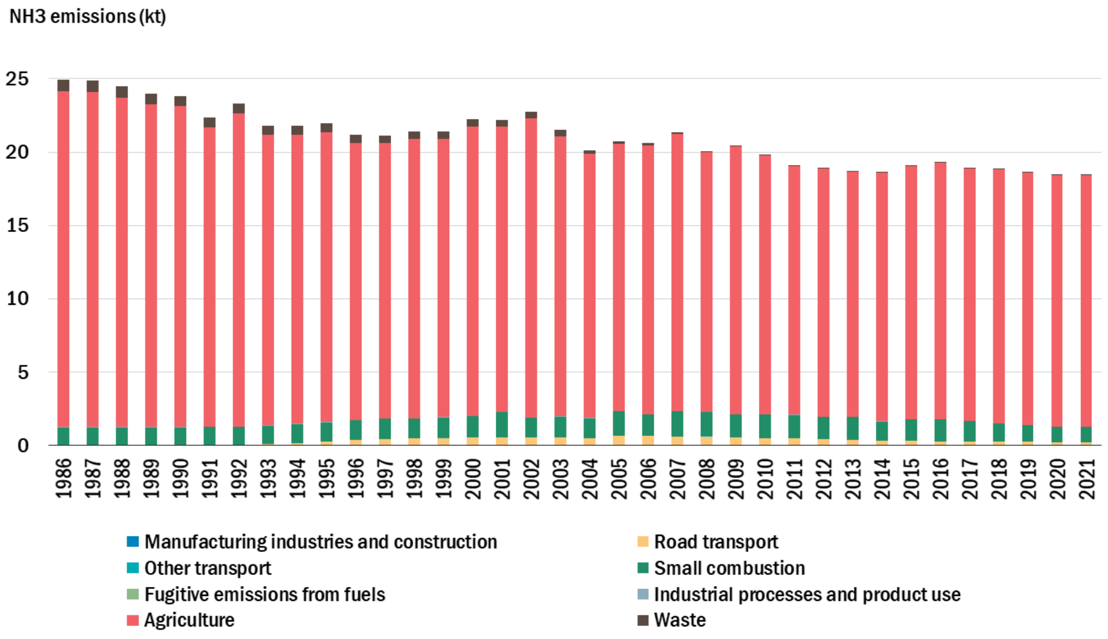

Figure 2.6.1.7 NH_3 emissions in Slovenia for the period 1986 – 2021

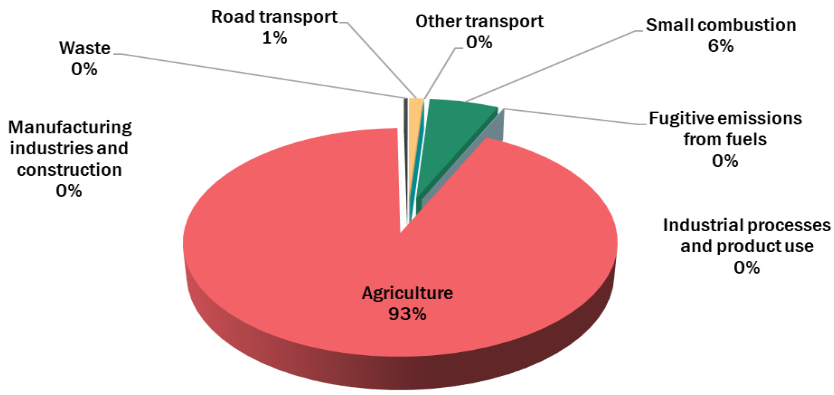

Figure 2.6.1.8 Individual sectors contribution of NH_3 emissions for 2021

CO Emissions

National CO emissions gradually decreased from the year 1980, when total amount was 303,7 kt to 87,2 kt in 2021. Emissions were reduced by 71 %. This decrease has been achieved mainly as a result of the introduction of catalytic converters for gasoline vehicles, which has significantly reduced emissions of CO from the road transport sector. CO is mainly emitted from incomplete combustion. Combustion in commercial, institutional and households is responsible for the dominant share of the total CO emissions.

Emissions of carbon monoxide (as well as non-methane volatile organic compounds, nitrogen oxides and methane) contribute to the formation of ground-level (tropospheric) ozone. Ozone is a powerful oxidant and tropospheric ozone can have adverse effects on human health and ecosystems. It is a problem mainly during the summer months. High concentrations of ground-level ozone adversely affect the human respiratory system and there is evidence that long-term exposure accelerates the decline in lung function with age and may impair the development of lung function. Some people are more vulnerable to high concentrations than others, with the worst effects generally being seen in children, asthmatics and the elderly. High concentrations in the environment are harmful to crops and forests, decreasing yields, causing leaf damage and reducing disease resistance.

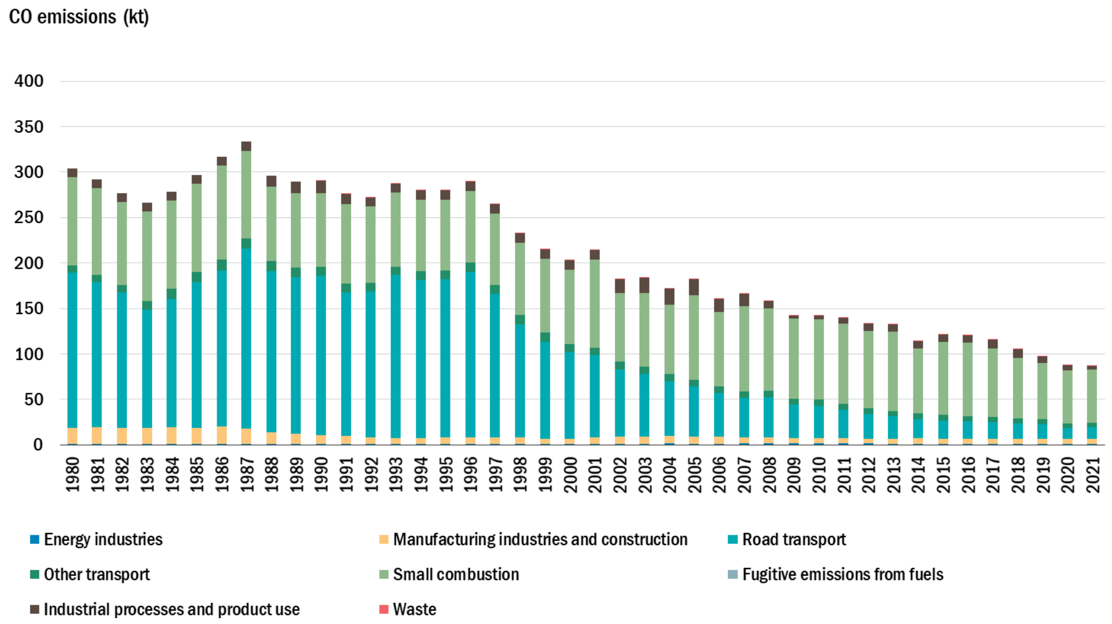

Figure 2.6.1.9 CO emissions in Slovenia for the period 1980 – 2021

In 2021, the main sources for CO emissions in Slovenia is small combustion (mainly combustion of fuel in residential sector) sector with a share of 66 %. Also road transport contributes significantly to the total emission of this pollutant (15 %).

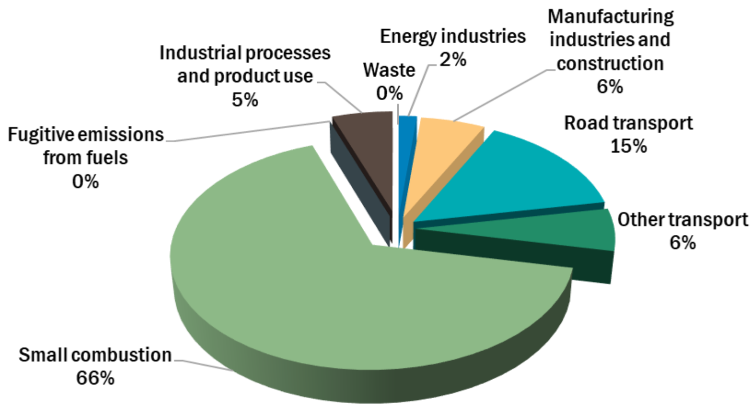

Figure 2.6.1.10 Individual sectors contribution of CO emissions for 2021

2.6.2 Emission Trends for Particulate Matter

The most important source of particulate matter emissions ($PM_{2.5}$, PM_{10}, TSP and BC) has been combustion of wood in stationary residential sector. Other significant sources are industrial processes, transport and use of fuel in industry production. The particulate matter emissions have decreased significant in the year 2009 due to modernization of technological processes. The decrease in emissions in 2014 was due to significantly reduced emissions from residential combustion. Warmer winter and improved thermal insulation of buildings contributed to lower fuel consumption. The emission trend from year 2000 to 2021 were on the decrease of $PM_{2.5}$ for 29 %, for PM_{10} for 21%, for TSP by 20 % and BC for 35 %.

The reductions in total emissions of primary PM_{10} have not been achieved in the past decade despite of introduction or improvement of abatement measures across the energy, road transport, and industrial sectors coupled with other developments in industrial sectors such as fuel switching from high-sulphur fuels to low-sulphur fuels, which has also contributed to decreased formation of secondary particulate matter from SO_2 in the atmosphere. Emissions of primary PM_{10} are expected to decrease in the future as vehicle technologies are further improved and stationary fuel combustion emissions are controlled through abatement or use of low-sulphur fuels such as natural gas. Despite this, it is expected that within many of the urban areas across the EU, PM_{10} concentrations will still be well above the EU air quality limit value. Substantial further reductions in emissions will therefore be needed if the limit value set in the EU's Air Quality Directive is to be reached.

The 2012 revision of the Gothenburg Protocol to the UNECE LRTAP Convention and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants set emission reduction targets for $PM_{2.5}$ based on 2005 emission totals, to be met by countries in or before 2020. Reduction of emissions has to be 25 % compared to 2005 emissions. Emissions for Slovenia in 2021 were below a linear target path to its 2020 target by 38 % of its 2005 emission totals.

There are no specific EU emission targets for primary PM_{10}. However the EU National Emission Ceilings Directive (NECD) and the Gothenburg Protocol to the UNECE LRTAP Convention both set ceilings for the secondary particulate matter precursors NH_3, NO_x and SO_x that countries must have met by 2010. NH_3, NO_x and SO_x are ranked among secondary particulate matter precursor as well as substances which cause acidifying and eutrophication.

In recent years scientific evidence has been strengthened by many epidemiological studies that indicate there is an association between long and short-term exposure to fine particulate matter and various serious health impacts. Fine particles have adverse effects on human health and can be responsible for and/or contribute to a number of respiratory problems. Fine particles in this context refer to primary particulate matter ($PM_{2.5}$ and PM_{10}) and emissions of secondary particulate matter precursors (NO_x, SO_x and NH_3). Primary $PM_{2.5}$ and PM_{10} refers to fine particles (defined as having diameter of 2.5 µm or 10 µm or less, respectively) emitted directly to the atmosphere. Secondary particulate matter precursors are pollutants that are partly transformed into particles by photo-chemical reactions in the atmosphere. A large fraction of the urban population is exposed to levels of fine particulate matter in excess of limit values set for the protection of human health. There have been a number of recent policy initiatives that aim to control particulate concentrations and thus protect human health.

Table 2.6.2.1 National total emissions and emission trends for the period 2000-2021 for particulate matter

Year	Emissions (kt)			
	$PM_{2.5}$	PM_{10}	TSP	BC
2000	14,2	17,9	25,3	2,6
2001	16,4	20,2	27,9	2,9
2002	14,0	18,0	25,9	2,5
2003	14,6	18,6	26,8	2,6
2004	14,3	18,4	26,8	2,7
2005	16,3	20,7	30,0	3,0
2006	14,7	19,1	28,8	2,8
2007	16,1	20,8	31,1	3,0
2008	15,7	20,2	30,2	3,1
2009	14,4	16,8	21,3	2,8
2010	14,7	18,2	25,9	2,8
2011	14,5	17,7	24,4	2,7
2012	14,0	16,8	22,4	2,6
2013	14,1	16,4	21,1	2,6
2014	12,1	13,7	16,3	2,3
2015	13,0	14,5	17,1	2,4
2016	13,0	15,4	20,3	2,3
2017	12,4	14,8	19,6	2,2
2018	11,3	13,9	19,0	2,0
2019	10,6	13,3	18,7	1,8
2020	10,1	13,0	19,3	1,7
2021	10,1	14,2	20,3	1,7
Trend (%)	***-29 %***	***-21 %***	***-20 %***	***-35 %***

PM_{10} Emissions

In the year 2021 the total amount of primary PM_{10} (sub-10µm particulate matter) emissions accounted to 14,2 kt. Emissions in the year 2000 were 17,9 kt. The most important source of primary PM_{10} emissions in 2021 was small combustion sector which includes combustion-related emissions from sources such as heating of residential and commercial properties mainly wood consumption in residential sector (53 %). Other important sectors are industrial processes (25 %), road transport (7 %) and fuel used in manufacturing industries and construction (5 %).

Emissions of primary PM_{10} have decreased from 2000 to 2021 by 21 %. Decrease of emissions was the most pronounced in industrial processes sector due to improvements and modernization of cement, lime and aluminium production technology. Also other sectors have annotated a decrease of emissions, especially energy industry and other transport. Increase of emissions was observed in road transport sector. Bigger fuel consumption in recent years is the reason for increase of particle emissions, in spite of improvements in vehicle technologies. The use of biomass in households increased due to favourable price of biomass compared to other fuels as well as state measures to promote renewable energy sources. The decrease in emissions in the period 2019-2020 was due to significantly reduced emissions from residential combustion. Warmer winter and improved thermal insulation of buildings contributed to lower fuel consumption.

Other factors which contributed to the reduction of primary PM_{10} emissions in some sectors are: improvements in the performance of particulate abatement equipment at industrial combustion facilities (coal-fired power stations), a fuel shift from the use of coal in the energy industries, industrial and domestic sectors to cleaner burning fuels such as gas, cleaner stoves for domestic heating, introduction of particle filters on new vehicles (driven by the legislative EURO standards).

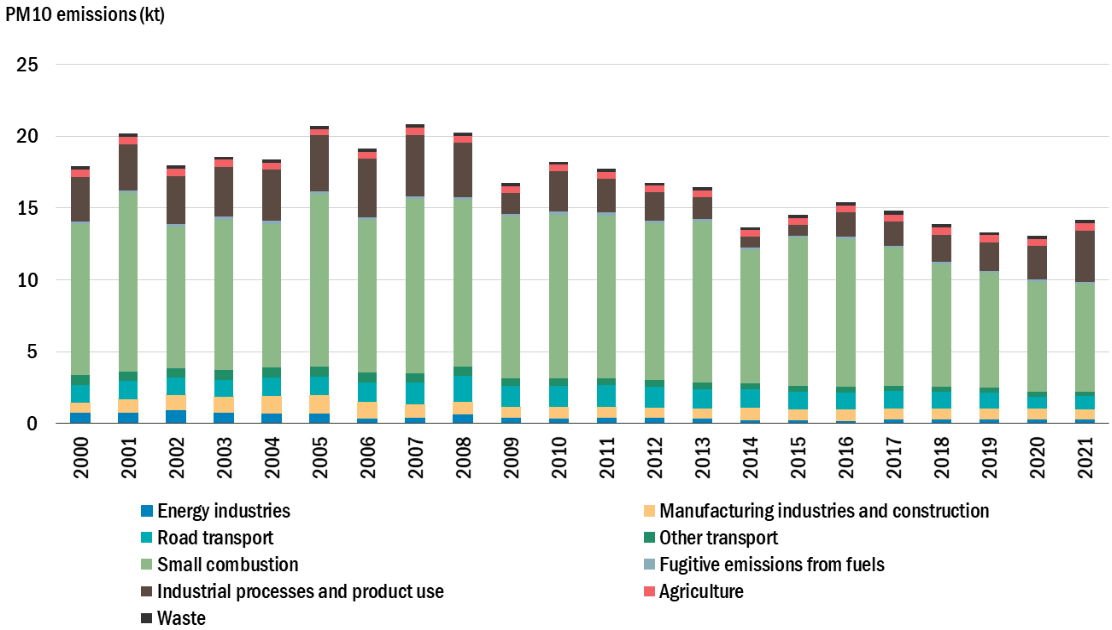

Figure 2.6.2.1 PM_{10} emissions in Slovenia for the period 2000 – 2021

The main source for PM_{10} emissions in the year 2021 was small combustion sector mainly wood consumption in residential sector with a share of about 53 %, followed by industrial processes with 25 % and road transport with 7 %.

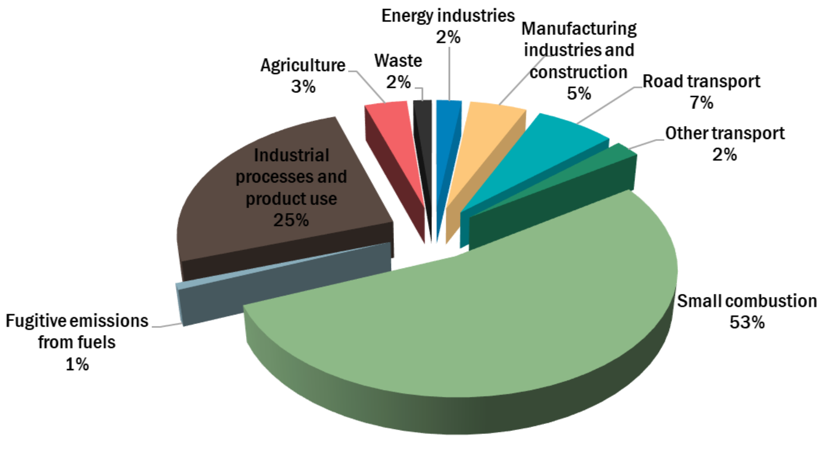

Figure 2.6.2.2 Individual sectors contribution of PM_{10} emissions for 2021

$PM_{2.5}$ Emissions

National $PM_{2.5}$ emissions decreased by 29 % from the year 2000, when total amount was 14,2 kt to 10,1 kt in 2021.

The $PM_{2.5}$ emissions have increased in 2007 in stationary residential sector due to increase of wood consumption. Increasing consumption of biomass is probably a result of economic crisis and a high price of petroleum products as well as state measures to promote renewable energy sources. The particulate matter emissions have decreased significant in the year 2009 due to modernization of technological processes. The decrease in emissions in 2014 was due to significantly reduced emissions from residential combustion. Warmer winter and improved thermal insulation of buildings contributed to lower fuel consumption.

Far most important source of $PM_{2.5}$ emissions in the year 2021 was small combustion sector with a share of 73 %, followed by fuel used in manufacturing industries with 7 %.

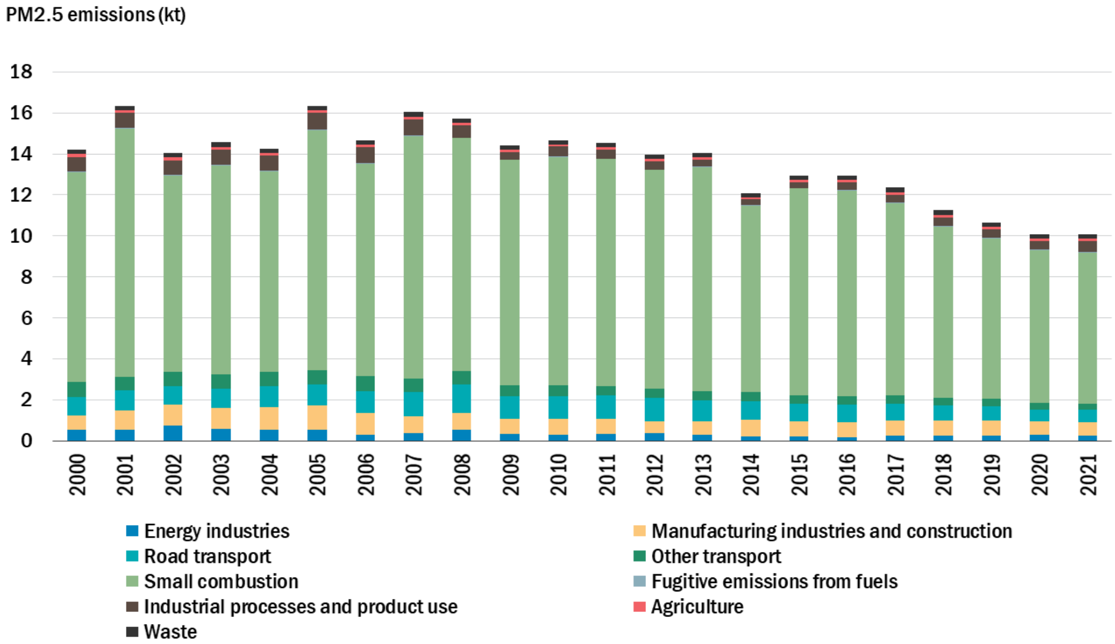

Figure 2.6.2.3 $PM_{2.5}$ emissions in Slovenia for the period 2000 – 2021

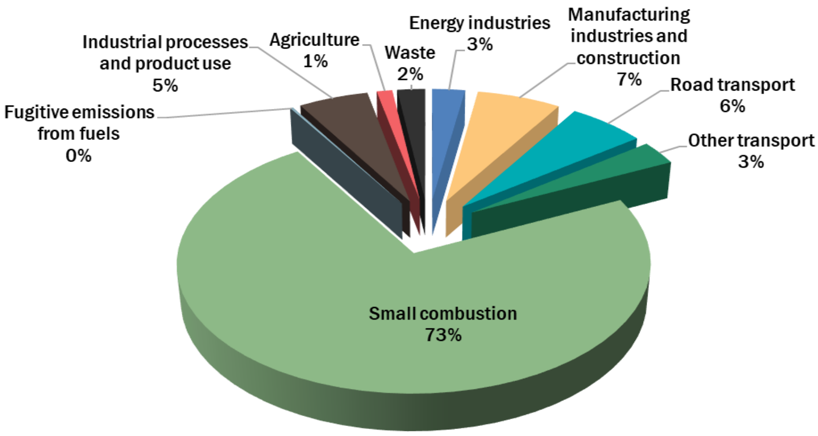

Figure 2.6.2.4 Individual sectors contribution of $PM_{2.5}$ emissions for 2021

TSP Emissions

National total suspended particulate (TSP) emissions have decreased from the year 2000 when the total amount was 25,3 kt to 20,3 kt in 2021. Emissions were decreased by 20 % mainly due to a decrease in emissions in the production of energy. The TSP emissions have decreased in 2009 in the industrial process sector due to the introduction of abatement technology in cement and lime production. The increase in emissions in the industrial processes sector in 2010 was due to the increased length of road construction. The decrease in emissions in the last period was due to significantly reduced emissions from residential combustion. Warmer winters and improved thermal insulation of buildings contributed to lower fuel consumption. Flucuaction on TSP emissions have been due to changing activity in the construction sector, especially road construction. The biggest share of TSP emissions is contributed by the construction and demolition sectors.

The main source of TSP emissions in the year 2021 was industrial processes with a share of 41 %. Contribution of small combustion sector was 39 %.

Black carbon Emissions

National black carbon (BC) emissions decreased from the year 2000, when total amount was 2,6 kt to 1,7 kt in 2021. Emissions were decreased by 35 %. Far most important source of BC emissions in the year 2021 was small combustion sector with a share of 65 %, followed by road transport with 14 %.

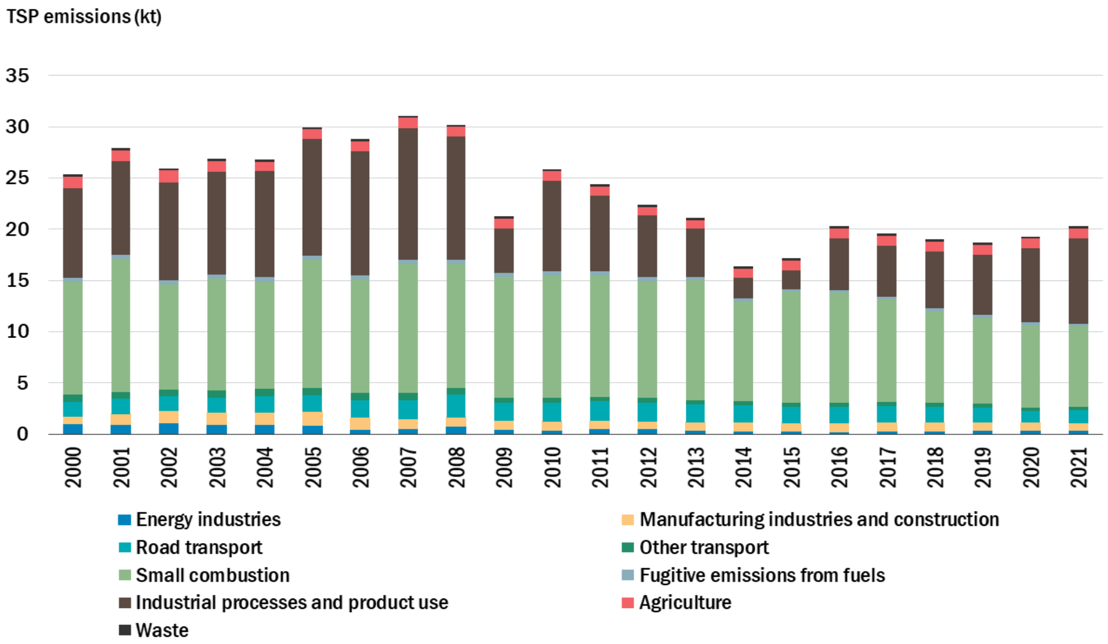

Figure 2.6.2.5 TSP emissions in Slovenia for the period 2000 – 2021

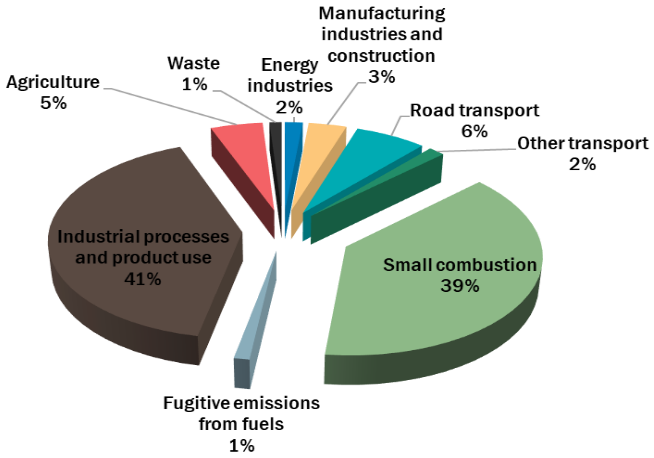

Figure 2.6.2.6 Individual sectors contribution of TSP emissions for 2021

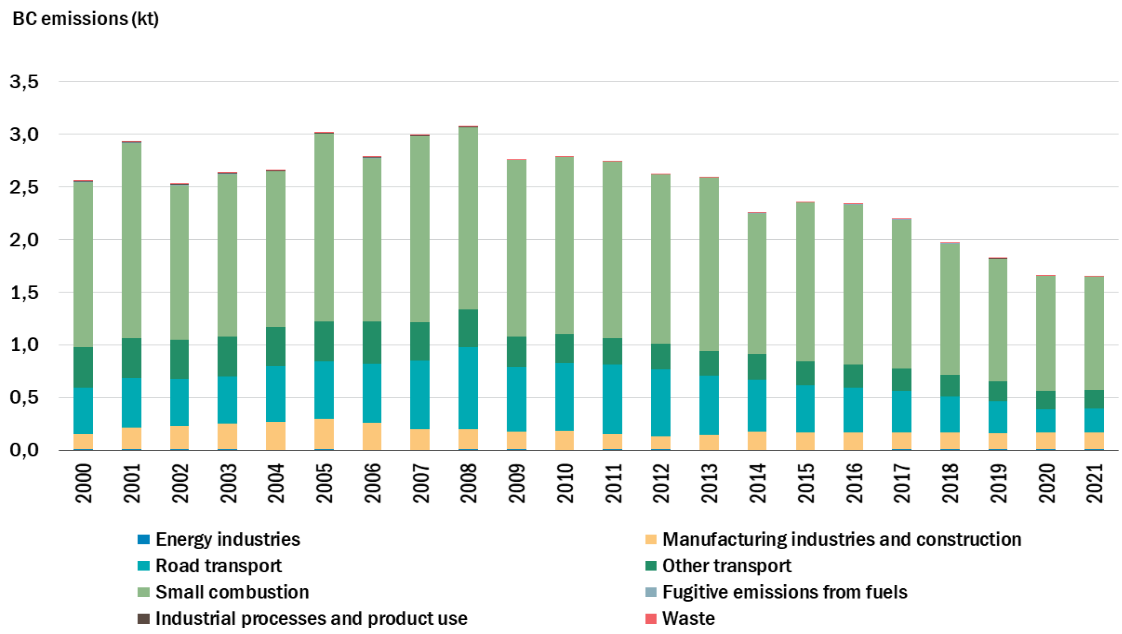

Figure 2.6.2.7 BC emissions in Slovenia for the period 2000 – 2021

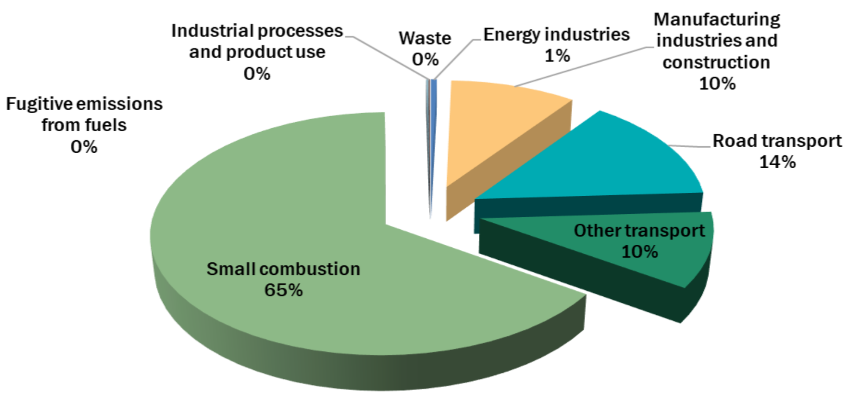

Figure 2.6.2.8 Individual sectors contribution of BC emissions for 2021

2.6.3 Emission Trends for Heavy Metals

In general, the most important sources of heavy metals (Pb, Cd and Hg) emissions have been production processes, combustion of fossil fuels and road transport. Emissions of lead have decreased by 87 %, mercury by 48 % and cadmium by 6 % between 1990 and 2021. The most significant sources of heavy metals are from industrial facilities and energy-related fuel combustion. The reason for the reduced emissions is mainly increased use of gas cleaning devices at power plants. Lead and cadmium emissions have also both decreased from certain industrial processes, such as metal refining and smelting activities, reflecting improved pollution abatement control and also as a result of economic restructuring and the closure of older and more polluting industrial facilities. In the case of mercury, the observed decrease in emissions may be largely attributed to improved controls on mercury in industrial processes (installation of pollution control equipment – flue gas desulphurization system and the decline of coal use as a result of fuel switching. The promotion of unleaded petrol has been the main reason for decline of Pb emissions. Leaded petrol was phased out in Slovenia in the year 2002. Nevertheless, the road transport sector still remains an important source of lead, contributing around 34 % of total lead emissions. However since 2002 little progress has been made in reducing emissions further. 98 % of the total reduction from 1990 emissions of lead had been achieved by 2002. Residual lead in fuel, from engine lubricants and parts, and from tyre and brake wear contribute to the on-going lead emissions from this sector.

Heavy metals such as cadmium, lead and mercury are recognised as being toxic to biota. All are prone to biomagnification, being progressively accumulated higher up the food chain, such that bioaccumulation in lower organisms at relatively low concentrations can expose higher consumer organisms, including humans, to potentially harmful concentrations. In humans they are also of direct concern because of their toxicity, their potential to cause cancer and their potential ability to cause harmful effects at low concentrations. The relative toxic/carcinogenic potencies of heavy metals are compound specific, but exposure to heavy metals has been linked with developmental retardation, various cancers and kidney damage. Metals are persistent throughout the environment. These substances tend not just to be confined to a given geographical region, and thus are not always open to effective local control. For example, in the case of cadmium, much is found in fine particles which do not readily dry-deposit, and therefore have long residence times in the atmosphere and are subject to long-range transport processes.

Slovenia in 2021 did not exceed emission levels set in protocol on heavy metals. Emissions are much below values from the reference year 1990.

Emissions of additional heavy metals (As, Cr, Cu, Ni, Se, Zn) have been estimated for the first time in 2019 submission. Emissions of As, Ni and Se have decreased by 33, 52 and 42, respectively, from the year 1990 to 2021. Emissions of Cu, Cr and Zn have increased by 66, 3 and 6 % between 1990 and 2021.

Table 2.6.3.1 National total emissions and emission trends for the period 1990 - 2021 for Pb, Cd and Hg

Year	Emissions (t)		
	Pb	Cd	Hg
1990	43,2	0,61	0,36
1991	38,8	0,54	0,34
1992	36,4	0,55	0,33
1993	35,8	0,53	0,30
1994	36,2	0,54	0,30

1995	23,8	0,54	0,26
1996	12,0	0,53	0,24
1997	11,2	0,56	0,27
1998	9,7	0,57	0,28
1999	8,8	0,53	0,25
2000	8,1	0,56	0,25
2001	6,8	0,64	0,23
2002	6,1	0,59	0,24
2003	6,2	0,62	0,23
2004	6,3	0,62	0,22
2005	6,9	0,69	0,23
2006	6,8	0,66	0,21
2007	7,0	0,70	0,22
2008	7,3	0,70	0,22
2009	6,1	0,62	0,19
2010	6,8	0,67	0,19
2011	6,8	0,67	0,19
2012	6,5	0,63	0,19
2013	6,3	0,64	0,19
2014	6,0	0,57	0,18
2015	6,0	0,61	0,18
2016	6,2	0,62	0,18
2017	6,2	0,61	0,19
2018	6,1	0,58	0,19
2019	5,8	0,55	0,19
2020	5,0	0,53	0,19
2021	5,6	0,58	0,19
Reduction trend (%)	***-87%***	***-6 %***	***-48 %***

Table 2.6.3.2 National total emissions and emission trends for the period 1990 - 2021 for additional heavy metals: As, Cr, Cu, Ni, Se, Zn

Year	Emissions (t)					
	As	**Cr**	**Cu**	**Ni**	**Se**	**Zn**
1990	0,93	1,71	9,7	9,7	2,94	20,1
1991	0,84	1,62	9,2	9,2	2,81	18,9
1992	0,92	1,65	9,4	9,4	2,99	18,4
1993	0,87	1,69	11,0	11,0	2,78	18,4
1994	0,84	1,72	12,2	12,2	2,60	18,9
1995	0,83	1,76	13,4	13,4	2,53	19,2
1996	0,77	1,85	15,0	15,0	2,30	19,7
1997	0,84	1,93	15,7	15,7	2,46	20,2
1998	0,88	1,86	13,5	13,5	2,57	19,6
1999	0,79	1,73	12,9	12,9	2,31	18,2
2000	0,83	1,74	12,9	12,9	2,39	18,5
2001	0,89	1,94	13,3	13,3	2,58	21,6
2002	0,93	1,87	13,6	13,6	2,69	19,4
2003	0,88	1,88	13,6	13,6	2,54	20,7

2004	0,90	1,90	14,0	14,0	2,58	20,8
2005	0,90	2,05	14,9	14,9	2,57	23,9
2006	0,93	2,01	15,5	15,5	2,64	22,3
2007	0,95	2,12	17,2	17,2	2,71	23,9
2008	0,95	2,23	19,3	19,3	2,62	24,8
2009	0,87	1,99	16,1	16,1	2,48	22,0
2010	0,89	2,05	16,7	16,7	2,53	23,1
2011	0,89	2,09	17,5	17,5	2,56	23,4
2012	0,84	2,02	17,4	17,4	2,44	22,7
2013	0,82	2,00	16,6	16,6	2,36	23,1
2014	0,64	1,80	16,5	16,5	1,80	21,2
2015	0,67	1,85	16,2	16,2	1,89	22,3
2016	0,72	1,93	17,0	17,0	2,04	22,7
2017	0,72	1,91	17,2	17,2	2,02	22,5
2018	0,70	1,86	17,7	17,7	1,97	21,4
2019	0,68	1,80	17,1	17,1	1,90	20,5
2020	0,66	1,63	14,1	14,1	1,84	19,0
2021	0,62	1,76	16,2	16,2	1,72	21,3
Trend (%)	***-33 %***	***+3 %***	***+66 %***	***-52 %***	***-42 %***	***+6 %***

Lead Emissions

National lead (Pb) emissions decreased from the year 1990, when total amount was 43,2 t to 5,6 t in 2021. Emissions of lead have declined by 87 % between 1990 and 2021, primarily due to reductions made in emissions from the road transport sector. The promotion of unleaded petrol was the main reason for huge reduction. The leaded petrol was phased out in Slovenia in July 2002. The large reduction of lead emissions from the road transport sector (of nearly 99 %) has been responsible for the vast majority of the overall reduction of lead emissions since 1990. Nevertheless, the road transport sector still remains an important source of lead, contributing 34 % to total national lead emission. Pb emissions decreased in 1995 and 1996 due to lowering levels of lead content in gasoline. Residual lead in fuel, from engine lubricants and parts, and from tyre and brake wear contribute to the on-going lead emissions from this sector.

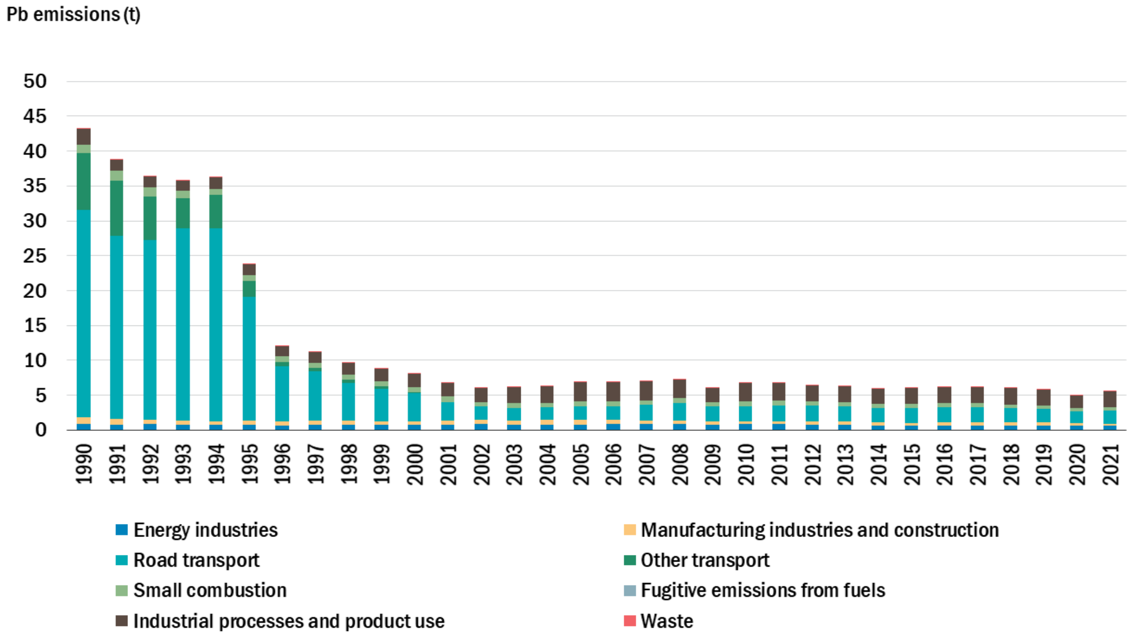

Figure 2.6.3.1 Pb emissions in Slovenia for the period 1990 – 2021

The main source for Pb emissions in the year 2021 was industrial processes sector with a share of 40 %.

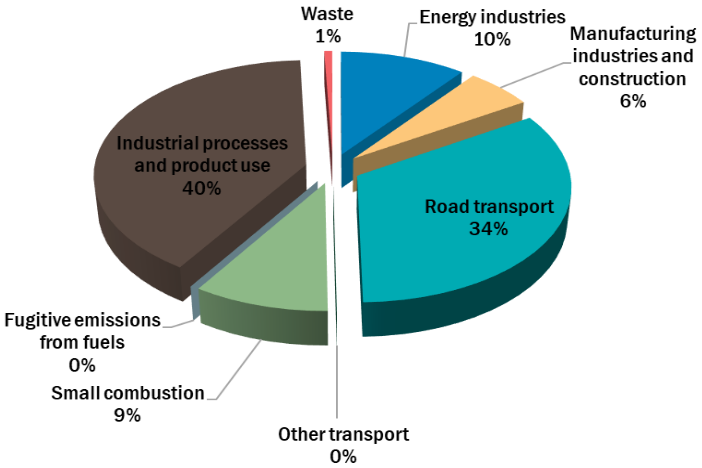

Figure 2.6.3.2 Individual sectors contribution of Pb emissions for 2021

Cadmium Emissions

National cadmium (Cd) emissions decreased from the year 1990, when total amount was 0,61 t to 0,58 t in 2021. Emissions were reduced between 1990 and 2021 by 6 %. Decline in emissions is largely due to improvements in abatement technologies for wastewater treatment, incinerators and in metal refining and smelting facilities, coupled with the effect of European commission directives and regulations mandating reductions and limits on heavy metal emissions (e.g. the IED, IPPC directive and associated permitting conditions). The main source of Cd emissions in the year 2021 was small combustion sector with a share of 43 %. Contribution of industrial processes was 30 %.

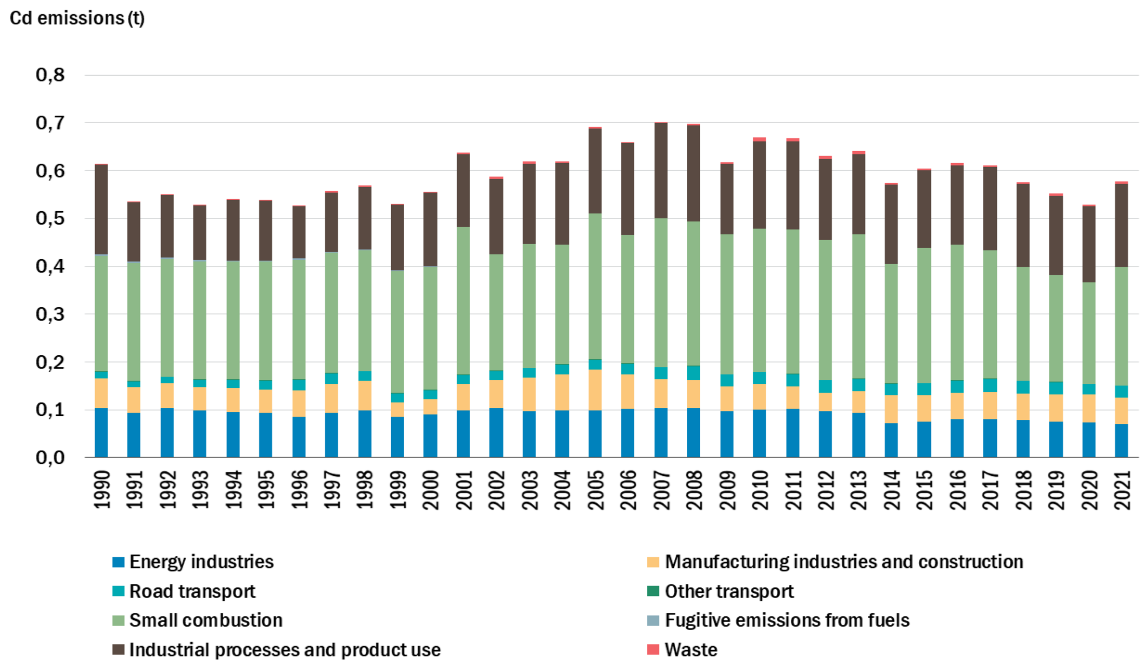

Figure 2.6.3.3 Cd emissions in Slovenia for the period 1990 – 2021

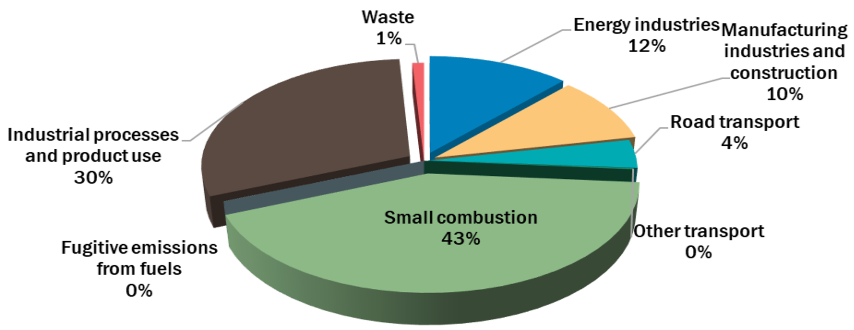

Figure 2.6.3.4 Individual sectors contribution of Cd emissions for 2021

Mercury Emissions

National emissions of mercury (Hg) decreased from 0,36 t in year 1990 to 0,19 t in 2021. Emissions of mercury have declined by 48 % between 1990 and 2021. Since 1990 the largest reduction in mercury emissions has been achieved by the energy production and distribution sector in public power and heat generation. Mercury emissions from this sector are closely linked to the use of coal, which contains mercury as a contaminant. Past changes in fuel use within this sector since 1990, particularly fuel switching in many countries from coal to gas and other energy sources, closure of older inefficient coal-burning plants, and improved pollution abatement equipment are mainly responsible for the past decreases in emissions from this sector.

The main source of Hg emissions in the year 2021 was the use of fuel in manufacturing industries and construction with a share of 35 %, followed by industrial processes with a share of 20 %.

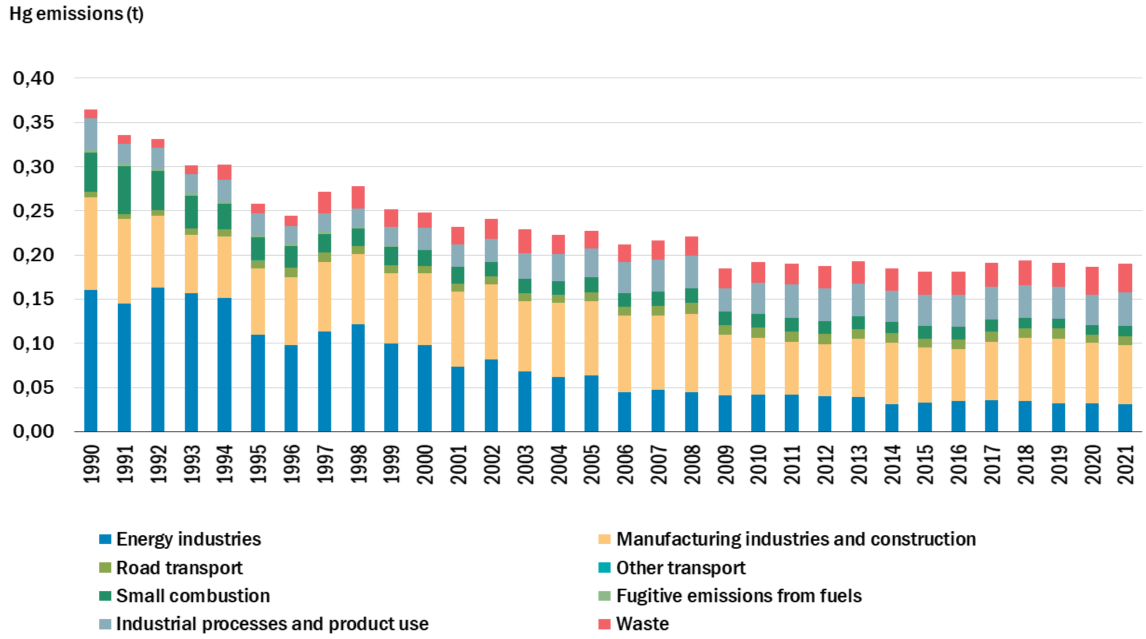

Figure 2.6.3.5 Hg emissions in Slovenia for the period 1990 – 2021

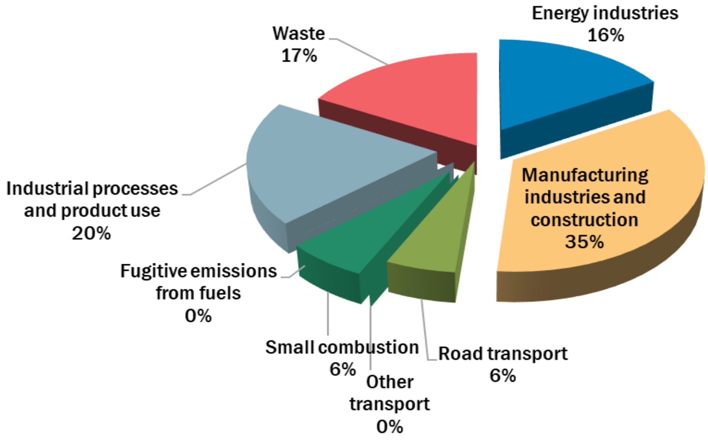

Figure 2.6.3.6 Individual sectors contribution of Hg emissions for 2021

Arsenic Emissions

National emissions of arsenic (As) decreased from 0,93 t in year 1990 to 0,62 t in 2021. Emissions of arsenic have declined by 33 % between 1990 and 2021. Significant drop of emissions in 2014 was due to smaller use of fuels in energy and small combustion sector. The main source of As emissions in the year 2021 was production of public electricity and heat with a share of 85 %.

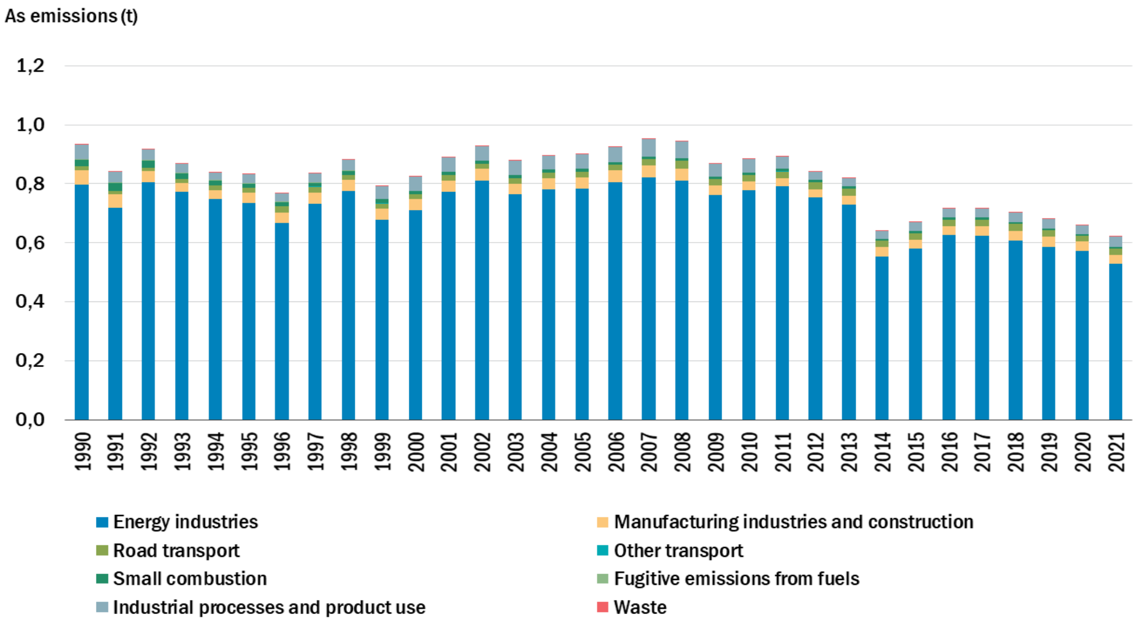

Figure 2.6.3.7 As emissions in Slovenia for the period 1990 – 2021

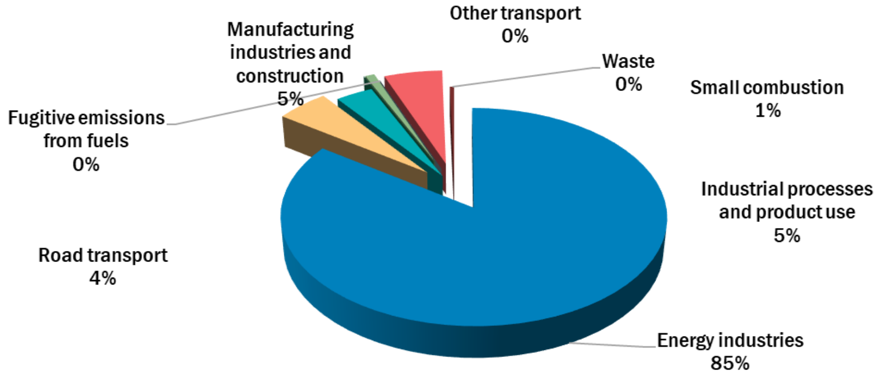

Figure 2.6.3.8 Individual sectors contribution of As emissions for 2021

Chromium Emissions

National chromium (Cr) emissions increased from the year 1990, when total amount was 1,71 t to 1,76 t in 2021. Emissions were increased between 1990 and 2021 by 3 %. Significant drop of emissions in 2014 was due to smaller use of fuels in energy and small combustion sector. The main source of Cr emissions in the year 2021 was road transport with 41 %. The source of emissions are tyres and brake wear.

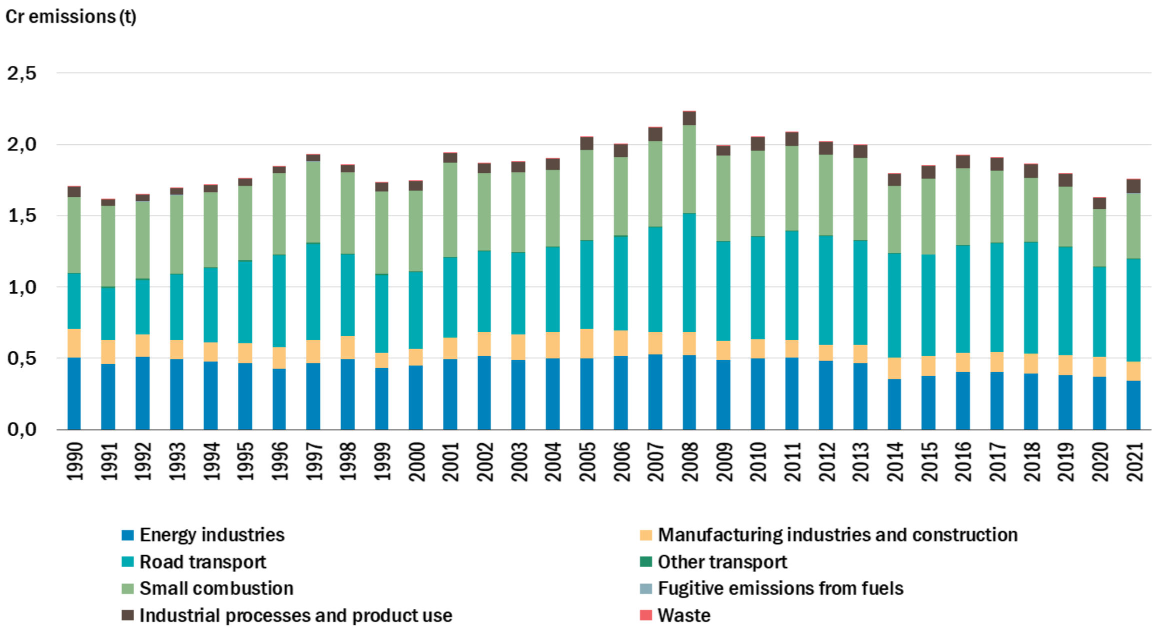

Figure 2.6.3.9 Cr emissions in Slovenia for the period 1990 – 2021

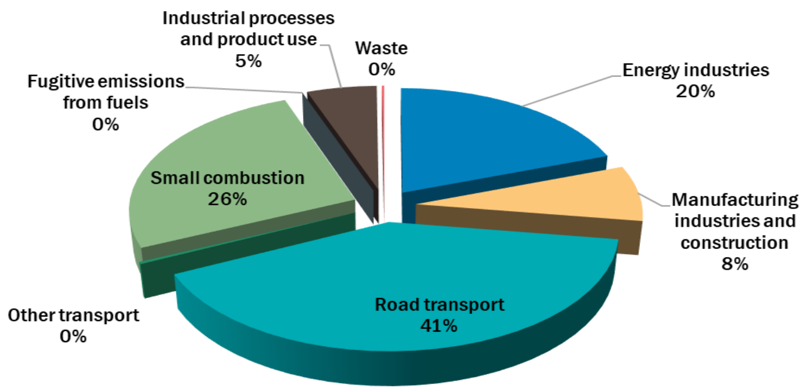

Figure 2.6.3.10 Individual sectors contribution of Cr emissions for 2021

Copper Emissions

National copper (Cu) emissions increased from the year 1990 when the total amount was 9,7 t to 16,2 t in 2021. Emissions increased between 1990 and 2021 by 66 %. Road transport was responsible for the increase in emissions in the last decade. The drop in emissions in 2020 was most pronounced in the transport sector due to reduced mobility as a consequence of the Covid-19 pandemic. The most important source of Cu emissions in the year 2021 was road transport with a share of 95 %. Tyres and brake wear contributed most of the Cu emissions.

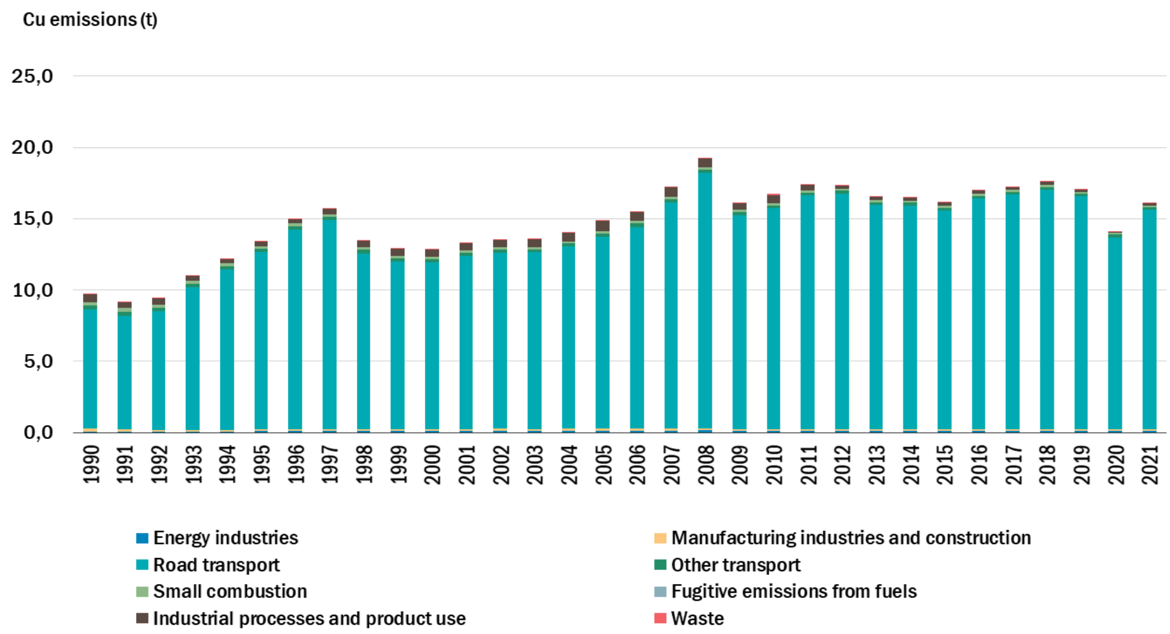

Figure 2.6.3.11 Cu emissions in Slovenia for the period 1990 – 2021

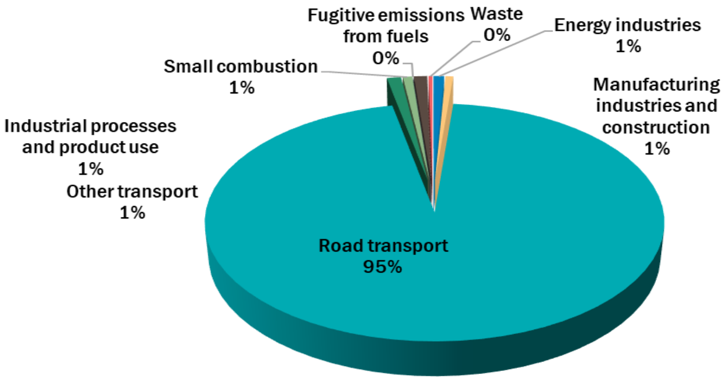

Figure 2.6.3.12 Individual sectors contribution of Cu emissions for 2021

Nickel Emissions

National nickel (Ni) emissions decreased from the year 1990, when total amount was 2,9 t to 1,4 t in 2021. Emissions were decreased between 1990 and 2021 by 52 %. Significant drop of emissions in 2007 and 2014 was due to smaller use of fuels in energy and small combustion sector. The main source of Ni emissions in the year 2021 was industrial processes and product use sector with a share of 39 %, followed by energy industries with 27 % and small combustion with 20 %.

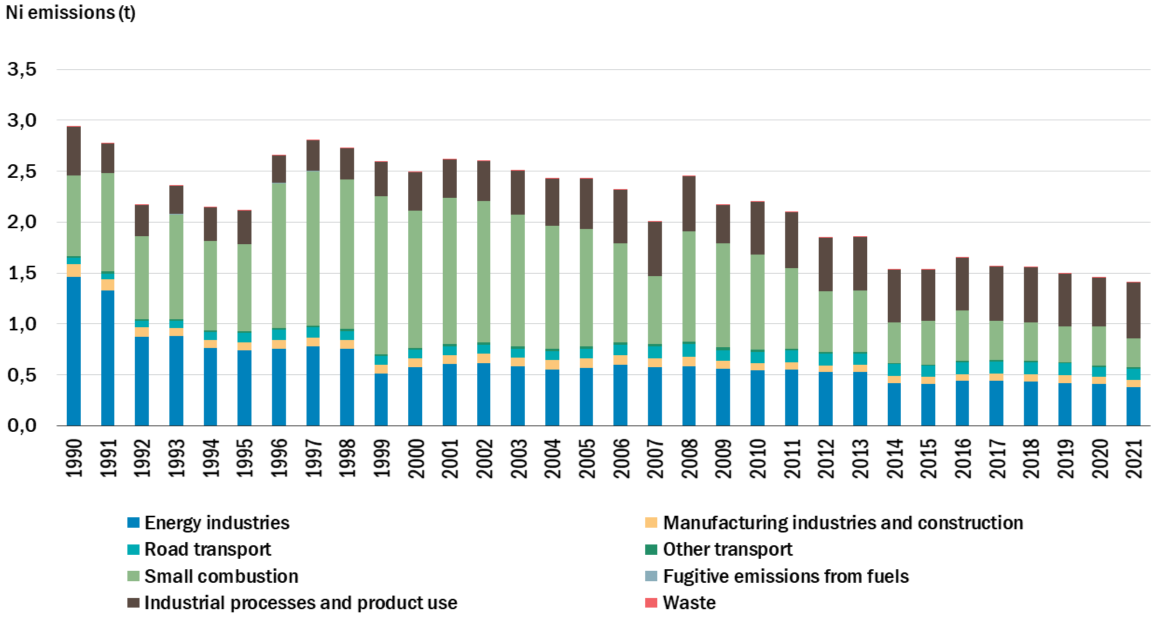

Figure 2.6.3.13 Ni emissions in Slovenia for the period 1990 – 2021

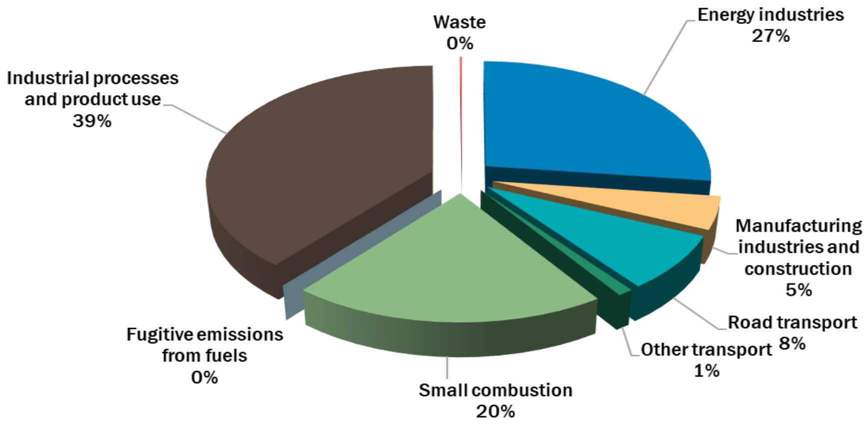

Figure 2.6.3.14 Individual sectors contribution of Ni emissions for 2021

Selenium Emissions

National selenium (Se) emissions decreased from the year 1990, when total amount was 2,9 t to 1,7 t in 2021. Emissions were decreased between 1990 and 2021 by 42 %. Significant drop of emissions in 2014 was due to smaller use of fuels in energy and small combustion sector. The most important source of Se emissions in the year 2021 was production of energy and heat with a share of 92 %.

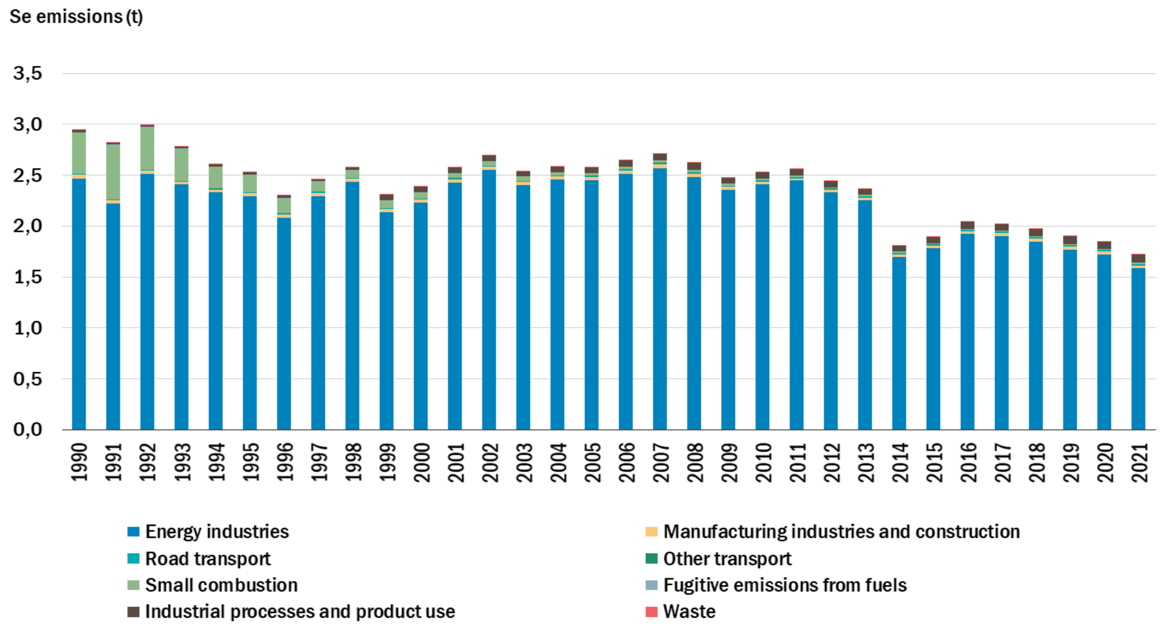

Figure 2.6.3.15 Se emissions in Slovenia for the period 1990 – 2021

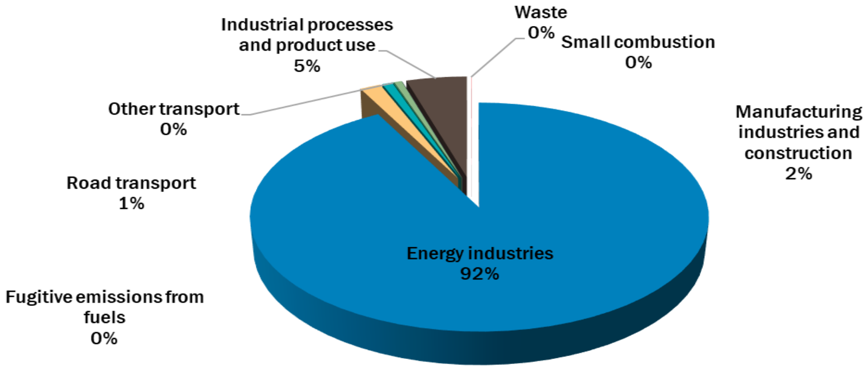

Figure 2.6.3.16 Individual sectors contribution of Se emissions for 2021

Zinc Emissions

National zinc (Zn) emissions increased from the year 1990, when total amount was 20,1 t to 21,3 t in 2021. Emissions were increased between 1990 and 2021 by 6 %. The emissions have increased in 2001 in stationary residential sector due to increase of wood consumption. Increasing consumption of biomass is probably a result of a high price of petroleum products as well as state measures to promote renewable energy sources. Significant drop of emissions in 2014 was due to smaller use of fuels in energy and small combustion sector. The main source for Zn emissions in the year 2021 was small combustion sector with a share of 46 %.

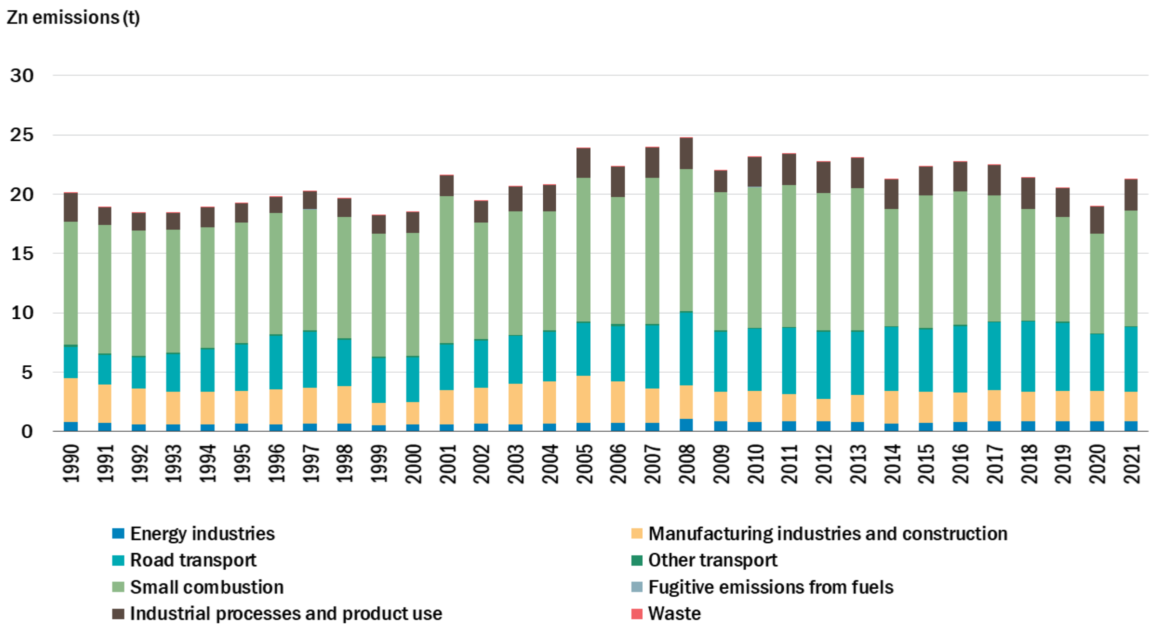

Figure 2.6.3.17 Zn emissions in Slovenia for the period 1990 – 2021

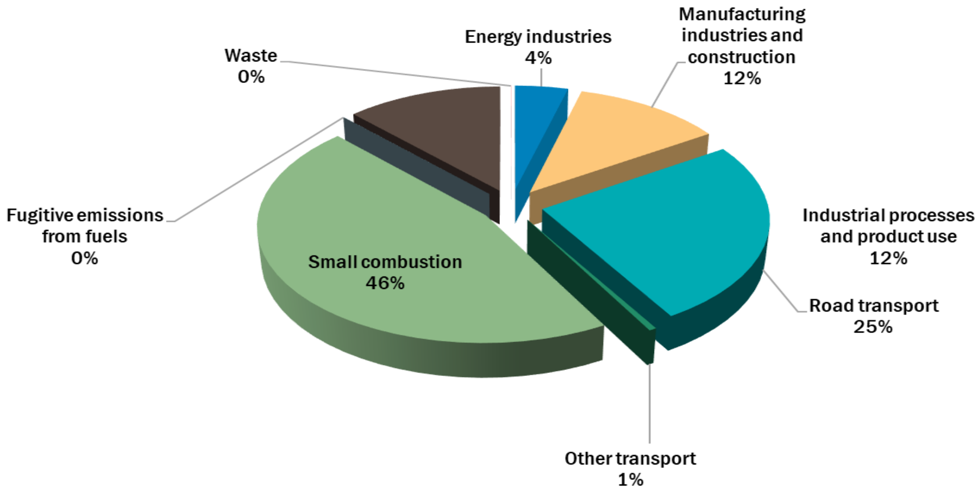

Figure 2.6.3.18 Individual sectors contribution of Zn emissions for 2021

2.6.4 Emission Trends for Persistent Organic Pollutants

Persistent Organic Pollutants (POPs) is a common name of a group of pollutants that are semi-volatile, bioaccumulative, persistent and toxic. POPs are recognised as being directly toxic to biota. All have the quality of being progressively accumulated higher up the food chain, such that chronic exposure of lower organisms to much lower concentrations can expose predatory organisms, including humans and wildlife, to potentially harmful concentrations. In humans they are also of concern for human health because of their toxicity, their potential to cause cancer and their ability to cause harmful effects at low concentrations. Their relative toxic/carcinogenic potencies are compound specific. POPs including PAHs have also been shown to possess a number of toxicological properties. The major concern is centred on their possible role in carcinogenic, immunological and reproductive effects but more recently concern has also been expressed over their possible harmful effects on human development. The overall and long-term goal of the Aarhus Protocol on POPs is to eliminate any discharges, emissions and losses of POPs to the environment. Another agreement, which is ratified by Slovenia, is Stockholm Convention on Persistent Organic Pollutants. Within these conventions, the establishment of emission inventories for POPs is mandatory and provides the basis for further emission reductions among Parties.

In general, the most accurate way to establish emission rates is to measure them. However in most cases only limited measurements data are available. Therefore several guidebooks, guidelines and scientific literature make proposals for emission estimates when measurements data are lacking. In Slovenia emission national emission factors are not available; therefore they were taken from EMEP/EEA Emission inventory guidebook, 2019.

Persistent Organic Pollutants have been reported:

- Polycyclic aromatic hydrocarbons (PAHs): benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene
- Dioxins and furans
- Hexachlorobenzene (HCB)
- Polychlorinated Biphenyls (PCB)

Emissions of PCB, dioxins and furans, PAH and HCB declined since 1990 as a result of decreased residential use of coal, improvements in abatement technologies for metal refining and smelting, and stricter regulations on emissions from the road transport sector. Implementation of legislation, stricter inspection and use of best available techniques has been responsible for decrease of POPs in last two decades.

Emissions of POPs declined substantially from year 1990 to 2021: for PCB (91 %), dioxins/furans (33 %), PAH (48 %) and HCB (98 %)

Slovenia in 2021 did not exceed emission levels set in protocol on persistent organic pollutants for PCB, dioxins/furans, HCB and PAHs. Emissions are much below values from the reference year 1990.

Table 2.6.4.1 National total emissions and emission trends for PCB, Dioxins/Furans, PAHs and HCB for the period 1990 - 2021

Year	PCB	Dioxins/ Furans	PAH Total 1- 4	HCB
	kg	g I-Teq	t	kg
1990	415,4	21,2	8,7	21,4
1991	414,3	20,9	9,4	19,0
1992	373,0	20,0	8,4	17,8
1993	349,4	19,1	7,7	17,8
1994	322,1	18,6	7,0	17,7
1995	290,4	18,6	6,8	17,7
1996	274,0	18,4	6,6	15,1
1997	255,3	18,6	6,4	15,7
1998	243,9	18,8	6,3	15,6
1999	227,3	18,7	6,3	16,1
2000	213,6	19,3	6,3	19,5
2001	201,9	21,8	7,2	21,6
2002	184,1	17,8	6,0	0,9
2003	154,2	18,6	6,3	0,9
2004	142,5	18,2	6,1	0,9
2005	134,6	20,6	7,0	0,9
2006	122,3	19,3	6,4	0,9
2007	99,2	21,2	7,0	0,9
2008	93,5	20,7	6,8	0,9
2009	82,4	19,1	6,4	1,0
2010	75,7	19,6	6,5	1,3
2011	50,7	19,8	6,5	0,8
2012	43,7	18,8	6,3	0,8
2013	40,6	19,0	6,4	0,8
2014	40,6	16,6	5,5	0,7
2015	38,9	17,8	6,0	0,6
2016	38,9	17,8	6,0	0,6
2017	35,6	17,4	5,7	0,5
2018	35,6	15,8	5,1	0,5
2019	35,6	14,8	4,8	0,5
2020	35,4	14,1	4,5	0,5
2021	35,5	14,3	4,5	0,5
Reduction trend (%)	***-91 %***	***-33 %***	***-48 %***	***-98 %***

The sum of emissions of four individual species: benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene could be expressed as PAH Total 1-4 emission. In some cases emission factors for individual PAHs are not available, but there is an emission factor given only for Total 1-4. The sum of individual species dos not always equal to Total 1-4 emission.

PAH Emissions

Polycyclic aromatic hydrocarbons (PAHs) are a group of compounds composed of two or more fused aromatic rings and do not contain heteroatoms or carry substituents. The UNECE POPs Protocol specified that the following 4 PAHs should be used as indicators for the purposes of emission inventories: benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene. PAH Total 1-4 emission is the sum of emissions of four individual species.

Table 2.6.4.2 PAHs emissions for the year 2021

Pollutant	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4
Unit	t	t	t	t	t
Emissions	1,8	1,0	1,0	0,3	4,5

National PAH emissions decreased from 8,7 t in the year 1990 to 4,5 t in year 2021. Emissions were reduced by 48 %. The most significant emission source of PAH were residential combustion processes (open fires, coal and wood burning for heating purposes) with a share of 80 %. Emissions have declined since 1990 as a result of decreased residential use of coal and improvements in abatement technologies. The emissions have increased in 2001 in stationary residential sector due to increase of wood consumption. Increasing consumption of biomass is probably a result of a high price of petroleum products as well as state measures to promote renewable energy sources. The reason for decrease of emissions in 2014 was smaller use of wood biomass in the residential sector. Warmer winter and improved thermal insulation of buildings contributed to lower fuel consumption.

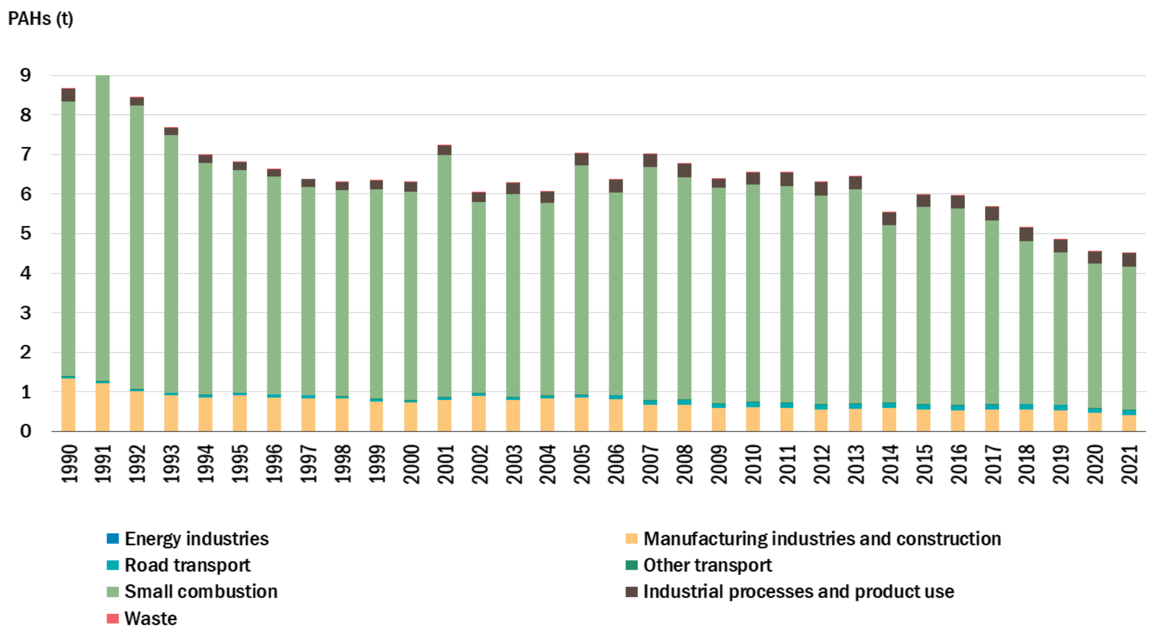

Figure 2.6.4.1 PAH emissions in Slovenia in the period 1990 – 2021

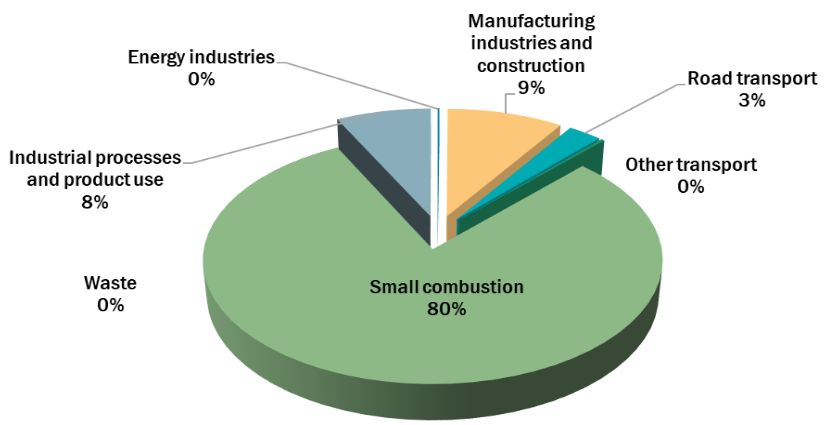

Figure 2.6.4.2 Individual sectors contribution of PAHs emissions for 2021

PCB Emissions

National PCB emissions steadily decreased from the year 1990, when total amount was 415,4 kg to 35,5 kg in the year 2021. Emissions were reduced by 91 %, mainly due to reductions in product use subsector. Emissions have fallen due to phasing out of electrical equipment containing PCB. The main source for PCB emissions is industrial processes and product use with a share of more than 99 %.

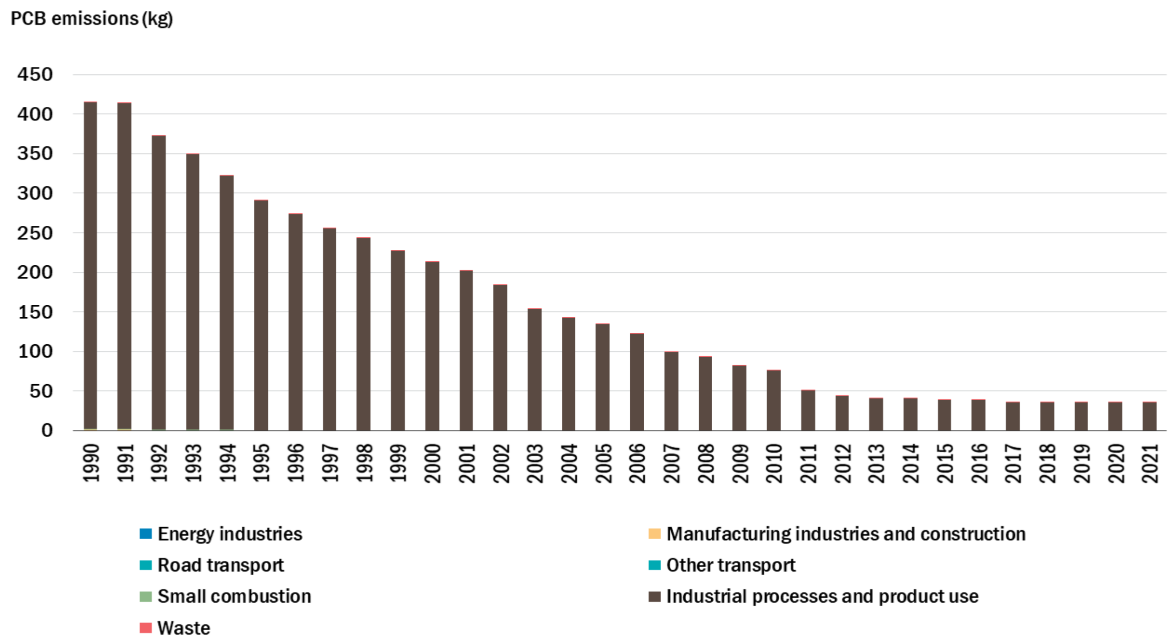

Figure 2.6.4.3 PCB emissions in Slovenia in the period 1990 – 2021

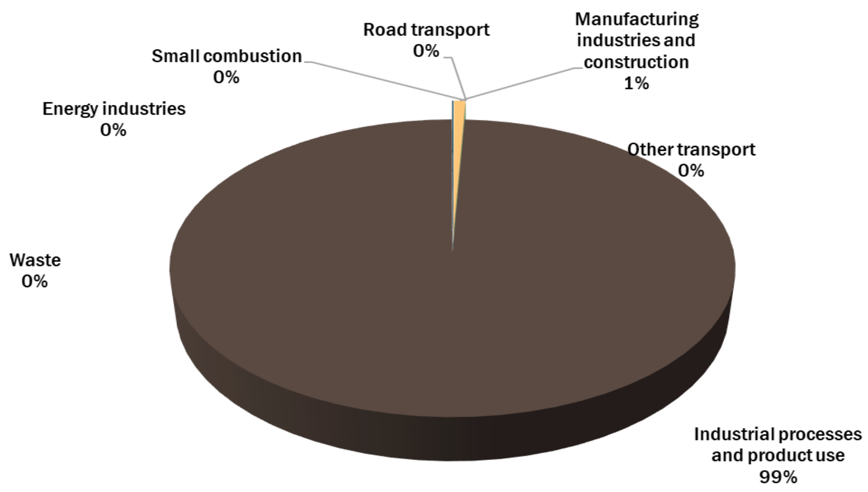

Figure 2.6.4.4 Individual sectors contribution of PCB emissions for 2021

Dioxins and Furans Emissions

National dioxins and furans emissions steadily decreased from the year 1990, when total amount was 21,2 g I-Teq to 14,3 g I-Teq in 2021. Emissions were reduced by 33 %. The main sources of dioxins/furans emissions in 2021 were small combustion with a share of 59 % and industrial processes and product use with 16 %. The emissions have increased in 2001 in stationary residential sector due to increase of wood consumption. Increasing consumption of biomass is probably a result of a high price of petroleum products as well as state measures to promote renewable energy sources. The decrease in emissions in 2014 was due to significantly reduced emissions from residential combustion. Warmer winter and improved thermal insulation of buildings contributed to lower fuel consumption.

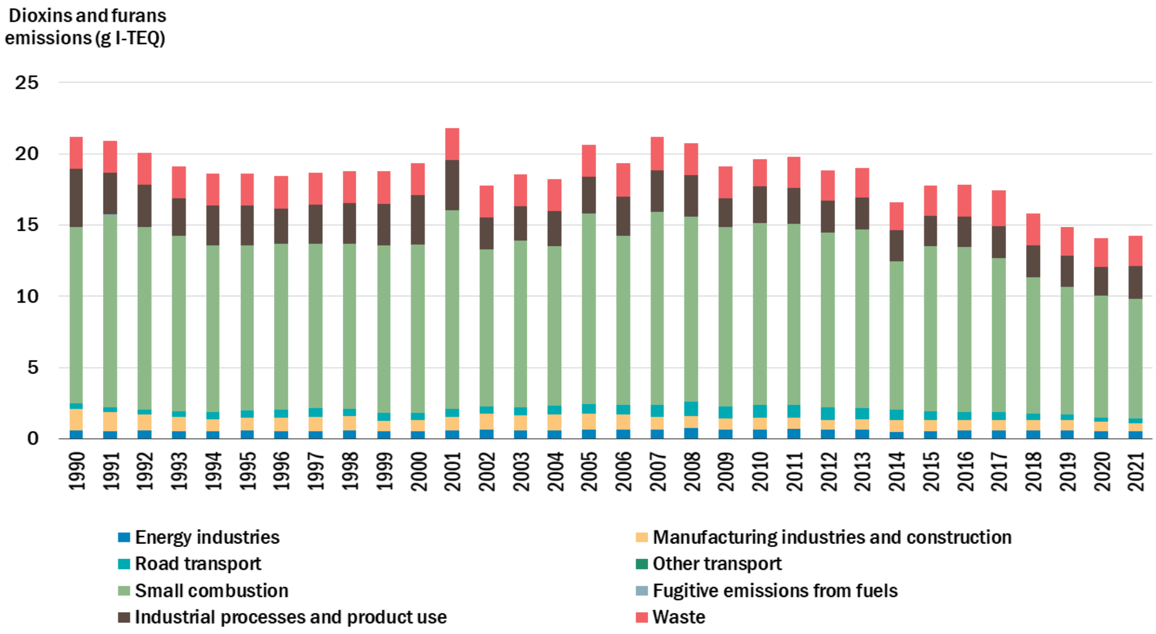

Figure 2.6.4.5 Dioxins and furans emissions in Slovenia for the period 1990 – 2021

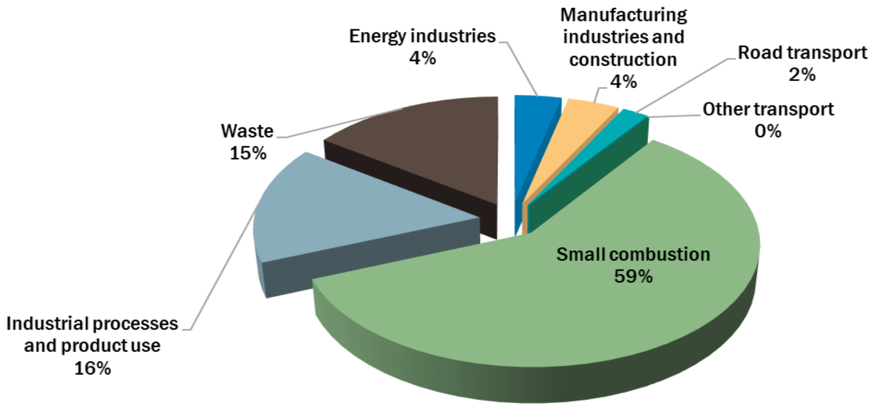

Figure 2.6.4.6 Individual sectors contribution of dioxins and furans emissions for 2021

HCB Emissions

Emissions of HCB have decreased significantly since 1990 when total amount was 21,4 kg to 0,46 kg in 2021. Emissions were decreased by 98 %. The reason for drastic drop of emissions

in 2002 was termination of hexachloroethane (HCE) tablets as a degassing agent in aluminium production.
In 2021, the main source for HCB emissions in Slovenia was heat and electricity production, with a share of 61 %, followed by small combustion sector (21 %).

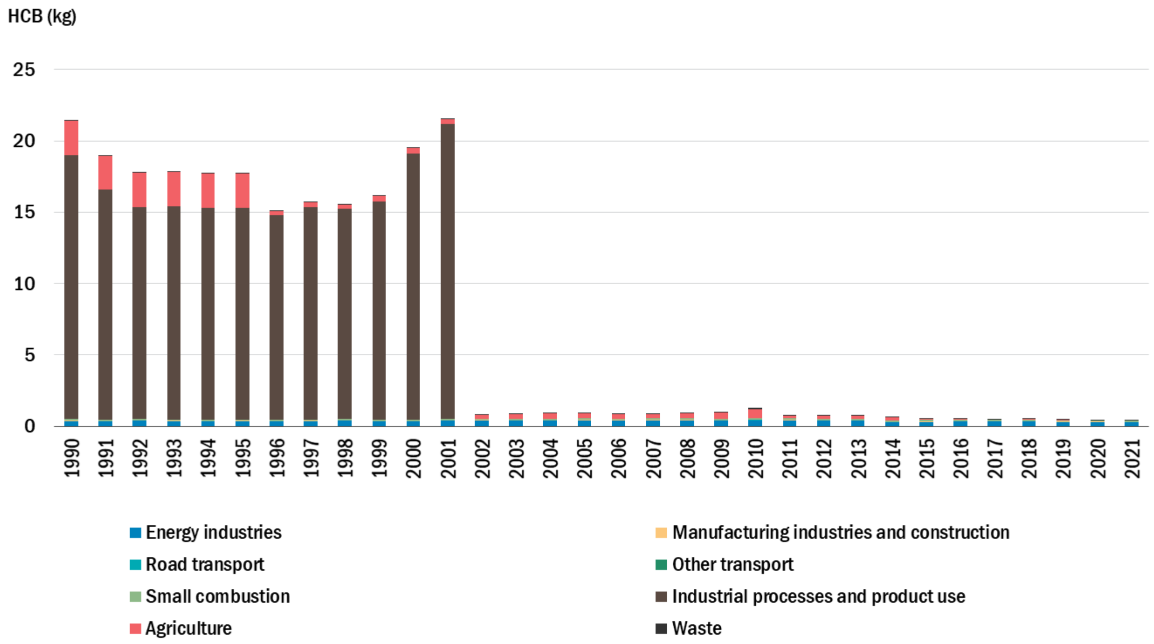

Figure 2.6.4.7 HCB emissions in Slovenia for the period 1990 – 2021

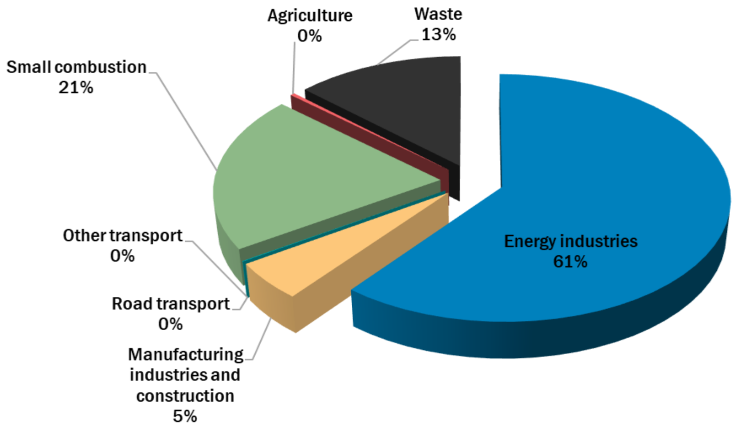

Figure 2.6.4.8 Individual sectors contribution of HCB emissions for 2021

3 ENERGY

The energy sector is the most important sector considering major air pollutants air emissions in the Republic of Slovenia. Emissions from this sector arise from fuel combustion (NFR sector 1. A) and fugitive emissions from fuels (NFR sector 1. B).

3.1 Energy Industries (1. A. 1)

This chapter describes the methods and data needed to estimate emissions from NFR Sector 1A1 Energy industries. The activity covers combustion and conversion of fuels to produce energy, for example electricity or heat from point sources:

NFR Codes:

1A1a Public electricity and heat production
1A1b Petroleum refining
1A1c Manufacture of solid fuels

Public electricity and heat production is the most important category in this sub-sector. The other two categories consist mainly of fuel consumption in one refinery (closed in 2004) and in fuel consumption for coal mining activities and gas extraction.

3.1.1 Public electricity and heat production

NFR Code 1A1a

Until 2015 there have been three big point sources in the Republic of Slovenia, which represented the backbone of the production of electrical energy from thermal power plants: Šoštanj Thermal Power Plant (TEŠ), Trbovlje Thermal Power Plant (TET) and Termoelektrarna Ljubljana (TE-TOL). All three plants have used coal for the production of electrical energy. Two of these thermal power plants, TEŠ and TET, are located beside coal pits. Since 2003, TE-TOL uses exclusively imported coal with high net calorific value and low sulphur contents for the production of electrical energy and heat.
In 2014, TET power plant was closed down. There are only two thermal power plants in operation since 2015.

Table 3.1.1.1 Public electricity and Combined Heat and Power Plants in Slovenia

Power plant	Location	Unit	Year	Power (MW)	Main fuel type
TEŠ	Šoštanj	A/1	1956-2010	30.0	Lignite from Velenje
TEŠ	Šoštanj	A/2	1956-2008	30.0	Lignite
TEŠ	Šoštanj	A/3	1960-2014	75.0	Lignite
TEŠ	Šoštanj	Unit 4	1972	275.0	Lignite
TEŠ	Šoštanj	Unit 5	1977	345.0	Lignite
TEŠ	Šoštanj	Unit 6	2016	600.0	Lignite
TEŠ	Šoštanj	Gas units	2008	2 x 42.0	Natural gas
TE-TOL	Ljubljana	D/1	1966	136.0	Imported coal
TE-TOL	Ljubljana	D/2	1967	126.0	Imported coal
TE-TOL	Ljubljana	D/3	1984	202.0	Imported coal, since 2008 also wood
TET	Trbovlje	F/4	1968-2014	125.0	Coal, mostly domestic brown coal

Besides thermal power plants, we have also one small plant Brestanica – TEB which use natural gas and operate mainly as a backup plant when more electricity is needed or when any other plant is on refit.

Methodology

To estimate emissions from Public Electricity and Heat Production, the following methodologies have been adopted:

$E = m \times NCV \times EF$ *Equation 1*

E - emission (g)
m - quantity of fuel combusted (t)
NCV - net calorific value (TJ/kt)
EF - emission factor per energy of fuel (g/GJ)

$E = m \times EF$ *Equation 2*

E - emission (g)
m - quantity of fuel combusted (t)
EF - emission factor per quantity of fuel (g/t)

To estimate SO_x emissions in same cases the following two equations for calculation of EF were used:

$EF_{SOx} = [S] \times 20000 / NCV$ *Equation 3*

EF_{SOx} - SO_x emission factor (g/GJ)
[S] – sulphur content of the fuel (% w/w)
NCV - net calorific value (GJ/t)
2 – ratio of the relative molecular mass of SO_2 to sulphur

$EF_{SOx} = [S] \times 19000 / NCV$ *Equation 4*

EF_{SOx} - SO_x emission factor (g/GJ)
[S] – sulphur content of the fuel (% w/w)
NCV - net calorific value (GJ/t)
1.9 – ratio of the relative molecular mass of SO_2 to sulphur, considering 5 % absorption in the ash

Activity data

The main source of data for all energy industries in the Republic of Slovenia for the period 1980 - 2003 is LEG (Annual Energy Statistics of the Energy Sector of the Republic of Slovenia). As LEG was not published early enough to enable us to calculate national inventory on time in 2005 we have for the first time received data directly from the Statistical Office of the Republic of Slovenia (SORS) in electronic format before they are published. This excel sheets are going to be our source of data for all fuel consumption in the future. Since 2005 all public power plants are included in ETS and verified reports from ETS have been used as the data source.

Emissions from the category “Other fuels” have arisen from Slovenian only waste incineration thermal plant which has started to work in 2009. Data on the amount of incinerated waste, NCVs and distribution between biogenic and other waste have been obtained directly from the plant. It shows up that most of the waste in non-biogenic parts of the waste is plastics.

Data on fuel consumption by type and year are reported in Annex 1 to the IIR (Table 1.1: Fuel used in Energy industries).

Net calorific values

Net calorific values (NCV) have been taken from SORS except for coal since 2005 when all three thermal power plants were included in the ETS and very detailed data on NCV become available. The values for solid fuel vary from year to year but for the liquid and gaseous fuel almost the same values have been used for the entire period as these types of fuel do not change a lot from year to year.

Table 3.1.1.2 NCVs for the fuel used in the energy industry

Year	Lignite – domestic	Sub-bituminous Coal - domestic	Sub-bituminous Coal - imported	Residual Fuel Oil	Heavy Fuel Oil	Liquefied Petroleum Gas (LPG)	Natural Gas	Wood and Other Biomass	Waste
	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/Mm3	TJ/kt	TJ/kt
1980	9,360	12,980		41,800	39,700		33,500	12,170	
1981	9,330	11,570		41,800	39,700		34,100	12,170	
1982	9,330	11,570		41,900	39,800		33,490	12,170	
1983	9,610	11,180		41,900	39,800		33,800	12,170	
1984	9,590	11,420		41,900	40,000		33,500	12,170	
1985	9,430	11,690		41,900	39,800		33,500	12,170	
1986	9,390	11,880		41,820	39,740	43,190	33,500	12,170	
1987	9,650	11,820		41,780	39,800	42,870	33,500	12,170	
1988	9,440	12,000		41,710	39,800	43,100	34,080	12,170	
1989	9,820	12,050		41,850	39,800	43,070	34,100	12,170	
1990	9,810	12,760		41,870	39,800	43,070	34,100	12,170	
1991	9,980	12,879		41,880	39,800	43,170	34,100	12,170	
1992	10,260	12,589		41,900	39,900	43,100	34,100	12,170	
1993	10,070	12,050		41,900	39,800	46,050	34,100	12,170	
1994	9,960	12,666		41,900	39,860	46,050	34,100	12,170	
1995	10,220	11,250	17,410	41,900	40,000	46,050	34,100	12,170	
1996	9,690	11,300	17,410	41,900	40,000	46,050	34,100	12,170	
1997	9,610	11,300	17,360	41,900	40,000	46,050	34,080	12,170	
1998	10,010	11,230	17,760	41,900	40,000	46,050	34,080	12,170	
1999	9,690	11,110	17,560	41,900	40,000	46,050	34,080	12,170	
2000	10,170	11,230	17,940	41,900	40,000	46,050	34,080	12,170	
2001	10,660	10,660	17,940	41,900	40,000	46,050	34,080	12,170	
2002	10,350	11,220	18,380	41,900	40,000	46,050	34,080	12,170	
2003	10,138	11,560	18,310	41,900	40,000	46,050	34,080	12,170	
2004	10,301	11,680	18,676	42,600	41,420	46,050	34,080	12,170	
2005	10,803	11,724	18,180	42,600	41,420	46,050	34,080	10,714	
2006	11,132	10,880	18,874	41,900	40,000	46,050	34,072	12,170	
2007	11,258	11,629	18,275	42,634	41,374	46,050	34,078	9,141	
2008	10,949	10,641	17,735	42,600	41,420	46,050	34,096	11,511	
2009	10,894	11,094	17,872	42,600	41,420	46,050	34,074	11,128	27,800
2010	11,097	12,815	18,130	42,600	41,420	46,050	34,080	9,871	27,800
2011	11,068	11,935	18,428	42,600	41,420	46,050	34,087	10,267	27,800
2012	10,616	11,778	18,524	42,600	41,420	46,050	34,093	10,560	27,800
2013	11,591	11,946	18,457	42,600	41,420	46,050	34,079	10,193	27,762
2014	10,823	11,727	18,655	42,600	41,420	46,050	34,083	11,282	27,762
2015	11,418		18,629	42,600		46,050	34,086	10,957	26,700

2016	11,733		18,595	42,600		46,050	34,087	10,896	26,700
2017	11,640		18,230	42,600		46,050	34,085	11,310	26,700
2018	11,521		18,238	42,600		46,050	34,084	10,963	26,700
2019	11,716		18,247	42,600		46,050	34,081	10,874	26,700
2020	11,329		17,929	42,600		46,050	34,087	11,063	26,700
2021	11,447		17,881	42,600		46,050	34,086	10,082	26,700

Emission factors

County specific emissions factors were used for emission calculations of NO_x, SO_x, CO and particulate matter for the period 1980 – 2008 for domestic lignite, domestic sub-bituminous coal and imported sub-bituminous coal. Country specific emission factors were obtained from Electro Institute Milan Vidmar.

For the period 2009-2021 direct emissions of NO_x, SO_x, CO and TSP have been taken from REMIS database, established and handled by Slovenian Environmental Agency. These data represent plant specific values. Emissions of PM_{10} and $PM_{2.5}$ have been calculated from TSP emissions. Ratios 0,9=EPM_{10}/ETSP and 0,8=$EPM_{2.5}$/ETSP were used for emissions estimations. Emissions of BC was estimated from $PM_{2.5}$ emissions using information from EMEP/EEA Emission Inventory Guidebook, 2019.

REMIS database is obtained in compliance with Rules on initial measurements and operational monitoring of the emission of substances into the atmosphere from the stationary pollution sources and on the conditions for their implementation (OJ RS, No. 105/08 and 44/22 – ZVO-2). Each year all obligators must provide a report on the implementation of emission monitoring of substances into the air. Annual emission report includes emissions of substances into the air. These emissions data are direct measurements of emissions into the air and reflect plant specific values.

According to the 2017 in-depth EU NECD review, a thorough examination of annual emissions reported by operators was performed. All operators were checked individually. We carried out a survey for each company and we eliminated the risk of misinterpretation of measurement data. It was confirmed that the values that we used for the estimation of national emissions are not validated average values with the confidence limits subtracted. Reported data in Slovenian national inventory are raw measured values. Data used for NECD and CLRTAP reporting are not processed or changed in any way. The national emissions are not underestimated.

The validated average values where confidence interval is subtracted are used for another purpose, this is for the determination of exceeding the emission limit values. Those data are not used for reporting national emissions.

Table 3.1.1.3 National emission factors for NO_x, SO_x, CO, $PM_{2.5}$, PM_{10}, TSP for domestic lignite from Velenje pit until 2008

Year/ polutant	NO_X	SO_x	CO	PM_{10}	$PM_{2.5}$	TSP
Unit	**g/GJ**	**g/GJ**	**g/GJ**	**g/GJ**	**g/GJ**	**g/GJ**
1980	364,85	2638,89	13,78			
1981	368,97	2647,37	14,45			
1982	356,81	2647,37	13,31			
1983	346,68	2570,24	12,84			
1984	349,12	2575,60	13,01			
1985	342,26	2619,30	12,83			
1986	344,39	2630,46	12,57			

1987	363,89	2559,59	13,48			
1988	351,48	2616,53	12,82			
1989	372,76	2515,27	14,20			
1990	346,05	2517,84	13,19			
1991	319,35	2474,95	12,93			
1992	271,16	2407,41	13,04			
1993	292,99	2452,83	13,22			
1994	314,32	2479,92	13,41			
1995	269,89	1378,66	20,29			
1996	295,55	1489,82	18,19			
1997	298,06	1367,70	19,01			
1998	290,92	1339,51	17,86			
1999	251,85	1319,67	16,26			
2000	273,86	1170,24	14,26	9,123	4,257	12,164
2001	268,50	425,71	16,31	8,251	3,851	11,002
2002	283,91	508,67	20,69	10,542	4,920	14,056
2003	264,14	322,49	24,98	8,707	4,063	11,609
2004	206,29	184,91	30,21	7,308	3,411	9,744
2005	208,61	238,46	19,79	5,742	2,680	7,656
2006	205,27	139,30	18,59	2,667	1,244	3,556
2007	183,93	115,12	27,33	3,415	1,594	5,533
2008	188,61	103,87	23,20	3,664	1,710	4,886

Table 3.1.1.4 National emission factors for NO_x, SO_x, $PM_{2.5}$, PM_{10} and TSP for domestic sub-bituminous from Trbovlje coalmine until 2008

Year/ polutant	NO_X	SO_x	PM_{10}	$PM_{2.5}$	TSP
Unit	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ
1980	225,86	2927,58			
1981	226,21	3284,36			
1982	233,71	3284,36			
1983	238,61	3398,93			
1984	242,16	3327,50			
1985	265,12	3250,64			
1986	231,83	3198,65			
1987	235,22	3214,89			
1988	231,65	3166,67			
1989	199,05	3153,53			
1990	212,25	2978,06			
1991	185,24	2950,45			
1992	220,48	3018,57			
1993	237,27	3153,53			
1994	223,03	3000,16			
1995	192,96	3377,78			
1996	201,32	3867,26			
1997	216,58	4203,54			
1998	190,01	4229,74			
1999	253,21	4275,43			
2000	247,92	4229,74	36,529	17,047	48,706
2001	187,97	4099,44	35,908	16,757	47,878
2002	239,31	3894,83	34,700	26,000	39,232

2003	233,06	4602,08	34,281	15,998	45,708
2004	282,08	4554,79	41,526	19,379	55,368
2005	243,15	3076,35	39,796	18,571	53,061
2006	235,43	284,07	7,507	3,503	10,009
2007	197,54	296,93	10,145	4,734	13,527
2008	190,00	289,40	15,991	7,463	21,322

Table 3.1.1.5 National emission factors for NO_x, $PM_{2.5}$, PM_{10}, TSP and sulphur content for imported sub-bituminous coal until 2008

Year/ polutant	NO_X	PM_{10}	$PM_{2.5}$	TSP	SO_x *Equation 4*
Unit	**g/GJ**	**g/GJ**	**g/GJ**	**g/GJ**	**[S] (% w/w)**
1990					
1991					
1992					
1993					
1994					
1995	200,00				1,60
1996	220,00				1,60
1997	280,00				1,60
1998	280,00				0,12
1999	230,00				0,12
2000	210,00	8,000	6,000	9,000	0,12
2001	220,00	8,000	6,000	9,000	0,12
2002	190,00	13,648	6,369	18,197	0,07
2003	180,00	6,460	3,015	8,613	0,09
2004	164,02	6,246	2,915	8,328	0,09
2005	162,97	6,994	3,264	9,326	0,14
2006	177,38	6,090	2,842	8,119	0,14
2007	154,61	2,539	1,185	3,386	0,14
2008	156,86	3,554	1,659	4,739	0,10

In calculating emissions of other individual gases, following emission factors have been used:

Table 3.1.1.6 Emission factors used for domestic lignite and domestic sub-bituminous coal for the period 1990 - 2021

Pollutant	Value	Unit	References
NMVOC	1,4	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cd	1,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Pb	15	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Hg	2,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
As	14,3	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cr	9,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cu	1,0	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16

Ni	9,7	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Se	45	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Zn	8,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Dioxins/ Furans	10	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(a)pyrene	1,3	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(b)fluoranthene	37	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(k)fluoranthene	29	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Indeno(1,2,3-cd)pyrene	2,1	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
HCB	6,7	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
CO	8,7 (except for domestic lignite, see Table 3.1.1.3)	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16

Table 3.1.1.7 Emission factors used for imported sub-bituminous coal for the period 1995 - 2021

Pollutant	Value	Unit	References
NMVOC	1,0	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Cd	0,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Pb	7,3	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Hg	1,4	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
As	7,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Cr	4,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Cu	7,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Ni	4,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Se	23	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Zn	19	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Dioxins/ Furans	10	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Benzo(a)pyrene	0,7	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Benzo(b)fluoranthene	37	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Benzo(k)fluoranthene	29	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Indeno(1,2,3-cd)pyrene	1,1	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
HCB	6,7	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15

Emission factor for Hg was corrected for domestic lignite and domestic sub-bituminous coal. Correction of EF was performed due to use of flue-gas desulfurization device. Prescribed emission factor without flue-gas desulfurization applied is 2,9 mg/GJ. Estimation of Hg capture by currently installed pollution control equipment range from 47-81 % Hg capture for electrostatic precipitators and flue-gas desulfurization.

Table 3.1.1.8 Emission factors used for heavy fuel oil for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	142	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
SO_x	*Equation 3*	[S] (% w/w), see Table 3.1.1.10	Slovene national legislation relating quality of liquid fuels
CO	15,1	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
NMVOC	2,3	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
PM_{10}	25,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
$PM_{2.5}$	19,3	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
TSP	35,4	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
BC	1,081	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Cd	1,2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Pb	4,56	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Hg	0,341	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
As	3,98	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Cr	2,55	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Cu	5,31	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Ni	255	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Se	2,06	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Zn	87,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Dioxins/ Furans	2,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Benzo(b)fluoranthene	4,5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Benzo(k)fluoranthene	4,5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Indeno(1,2,3-cd)pyrene	6,92	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18

Table 3.1.1.9 Emission factors used for residual fuel oil for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	65	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
SO_x	*Equation 3*	[S] (% w/w), see Table 3.1.1.10	Slovene national legislation relating quality of liquid fuels
CO	16,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19

NMVOC	0,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
PM_{10}	3,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
$PM_{2.5}$	0,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
TSP	6,5	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
BC	0,268	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Cd	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Pb	4,07	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Hg	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
As	1,81	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Cr	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Cu	2,72	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Ni	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Se	6,79	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Zn	1,81	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Dioxins/ Furans	0,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Indeno(1,2,3-cd)pyrene	6,92	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19

Table 3.1.1.10 Sulphur content in residual fuel oil and heavy fuel oil for 1980 - 2021

Fuel	Heavy fuel Oil	Residual fuel Oil	Fuel	Heavy fuel Oil	Residual fuel Oil
Year	[S] (% w/w)	[S] (% w/w)	year	[S] (% w/w)	[S] (% w/w)
1980	3,0	1,2	2001	1,0	0,2
1981	3,0	1,2	2002	1,0	0,2
1982	3,0	1,2	2003	1,0	0,2
1983	3,0	1,2	2004	1,0	0,2
1984	3,0	1,2	2005	1,0	0,2
1985	3,0	1,2	2006	1,0	0,2
1986	3,0	1,2	2007	1,0	0,2
1987	3,0	1,2	2008	1,0	0,1
1988	3,0	1,2	2009	1,0	0,1
1989	3,0	1,2	2010	1,0	0,1
1990	3,0	1,2	2011	1,0	0,1
1991	3,0	1,2	2012	1,0	0,1
1992	3,0	1,2	2013	1,0	0,1
1993	3,0	1,2	2014	1,0	0,1
1994	3,0	1,2	2015	1,0	0,1
1995	1,5	0,5	2016	1,0	0,1
1996	1,0	0,2	2017	1,0	0,1
1997	1,0	0,2	2018	1,0	0,1

1998	1,0	0,2	2019	1,0	0,1
1999	1,0	0,2	2020	1,0	0,1
2000	1,0	0,2	2021	1,0	0,1

Table 3.1.1.11 Emission factors used for natural gas, biogas and liquefied petroleum gas for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
CO	39	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
SOx	0,281	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
NMVOC	2,6	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
PM_{10}	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
$PM_{2.5}$	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
TSP	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
BC	0,0223	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cd	0,00025	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Pb	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Hg	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
As	0,12	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cr	0,00076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cu	0,000076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Ni	0,00051	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Se	0,0112	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Zn	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Dioxins/ Furans	0,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(a)pyrene	0,56	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(b)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(k)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Indeno(1,2,3-cd)pyrene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17

Table 3.1.1.12 Emission factors used for wood and other biomass for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	81	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
CO	90	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20

NMVOC	7,31	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
SO_x	10,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
PM_{10}	155	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
$PM_{2.5}$	133	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
TSP	172	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
BC	4,389	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Cd	1,76	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Pb	20,6	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Hg	1,51	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
As	9,46	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Cr	9,03	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Cu	21,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Ni	14,2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Se	1,2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Zn	181	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Benzo(a)pyrene	1,12	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Benzo(b)fluoranthene	0,043	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Benzo(k)fluoranthene	0,0155	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Indeno(1,2,3-cd)pyrene	0,0374	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
Dioxins/ Furans	50	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
PCB	3,5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20
HCB	5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-7, pg 20

Table 3.1.1.13 Emission factors used for waste 2009 - 2021

Pollutant	Value	Unit	References
NO_x	0,87	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
SO_x	0,047	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
CO	0,07	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
NMVOC	7,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
$PM_{2.5}$	0,004	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
PM_{10}	0,007	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
TSP	0,01	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10

BC	0,00014	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
Cd	0,1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
Hg	0,056	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
Pb	1,3	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
As	0,016	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
Ni	0,14	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
Dioxins/ Furans	1	microg I-TEQ/t	Plant specific
Total 4 PAHs	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10
HCB	0,002	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Industrial waste incineration, Table 3-1, pg 10

Data on particulate matter from hard and brown coal, heavy fuel oil and gas oil, biomass and gaseous fuel include filterable emissions. But there is no information on whether PM emission factors used for waste include or exclude condensable components.

Emissions

Public electricity and heat production are important sources of SO_x emissions. It contributed almost 40 % to total national emissions in 2021. It was an even bigger SO_x polluter before the introduction of flue gas desulphurization devices and gas turbines in power cogeneration plants. Emissions of most pollutants have decreased in the last decades due to improvements in technologies, implementation of abatement techniques and fuel switching to cleaner fuels. Energy industries are important sources of Se, As and HCB. They contributed 92, 85 and 61 % to the national totals.

Category-specific QA/QC and verification

In 2005, all thermal power plants in the Republic of Slovenia have carried out regular coal sampling and determined the carbon contents in accordance with the Monitoring guidelines for monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of European Parliament and of the Council and all amending directive, necessary for CO_2 emission trading on the territory of the European Union. The monitoring of fuel in four plants under EU-ETS is defined in the permit and accompanied monitoring plan. Each fuel is monitored with maximum uncertainty which depends on total GHG emissions from the plant and typical consumption of a particular fuel. All three plants have to monitor the coal consumption on a higher level of accuracy and determine NCV and carbon content in the accredited laboratory for every batch of fuel. The fourth plant is using natural gas as a main fuel.

For three thermal power plants the aggregated solid fuel from SORS data is compared with the sum of fuel used from verified ETS reports. The NCV values are also checked. In case these numbers are not the same as in ETS, data from ETS is taken into account and notification to SORS is made.

Additional QA activity is the reference approach. Before entering data into a database, the sum of each fuel from disaggregated data is compared with energy balance data, reported in the Joint Questioner. As data in JQ are rounded to 1000 units, the difference should be 500 units or less. If it is higher, the reasons for this should be found.

According to the 2017 in-depth EU NECD review, a thorough examination of annual emissions reported by operators was performed. All operators were checked individually. We carried out a survey for each company and we eliminated the risk of misinterpretation of measurement data. It was confirmed that the values that we used for the estimation of national emissions are not validated average values with the confidence limits subtracted. Reported data in Slovenian national inventory are raw measured values. Data used for NECD and CLRTAP reporting are not processed or changed in any way. The national emissions are not underestimated.

Information on a condensable component of particulate matter was introduced into IIR 2019 for the first time. A table summarising whether PM_{10} and $PM_{2.5}$ emission factors for each source sector include or exclude the condensable component and references for their emission factors are presented in Annex 2 to the IIR 2023.

According to the 2019 in-depth EU NECD emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 were used for emissions calculation.

In addition, notation keys were revised as well. NFR tables were checked and corrected, if necessary.

Recalculations

Emissions of $PM_{2.5}$, PM_{10}, TSP and BC have been recalculated for the period 2008-2020 due to mistakes found in importing data to the reporting tables. The error was found during QA/QC procedure.

Future improvements

No improvements are planned for the next submission.

3.1.2 Petroleum refining

NFR Code 1A1b

The main representative of this category was the company the Nafta Lendava Refinery, Slovenian only refinery that stopped oil refining in 2002. According to the statistical methodology in the period 1986-1996, this sector also included quantities of fuels that were consumed for the production of electric energy in this sector.

Emissions of all pollutants from this sector were insignificant in the period 1980-2003. Since the only petroleum refinery was closed in 2003, no emissions have occurred from this category after 2003. Notation key “NO” (not occurring) have been used since 2004 for this sector.

Methodology

To estimate emissions from Petroleum Refining, the same methodology as in Energy Industries was used.

Activity data

Data on the consumption of fuels in this sector for the period 1986-2003 have been collected in LEG (Annual Energy Statistics of the Energy Sector of the Republic of Slovenia).

For the period 1986-1996 under “Oil Industry”.

From 1997-2003 under “DF–Production of coke, refined petroleum products and nuclear fuel”:

- for the consumption of liquid fuels Table Tg/3 or Table Pg/6 for LPG
- for the consumption of solid fuels Table Pr/6
- for the consumption of gaseous fuels Table Pg/6

After 1996, data on the consumption in this sector have been included in the industrial sector DF – Production of coke, refined petroleum products, and nuclear fuel. With regard to the fact, there is neither production of coke nor nuclear fuel in the Republic of Slovenia, data for the period 1997-2003 are comparable to the data from the period 1986-1996.

Data for the period 1980-1985 have been estimated.

Data on fuel consumption by type and year are reported in Annex 1 to the IIR (Table 1.1: Fuel used in Energy industries).

Net calorific values

Net calorific values have been taken from the Statistical Office of the Republic of Slovenia.

Table 3.1.2.1 NCVs for the fuel used in petroleum refining

Year	Residual Fuel Oil	Heavy Fuel Oil	Natural gas
	TJ/kt	TJ/kt	TJ/Mm3
1980	41,82	39,74	33,50
1981	41,82	39,74	33,50
1982	41,82	39,74	33,50
1983	41,82	39,74	33,50
1984	41,82	39,74	33,50
1985	41,82	39,74	33,50
1986	41,82	39,74	33,50
1987	41,78	39,80	33,50
1988	41,71	39,80	34,08
1989	41,85	39,80	34,10
1990	41,87	39,80	34,10
1991	41,88	39,80	34,10
1992	41,90	39,90	34,10
1993	41,90	39,80	34,10
1994	41,90	39,86	34,10
1995	41,90	40,00	34,10
1996	41,90	40,00	34,10
1997	41,90	40,00	34,08
1998	41,90	40,00	34,08
1999	41,90	40,00	34,08
2000	41,90	40,00	34,08
2001	41,90	40,00	34,08
2002	41,90	40,00	34,08
2003	41,90	40,00	34,08

Emission factors

For calculating emissions of individual gases in petroleum refining following emission factors have been used:

Table 3.1.2.2 Emission factors used for heavy fuel oil for 1980 – 2003

Pollutant	Value	Unit	References
NO_x	142	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
SO_x	*Equation 3*	[S] (% w/w), see Table 3.1.1.10	Slovene national legislation relating quality of liquid fuels
CO	15,1	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
NMVOC	2,3	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
PM_{10}	25,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
$PM_{2.5}$	19,3	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
TSP	35,4	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
BC	1,081	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Cd	1,2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Pb	4,56	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Hg	0,341	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
As	3,98	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Cr	2,55	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Cu	5,31	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Ni	255	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Se	2,06	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Zn	87,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Dioxins/ Furans	2,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Benzo(b)fluoranthene	4,5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Benzo(k)fluoranthene	4,5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18
Indeno(1,2,3-cd)pyrene	6,92	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-5, pg 18

Table 3.1.2.3 Emission factors used for residual fuel oil for 1980 - 2003

Pollutant	Value	Unit	References
NO_x	65	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
SO_x	*Equation 3*	[S] (% w/w), see Table 3.1.1.10	Slovene national legislation relating quality of liquid fuels

CO	16,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
NMVOC	0,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
PM_{10}	3,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
$PM_{2.5}$	0,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
TSP	6,5	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
BC	0,268	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Cd	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Pb	4,07	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Hg	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
As	1,81	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Cr	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Cu	2,72	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Ni	1,36	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Se	6,79	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Zn	1,81	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Dioxins/ Furans	0,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19
Indeno(1,2,3-cd)pyrene	6,92	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-6, pg 19

Table 3.1.2.4 Emission factors used for natural gas for 1980 - 2001

Pollutant	Value	Unit	References
NOx	89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
CO	39	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
SOx	0,281	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
NMVOC	2,6	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
PM10	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
PM2.5	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
TSP	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
BC	0,0223	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cd	0,00025	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Pb	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Hg	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
As	0,12	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17

Cr	0,00076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cu	0,000076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Ni	0,00051	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Se	0,0112	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Zn	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(a)pyrene	0,56	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(b)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(k)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Indeno(1,2,3-cd)pyrene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Dioxins/ Furans	0,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17

TSP, PM_{10}, $PM_{2.5}$ emission factors represent filterable PM emissions.

Category-specific QA/QC and verification

The source category QA/QC for this sector was performed as explained in the Public electricity and heat production sector.

Recalculations

No recalculations were performed since the last submission.

Future improvements

No improvements are planned for the next submission.

3.1.3 Manufacture of solid fuels and other energy industries

NFR Code 1A1c

Emissions of all pollutants from this sector are insignificant. This sector contributed in the year 2021 less than 0,002 % to total national emissions.

Methodology

To estimate emissions from the Manufacture of solid fuels and Other energy Industries the same methodology as in Energy Industries was used.

Activity data

Consumptions according to individual energy products are collected in LEG tables as follows:
For the period 1986-1996 under “Coal-mining”.
From 1997 onwards under “CA–Production of energy commodities”:
- for the consumption of liquid fuels Table Tg/3 or Table Pg/6 for LPG

- for the consumption of solid fuels		Table Pr/6
- for the consumption of gaseous fuels	Table Pg/6

Since 2004, data are available in the excel files from SORS.
In the period 2004 - 2007 according to the old SKD classification the following SKD categories have been included in this category:

CA10 Mining of coal and lignite
CA11 Extraction of crude petroleum and natural gas including support activities
DF Production of coke, refined petroleum products and nuclear fuel

Since 2008, the new SKD_2008 classification has been used and the following categories have been included in this category:

B05 Mining of coal and lignite
B06 Extraction of crude petroleum and natural gas
B09.1 Support activities for petroleum and natural gas mining
C19.1 Manufacturing of coke oven products - do not exist in Slovenia.
C19.2 Manufacturing of refined petroleum products

In the year 2021 only natural gas was consumed in this sector. Data on fuel consumption by type and year are reported in Annex 1 to the IIR (Table 1.1: Fuel used in Energy industries).

Net calorific values

Net calorific values have been taken from the Statistical Office of the Republic of Slovenia.

Table 3.1.3.1 NCVs and % S for the fuel used in Manufacture of solid fuels and other energy Industries

Year	Sub-bituminous Coal - domestic	Sub-bituminous Coal - imported	Residual Fuel Oil	Heavy Fuel Oil	LPG	Natural Gas	Sub-bituminous Coal - domestic	Sub-bituminous Coal - imported
	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/Mm3	[S] (% w/w)	[S] (% w/w)
1986	11,88		41,82		46,00	33,500	1,600	
1987	11,82		41,78		46,00	33,500	1,600	
1988	12,00		41,71		46,00	34,080	1,600	
1989	12,05		41,85		46,00	34,100	1,600	
1990	12,76		41,87		46,00	34,100	1,600	
1991	12,88		41,88		46,00		1,600	
1992	12,59		41,90	39,90	46,00	34,100	1,600	
1993	13,35		41,90		46,00	34,100	1,600	
1994	12,67		41,90		46,00		1,600	
1995		17,40	41,90		46,00	34,100		1,600
1996		16,35	41,90		46,00			1,600
1997		17,71			46,05			1,600
1998		20,66	41,90					0,120
1999		20,81	41,90					0,120
2000		20,78	41,90					0,120
2001		20,95	41,90					0,120
2002			41,90					
2003			41,90					
2004			41,90		46,05			
2005			42,60	41,42	46,05			

2006			41,90	40,00	46,05	34,080		
2007			42,61	41,42	46,11			
2008			42,60	41,12	46,05	34,096		
2009			42,60			34,080		
2010			42,60			34,080		
2011			42,60			34,087		
2012			42,60			34,093		
2013			42,60			34,079		
2014						34,083		
2015						34,086		
2016						34,087		
2017						34,085		
2018						34,084		
2019						34,081		
2020						34,087		
2021						34,086		

Emission factors

For calculating emissions of individual gases in the manufacture of solid fuels and other energy industries emission factors used for residual fuel oil, heavy fuel oil and natural gas are the same as stated in chapter petroleum refining (Tables 3.1.2.2 - 3.1.2.4). Emission factors used for domestic sub-bituminous coal, imported sub-bituminous coal and liquefied petroleum gas are presented in Table 3.1.3.2, Table 3.1.3.3. and Table 3.1.3.4.

Table 3.1.3.2 Emission factors used for domestic sub-bituminous coal for 1986 - 1994

Pollutant	Value	Unit	References
NO_x	247	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
SO_x	*Equation 4*	[S] (% w/w,) See Table 3.1.3.1	Slovene national legislation relating quality of liquid fuels
CO	8,7	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
NMVOC	1,4	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
PM_{10}	7,9	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
$PM_{2.5}$	3,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
TSP	11,7	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
BC	0,032	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cd	1,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Pb	15	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Hg	2,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
As	14,3	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cr	9,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cu	1,0	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16

Ni	9,7	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Se	45	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Zn	8,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Dioxins/ Furans	10	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(a)pyrene	1,3	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(b)fluoranthene	37	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(k)fluoranthene	29	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Indeno(1,2,3-cd)pyrene	2,1	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
HCB	6,7	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16

Table 3.1.3.3 Emission factors used for imported sub-bituminous coal for 1995 – 2001

Pollutant	Value	Unit	References
NO_x	209	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
SO_x	*Equation 4*	[S] (% w/w,) See Table 3.1.3.1	Slovene national legislation relating quality of liquid fuels
CO	8,7	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
NMVOC	1,0	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
PM_{10}	7,7	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
$PM_{2.5}$	3,4	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
TSP	11,4	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
BC	0,0748	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Cd	0,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Pb	7,3	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Hg	1,4	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
As	7,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Cr	4,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Cu	7,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Ni	4,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Se	23	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Zn	19	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Dioxins/ Furans	10	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Benzo(a)pyrene	0,7	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15

Benzo(b)fluoranthene	37	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Benzo(k)fluoranthene	29	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
Indeno(1,2,3-cd)pyrene	1,1	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15
HCB	6,7	microg /GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-2, pg 15

Table 3.1.3.4 Emission factors used for liquefied petroleum gas for 1986 - 2008

Pollutant	Value	Unit	References
NOx	89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
CO	39	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
SOx	0,281	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
NMVOC	2,6	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
PM10	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
PM2.5	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
TSP	0,89	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
BC	0,0223	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cd	0,00025	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Pb	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Hg	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
As	0,12	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cr	0,00076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Cu	0,000076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Ni	0,00051	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Se	0,0112	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Zn	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(a)pyrene	0,56	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(b)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Benzo(k)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Indeno(1,2,3-cd)pyrene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17
Dioxins/ Furans	0,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-4, pg 17

TSP, PM_{10}, $PM_{2.5}$ emission factors represent filterable PM emissions.

Category-specific QA/QC and verification

The source category QA/QC for this sector was performed as explained in the Public electricity and heat production sector.

Recalculations

No recalculations were performed since the last submission.

Future improvements

No improvements are planned for the next submission.

3.2 Combustion in manufacturing industries and construction (1. A. 2)

3.2.1 Stationary Combustion in manufacturing industries and construction

Sectors covered in this chapter are:

NFR Codes:

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
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals
1A2gviii	Stationary combustion in manufacturing industries and construction: Other

This chapter presents the consumption of fuels and emissions of air pollutants in six specific types of industry, all other industries are hidden under NFR Code 1A2gviii, Stationary combustion in manufacturing industries and construction: Other. NFR Code 1A2gviii includes a big number of enterprises. In addition, fuel for construction is included under 1A2gviii: Other, except diesel and gasoline. Diesel and gasoline are included under 1A2gvii: Mobile Combustion in manufacturing industries and construction.

Emissions

Combustion in manufacturing industries and the construction sector is a significant source of emissions. In 2021 contributed about 22 % to total national SO_x emissions, 14 % to NO_x, 6 % to NMVOC, up to 10 % to particulates. It is a very important source of heavy metals: 35 % Hg, 12 % Zn, 10 % Cd, 8 % Cr and individual PAHs (up to 18 %). Emissions of almost all pollutants have declined in the last decades due to improvements in technologies, implementation of abatement techniques and fuel switching to cleaner fuels.

Methodology

To estimate emissions from combustion in manufacturing industries and construction the following formulas have been used:

$$E = m \times NCV \times EF \qquad \textit{Equation 1}$$

E - emission (g)
m - quantity of fuel combusted (t)
NCV - net calorific value (TJ/kt)
EF - emission factor per energy of fuel (g/GJ)

$$E = m \times EF \qquad \textit{Equation 2}$$

E - emission (g)
m - quantity of fuel combusted (t)
EF - emission factor per quantity of fuel (g/t)

To estimate SO_x emissions in some cases the following two equations for calculation of EF were used:

$$EF_{SOx} = [S] \times 20000 / NCV \qquad \textit{Equation 3}$$

EF_{SOx} – SO_x emission factor (g/GJ)
[S] – sulphur content of the fuel (% w/w)
NCV - net calorific value (GJ/t)
2 – ratio of the relative molecular mass of SO_2 to sulphur

$$EF_{SOx} = [S] \times 19000 / NCV \qquad \textit{Equation 4}$$

EF_{SOx} - SO_x emission factor (g/GJ)
[S] – sulphur content of the fuel (% w/w)
NCV - net calorific value (GJ/t)
1.9 – ratio of the relative molecular mass of SO_2 to sulphur, considering 5 % absorption in the ash

Emissions from NFR Codes 1A2a, 1A2b, 1A2c, 1A2d, 1A2e and 1A2gviii were calculated according to a Tier 1 methodology.

Emissions from 1A2f were calculated as a combination of Tier 1 and a Tier 2 method. Emissions from cement production in 1A2f were calculated using Tier 2 method. Data on clinker produced and a Tier 2 emission factors were used for emission calculations. Emissions from other non-metallic minerals production in NFR 1A2f were estimated according to a Tier 1 method.

The total emission for this sub/sector is the sum of different industrial activities, using diverse fuels and combustion technologies.

Activity data

The fuel consumption in each category has to be determined in accordance with the classification of activities applied in the EMEP/EEA air pollutant emission inventory guidebook, 2019.

Period 1980 - 1996

Table 3.2.1.1 Conversion table between national energy statistics (LEG) and NFR category

NFR category	LEG Classification (1986-1996)
Iron and steel	Iron and Steel Production
Non-ferrous metals	Non-Ferrous Metals
Chemicals	Chemical Industry
Pulp. Paper and Print	Pulp and Paper Industry, Print Industry
Food processing. beverages and tobacco	Food Processing Industry, Tobacco Industry
Non-metallic minerals	Non-metal industry
Other	Metal Industry Shipbuilding Electrical Industry Construction Timber Industry Textile Industry Leather Industry Rubber Industry Recycling Other Industry

The classification applied in LEG has been taken as the basis and the conversion table between LEG and NFR is presented in Table 3.2.1.1.

Period 1997 - 2003

In 1997, LEG began to publish data according to the Standard Classification of Activities (SCA) which in some categories differs from the classification, which had been used until 1996. Most activities are defined in a similar manner, but this is not possible for certain activities. Table 3.2.1.2 shows the distribution of activities in accordance with the EMEP/EEA classification.

For consumption in individual industrial sectors, there are detailed (disaggregated) data, the values of which were strongly dependent on the mode of reporting and features of individual industrial sectors characterized by high concentration (values depending on the consumption in one or two factories) in Slovenia. Data from basic sources hint at some relatively big changes in the consumption of fuels in some sectors.

Table 3.2.1.2 Conversion table between national energy statistics (LEG) and NFR category

NFR category	LEG Classification – SCA category
Iron and steel	DJ - Production of metals and metal products
Non-ferrous metals	
Chemicals	DG - Production of chemicals
Pulp. Paper and Print	DE - Production of fibres, pulp, paper, and cardboard
Food processing. beverages and tobacco	DA – Production of food, beverages, and tobacco products
Non-metallic minerals	DI - Production of non-metal mineral products
Other	DB - Production of textiles
	DC - Production of leather and leather goods
	DD – Wood-processing and woodworking
	DH - Production of rubber products
	DK - Production of machines and devices
	DL - Production of electrical and optical equipment
	DM – Production of vehicles and vessels
	DN - Production of furniture. not included elsewhere
	F - Construction

Period 2004 - 2007

Since 2004 very detailed data about fuel consumption in the industry become available in electronic format. The non-energy and energy use of fuels is reported separately. Data about fuel consumption and NCV are reported on the lowest level of disaggregation possible. For this reason, from the year 2004 fuel consumption in the Iron and steel industry and in the Non-ferrous metals industry can be separated according to the rules presented in the following Table 3.2.1.3.

Table 3.2.1.3 Table for disaggregation of fuel in DJ sector (manufacture of basic metals and fabricated metal products)

SCA category	NFR category	Description
DJ 27.1	Iron and steel	Manufacture of basic iron and steel and of ferrous alloys
DJ 27.2	Iron and steel	Manufacture of tubes
DJ 27.3	Iron and steel	Other first processing of iron and steel
DJ 27.4	Non-ferrous metals	Manufacture of basic precious and non-ferrous metals
DJ 27.510	Iron and steel	Casting of iron
DJ 27.520	Iron and steel	Casting of steel
DJ 27.530	Non-ferrous metals	Casting of light metal
DJ 27.540	Non-ferrous metals	Casting of other non-ferrous metal
DJ 28	Other industry	Manufacture of fabricated metal products, except machinery and equipment

Period 2008 - 2021

Table 3.2.1.4 Conversion table between the NFR categories and The Standard Classification of Activities (SKD)

NFR category	**Description**
1.A.2.a Iron and steel	C 24.1 Manufacture of basic iron and steel and of ferrous alloys
	C 24.2 Manufacture of tubes, pipes, hollow profiles and related fittings, of steel
	C 24.3 Manufacture of other products of first processing of steel
	C 24.51 Casting of iron
	C 24.52 Casting of steel
1.A.2.b Non-ferrous metals	C 24.4 Manufacture of basic precious and non-ferrous metals
	C 24.53 Casting of light metal
	C 24.54 Casting of other non-ferrous metal
1.A.2.c Chemicals	C 20 Manufacture of chemicals and chemical products
1.A.2.d Pulp. Paper and Print	C 17 Manufacture of paper and paper products C 18 Printing and reproduction of recorded media
1.A.2.e Food processing, beverages and tobacco	C 10 Manufacture of food products C 11 Manufacture of beverages C 12 Manufacture of tobacco products
1.A.2.f Non-metallic minerals	C 23 Manufacture of other non-metallic mineral products
1.A.2.g.vii Off road vehicles and other machinery	F Construction (only gasoline and diesel fuel)
1.A.2.g.viii Other	C 13 Manufacture of textiles
	C 14 Manufacture of wearing apparel
	C 15 Manufacture of leather and related products
	C 16 Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials
	C 21 Manufacture of basic pharmaceutical products and pharmaceutical preparations
	C 22 Manufacture of rubber and plastic products

	C 25 Manufacture of metallic products
	C 26 Production of electrical and optical equipment
	C 27 Production of electrical equipment
	C 28 Production of machines and devices
	C 29 Production of vehicles
	C 30 Production of vessels
	C 31 Production of furniture
	C 32 Other manufacturing
	C 33 Repair and installation of machinery and equipment
	F Construction (all other fuels except diesel and gasoline)

In 2008 the new SCA (Standard Classification of Activities) was applied by SORS which was used until the present. The main advantage is that the new classification enables disaggregation of data on a much more detailed level. An important difference is that the "Manufacture of basic pharmaceutical products and pharmaceutical preparations" industry is no longer part of the Chemical industry and is included under the category Other. The conversion table between NFR and national energy statistics is presented in Table 3.2.1.4.

In industry, particularly in the cement industry, in addition to commonly used fuel, some waste is also incinerated because of the very high temperature in the oven. We have obtained very detailed data about the amount and composition of waste from one cement plant, where the main process of waste incineration in Slovenia was occurring. Since 2005, all waste fuels have also been included in ETS.

We had also obtained data from the pulp and paper industry about the consumption of black liquor from 2004 to 2006. NCV was between 6,1 and 6,4 TJ/kt. We used the same emissions factors for calculation as for wood. From 2007, there has been no consumption of black liquor anymore.

Inclusion of auto producers into Manufacturing Industries sector

In accordance with the IPCC Reference manual, the item Industry reports the consumption of fuels in the group of industrial power plants (auto producers – enterprises that generate electric energy for internal consumption and/or heat for sale) as well as other consumption in the industry (except in production processes). The same methodology was adopted also for emission calculation of air pollutants.

In the period 1986 -1996, consumption of fuels by auto producers in LEG was recorded under Electric utilities – Industry, and in the period 1997- 2003 under Conversion – Auto producers.

<u>Period 1986 - 2000</u>
Because there are no published data on auto producers at the level of industrial branches for the period 1986-2000, on the basis of which it would be possible to assign the consumption of fuel to each individual industrial branch, for each kind of fuel a different (most appropriate) approach was used.

Lignite
Total consumption is attributed to the pulp and paper industry. The paper mill in Krško used lignite in its power cogeneration plant. In the documents of the SORS, the total consumption is attributed to the consumption in thermal power plants, while in LEG one half of the consumption is attributed to the consumption in industry, the other half to industrial thermal power plants. In

this report, a half is reported as consumption in pulp and paper industry (heat), a half as consumption in industrial power plants in the pulp and paper industry. Consumption of lignite in other sectors has not been reported.

Brown Coal
Consumption of brown coal in industrial power plants in the monitored period was reported only in 1986. Since quantities are quite small, consumption is reported in the sector Other.

Residual Fuel Oil
Consumption of residual fuel oil in industrial power plants in the monitored period was low (from 0 to 10176 t). Since quantities are quite small, consumption is reported in sector Other.

Gas Oil and Natural Gas
The majority of industrial thermal power plants use gas oil or natural gas. Total quantities of consumed gas oil and natural gas are disaggregated according to the produced quantities of electric energy in those power plants.

Period 2000 - 2021
Since 2000 we have commenced treating auto producers individually, since the SORS, which prepares data for LEG, has completed its database. Now, aggregated data on the consumption of fuels by auto producers at the level of industrial branches are available, where the sums of individual fuels correspond to the consumption of auto producers from LEG.

Following the recommendations of the expert review team data on fuel consumption by industry type, fuel type and year are reported in Annex 1 to the IIR, (Table 1.2: Fuel used in Manufacturing industries and construction).

Net calorific values

Tables 3.2.1.5 to 3.2.1.8 present the net calorific values (NCV) which have been used for fuel combusted in manufacturing industries. In the past, they have been mostly taken from the Statistical Office of the Republic of Slovenia while since 2005 the ETS data are used, if available. Plant specific data for 2021 for solid fuels are presented in Table 3.2.1.7. The values for liquid fuels excluding petrol coke, natural gas and biomass have been taken from SORS for the entire period.

Table 3.2.1.5 NCVs for the fuel used in manufacturing industry and construction

Year	Lignite – domestic (Velenje)	Sub-bituminous Coal - domestic	Lignite - imported	Sub-bituminous Coal - imported	Other Bituminous Coal	Anthracite	Coke	Petroleum coke
	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt
1980	9,390	11,880			27,57	29,25	29,30	31,000
1981	9,390	11,880			27,57	29,25	29,30	31,000
1982	9,390	11,880			27,57	29,25	29,30	31,000
1983	9,390	11,880			27,57	29,25	29,30	31,000
1984	9,650	11,820			27,57	29,25	29,30	31,000
1985	9,390	11,880			27,57	29,25	29,30	31,000
1986	9,390	11,880			27,57	29,25	29,30	31,000
1987	9,650	11,820			27,57	29,25	29,30	31,000
1988	9,440	12,000			27,57	29,25	29,30	31,000

1989	9,820	12,050			27,57	29,25	29,30	31,000
1990	9,810	12,760			27,57	29,25	29,30	31,000
1991	9,980	12,879			25,00	29,25	29,30	31,000
1992	10,260	12,589			25,00	29,25	29,30	31,000
1993	10,070	13,351			25,00	29,25	29,30	31,000
1994	9,960	12,666			25,00	29,25	29,30	31,000
1995	10,220			17,404	25,00	29,31	29,31	31,000
1996	9,690			16,353	25,00	29,31	29,31	31,000
1997	9,610			17,712	25,00	29,31	29,310	31,000
1998	10,010			20,664	25,00	29,31	29,310	31,000
1999	9,690			20,806	25,00	29,31	29,310	31,000
2000	10,170			20,782	25,00	29,31	29,310	31,000
2001	10,660			20,947	25,00	29,31	29,310	31,000
2002	10,350			21,000	25,00	29,31	29,310	31,000
2003	10,138			21,570	25,00	29,31	29,310	31,000
2004	10,301			19,908		29,40	30,031	29,927

Table 3.2.1.6 NCVs for the fuel used in manufacturing industry and construction

Year	Residual Fuel Oil	Heavy Fuel Oil	Diesel	Gasoline	LPG	Natural Gas
	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/Mm3
1980	41,82	39,74	42,70	43,18	46,00	33,50
1981	41,82	39,74	42,70	43,18	46,00	33,50
1982	41,82	39,74	42,70	43,18	46,00	33,50
1983	41,82	39,74	42,70	43,18	46,00	33,50
1984	41,82	39,74	42,70	43,18	46,00	33,50
1985	41,82	39,74	42,70	43,18	46,00	33,50
1986	41,82	39,74	42,70	43,18	46,00	33,50
1987	41,78	39,80	42,70	43,10	46,00	33,50
1988	41,71	39,80	42,70	43,10	46,00	34,08
1989	41,85	39,80	42,70	43,10	46,00	34,10
1990	41,87	39,80	42,70	43,07	46,00	34,10
1991	41,88	39,80	42,70	43,17	46,00	34,10
1992	41,90	39,90	42,70	43,10	46,00	34,10
1993	41,90	39,80	42,70	43,08	46,00	34,10
1994	41,90	39,86	42,70	43,08	46,00	34,10
1995	41,90	40,00	42,70	43,08	46,00	34,10
1996	41,90	40,00	42,70	43,08	46,00	34,10
1997	41,90	40,00	42,70	43,08	46,05	34,08
1998	41,90	40,00	42,70	43,08	46,05	34,08
1999	41,90	40,00	42,70	43,08	46,05	34,08
2000	41,90	40,00	42,70	43,08	46,05	34,08
2001	41,90	40,00	42,70	43,08	46,05	34,08
2002	41,90	40,00	42,70	43,08	46,05	34,08
2003	41,90	40,00	42,70	43,08	46,05	34,08
2004	41,90	40,00	42,70	43,08	46,05	34,08
2005	42,60	41,42	42,70	43,08	46,05	34,08
2006	42,60	41,42	42,70	43,08	46,05	34,07
2007	42,60	41,42	42,70	43,08	46,05	34,08
2008	42,60	41,42	42,70	43,85	46,05	34,09
2009	42,60	41,42	42,70	43,85	46,05	34,08
2010	42,60	41,42	42,70	43,85	46,05	34,08
2011	42,60	41,42	42,60	43,85	46,05	34,09
2012	42,60	41,42	42,60	43,85	46,05	34,09

2013	42,60	41,42	42,60	43,85	46,05	34,08
2014	42,60	41,42	42,60	43,85	46,05	34,08
2015	42,60	41,42	42,60	43,85	46,05	34,08
2016	42,60	41,42	42,60	43,85	46,05	34,08
2017	42,60	41,42	42,60	43,85	46,05	34,08
2018	42,60	41,42	42,60	43,85	46,05	34,08
2019	42,60	41,42	42,60	43,85	46,05	34,08
2020	42,60	41,42	42,60	43,85	46,05	34,08
2021	42,60	41,42	42,60	43,85	46,05	34,08

Table 3.2.1.7 NCVs for the solid fuel used in manufacturing industry and construction in 2021

Industry	Unit	Sub-bituminous Coal - imported	Other Bituminous Coal	Coke	Petroleum coke	Wood	Other biomass
Iron and steel	TJ/kt			29,500		15,667	
Non-Ferrous metals	TJ/kt		25,00				
Chemicals	TJ/kt					9,586	
Pulp. Paper and Print	TJ/kt	17,795	25,096			6,527	3,35
Food processing	TJ/kt					13,471	
Non-metallic minerals	TJ/kt			31,560	29,300	15,606	
Other	TJ/kt					11,263	

Table 3.2.1.8 NCVs for other fuels

	Waste industrial oils	Waste cooking fat	Waste cooking oils	Waste organic solvents
	TJ/kt	TJ/kt	TJ/kt	TJ/kt
2004			40,00	
2005			40,00	
2006				
2007		39,20		
2008		39,20		
2009		39,20		
2010		39,20		25,00
2011		39,20		25,00
2012		39,20		25,00
2013		39,20		25,00
2014		39,20		25,00
2015		39,20		25,00
2016		39,20		25,00
2017		38,24		25,00
2018				25,00
2019	37,37			25,00
2020	38,13		15,16	
2021	39,32		15,03	

Emission factors

For calculating emissions of individual gases in the manufacturing industry and construction following emission factors have been used.

Table 3.2.1.9 Emission factors used for domestic sub-bituminous coal, imported sub-bituminous coal, domestic and imported lignite, other bituminous coal, anthracite and coke for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	173	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
SO_x	*Equation 4*	[S] (% w/w) See Table 3.2.1.10	Slovene national legislation relating quality of liquid fuels
CO	931	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
NMVOC	88,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
PM_{10}	117	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
$PM_{2.5}$	108	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
TSP	124	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
BC	6,91	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Cd	1,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Pb	134	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Hg	7,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
As	4	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Cr	13,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Cu	17,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Ni	13	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Se	1,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Zn	200	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Dioxins/ Furans	203	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Benzo(a)pyrene	45,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Benzo(b)fluoranthene	58,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15

Benzo(k)fluoranthene	23,7	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
Indeno(1,2,3-cd)pyrene	18,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
HCB	0,62	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15
PCB	170	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-2, pg 15

Table 3.2.1.10 Sulphur content in coals, anthracite and coke for 1980 - 2021

Year	Lignite domestic/ imported	Sub-bituminous Coal - domestic	Sub-bituminous Coal - imported	Other Bituminous Coal	Anthracite	Coke/ Petroleum coke
	[S] (% w/w)	[S] (% w/w)	[S] (% w/w)	[S] (% w/w)	[S] (% w/w)	[S] (% w/w)
1980	1,45	1,6		8	1	1
1981	1,45	1,6		8	1	1
1982	1,45	1,6		8	1	1
1983	1,45	1,6		8	1	1
1984	1,45	1,6		8	1	1
1985	1,45	1,6		8	1	1
1986	1,45	1,6		8	1	1
1987	1,45	1,6		8	1	1
1988	1,45	1,6		8	1	1
1989	1,45	1,6		8	1	1
1990	1,45	1,6		8	1	1
1991	1,45	1,6		8	1	1
1992	1,45	1,6		8	1	1
1993	1,45	1,6		8	1	1
1994	1,45	1,6		8	1	1
1995	1,45		1,60	8	1	1
1996	1,45		1,60	8	1	1
1997	1,45		1,60	8	1	1
1998	1,45		0,12	8	1	1
1999	1,45		0,12	8	1	1
2000	1,45		0,12	8	1	1
2001	1,45		0,12	8	1	1
2002	1,45		0,07	1	1	1
2003	1,45		0,09	1	1	1
2004	1,45		0,09	1	1	1
2005			0,14	1		1
2006			0,14	1		1
2007			0,14	1		1
2008			0,10	1		1
2009	1,45		0,10	1		1
2010	1,45		0,10	1		1
2011	1,45		0,10	1		1
2012	1,45		0,10	1		1
2013	1,45		0,10	1		1
2014	1,45		0,10	1		1
2015	1,45		0,10	1		1
2016	1,45		0,10	1		1
2017			0,10	1		1
2018			0,10	1		1

2019			0,10	1		1
2020			0,10	1		1
2021			0,10	1		1

Table 3.2.1.11 Emission factors used for heavy fuel, residual fuel oil, petroleum coke, waste industrial oils and waste organic solvents for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	513	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
SO_x	*Equation 3*	[S] (% w/w) See Table 3.2.1.12	Slovene national legislation relating quality of liquid fuels
CO	66	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
NMVOC	25	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
PM_{10}	20	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
$PM_{2.5}$	20	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
TSP	20	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
BC	11,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Cd	0,006	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Pb	0,08	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Hg	0,12	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
As	0,03	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Cr	0,20	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Cu	0,22	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Ni	0,008	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Se	0,11	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Zn	29	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Benzo(a)pyrene	1,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17

Benzo(b)fluoranthene	15	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Benzo(k)fluoranthene	1,7	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Indeno(1,2,3-cd)pyrene	1,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17
Dioxins/ Furans	1,4	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-4, pg 17

Table 3.2.1.12 Sulphur content in residual fuel oil and heavy fuel oil for 1980 – 2021

Fuel	Heavy fuel Oil	Residual fuel Oil	Fuel	Heavy fuel Oil	Residual fuel Oil
Year	[S] (% w/w)	[S] (% w/w)	year	[S] (% w/w)	[S] (% w/w)
1980	3,0	1,2	2001	1,0	0,2
1981	3,0	1,2	2002	1,0	0,2
1982	3,0	1,2	2003	1,0	0,2
1983	3,0	1,2	2004	1,0	0,2
1984	3,0	1,2	2005	1,0	0,2
1985	3,0	1,2	2006	1,0	0,2
1986	3,0	1,2	2007	1,0	0,2
1987	3,0	1,2	2008	1,0	0,1
1988	3,0	1,2	2009	1,0	0,1
1989	3,0	1,2	2010	1,0	0,1
1990	3,0	1,2	2011	1,0	0,1
1991	3,0	1,2	2012	1,0	0,1
1992	3,0	1,2	2013	1,0	0,1
1993	3,0	1,2	2014	1,0	0,1
1994	3,0	1,2	2015	1,0	0,1
1995	1,5	0,5	2016	1,0	0,1
1996	1,0	0,2	2017	1,0	0,1
1997	1,0	0,2	2018	1,0	0,1
1998	1,0	0,2	2019	1,0	0,1
1999	1,0	0,2	2020	1,0	0,1
2000	1,0	0,2	2021	1,0	0,1

Table 3.2.1.13 Emission factors used for wood, waste cooking, waste cooking oils, and other biomass for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	91	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
CO	570	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
NMVOC	300	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
SO_x	11	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18

NH_3	1,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
PM_{10}	143	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
$PM_{2.5}$	140	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
TSP	150	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
BC	39,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Cd	13	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Pb	27	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Hg	0,56	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
As	0,19	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Cr	23	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Cu	6	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Ni	2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Se	0,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Zn	512	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Benzo(a)pyrene	10	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Benzo(b)fluoranthene	16	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Benzo(k)fluoranthene	5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Indeno(1,2,3-cd)pyrene	4	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
Dioxins/ Furans	100	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
PCB	0,06	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18
HCB	5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-5, pg 18

Table 3.2.1.14 Emission factors used for natural gas, biogas and liquefied petroleum gas for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	74	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
CO	29	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
SO_x	0,67	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
NMVOC	23	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
PM_{10}	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
$PM_{2.5}$	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
TSP	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
BC	0,0312	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Cd	0,0009	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Pb	0,011	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Hg	0,54	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
As	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Cr	0,013	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Cu	0,0026	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Ni	0,013	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Se	0,058	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Zn	0,73	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Benzo(a)pyrene	0,72	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Benzo(b)fluoranthene	2,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Benzo(k)fluoranthene	1,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Indeno(1,2,3-cd)pyrene	1,08	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16

Dioxins/ Furans	0,52	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16

TSP, PM_{10}, $PM_{2.5}$ emission factors for biomass represent filterable PM emissions. It is unclear for solid fuels, gaseous fuel, liquid fuels and waste whether emission factors represent filterable PM emissions or total (filterable and condensable) emissions.

Emissions from 1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals

In the 2021 in-depth EU NECD review the TERT noted that using a Tier 1 method for cement production in 1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals is not best practice. Emissions from cement production have been calculated according to a Tier 2 method. Data on clinker produced and a Tier 2 EF were used for emission calculations. Emissions from other non-metallic minerals production in NFR 1A2f were estimated according to a Tier 1 method. Other non-metallic minerals production comprised lime, glass, mineral wool, ceramic production. Data on fuel consumption from other non-metallic minerals production and a Tier 1 EF were used for emissions calculations. To avoid double-counting fuel consumption in cement production was subtracted from the whole fuel consumption in 1A2f. Revised emissions in NFR 1A2f are a sum of emissions based on Tier 2 (cement production) and Tier 1 (other non-metallic minerals production). Particulate matter emissions from cement production are reported in NFR 2A1 Cement production.

Cement production

Methodology

To estimate emissions from cement production, the following methodology has been adopted for individual pollutant:

E = m x EF

E – emission (kg)
m – amount of clinker produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of clinker. Data have been obtained from cement producers for the whole period. In 2021 only one cement plant was in operation.

Emission factors

Emission factors applied for emission calculations were taken from EMEP/EEA Emission Inventory Guidebook, 2019, 1.A.2 Manufacturing industries and construction (combustion), Table 3-24 Tier 2 emission factors for the source category 1.A.2.f.i cement production; pg 31.

Table 3.2.1.15 Emission factors used for cement production

Pollutant	Value	Unit	References
NO_x	1241	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31

CO	1455	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
SO_x	374	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
NMVOC	18	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Cd	0,008	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Pb	0,098	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Hg	0,049	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
As	0,0265	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Cr	0,041	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Cu	0,0647	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Ni	0,049	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Se	0,0253	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-3, pg 16
Zn	0,424	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Benzo(a)pyrene	0,000065	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Benzo(b)fluoranthene	0,00028	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Benzo(k)fluoranthene	0,000077	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Indeno(1,2,3-cd)pyrene	0,000043	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
Dioxins/ Furans	4,1	ng I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31
HCB	4,6	microg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31

PCB	103	microg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-24, pg 31

Table 3.2.1.16 Amount of clinker produced

Year	Clinker produced (t)	Year	Clinker produced (t)
1980	951230	2001	957150
1981	951230	2002	840870
1982	951230	2003	853837
1983	951230	2004	897562
1984	951230	2005	921699
1985	951230	2006	972233
1986	951230	2007	1028146
1987	897692	2008	1124760
1988	988462	2009	801362
1989	903846	2010	680725
1990	891067	2011	589370
1991	789328	2012	605240
1992	728934	2013	743138
1993	546777	2014	807262
1994	724764	2015	713040
1995	769221	2016	667195
1996	825949	2017	796930
1997	836201	2018	873487
1998	871521	2019	927768
1999	878997	2020	923892
2000	928498	2021	916029

Other non-metallic minerals production (without cement production)

Methodology

To estimate emissions from other non-metallic minerals production Tier 1 methodology was used. Description is given in general methodology for emission calculation in combustion in manufacturing industries and construction (IIR 2023, Equations 1-4, pg 80).

Activity data

Activity data used for emission calculation from other non-metallic minerals production are data on the annual consumption of fuel. Data on fuel consumption by fuel type and year used in non-metallic minerals production are reported in Annex 1 to the IIR (Table 1.2: Fuel used in Manufacturing industries and construction).

Emission factors

Emission factors applied for emission calculations from other non-metallic minerals production were taken from EMEP/EEA Emission Inventory Guidebook, 2019, EMEP/EEA Emission Inventory Guidebook, 2019, Combustion in manufacturing industries and construction, Table 3-

2, Table 3-3, Table 3-4 and Table 3-5. Tables with emission factors are presented in general methodology for emission calculation in combustion in manufacturing industries and construction. Emission factors and NCV used are presented in IIR 2023, pg. 84-92.

Category-specific QA/QC and verification

The source category QA/QC is covered by the general QC procedures described in chapter 2.5. Our main source specific QA/QC activity is a comparison of the ETS data with statistical data. The aggregated fuel from SORS data is compared with the sum of fuel used from verified ETS reports and where the connection between both sets of data is uniform, the data from SORS are substituted with data from the verified reports from installations included in ETS, if necessary. ETS data are also used for different types of waste used as fuel. The list of waste types is not always complete in the SORS data. Additional QA activity is the reference approach. Before entering data into a database, the sum of each fuel from disaggregated data is compared with energy balance data, reported in the Joint Questioner. As data in JQ are rounded to 1000 units, the difference should be 500 units or less. If it is higher, the reasons for this should be found.

Recalculations

No recalculations have been performed since last submission.

Future improvements

No improvements are planned for the next submission.

3.3 Transport (1. A. 3)

Transport is an important source of emissions of air pollutants, mostly nitrous oxide. It is also an important source of other emissions that cause problems in terms of air quality. The most important source in category transport is road transport, which accounts for more than 95 % of all transport emissions.

Sectors covered in this chapter are:

NFR Codes:

1A3bi -1A3bvii	Road transport
1A3c	Railways
1A3ai(i)	International aviation LTO (civil)
1A3aii(i)	Domestic aviation LTO (civil)
1A5b	Other, Mobile (including military, land based and recreational boats)
1A3dii	National navigation (Shipping)
1A3ei	Pipeline transport

Emissions from reported under Memo items. Those emissions are not included in national total emissions.

1A3ai(ii)	International aviation cruise (civil)
1A3aii(ii)	Domestic aviation cruise (civil)
1A3di(i)	International maritime navigation
1A5c	Multilateral operations

3.3.1 Road transport

Sectors covered in this chapter are:

NFR Codes:

1A3bi	Road transport: Passenger cars
1A3bii	Road transport: Light duty vehicles
1A3biii	Road transport: Heavy duty vehicles and buses
1A3biv	Road transport: Mopeds & motorcycles
1A3bv	Road transport: Gasoline evaporation
1A3bvi	Road transport: Automobile tyre and brake wear
1A3bvii	Road transport: Automobile road abrasion

Introduction

Road transportation is one of the most important emitters of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). It is also a significant emission source of pollutants associated with transboundary, regional and local air problems, comprehending sulphur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), non-volatile organic compounds (NMVOC) and are indirectly responsible for the formation of ozone (O_3) in the lower troposphere. Substantial emissions of ammonia (NH_3), particulate matter (PM) and heavy metals also result from this activity.

Methodology

COPERT 5 (version 5.6.1) methodology has been used for the calculation of the national air pollutants emissions from road transport for the entire 1980-2021 period. The methodology is fully incorporated in the computer software program COPERT 5 (version 5.6.1) which facilitates its application. The actual calculations have been therefore performed by using this computer software.

COPERT 5 estimates emissions of all major air pollutants (NO_x, NMVOC, NH_3, SO_x, CO, particulate matter ($PM_{2.5}$, PM_{10}, TSP, black carbon), heavy metals as well as greenhouse gas emissions (CO_2, N_2O, CH_4) produced by different vehicle categories (passenger cars, light duty vehicles, heavy duty trucks, buses, mopeds and motorcycles). The program also provides speciation of polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, HCB and PCB. Emissions estimated are distinguished in three sources: emissions produced during thermally stabilized engine operation (hot emissions), emissions occurring during engine start from ambient temperature (cold-start and warming-up effects) and NMVOC emissions due to fuel evaporation. The total emissions are calculated as a product of activity data provided by the user and speed-dependent emission factors calculated by the software. COPERT 5 estimates exhaust emissions and emissions from automobile tyre and brake wear and road abrasion.

The COPERT methodology is also part of the EMEP/EEA air pollutant emission inventory guidebook (formerly referred to as the EMEP/ CORINAIR Guidebook). The Guidebook is prepared by the UNECE/EMEP Task Force on Emission Inventories and Projections (TFEIP) and published by the European Environment Agency. It is intended to support reporting under the UNECE Convention on Long-Range Transboundary Air Pollution and the EU directive on the reduction of national emissions of certain atmospheric pollutants as well as under United Nations Framework Convention on Climate Change (UNFCCC). The COPERT methodology is fully consistent with the Road Transport chapter of the Guidebook. The use of a software tool to calculate road transport emissions allows for a transparent and standardized, hence consistent and comparable data collecting and emissions reporting procedure, in accordance with the requirements of international conventions and protocols and EU legislation.

Applied methodology is fully described in the following literature:

- EMEP/EEA air pollutant emission inventory guidebook 2019, Technical guidance to prepare national emission inventories, Chapters: 1.A.3.b.i-iv Road transport 2019, 1.A.3.b.v Gasoline evaporation 2019, 1.A.3.b.vi-vii Road tyre and brake wear, Road abrasion 2019
- https://www.emisia.com/utilities/copert/documentation/
- https://www.emisia.com/utilities/copert/versions/

To calculate emissions using the COPERT 5 software, at least the following input data is necessary: vehicle fleet data, mileage data per vehicle category and type of roads, speed data, fuel consumption and fuel characteristic, monthly air minimum and maximum temperatures, fuel vapour pressure.

COPERT 5 (version 5.6.1) program was used for emissions calculation of exhaust emissions and emissions from automobile tyre and brake wear and road abrasion.

Exhaust emissions of NO_x, SO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, Black carbon (BC), CO, Lead (Pb), Cadmium (Cd), Mercury (Hg), Arsenic (As), Chromium (Cr), Copper (Cu), Nickel (Ni), Selenium (Se), Zinc (Zn), dioxins/furans and four indicator PAHs (benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene), PCB and HCB have been calculated using COPERT 5 (version 5.6.1).
Emissions of particulate matter ($PM_{2.5}$, PM_{10}, TSP, BC) from automobile tyre and brake wear and road abrasion have been calculated by COPERT 5 (version 5.6.1) as well.
COPERT 5 (version 5.6.1) calculates also emissions of heavy metals (Pb, Cd, As, Cu, Cr, Ni Se, Zn) from automobile tyre and brake wear.

Vehicle fleet

The COPERT 5 methodology requires detailed knowledge of the structure of the vehicle fleet composition. The vehicle numbers per all vehicle classes for the period 1980−2021 are shown in Annex 1 to the IIR (Table 1.3 Road transport: Fleet data (number of vehicles)).

The fleet composition for the years 1992−2021 was taken from the official database of registered motor and trailer vehicles in the Republic of Slovenia. Until 2009 data were provided by the Ministry of the Interior. Since 2010, those data have been collected by the Ministry of Infrastructure of the Republic of Slovenia. Since no database exists on licensed motor and trailer vehicles in the Republic of Slovenia for the years 1980−1991, an expert estimate has been made on the basis of the annual Statistical Yearbooks, published by the Statistical Office of the Republic of Slovenia (SORS).

The vehicle fleet structure is presented in Figure 3.3.1.1. The increase in the total number of passenger cars is mostly due to a growth in the number of diesel passenger cars. After the year 2003 a considerable decline in the number of gasoline passenger cars is observed and at the same time a rise in the number of diesel passenger cars. LPG and CNG passenger cars represent only a small share of all passenger cars.

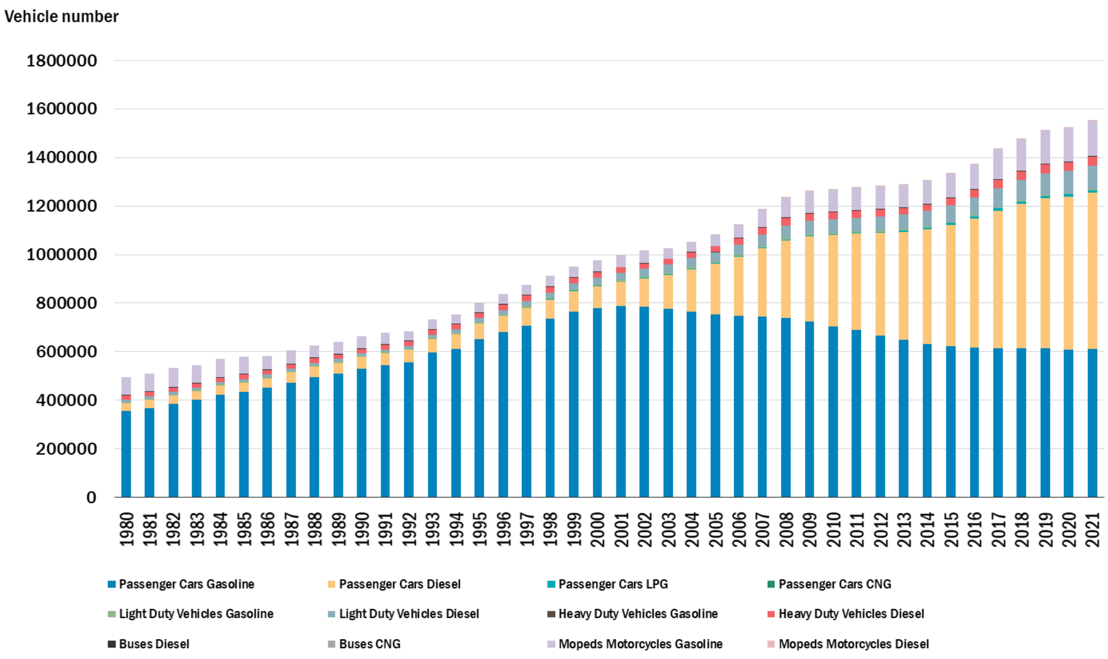

Figure 3.3.1.1 Vehicle fleet 1980–2021

Mileage

Annual mileage (km/year) for each vehicle category for 2015-2021 has been calculated from data on odometer readings from a database on roadworthiness tests that has been coupled with a database on registered motor vehicles. The database is administered by the Ministry of Infrastructure of the Republic of Slovenia. For other years the starting point is the same average yearly kilometres per vehicles class as in 2015, corrected to actual fuel consumption. The values used are shown in Annex 1 (Table 1.4: Road transport: Mileage data).

Speed

Three driving modes are individualized in accordance with COPERT 5 methodology: urban (peek, off peak), rural and highway. For each specific driving mode average speeds have to be set by vehicle types whereas vehicle exhaust emissions and fuel consumption are dependent on the speed. Speeds in specific driving modes have been assessed on the basis of the speed data for different types of road assessed from roads counters data. The values used are shown in Annex 1 to the IIR (Table 1.5: Road transport: Speed data).

Fuel Consumption

Statistical data on the total volume of fuel consumed in the Republic of Slovenia is obtained from the SORS. From the total volume of fuel sold, the consumption in the fields of agriculture, forestry and construction has been excluded. Diesel, gasoline, liquefied petroleum gas (LPG) and compressed natural gas (CNG) have been used as fuels in road transportation.

As shown in Figure 3.3.1.2 the total fuel consumption in road transport. Diesel, gasoline, liquefied petroleum gas (LPG) and compressed natural gas (CNG) have been used as fuels in road transportation. The fuel consumption began to grow markedly during the years 1991–1997 due to fuel being sold to foreigners as a consequence of the lower fuel prices in Slovenia. During the years 2000–2008 an extensive growth in usage of diesel fuel can be observed. The transit of heavy duty trucks has been an important factor for the increase in diesel consumption. In the year 2005, the sale of diesel exceeded the sale of gasoline. In 2009, a significant decline in gasoline and diesel consumption appeared. In comparison with the year 2008 consumption of gasoline dropped by 9 % and diesel by 20 %. The lower consumption of fuel was due to the world economic crisis. Another huge drop in fuel consumption is seen in 2020. In comparison with the year 2019, consumption of gasoline dropped by 21% and diesel by 18%. Lower fuel consumption was due to reduced mobility as a consequence of the Covid-19 pandemic lockdown measures. In 2021 the sale of fuel was on the rise again due to the release of Covid-19 measures. In 2021, the fuel use shares for diesel and gasoline were about 77% and 22 %, respectively. The share of LPG was about 1% and CNG only 0,3%. Consumption of LPG was reported for the first time in 2006. It has been used by passenger cars. CNG was reported for the first time in 2012 and has been applied by passenger cars and busses. In addition to fossil fuels biofuels have also been used in road transportation in Slovenia. Biodiesel has been used since 2006 and biogasoline since 2007. Biodiesel in road transportation is mostly blended into fossil diesel, biogasoline into fossil gasoline

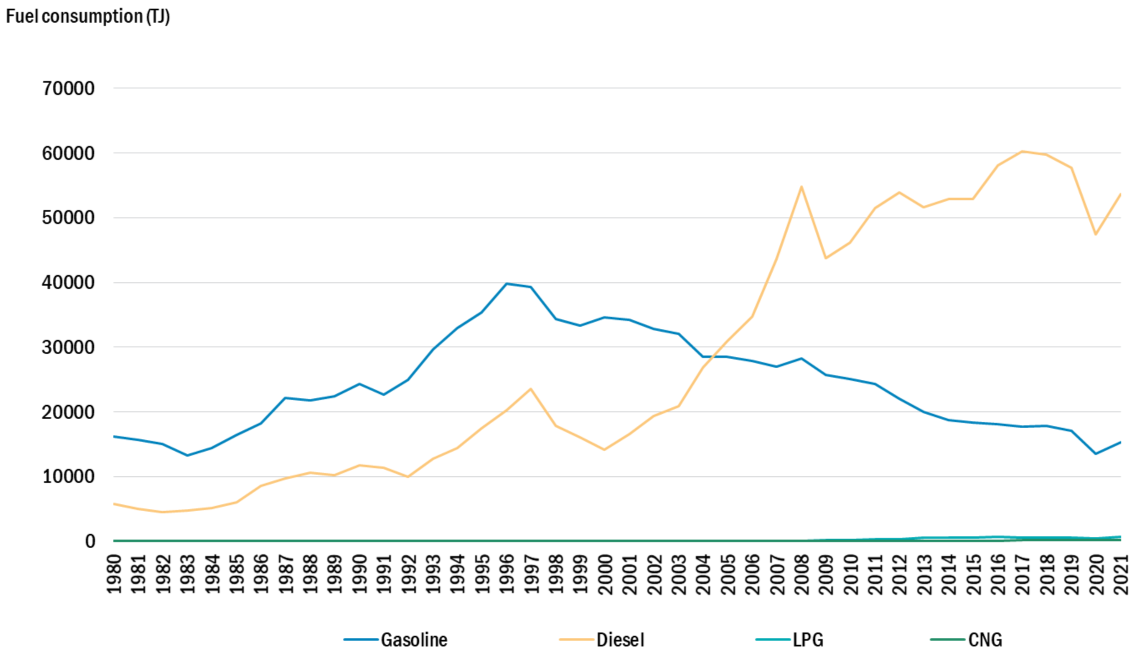

Figure 3.3.1.2 Fuel consumption in road transport for 1980–2021

As shown in Figure 3.3.1.3 and Figure 3.3.1.4, passenger cars represent the most fuel-consuming vehicle category, followed by heavy duty trucks, light duty vehicles, buses, motorcycles and mopeds, in decreasing order. Fuel consumption for gasoline passenger cars dominates the overall gasoline consumption trend. The development in diesel fuel consumption in recent years is characterised by increasing fuel use for diesel passenger cars and heavy duty trucks, while the fuel use for buses and light duty vehicles is less distinctive. Due to transparency fuel consumption by types of vehicles is shown in the table in Annex 1 to the IIR (Table 1.6: Road transport: Fuel Consumption by types of vehicle).

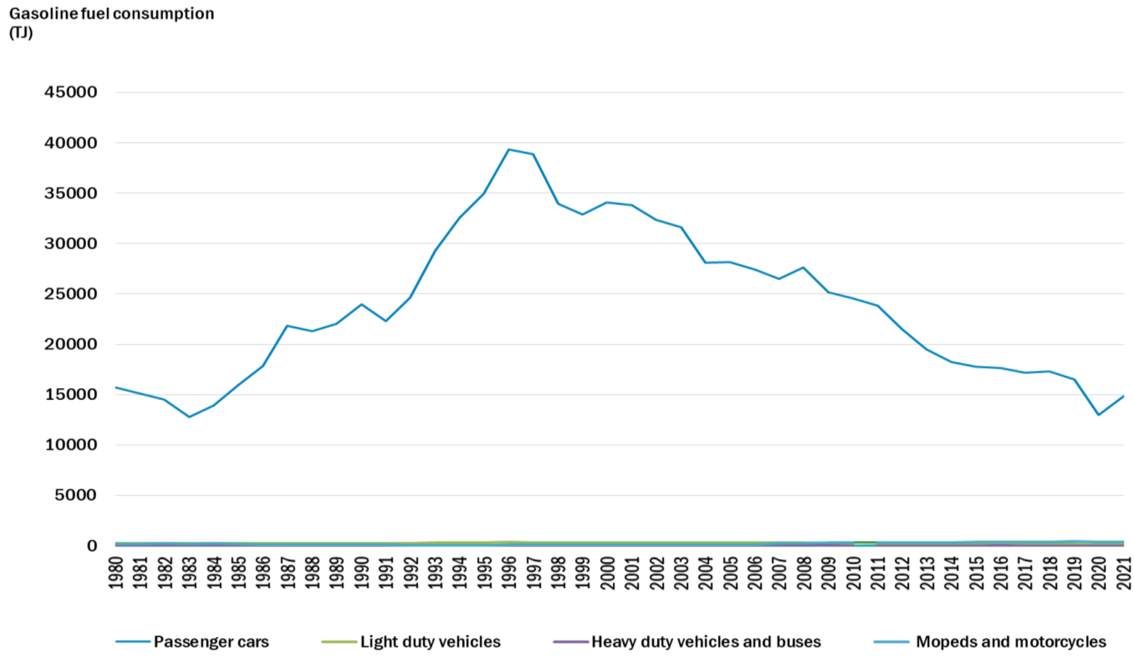

Figure 3.3.1.3 Gasoline fuel consumption per vehicle type for road transport 1980–2021

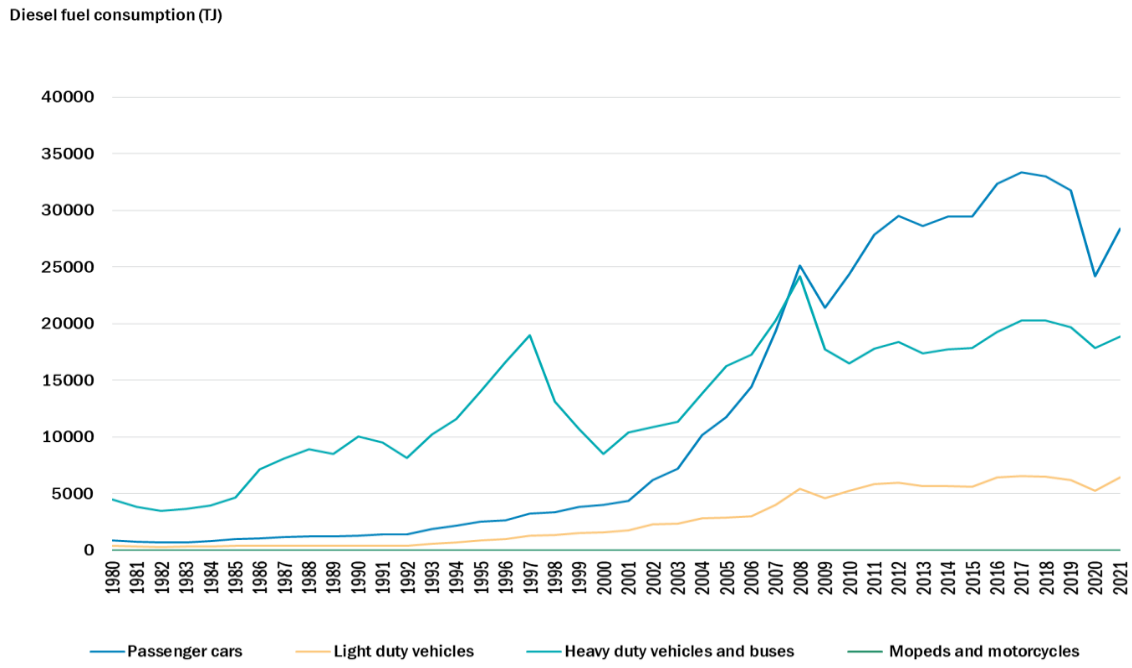

Figure 3.3.1.4 Diesel fuel consumption per vehicle type for road transport 1980–2021

In 2021 the fuel consumption shares for diesel passenger cars, diesel heavy duty vehicles and buses, gasoline passenger cars were about 41, 27 and 21%, respectively (Figure 3.3.1.5).

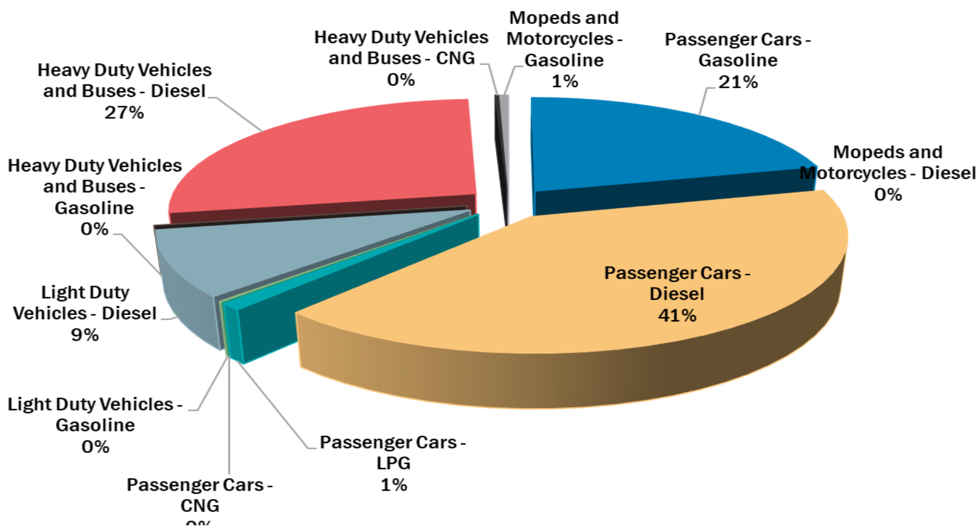

Figure 3.3.1.5 Fuel consumption share per vehicle type for road transport in 2021

Fuel Characteristics

Sulphur and lead content of liquid fuels and monthly values of fuel volatility (RVP – Reid Vapour Pressure) were taken from Slovene national legislation relating quality of liquid fuels. Leaded gasoline was removed from the market in 2002. All the other physical and chemical data used was proposed as default values by the COPERT 5.

RVP values used were 70 kPa for the winter period (1 October – 30 April) and 60 kPa for the summer period (1 May – 30 September). The sulphur and lead contents were set as presented in Table 3.3.1.1 and Table 3.3.1.2.

Table 3.3.1.1 Levels of sulphur content in gasoline and diesel fuel

Fuel	Period	Sulphur [% wt]
Gasoline Leaded	1980-1994	0,1
	1995-2001	0,05
Gasoline Unleaded	1986-1994	0,1
	1995-2001	0,05
	2002-2004	0,015
	2005-2008	0,005
	2009-2021	0,001
Diesel	1980-1994	1
	1995	0,25
	1996-2001	0,20
	2002-2004	0,035
	2005-2008	0,005

	2009-2021	0,001

Table 3.3.1.2 Levels of lead content in gasoline

Fuel	Period	Lead [g/l]
Gasoline Leaded	1980-1994	0,6
	1995	0,4
	1996-2001	0,15
Gasoline Unleaded	1986-1994	0,026
	1995-2001	0,013
	2002-2021	0,005

Monthly minimum and maximum air temperatures

Meteorological data necessary for evaporative emission calculation (annual average minimum temperature and maximum temperature) was obtained from Slovenian Environment Agency. Data for Ljubljana was taken into consideration with the assumption that it is representative enough for the whole of Slovenia. Data are publicly available on the Slovenian Environment Agency's website.

Other input data

The average trip length (Ltrip) value corresponds to the mean distance covered in trips started with an engine of ambient temperature (cold start). The mean daily trip distance was set at 12 km in accordance with the recommendation of the COPERT 5. Ltrip value is introduced for the calculation of the Beta value which represents the fraction of the monthly mileage driven before the engine and any exhaust components have reached their nominal operation temperature. Beta values calculated according to the COPERT 5 methodology were used. All the other required input data used for a calculation of emissions using COPERT 5 program were default COPERT 5 (version 5.6.1) data.

Emission factors

All emission factors for calculating exhaust and non-exhaust emissions for NO_x, SO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins/furans and PAHs (benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene), HCB, PCB used in the emission inventory for the whole period 1980 - 2021 are default emission factors offered by the COPERT 5 (version 5.6.1).

Emission factors for calculating exhaust particulate emissions represent together filterable and condensable emissions. Exhaust emissions are considered to be $PM_{2.5}$

There is no information for automobile tyre and brake wear and road abrasion whether emission factors represent filterable TSP, PM_{10}, $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Emissions of SO_x, NO_X, CO, NMVOC, NH_3 and particulate matter

From 1980 to 2021 the road transport emissions of NO_x, SO_x and CO have decreased by 37, 99 and 92 %. Emissions of NMVOC have decreased by 88 % from 1990 to 2021 and emissions of NH_3 have increased by 1294 % from 1986 to 2021. From 2000 to 2021 emissions of exhaust particulate matter (PM) have decreased by 69 %. Due to the world economic crises and consecutively smaller fuel consumption emissions of all pollutants considerably decreased in 2009. A decreasing trend is observed after 2012 due to smaller fuel consumption and improved vehicle technologies. Lower emissions compared to previous years were also due to a bigger share of Euro 6 passenger cars and light duty vehicles and heavy duty trucks. Another huge drop in emissions is seen in 2020. In 2020 a drop in emissions occurred due to smaller fuel consumption. Lower fuel consumption was due to reduced mobility as a consequence of the Covid-19 pandemic lockdown measures. In comparison with the year 2019, consumption of gasoline dropped by 21 % and diesel by 18 %. In 2021 the sale of fuel was on the rise again due to the release of Covid-19 measures.

The gradual lowering of the sulphur content in diesel and gasoline fuel has given rise to a substantial decrease in the road transport emissions of SO_x. In 1995, the sulphur content was reduced from 0,1 % (wt) to 0,05 % (wt) for gasoline and from 1 % (wt) to 0,25 % (wt) for diesel. The next indicated emission drop occurred in 2002 when another substantial reduction in sulphur content in gasoline and diesel fuel were carried out. The last reduction of sulphur content in gasoline and diesel was performed in 2009. The sulphur content was reduced to 0,001 % (wt) in both fuels (Figure 3.3.1.6).

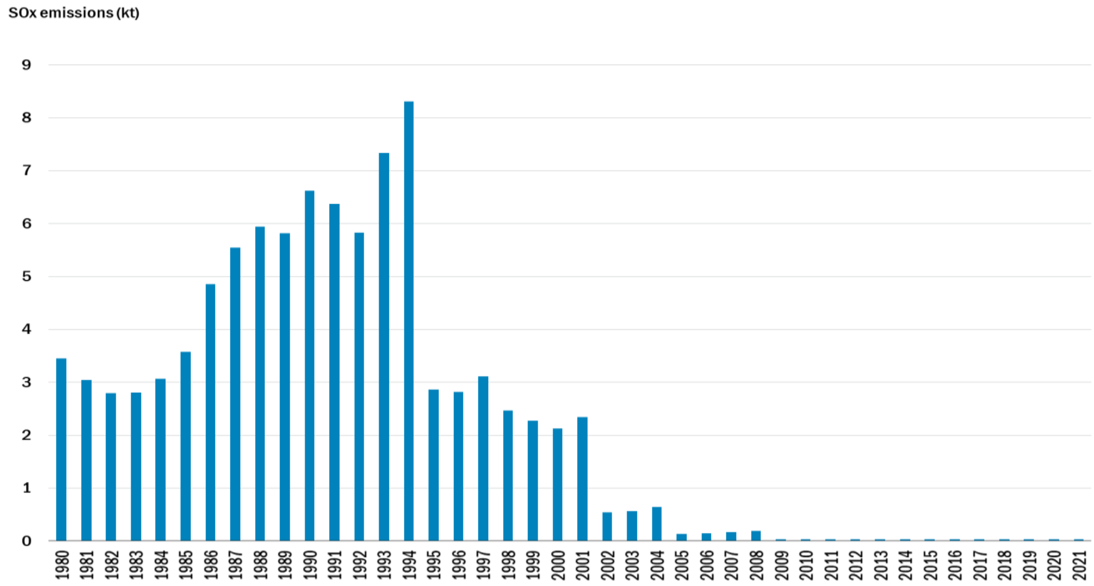

Figure 3.3.1.6 SO_x emissions (kt) in road transport 1980−2021

NO_x emissions have shown a steady decreasing tendency since the introduction of emission efficiently Euro 2 and Euro 3 catalyst cars into the Slovene fleet (introduced in 1996 and 2000, respectively). The positive effect of the implementation of the stricter EURO standards has been made to no avail, due to the increased motor fuel consumption. The increase in 2008 is due to bigger fuel consumption. In 2009, a significant decline in gasoline and diesel consumption appeared. In comparison with the year, 2008 consumption of gasoline dropped by 9 % and diesel by 20 %. Lower emissions after 2021 are due to lower fuel consumption and the introduction of EURO VI heavy duty trucks and Euro 6 passenger cars in the national fleet. A huge drop in emissions in 2020 was due to small fuel consumption as a consequence of the Covid-19 pandemic crisis. Emissions in 2021 increased again due to the release of Covid-19 measures and bigger fuel consumption (Figure 3.3.1.7).

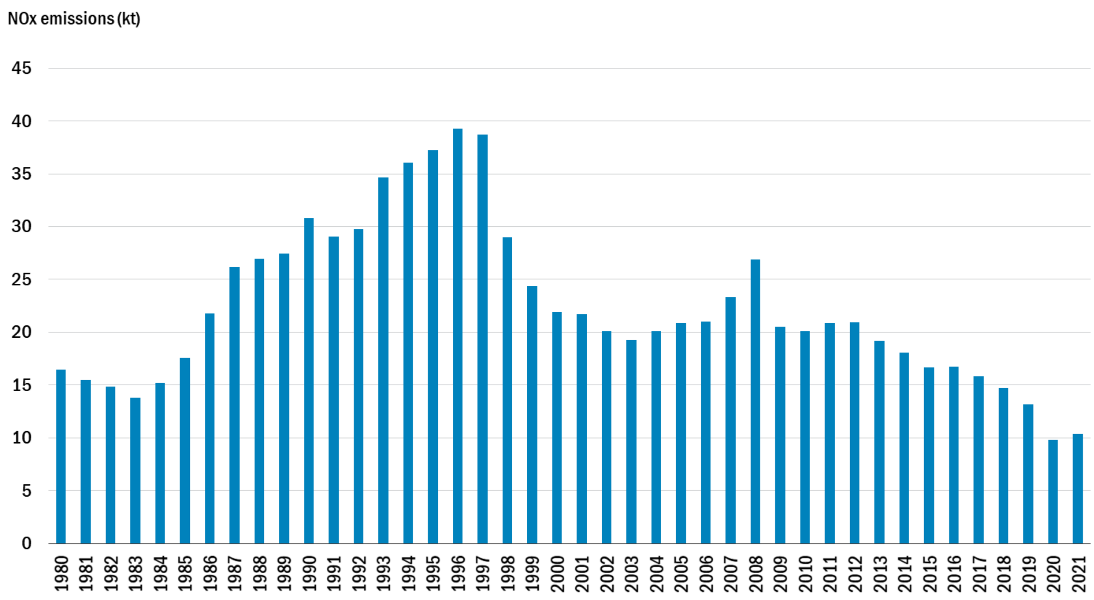

Figure 3.3.1.7 NO_X emissions (kt) in road transport 1980−2021

NMVOC and CO emissions have decreased in the last few years due to the growing share of vehicles that meet the stricter EURO standards. NMVOC and CO emission drops are also due to the decreasing share of gasoline passenger cars, as well as the decline in gasoline evaporation. A huge drop in emissions in 2020 was due to small fuel consumption as a consequence of the Covid-19 pandemic crisis. In 2021 the sale of fuel was on the rise again due to the release of Covid-19 measures (Figure 3.3.1.8 and Figure 3.3.1.9).

NH_3 emissions have increased rapidly from the year 1993 onward. The significant emission growth is related to the growth in the number of gasoline passenger cars fitted with catalysts. These produce ammonia as a by-product of the catalytic process that reduces emissions of nitrogen oxides. In the last few years, the decline in emissions was observed, mostly due to the growth in the share of diesel passenger cars and consequently due to greater diesel fuel consumption. A huge drop in emissions in 2020 was due to small fuel consumption as a consequence of the Covid-19 pandemic crisis. In 2021 the sale of fuel was on the rise again due to the release of Covid-19 measures (Figure 3.3.1.10).

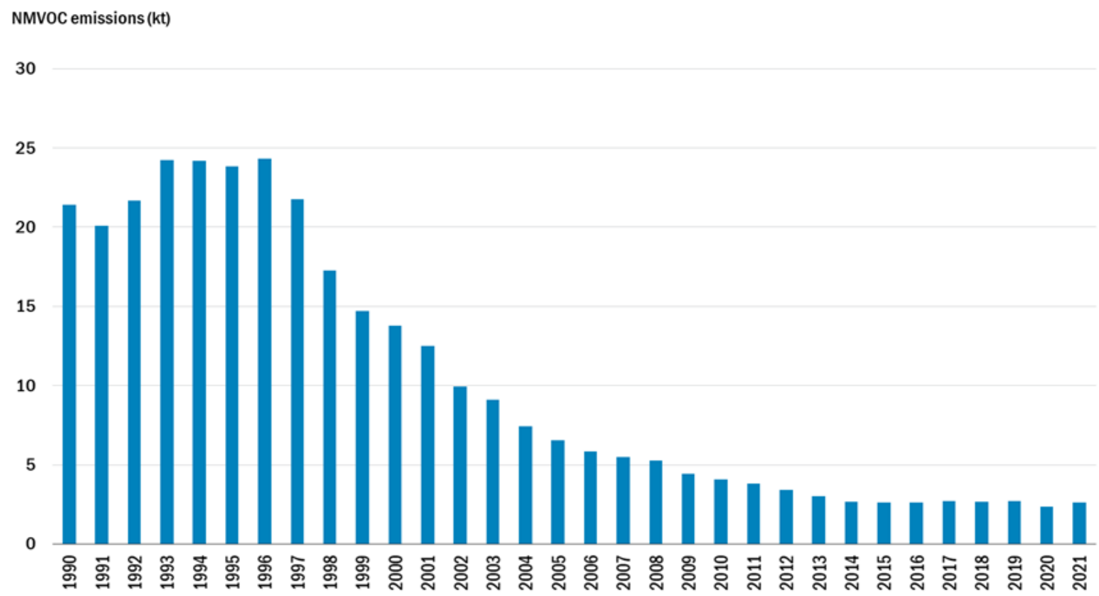

Figure 3.3.1.8 NMVOC emissions (kt) in road transport 1990−2021

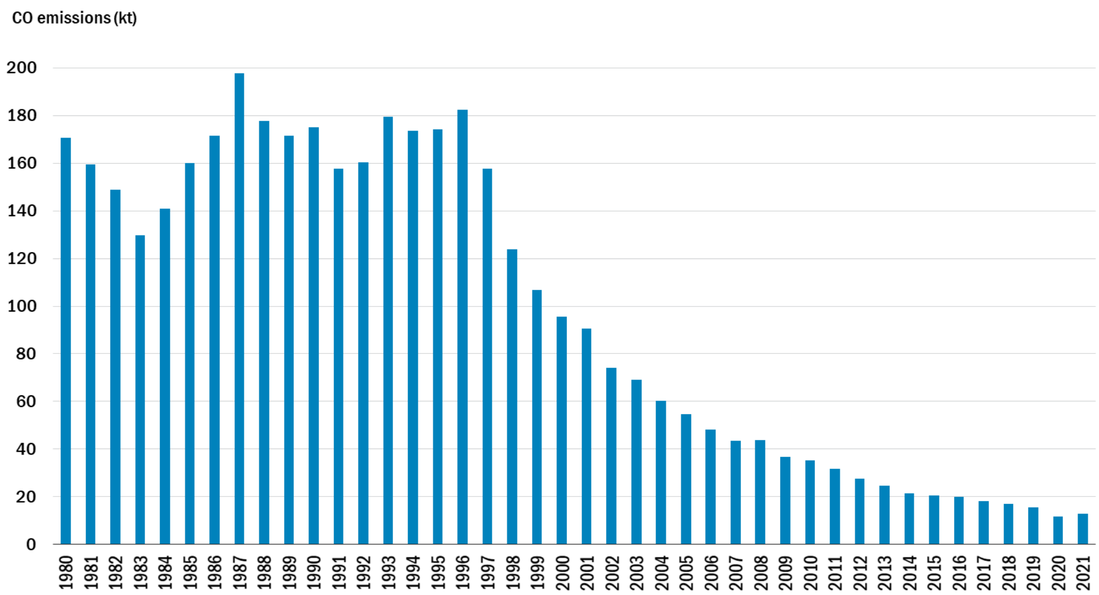

Figure 3.3.1.9 CO emissions (kt) in road transport 1980−2021

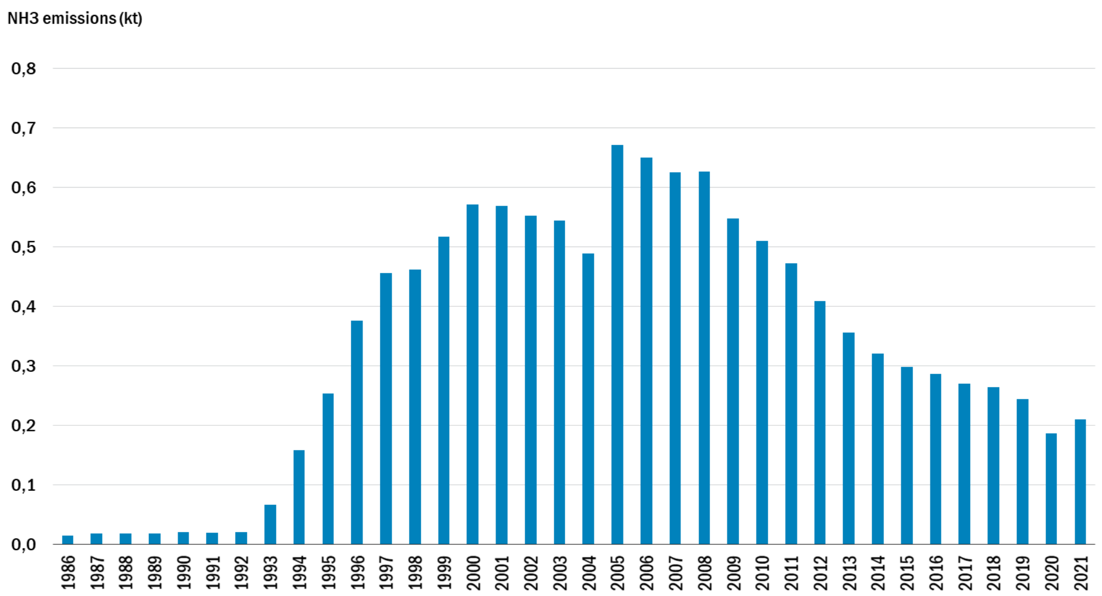

Figure 3.3.1.10 NH_3 emissions (kt) in road transport 1986−2021

Particulate emissions in the vehicle exhaust mainly fall in the $PM_{2.5}$ size range. Therefore, all PM emission corresponds to $PM_{2.5}$. PM emission reduction has been achieved due to the growing share of vehicles that meet the stricter EURO standards. Also fuel refinements (mainly sulphur content reduction) played an important role in PM emission (Figure 3.3.1.11).

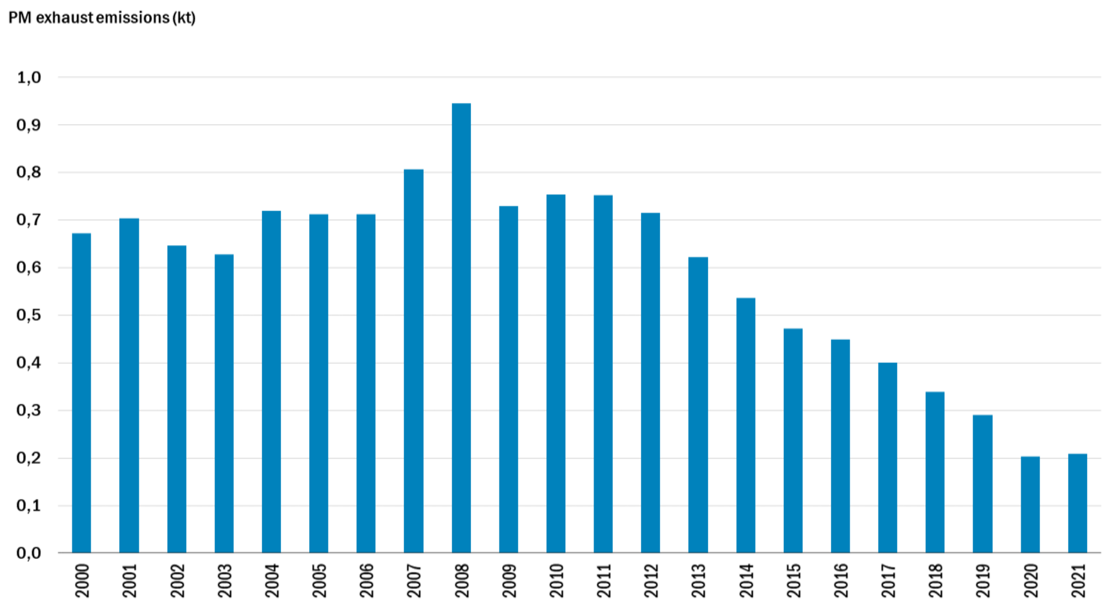

Figure 3.3.1.11 Exhaust PM emissions (kt) in road transport 2000−2021

Airborne particles are produced as a result of the interaction between a vehicle's tyres and the road surface, and also when the brakes are applied to decelerate the vehicle. Those particles are emitted directly as a result of the wear of surfaces and not those resulting from the resuspension of ta previously deposited material. A jump of particulates emission from road vehicle tyre, brake wear and road abrasion in the year 2008 was a consequence of bigger fuel consumption and vehicle kilometres driven. In 2009 a significant decline in gasoline and diesel consumption was observed. In comparison with the year 2008 consumption of gasoline dropped by 9 % and diesel by 20 %. A huge drop in emissions in 2020 was due to small fuel consumption as a consequence of the Covid-19 pandemic crisis. This was reflected in a decline in PM emissions. Lower consumption of fuel was due to the world economic and the Covid-19 pandemic crisis. In 2021 the sale of fuel was on the rise again due to the release of Covid-19 measures and emissions increased. Emissions for particulate matter (PM2.5, PM10, TSP, BC) from automobile tyre and brake wear and road abrasion depend on total mileage driven and vehicle category (Figure 3.3.1.12 and Figure 3.3.1.13). Data on vehicles kilometres per vehicle category and number of vehicles per vehicle category are shown in Annex 1 to the IIR (Table 1.7: Road transport: Particulate from tyre and brake wear and road abrasion).

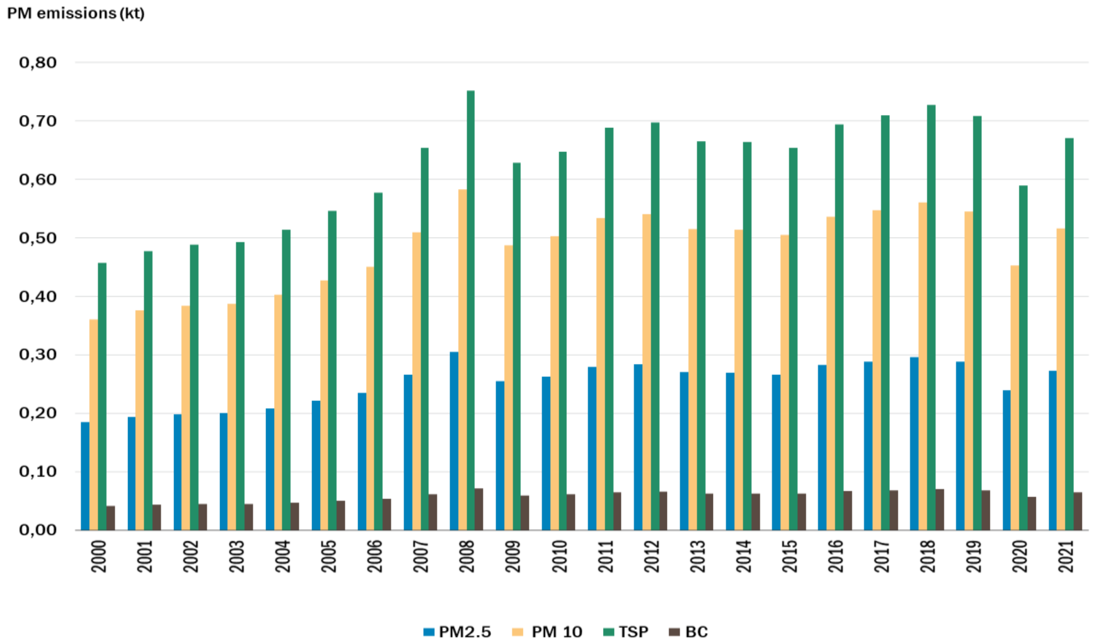

Figure 3.3.1.12 PM emissions from road vehicle tyre and brake wear (kt) in road transport 2000−2021

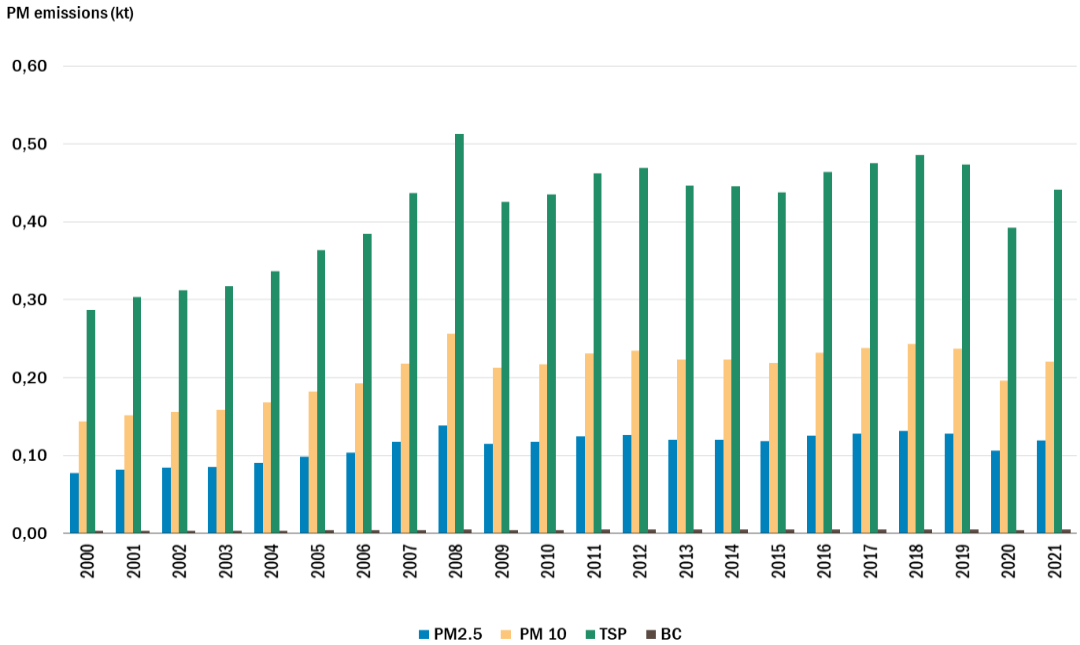

Figure 3.3.1.13 PM emissions from road surface wear (kt) in road transport 2000−2021

Particulate emissions including exhaust and non-exhaust emissions are shown in Figure 3.3.1.14, Figure 3.3.1.15, Figure 3.3.1.16 and Figure 3.3.1.17. Emissions of black carbon (BC) mostly origin from vehicle exhaust, but smaller part also from automobile tyre, brake wear and road abrasion. Emissions of BC follow $PM_{2.5}$ emissions.

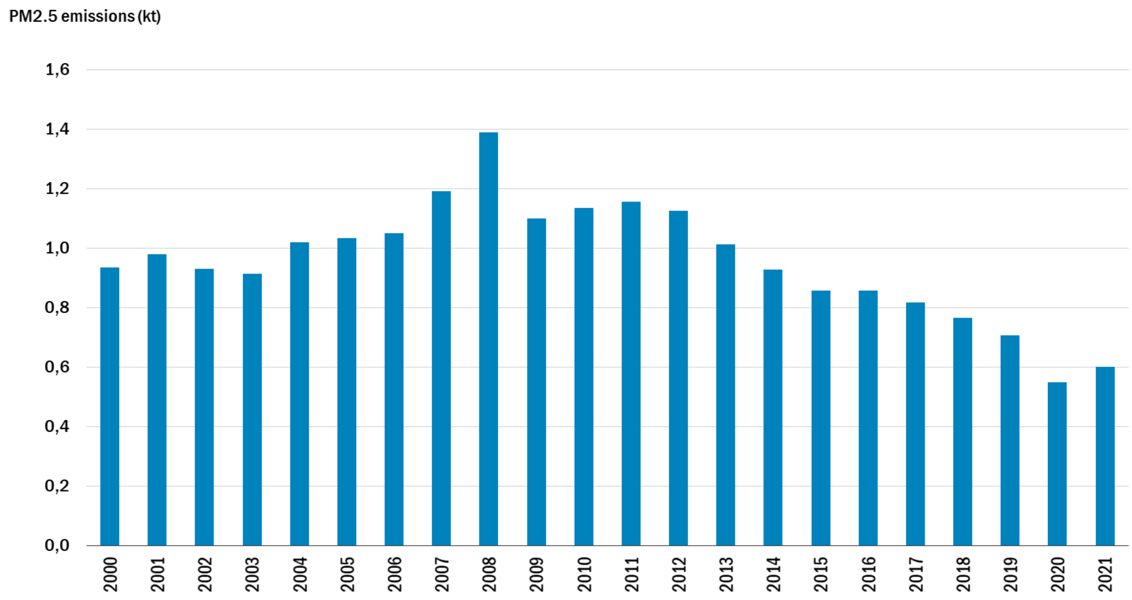

Figure 3.3.1.14 $PM_{2.5}$ emissions from road transport 2000−2021

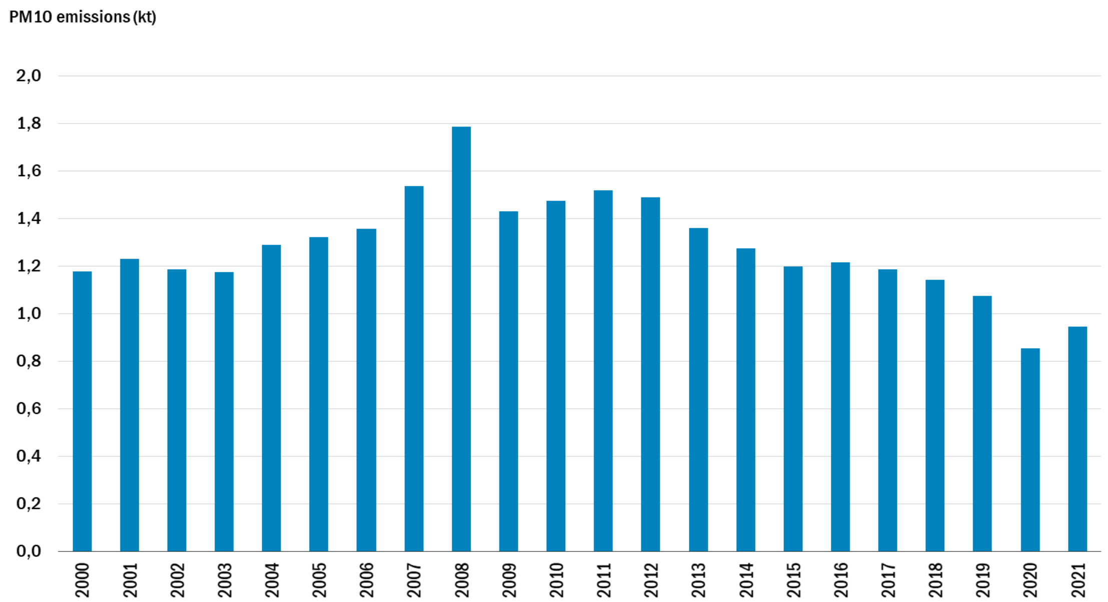

Figure 3.3.1.15 PM_{10} emissions from road transport 2000−2021

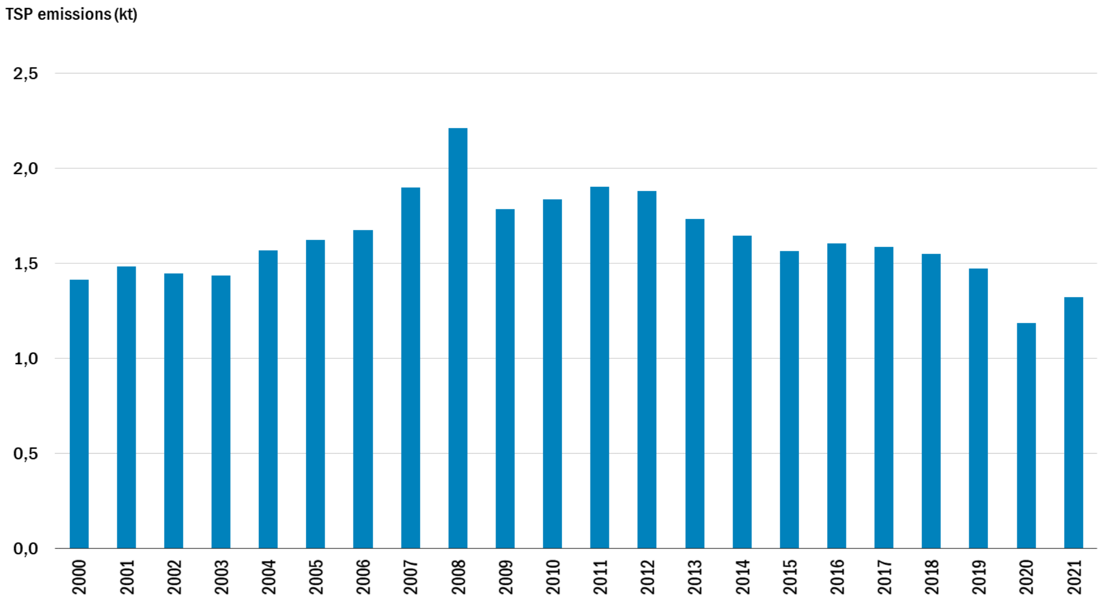

Figure 3.3.1.16 TSP emissions from road transport 2000−2021

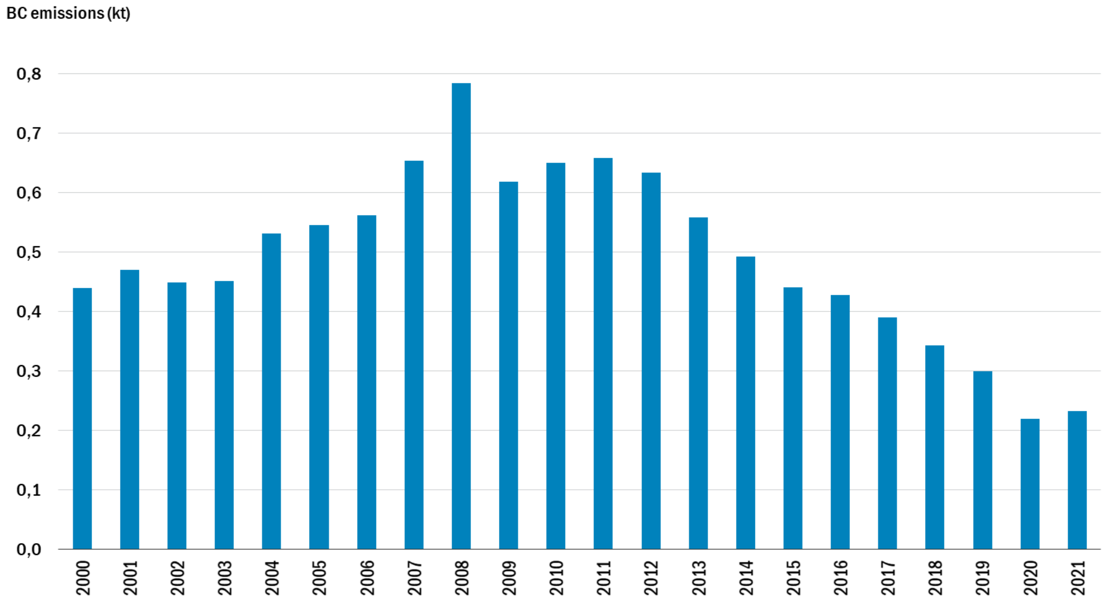

Figure 3.3.1.17 BC emissions from road transport 2000−2021

Emissions of Pb, Cd, Hg, PAHs, HCB, PCB, Dioxins and Furans

From 1990 to 2021 the road transport emissions of Pb, PCB and dioxins/furans have decreased by 94 %, 15 % and 13 %. In the same period, the emissions of Cd, Hg, HCB and PAHs have increased by 90, 64, 3 and 184 %, respectively. Road transport emissions of Pb, Cd, Hg, PAHs, dioxins/furans, HCB, PCB for the period 1990-2021 are shown in Figure 3.3.1.18 to Figure 3.3.1.24. Emissions of heavy metals presented in Figures comprise exhaust and non-exhaust emissions. Automobile tyre and brake wear is the main source of heavy metals emissions. The newest version of COPERT 5 (version 5.6.1) improved heavy metal emissions estimation from tyre and brake wear. It was found out that the previous methodology underestimated that source of metal emissions.

Pb emissions have decreased greatly from 1995 to 2021. The lowering is due to stricter legislation relating to the content of Pb in gasoline fuel. Emissions of Cd have increased in the last few years due to bigger fuel consumption. Total emissions of four PAHs (indeno(1,2,3-cd)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene) have been increasing due to changes in fleet vehicles. Total emissions of dioxins and furans have been decreasing due to growth in the share of diesel passenger cars. An increase in emissions in 2008 was due to bigger fuel consumption. Due to the world economic crises and consecutively smaller fuel consumption emissions of all pollutants considerably decreased in 2009. Another huge drop in emissions in 2020 was due to small fuel consumption as a consequence of the Covid-19 pandemic crisis. Emissions in 2021 increased again due to the release of Covid-19 measures and bigger fuel consumption.

Emissions of As, Cr and Ni have been individually increased between 1990 and 2021 by 85 %, emissions of Cu by 84 %. Emissions of Se and Zn have been doubled in the same period (increase by 105 %). A jump of heavy metals emissions in the year 2008 was due to bigger fuel consumption. In 2009 a significant decline in gasoline and diesel consumption was observed. In comparison with the year 2008 consumption of gasoline dropped by 9 % and diesel by 20 %. This was reflected in a decline in emissions. Another huge drop in emissions is seen in 2020. In 2021 a drop in emissions occurred due to smaller fuel consumption. Lower fuel consumption was due to reduced mobility as a consequence of the Covid-19 pandemic lockdown measures. In comparison with the year 2019, consumption of gasoline dropped by 21 % and diesel by 18 %. Emissions in 2021 increased again due to the release of Covid-19 measures and bigger fuel consumption. Automobile tyre and brake wear is the most important source of heavy metals. Non-exhaust emissions contributed more than 97 % to the total heavy metals emissions (Cu, Cr, Zn, As, Se, Zn, Pb). Non-exhaust emissions for Cd are smaller, but still 34 %.
Road transport emissions of As, Cr, Cu, Ni, Se and Zn for the period 1990 − 2021 are shown in Figure 3.3.1.25 to Figure 3.3.1.30.

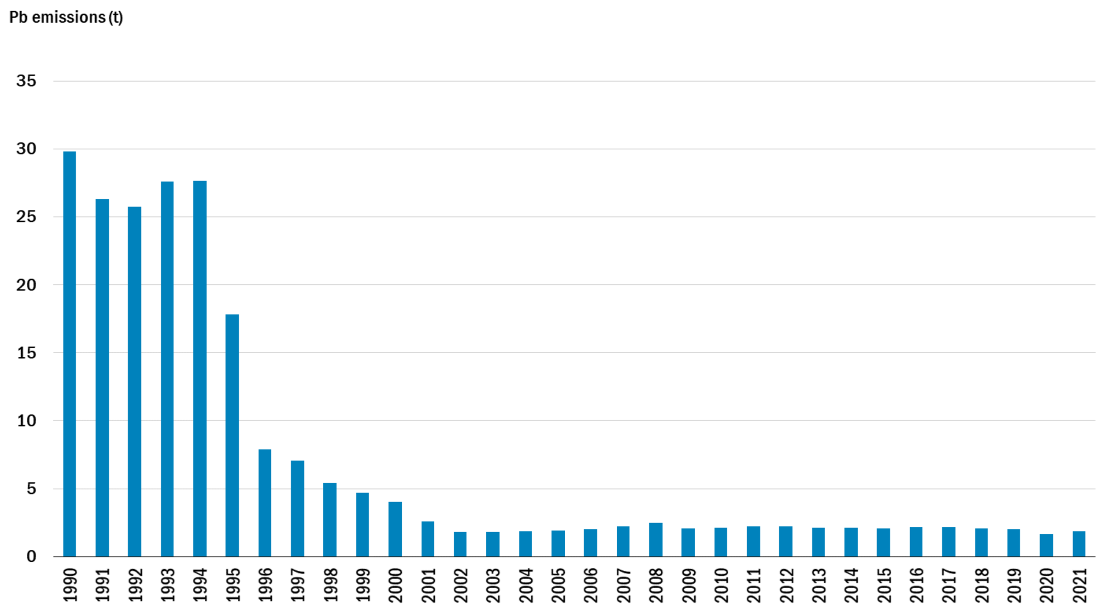

Figure 3.3.1.18 Pb emissions (t) in road transport 1990−2021

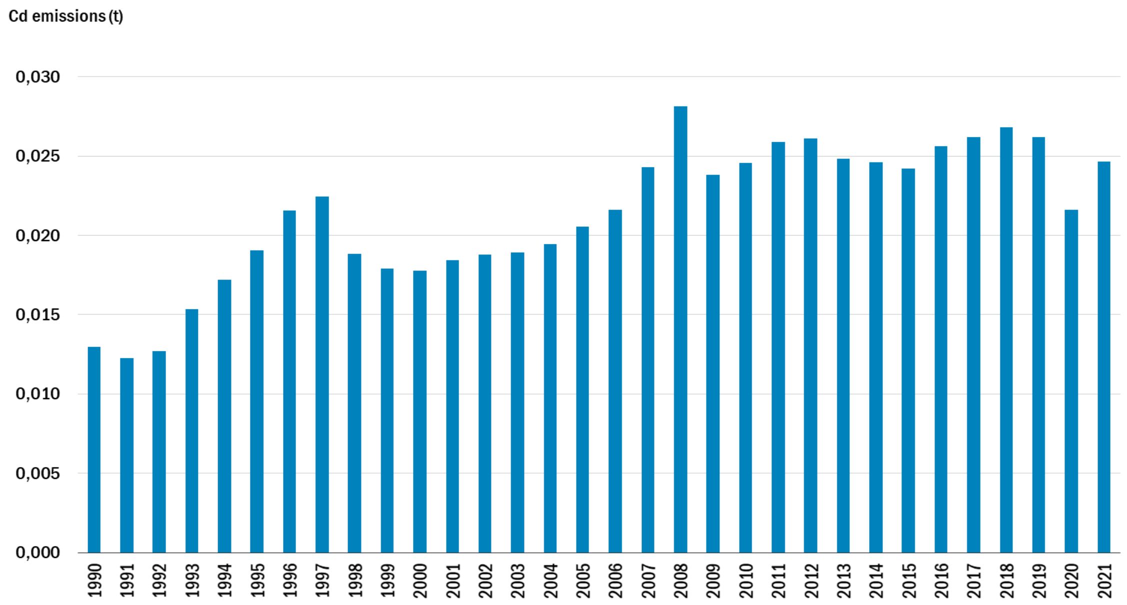

Figure 3.3.1.19 Cd emissions (t) in road transport 1990−2021

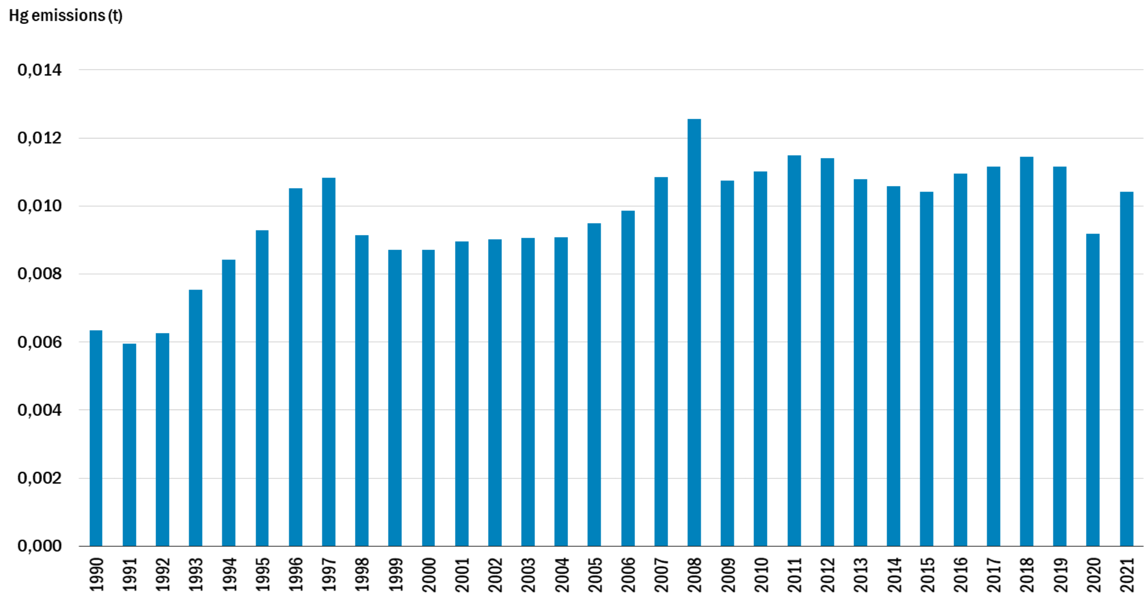

Figure 3.3.1.20 Hg (t) in road transport 1990−2021

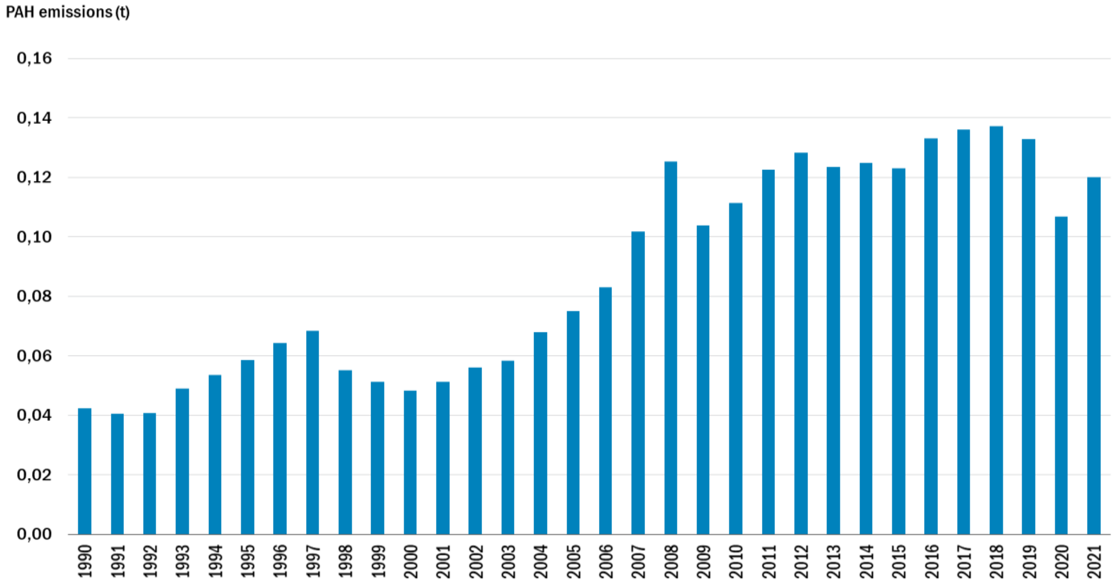

Figure 3.3.1.21 PAHs emissions (t) in road transport 1990−2021

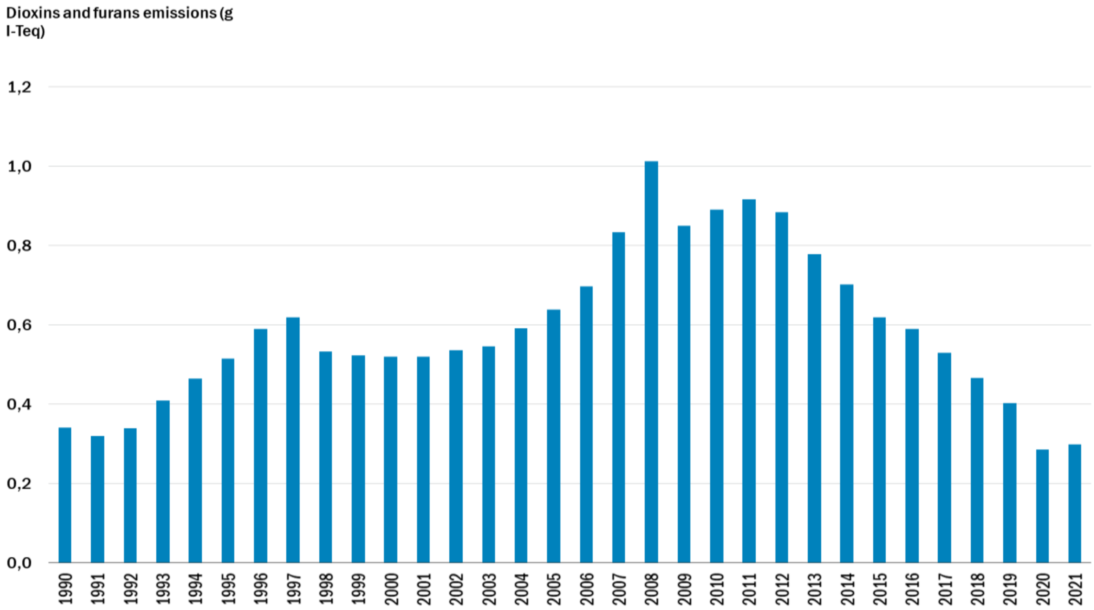

Figure 3.3.1.22 Dioxins/Furans emissions (g I-Teq) in road transport 1990−2021

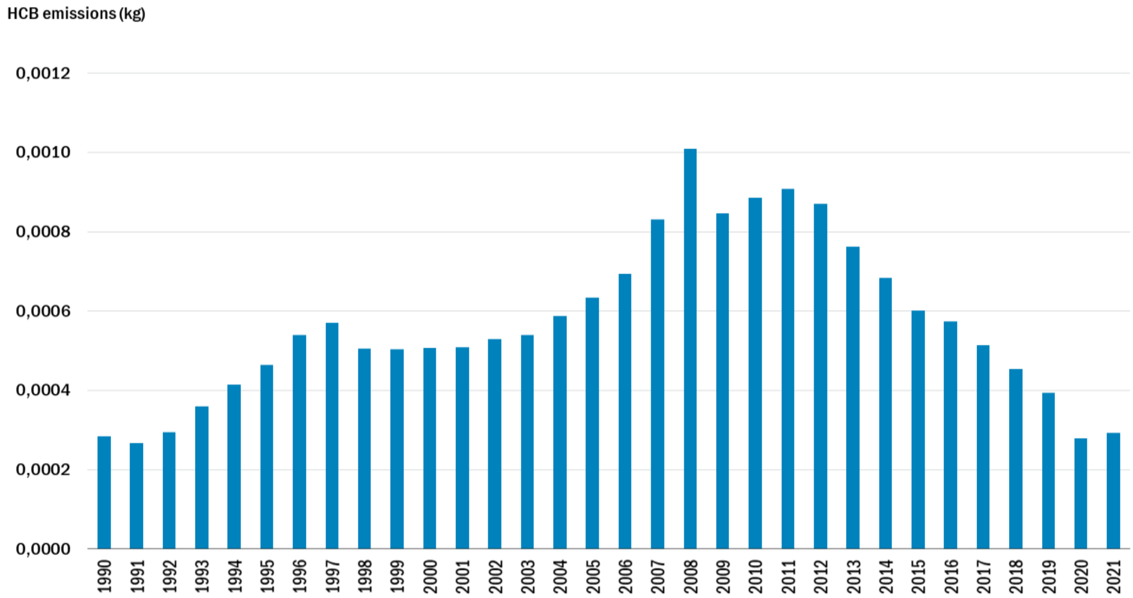

Figure 3.3.1.23 HCB (kg) in road transport 1990−2021

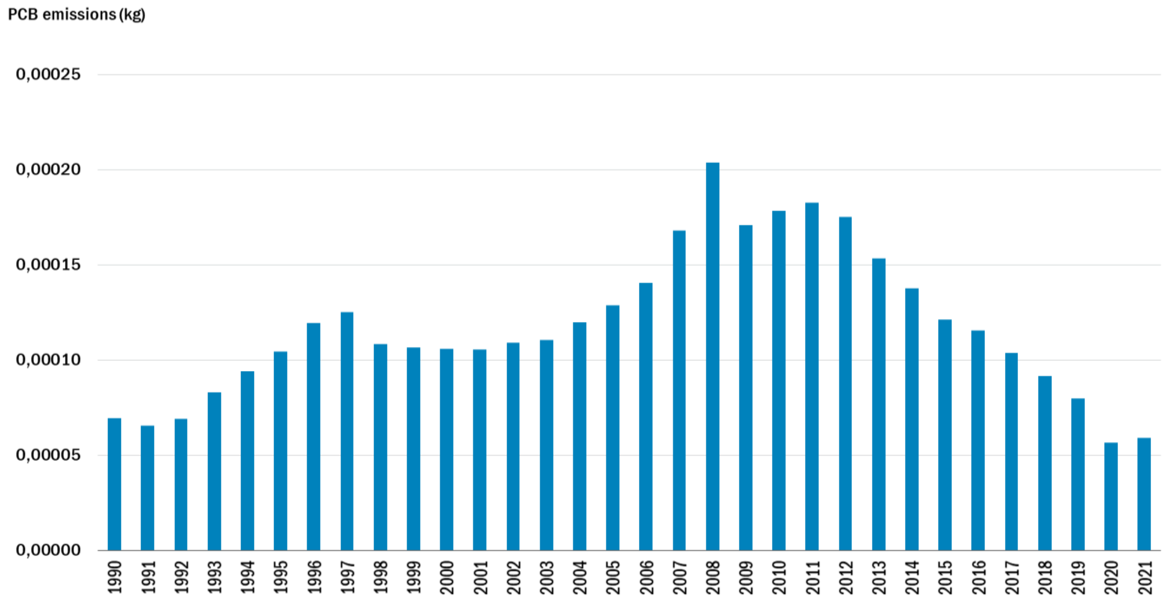

Figure 3.3.1.24 PCB (kg) in road transport 1990−2021

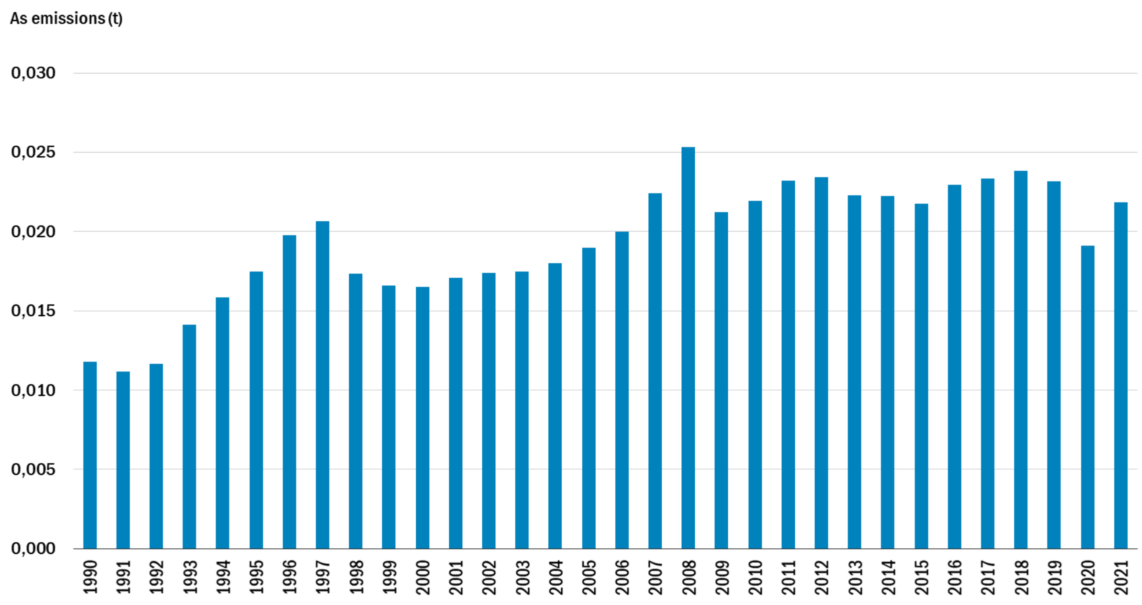

Figure 3.3.1.25 As (t) in road transport 1990−2021

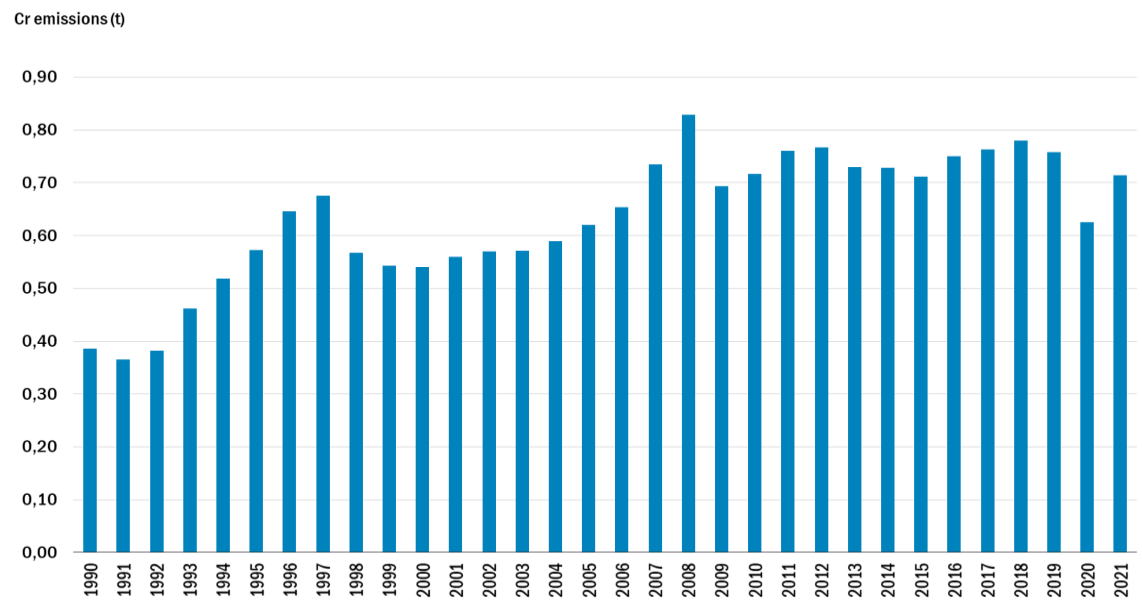

Figure 3.3.1.26 Cr (t) in road transport 1990−2021

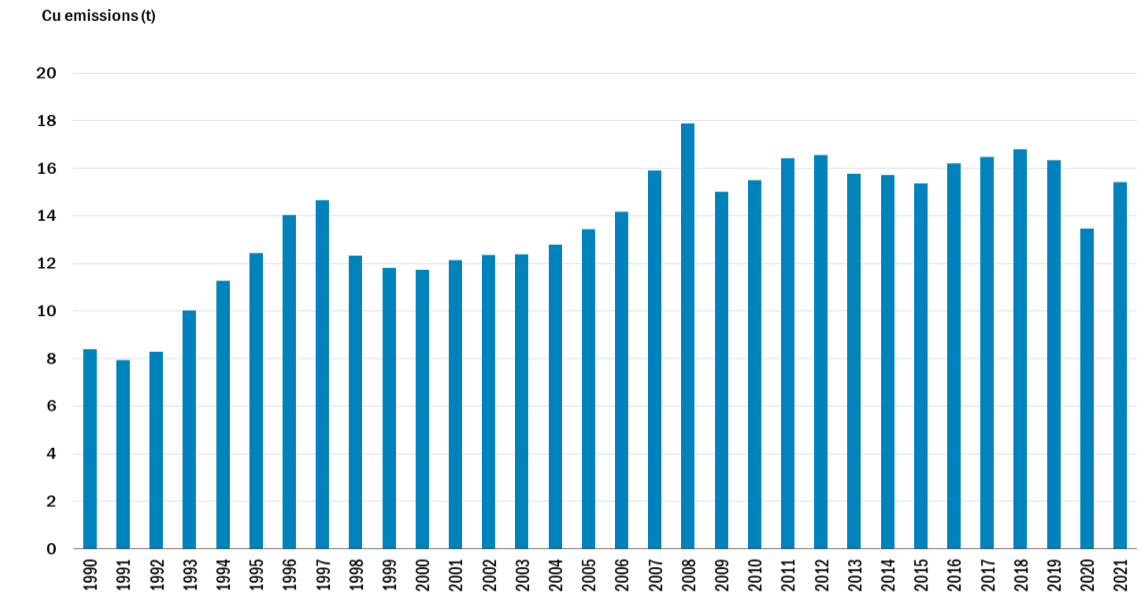

Figure 3.3.1.27 Cu (t) in road transport 1990−2021

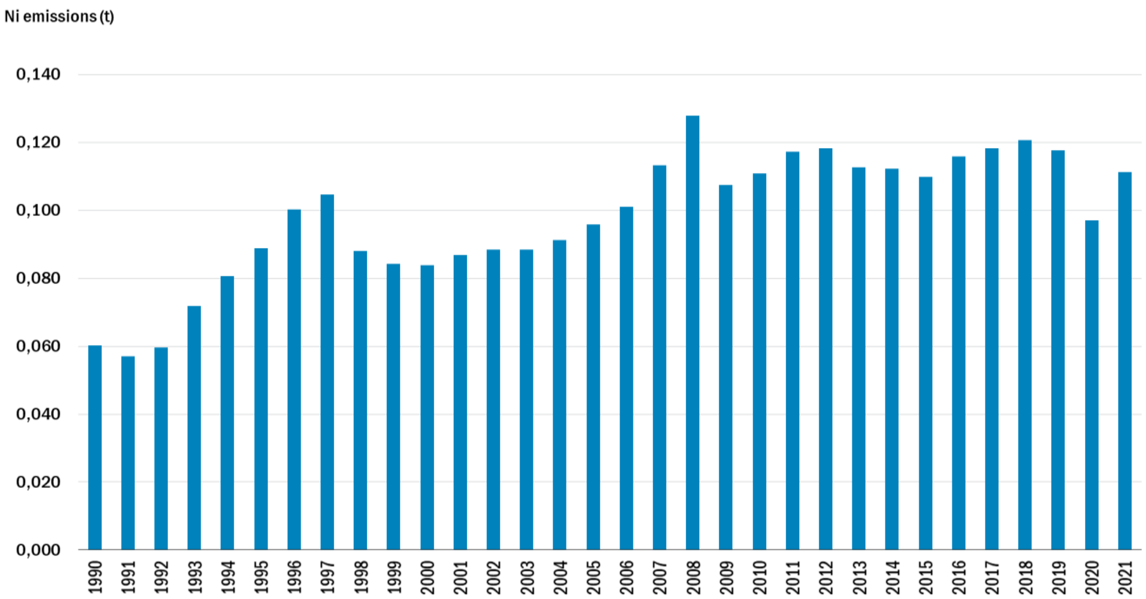

Figure 3.3.1.28 Ni (t) in road transport 1990−2021

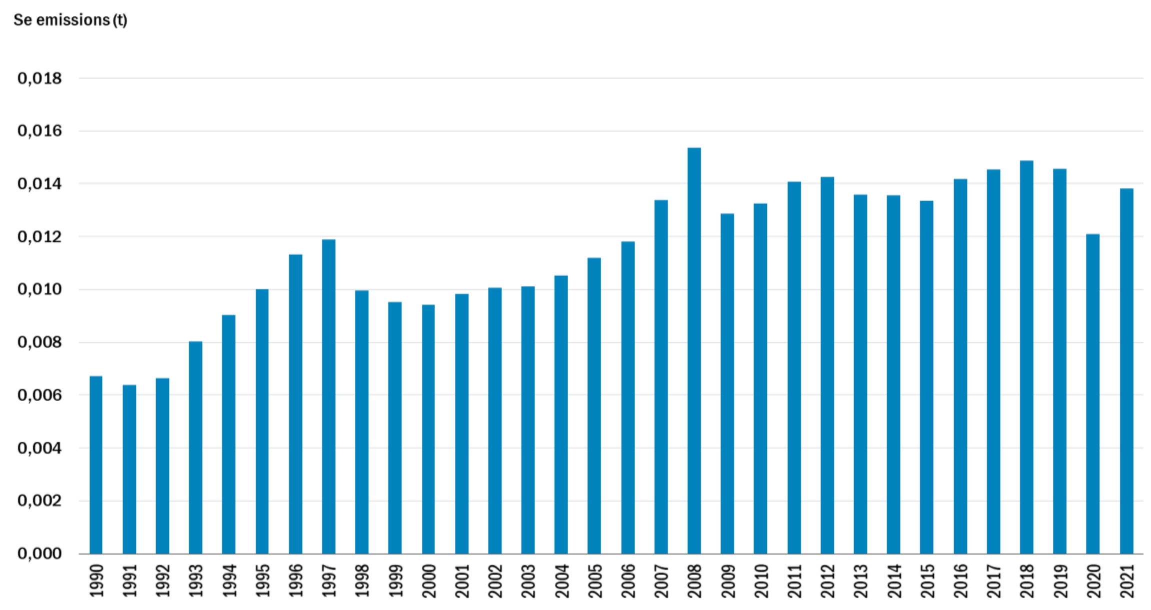

Figure 3.3.1.29 Se (t) in road transport 1990−2021

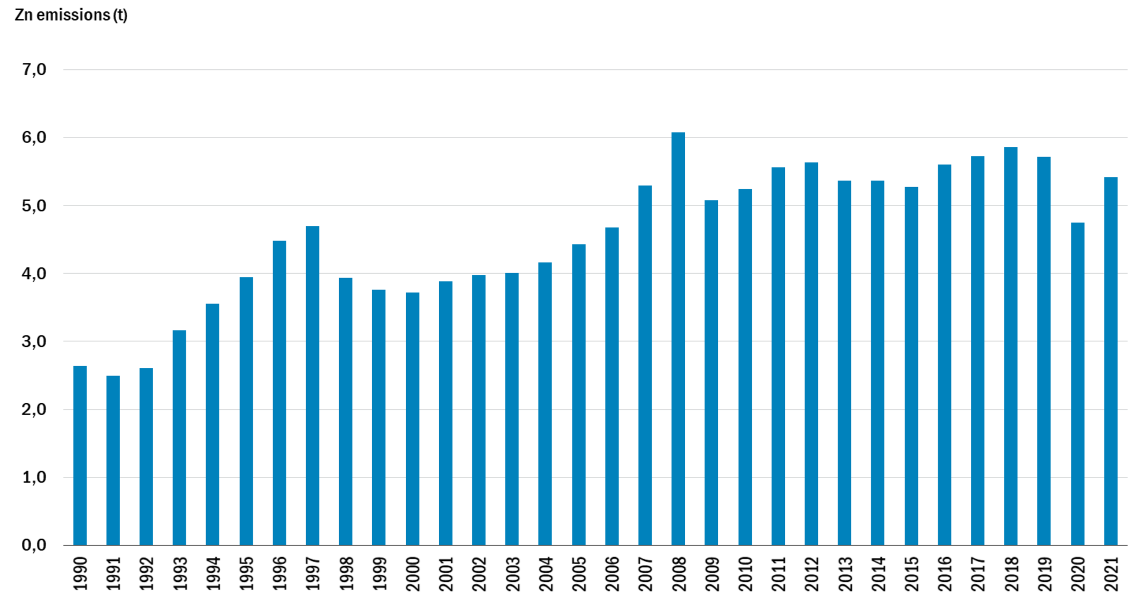

Figure 3.3.1.30 Zn (t) in road transport 1990−2021

Category-Specific QA/QC and Verification

Examination of input data, the model calculation and the data reported in NFR tables as part of a QC/QC procedure was performed. Mistakes in vehicle fleets for gasoline heavy duty trucks were found. Those vehicles were unintentionally omitted from the national fleet for the period 1980-1991. An error was corrected and recalculations were performed.

Recalculations

Recalculation of all emissions for the entire period was performed due to an application of a

new version of COPERT 5 model. The newest version of COPERT 5 (version 5.6.1) was used for emissions calculation. Emissions of SO_x, NO_x, CO have been recalculated for the period 1980-2020, emissions of NH_3 for the period 1986-2020, emissions of $PM_{2.5}$, PM_{10}, TSP, BC for the period 2000-2020, emissions of Pb, Cd, Ni, Se, Zn, Cr, Cu, Hg, As, dioxins/furans, indeno(1,2,3-cd)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, HCB, PCB for the period 1990-2020.
Additional recalculations were performed due to the introduction of gasoline heavy duty trucks into the national fleet for the period 1980-1991.

Planned improvements

No improvements are planned for the next submission.

3.3.2 Railways

NFR Code 1A3c

Introduction

Exhaust emissions from railways arise from the combustion of liquid fuels in diesel engines, and solid or liquid fuels in steam engines to provide propulsion. The principal pollutants are those from diesel engines, similar to those used in road transport. In the year 2021 railways mostly contributed to the total NO_x (1 %) and a lesser extent to other pollutants.

Methodology

To estimate emissions from the railways the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t) or (g/GJ)

In the case of EF expressed in the unit g/GJ net calorific value (NCV) of fuel is needed for emission calculation.

Activity data

The main source of emissions is the consumption of diesel. The consumption of coal in railway transportation was small. This coal was used in only one ‘’archaic’’ steam driven locomotive which is almost 100 years old. According to information from the Slovene Railway Company, they are trying to avoid using hard coal, due to safety reasons, durability and preservation of this piece of history. The specified data have been obtained from the Statistical Office of the Republic of Slovenia (SORS). In 2020 and 2021 only diesel fuel was used in railways.

There were no data available on consumption of diesel and brown coal used in railway sector before 1986. Activity data for the period 1980-1985 have been estimated.

Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.8: Fuel Consumption: Railways).

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used for emissions calculation.

Table 3.3.2.1 Emission factors for diesel used for emission calculation and references

Pollutant	Diesel	Unit	References
NO_x	52,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	10,7	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
NMVOC	4,65	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
NH_3	0,007	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
$PM_{2.5}$	1,37	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
PM_{10}	1,44	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
TSP	1,52	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
BC	0,8905	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Cd	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Cr	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Cu	1,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Ni	0,07	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Se	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Zn	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Benzo(a)pyrene	0,03	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Benzo(b)fluoranthene	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Railways, Table 3.1, pg 8
Benzo(k)fluoranthene	0,0344	g/t	EMEP/EEA Emission Inventory Guidebook, 2019¸ Exhaust emissions from road transport, Table 3-8, pg 19
Indeno(1,2,3-cd)pyrene	0,0079	g/t	EMEP/EEA Emission Inventory Guidebook, 2019¸ Exhaust emissions from road transport, Table 3-8, pg 19
Pb	0,052	g/t	EMEP/EEA Emission Inventory Guidebook, 2019¸Exhaust emissions from road transport, Table 3-10, pg 20

Table 3.3.2.2 Emission factors for brown coal used for emission calculation and references

Pollutant	Coal	Unit	References
NO_x	247	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
SO_x	1680	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
CO	8,7	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16

NMVOC	1,4	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
$PM_{2.5}$	3,2	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
PM_{10}	7,9	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
TSP	11,7	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
BC	0,032	g/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cd	1,8	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Hg	2,9	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Pb	15	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
As	14,3	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cr	9,1	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Cu	1	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Ni	9,7	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Se	45	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Zn	8,8	mg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Dioxins/ Furans	10	ng I-TEQ/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
HCB	6,7	microg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(a)pyrene	1,3	microg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(b)fluoranthene	37	microg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Benzo(k)fluoranthene	29	microg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16
Indeno(1,2,3-cd)pyrene	2,1	microg/GJ	EMP/EEA Emission Inventory Guidebook, 2019, Energy industries, Table 3-3, pg 16

There is no information for diesel whether emission factors include or exclude condensable components. PM emission factors for coal used represent filterable PM emissions.

Net calorific values

Data on NCV have been obtained from SORS.

Emissions

In the year 2021 railways mostly contributed to the national total NO_x (1 %) and to a lesser extent to other pollutants. There is a strong increase in diesel consumption in 2014. The reason for this increase is a severe ice storm that destroyed electrical infrastructure for the supply of trains on the route Ljubljana - Koper in February 2014. The repair was going on until summer 2015. In meantime, the trains on this line were using diesel locomotives which resulted in the higher consumption of diesel oil in 2014 and relatively high consumption in 2015.

Recalculations

No recalculations were performed since the last submission.

Future Improvements

No improvement is planned for the next submission.

3.3.3 Aviation

Sectors covered in this chapter are:

NFR Codes:

1A3ai(i)	International aviation LTO (civil)
1A3aii(i)	Domestic aviation LTO (civil)
1A5b	Other, Mobile (including military, land based and recreational boats)

3.3.3.1 International aviation LTO (civil)

NFR Code 1A3ai(i)

Introduction

In sector international aviation are included journeys where aircraft depart from one country and arrive in another country. There is only one operative international airport in Slovenia (Aerodrom Ljubljana) where international airport traffic has been taking place. Exhaust emissions from international airport traffic aviation arise from the combustion of jet kerosene. Contribution to total national emissions for all pollutants is negligible, the only contribution of NO_x is 0,1 % to total emissions.

Methodology

Period 2005-2021

Eurocontrol data on emissions of SO_x, NO_x, CO, NMVOC, TSP and fuel burnt (jet kerosene) are the relevant data used for reporting emissions. Tier 3 approach was used for emission estimation.

Period 1980-2004

Since there is no Eurocontrol data available before 2005 estimation for the period 1980-2004 was performed.

To estimate emissions from international aviation for the period 1980-2004, the following methodology has been adopted:

$$E = m \times EF$$

E - emission (kg)
m - quantity of fuel combusted (t)
EF - emission factor per quantity of fuel (kg/t)

The quantity of jet kerosene applied for emission calculation was estimated on the basis of the amount of total fuel used obtained from SORS. Emission factors derived for the year 2005 was used for the period 1980-2004 as well.

Table 3.3.3.1.1 Emission factors for jet kerosene

Pollutant	Emission factor	Unit
NO_x	12,73	kg/t
SO_x	0,84	kg/t
CO	11,87	kg/t
NMVOC	2,767	kg/t
$PM_{2.5}$	0,11	kg/t
PM_{10}	0,11	kg/t
TSP	0,11	kg/t
BC	0,0165	kg/t

There is no information on whether emission factors represent filterable PM_{10} and $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.9: Fuel Consumption: International aviation LTO (civil)).

Recalculations

No recalculations were performed since the last submission.

Future Improvements

No improvements are planned for the next submission.

3.3.3.2 Domestic aviation LTO (civil)

NFR Code 1A3aii(i)

Introduction

Civil domestic aviation comprises journeys where aircraft depart and arrive in the same country. In Slovenia, there are a couple of small airports used for sports or tourist activities. Emissions are very low due to the small amount of fuel used for these purposes. Contribution to total national emissions for all pollutants is negligible, the only contribution of CO is 0,6 % to total emissions.

Methodology

To estimate emissions from civil aviation, the following methodology has been adopted:

E = m x EF
E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

For domestic aviation gasoline and jet kerosene have been used. The quantity of fuel used in domestic aviation LTO (civil) has been derived by subtracting the amount of fuel used for domestic aviation cruise (civil) from the total fuel consumption obtained by SORS. Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.10: Fuel Consumption: Domestic aviation LTO (civil)).

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used for emissions calculation.

Table 3.3.3.2.1 Emission factors for aviation gasoline

Pollutant	Aviation gasoline	Unit	References
NO_x	4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Civil aviation (domestic, LTO), Table 3.3, pg 20
SO_x	1	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Civil aviation (domestic, LTO), Table 3.3, pg 20
CO	1200	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Civil aviation (domestic, LTO), Table 3.3, pg 20
NMVOC	19	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Civil aviation (domestic, LTO), Table 3.3, pg 20

Table 3.3.3.2.2 Emission factors for jet kerosene

Pollutant	Jet kerosene	Unit	References
NO_x	13,82	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22
SO_x	0,84	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22
CO	10,1	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22
NMVOC	1,81	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22
$PM_{2.5}$	0,08	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22
PM_{10}	0,08	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22
TSP	0,08	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22
BC	0,012	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.4, pg 22

There is no information on whether emission factors represent filterable PM_{10} and $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Recalculations

Emissions of SO_x, NO_x, CO, NMVOC, $PM_{2.5}$, PM_{10}, TSP and BC have been recalculated for the year 2020 due to new activity data applied. A mistake in the amount of jet kerosene was found due to a mistake in importing data to the reporting table. The error was found during QA/QC procedure.

Future Improvements

No improvements are planned for the next submission.

3.3.3.3 Other, Mobile (including military, land based and recreational boats)

NFR Code 1A5b

Introduction

Military and police aircraft and helicopters serve different purposes. Besides regular security operations and training activities, they are also engaged in emergency medical service, intervention in natural disasters and mountain rescue operations. Emissions of main pollutants have been estimated from the use of fuel in army and police air force fleets. Emissions do not contribute much (below 0,1 %) to the total emissions due to the small amount of fuel used.

Methodology

To estimate emissions from army and police aviation the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

The consumption of jet kerosene in the Slovenian army and police for the period 1980 - 2021 has been obtained from both institutions. The consumption of fuel for helicopters and military flights was small due to the small air force fleet. Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.11: Fuel Consumption: Other, Mobile (including military, land based and recreational boats).

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

Table 3.3.3.3.1 Emission factors for jet kerosene used for emission calculation and references

Pollutant	Jet kerosene	Unit	References
NO_x	4,631	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28
SO_x	1,025	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28
CO	33,9	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28
NMVOC	2,331	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28

Emission factors used for the calculations of TSP, BC, PM_{10} and $PM_{2.5}$ emissions were adopted from emissions factors used in the calculation of emissions from International aviation LTO (civil). There is no information on whether emission factors represent filterable PM_{10} and $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Recalculations

No recalculations were performed since the last submission.

Future Improvements

No improvement is planned for the next submission.

3.3.4 Navigation

3.3.4.1 National navigation (Shipping)

NFR Code 1A3dii

Introduction

This chapter includes emissions from consumption of fuels used by vessels of all flags that depart and arrive in the same country. National emissions from that source are negligible. The contribution to total national emissions is less than 0,01 %.

Methodology

To estimate emissions from national navigation the following methodology has been adopted:

E = m x EF

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

The quantity of gasoline and diesel oil used for emission calculation has been obtained from Slovenian Maritime Administration for the period 2012-2021. Fuel used for the period 1980-2011 was estimated. Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.12: Fuel Consumption: National navigation (shipping).

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

Table 3.3.4.1.1 Emission factors for diesel used for emission calculation and references

Pollutant	Heavy fuel oil	Unit	References
NO_x	78,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	7,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
NMVOC	2,8	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
$PM_{2.5}$	1,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
PM_{10}	1,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15

TSP	1,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
BC	0,434	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Cd	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Pb	0,13	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Hg	0,03	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
As	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Cr	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Cu	0,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Ni	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Se	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Zn	1,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Benzo(a)pyrene	0,002	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Benzo(b)fluoranthene	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Benzo(k)fluoranthene	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Indeno(1,2,3-cd)pyrene	0,001	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
PCB	0,038	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
HCB	0,08	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Dioxins/ Furans	0,13	microg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15

Table 3.3.4.1.2 Emission factors for gasoline used for emission calculation and references

Pollutant	Heavy fuel oil	Unit	References
NO_x	9,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-3, pg 17
SO_x	Values used for road transport (Table 3.3.1.2)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	573,9	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-3, pg 17
NMVOC	181,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-3, pg 17
$PM_{2.5}$	9,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-3, pg 17
PM_{10}	9,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-3, pg 17
TSP	9,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-3, pg 17
BC	0,475	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-3, pg 17

There is no information on whether emission factors represent filterable TSP, PM_{10} and $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Recalculations

No recalculations have been performed since the last submission.

Future Improvements

No improvement is planned for next submission.

3.3.5 Pipeline transport

NFR Code 1A3ei

Introduction

This category includes emissions from natural gas combusted on compressor stations. Emissions from this source are negligible. They are far below 0,005 %.

Methodology

To estimate emissions the following methodology has been adopted.

E = m x NCV x EF
E – emission (mg)
m – quantity of fuel combusted (m^3)
EF – emission factor per energy of fuel (g/GJ)
NCV - net calorific value (MJ/m^3)

Activity data

We have obtained data on natural gas used on compressor station from the company which is the owner of this compressor station. The data are available from 2008. Activity data for 2021 is 453305 m^3 of natural gas.

Net calorific values

Net calorific values have been taken from SORS.

Table 3.3.5.1 NCVs for natural gas used on compressor station

Year	Natural Gas
	MJ/m3
2008	34,096
2009	34,080
2010	34,080
2011	34,087
2012	34,093
2013	34,079
2014	34,083
2015	34,086
2016	34,087

2017	34,085
2018	34,084
2019	34,081
2020	34,087
2021	34,086

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

Table 3.3.5.2 Emission factors used for natural gas on compressor station for 2008 – 2021

Pollutant	Value	Unit	References
NO_x	74	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
CO	29	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
NMVOC	23	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
SO_x	0,67	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
PM_{10}	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
$PM_{2.5}$	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
TSP	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
BC	0,0312	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Cd	0,0009	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Pb	0,011	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Hg	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
As	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Cr	0,013	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Cu	0,0026	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Ni	0,013	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Se	0,058	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Zn	0,73	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Benzo(a)pyrene	0,72	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Benzo(b)fluoranthene	2,9	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Benzo(k)fluoranthene	1,1	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Indeno(1,2,3-cd)pyrene	1,08	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Dioxins/ Furans	0,52	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37

It is unclear whether emission factors for TSP, PM_{10}, $PM_{2.5}$ represent filterable PM emissions or total (filterable and condensable) emissions.

Recalculations

No recalculation were performed since the last submission.

Future Improvements

No improvement is planned for this category.

3.3.6 Memo items

Sectors covered in this chapter are:

NFR Codes:

1A3di(i)	International maritime navigation
1A5c	Multilateral operations
1A3ai(ii)	International aviation cruise (civil)
1A3aii(ii)	Domestic aviation cruise (civil)

3.3.6.1 International maritime navigation

NFR Code 1A3di(i)

Introduction

Slovenia has only one international port “Luka Koper” but in the period 1980-2005 no ships had been refuelled in that port. Ships were mostly refuelled in international waters by Italian ships under Panama flags. Since 2006 a small amount of heavy fuel oil has been reported as fuel sold to international marine bunkers. In 2018 and 2019 also diesel was reported.

Methodology

To estimate emissions from international maritime navigation the following methodology has been adopted:

E = m x EF

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

The quantity of heavy fuel oil used for emission calculation has been obtained from SORS for the period 2006-2021. In 2018 and 2019 also diesel was reported as fuel sold to the international marine bunkers. Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.13: Fuel Consumption: International maritime navigation/ International bunker fuels).

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

Table 3.3.6.1.1 Emission factors for heavy fuel oil used for emission calculation and references

Pollutant	Heavy fuel oil	Unit	References
NO_x	79,3	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
SO_x	1,0	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
CO	7,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
NMVOC	2,7	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
$PM_{2.5}$	5,6	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
PM_{10}	6,2	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
TSP	6,2	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
BC	0,672	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Cd	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Pb	0,18	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Hg	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
As	0,68	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Cr	0,72	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Cu	1,25	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Ni	32	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Se	0,21	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Zn	1,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
PCB	0,57	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
HCB	0,14	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14
Dioxins/ Furans	0,00047	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-1, pg 14

Table 3.3.6.1.2 Emission factors for diesel used for emission calculation and references

Pollutant	Heavy fuel oil	Unit	References
NO_x	78,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	7,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
NMVOC	2,8	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
$PM_{2.5}$	1,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15

PM_{10}	1,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
TSP	1,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
BC	0,434	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Cd	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Pb	0,13	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Hg	0,03	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
As	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Cr	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Cu	0,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Ni	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Se	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Zn	1,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Benzo(a)pyrene	0,002	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Benzo(b)fluoranthene	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Benzo(k)fluoranthene	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Indeno(1,2,3-cd)pyrene	0,001	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
PCB	0,038	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
HCB	0,08	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15
Dioxins/ Furans	0,13	microg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, Table 3-2, pg 15

There is no information on whether emission factors represent filterable TSP, PM_{10} and $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Emissions

The emissions produced by navigation are a consequence of combusting the fuel in an internal combustion engine. According to the 2023 Guidelines for reporting emissions and projections data under the Convention and EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 emissions resulting from international journeys are not included in national totals.

Recalculations

No recalculations have been performed since the last submission.

Future Improvements

No improvement is planned for the next submission.

3.3.6.2 Multilateral operations

NFR Code 1A5c

Introduction

The Slovenian Armed Forces have been participated in multinational operations and missions. Information on Slovenian cooperation in international operations is presented on the web page: https://www.slovenskavojska.si/en/translate-to-english-v-sluzbi-miru/international-operations-and-missions/

Methodology

To estimate emissions from multilateral operations the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

The quantity of jet kerosene used for emission calculation has been obtained from the Slovenian army. According to the data from Slovenian Army about 15 % of jet kerosene were used in international missions. Data are available for the period 1997-2021. Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.14: Fuel Consumption: Multilateral operations/ International bunker fuels).
The amount of jet kerosene used in Slovene Army and Police is excluded from international aviation bunkers and is reported under 1A5b Other, Mobile.

Emission factors

Table 3.3.6.2.1 Emission factors for jet kerosene used for emission calculation and references

Pollutant	Jet kerosene	Unit	References
NO_x	4,631	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28
SO_x	1,025	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28
CO	33,9	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28
NMVOC	2,331	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Aviation, Table 3.11, pg 28

Emissions

According to the 2023 Guidelines for reporting emissions and projections data under the Convention and EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 emissions resulting from multilateral operations are not included in national totals.

Recalculations

No recalculations have been performed since the last submission.

Future Improvements

No improvement is planned for the next submission.

3.3.6.3 International aviation cruise (civil)

NFR Code 1A3ai(ii)

Introduction

In sector of international aviation are included journeys where aircraft depart from one country and arrive in another country. There is only one operative international airport in Slovenia (Aerodrom Ljubljana) where international airport traffic has been taking place. Exhaust emissions from international airport traffic aviation arise from the combustion of jet kerosene. According to the 2023 Guidelines for reporting emissions and projections data under the Convention and EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 emissions resulting from international aviation cruise are not included in national totals.

Methodology

Period 2005-2021

Eurocontrol data on emissions of SO_x, NO_x, CO, NMVOC, TSP and fuel burnt (jet kerosene) are the relevant data used for reporting emissions. Tier 3 approach was used for emission estimation.

Period 1980-2004

Since there is no Eurocontrol data available before 2005 estimation for the period 1980-2004 was performed.

To estimate emissions from international aviation for the period 1980-2004, the following methodology has been adopted:

$$E = m \times EF$$

E - emission (kg)
m - quantity of fuel combusted (t)
EF - emission factor per quantity of fuel (kg/t)

The quantity of jet kerosene applied for emission calculation was estimated on the basis of the amount of total fuel used obtained from SORS. Emission factor derived for the year 2005 was used for the period 1980-2004 as well.

Table 3.3.6.3.1 Emission factors for jet kerosene

Pollutant	Emission factor	Unit
NO_x	12,96	kg/t
SO_x	0,84	kg/t
CO	6,765	kg/t
NMVOC	0,513	kg/t
$PM_{2.5}$	0,18	kg/t
PM_{10}	0,18	kg/t

TSP	0,18	kg/t
BC	0,027	kg/t

There is no information on whether emission factors represent filterable PM_{10} and $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.15: Fuel Consumption: International aviation cruise (civil)).

Recalculations

No recalculations have been performed since the last submission.

Future Improvements

No improvement is planned for the next submission.

3.3.6.4 Domestic aviation cruise (civil)

NFR Code 1A3aii(ii)

Civil domestic aviation comprises journeys where aircraft depart and arrive in the same country. In Slovenia, there are a couple of small airports used for sports or tourist activities. Exhaust emissions from domestic airport traffic aviation arise from the combustion of aviation gasoline and jet kerosene. According to the 2023 Guidelines for reporting emissions and projections data under the Convention and EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 emissions resulting from domestic aviation cruise are not included in national totals.

Methodology

Period 2016-2021

Eurocontrol data on emissions of SO_x, NO_x, CO, NMVOC, TSP and fuel burnt (aviaton gasoline and jet kerosene) are the relevant data used for reporting emissions. Tier 3 approach was used for emission estimation.

Period 1980-2015

Since there is no Eurocontrol data available estimation of activity data was performed.

To estimate emissions from domestic aviation for the period 1980-2015, the following methodology has been adopted:

$$E = m \times EF$$

E - emission (kg)
m - quantity of fuel combusted (t)
EF - emission factor per quantity of fuel (kg/t)

The quantity of jet kerosene and aviation gasoline applied for emission calculation was estimated on the basis of the amount of total fuel used obtained from SORS.

Emission factor for aviation gasoline derived for the year 2016 was used for the period 1980-2015 as well.

Table 3.3.6.4.1 Emission factors for aviation gasoline

Pollutant	Aviation gasoline	Unit
NO_x	6	kg/t
SO_x	0,84	kg/t
CO	1100	kg/t
NMVOC	14	kg/t

Jet kerosene in domestic aviation was not in use before 2005. Emission factors used for the period 2005-2015 were the same as used in international aviation cruises obtained from Eurocontrol.

There is no information on whether emission factors represent filterable PM_{10} and $PM_{2.5}$ emissions or total (filterable and condensable) emissions.

Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.16: Fuel Consumption: Domestic aviation cruise (civil)).

Recalculations

Emissions of SO_x, NO_x, CO, NMVOC, $PM_{2.5}$, PM_{10}, TSP and BC have been recalculated for the year 2020 due to new activity data applied. A mistake in the amount of jet kerosene was found due to a mistake in importing data to the reporting table. The error was found during QA/QC procedure.

Future Improvements

No improvement is planned for the next submission.

3.3.7 Other activities

International inland waterways; NFR Code 1A3di(ii)

Notation Key “NO” (not occurring) was used for this sector, since there is no emissions from international inland waterways in Slovenia.

Other (please specify in the IIR): NFR Code 1A3eii

Notation Key “NO” (not occurring) was used for this sector, since there is no other additional emissions in Slovenia.

3.4 Small Combustion and Non-road mobile sources and machinery (1. A. 4)

This chapter covers the methods and data needed to estimate stationary combustion emissions in smaller-scale combustion units than those in Chapter 1A1, Energy industries. The small combustion installations included in this chapter are mainly intended for heating and provision of hot water in residential and commercials/institutional sectors.

This chapter also provides the estimation of combustion emissions from non-road mobile sources and machinery. It covers a mixture of 'other' equipment which is distributed across a wide range of industry sectors. All the equipment covered uses reciprocating engines, fuelled with liquid hydrocarbon-based fuels. They comprise both diesel and petrol engined machinery.

This category is a very important source of air pollutant emissions. It mostly contributes to total emissions of particulate matter, CO, PAHs, dioxins/furans. It is an important source of Cd, Cr, Ni, Zn, NMVOC, $NO_{x,}$ HCB as well. The most important source of these pollutants in the residential sector, mostly due to much biomass burning.

Sectors covered in this chapter are:

NFR Codes:

1A4ai	Commercial/institutional: Stationary
1A4bi	Residential: Stationary
1A2gvii	Mobile Combustion in manufacturing industries and construction
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery
1A4bii	Residential: Household and gardening (mobile)
1A4ciii	Agriculture/Forestry/Fishing: National fishing

3.4.1 Commercial/institutional: Stationary (NFR Code 1A4ai) and Residential: Stationary (NFR Code 1A4bi)

Introduction

The small combustion installations included in this chapter are mainly intended for heating and provision of hot water in residential and commercials/institutional sectors. Some of these installations are also used for cooking, primarily in the residential sector. Emissions from smaller combustion installations are significant due to their numbers, different type of combustion techniques employed, and range of efficiencies and emissions.

Methodology

To estimate emissions from combustion in commercial and residential sectors the following formulas have been used:

$$E = m \times NCV \times EF \qquad \textit{Equation 1}$$

E - emission (g)
m - quantity of fuel combusted (t)
NCV - net calorific value (TJ/kt)
EF - emission factor per energy of fuel (g/GJ)

$$E = m \times EF$$ *Equation 2*

E - emission (g)
m - quantity of fuel combusted (t)
EF - emission factor per quantity of fuel (g/t)

To estimate SO_x emissions in some cases the following two equations for the calculation of EF were used:

$$EF_{SOx} = [S] \times 20000 / NCV$$ *Equation 3*

EF_{SOx} - SO_x emission factor (g/GJ)
[S] - sulphur content of the fuel (% w/w)
NCV - net calorific value (GJ/t)
2 - ratio of the relative molecular mass of SO_x to sulphur

$$EF_{SOx} = [S] \times 19000 / NCV$$ *Equation 4*

EF_{SOx} - SO_x emission factor (g/GJ)
[S] - sulphur content of the fuel (% w/w)
NCV - net calorific value (GJ/t)
1,9 - ratio of the relative molecular mass of SO_x to sulphur, considering 5 % absorption in the ash

Activity data

Data on the consumption of fuels in the commercial and residential sectors were obtained from the Statistical Office of the Republic of Slovenia (SORS). Lignite, domestic and imported sub-bituminous coal, heavy fuel oil, residual fuel oil, LPG, natural gas, wood and other biomass have been used in both categories. Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.17: Fuel used in the Other sectors).

The data on solid biomass reported by the Statistical Office of the Republic of Slovenia includes all wood: purchased wood and wood which is not purchased (collected wood). In Slovenia, there are many small owners of forests who sell their wood biomass also through unofficial channels. To get a realistic amount of annual wood consumption in Slovenian households a model approach is needed.

Net calorific values

Net calorific values have been taken from SORS. The values for solid fuel varies from year to year but for the liquid and gaseous fuel almost the same values have been used for the entire period, as these types of fuel do not change a lot from year to year.

Table 3.4.1.1 NCVs for the fuel used in commercial and residential sector

Year	Lignite – domestic	Sub-bituminous Coal - domestic	Sub-bituminous Coal - imported	Residual Fuel Oil	Heavy Fuel Oil	LPG	Natural Gas	Wood and Other Biomass
	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/kt	TJ/Mm3	TJ/kt
1980	9,360	12,980		41,800	39,700	46,050	33,500	14,000
1981	9,330	11,570		41,800	39,700	46,050	34,100	14,000
1982	9,330	11,570		41,900	39,800	46,000	33,490	14,000

1983	9,610	11,180		41,900	39,800	46,000	33,800	14,000
1984	9,590	11,420		41,900	40,000	46,000	33,500	14,000
1985	9,430	11,690		41,900	39,800	46,050	33,500	14,000
1986	9,390	12,850		41,820	39,740	46,000	33,500	14,000
1987	9,650	11,820		41,780	39,800	46,000	33,500	14,000
1988	9,440	12,000		41,710	39,800	46,000	34,080	14,000
1989	9,820	12,050		41,850	39,800	46,000	34,100	14,000
1990	9,810	12,760		41,870	39,800	46,000	34,100	14,000
1991	9,980	12,879		41,880	39,800	46,000	34,100	14,000
1992	10,260	12,589		41,900	39,900	46,000	34,100	14,000
1993	10,070	13,351		41,900	39,800	46,000	34,100	14,000
1994	9,960	12,666		41,900	39,860	46,000	34,100	14,000
1995	10,220	17,404		41,900	40,000	46,000	34,100	14,000
1996	9,690	16,353		41,900	40,000	46,000	34,100	14,000
1997	9,610	18,203		41,900	40,000	46,050	34,080	14,000
1998	10,010	18,531		41,900	40,000	46,050	34,080	14,000
1999	9,690	18,563		41,900	40,000	46,050	34,080	14,000
2000	10,170	17,983		41,900	40,000	46,050	34,080	14,000
2001	10,660	16,353		41,900	40,000	46,050	34,080	14,000
2002	10,350	19,000		41,900	40,000	46,050	34,080	14,000
2003	10,138	19,000		41,900	40,000	46,050	34,080	14,000
2004	10,138	19,000		41,900		46,050	34,080	14,037
2005	10,803		17,000	42,600		46,050	34,080	14,074
2006			17,318	41,900		46,050	34,072	14,111
2007			16,863	42,600		46,050	34,076	14,148
2008			16,407	42,600		46,050	34,096	14,185
2009			15,952	42,600		46,050	34,080	14,742
2010			16,155	42,600		46,050	34,080	14,747
2011			15,985	42,600		46,050	34,087	14,778
2012			16,032	42,600		46,050	34,093	14,800
2013			16,457	42,600		46,050	34,079	14,805
2014			15,734	42,600		46,050	34,083	14,809
2015			16,360	42,600		46,050	34,086	14,813
2016			16,575	42,600		46,050	34,087	14,816
2017			16,000	42,600		46,050	34,085	14,821
2018			17,647	42,600		46,050	34,084	15,802
2019			18,282	42,600		46,050	34,081	14,835
2020			18,198	42,600		46,050	34,087	14,840
2021			18,256	42,600		46,050	34,086	16,600

Emission factors

For calculating emissions of individual gases in commercial and residential sector the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

Table 3.4.1.2 Emission factors used for domestic and imported sub-bituminous coal and lignite in residential sector for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	110	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
SO_x	*Equation 4*	[S] (% w/w) See Table 3.2.1.10	Slovene national legislation relating quality of liquid fuels
CO	4600	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
NMVOC	484	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32

NH_3	0,3	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
PM_{10}	404	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
$PM_{2.5}$	398	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
TSP	444	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
BC	25,472	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Cd	1,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Pb	130	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Hg	5,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
As	2,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Cr	11,2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Cu	22,3	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Ni	12,7	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Se	120	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Zn	220	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Dioxins/ Furans	800	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Benzo(a)pyrene	230	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Benzo(b)fluoranthene	330	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Benzo(k)fluoranthene	130	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
Indeno(1,2,3-cd)pyrene	110	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
HCB	0,62	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32
PCB	170	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.3, pg 32

Table 3.4.1.3 Emission factors used for residual fuel oil in residential sector for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	51	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
SO_x	*Equation 3*	[S] (% w/w) See Table 3.2.1.12	Slovene national legislation relating quality of liquid fuels
CO	57	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
NMVOC	0,69	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
PM_{10}	1,9	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
$PM_{2.5}$	1,9	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
TSP	1,9	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34

BC	0,162	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Cd	0,001	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Pb	0,012	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Hg	0,12	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
As	0,002	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Cr	0,2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Cu	0,13	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Ni	0,005	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Se	0,002	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Zn	0,42	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Dioxins/ Furans	5,9	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Benzo(a)pyrene	80	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Benzo(b)fluoranthene	40	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Benzo(k)fluoranthene	70	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34
Indeno(1,2,3-cd)pyrene	160	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.5, pg 34

Table 3.4.1.4 Emission factors used for natural gas and liquefied petroleum gas oil in residential sector for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	51	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
CO	26	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
SOx	0,3	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
NMVOC	1,9	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
PM_{10}	1,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
$PM_{2.5}$	1,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
TSP	1,2	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
BC	0,0648	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Cd	0,00025	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Pb	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Hg	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
As	0,12	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Cr	0,00076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33

Cu	0,000076	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Ni	0,00051	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Se	0,011	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Zn	0,0015	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Benzo(a)pyrene	0,56	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Benzo(b)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Benzo(k)fluoranthene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Indeno(1,2,3-cd)pyrene	0,84	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33
Dioxins/ Furans	1,5	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.4, pg 33

Table 3.4.1.5 Emission factors used for wood and other biomass in residential sector for 1980 - 2021

Pollutant	Value	Unit	References
SO_x	11	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Cd	13	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Pb	27	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Hg	0,56	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
As	0,19	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Cr	23	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Cu	6	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Ni	2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Se	0,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
Zn	512	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35
HCB	5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.6, pg 35

For calculation of NO_x, CO, NH_3, NMVOC, PCB, dioxins/furans, PAHs and particulate matter emissions from wood combustion in residential plants Tier 2 emission factors were used. We have estimated a share of different types of technologies for wood combustion in a residential sector for the period 2005 - 2021.
For the period 1980 - 2004 data for 2005 was applied since no detailed information on the structure of heating equipment in the residential sector is available before 2005.

In the year 2021, there were 66 % conventional boilers < 50 kW burning wood and similar wood waste, 9 % advanced / ecolabelled stoves and boilers burning wood, 8 % pellet stoves and boilers burning wood pellets, 1 % open fireplaces burning wood, 16 % conventional stoves burning wood and similar wood waste.

Emission factors have been obtained from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, Small combustion, Table 3-39, pg. 77, Table 3.40, pg. 79, Table 3.43, pg. 83, Table 3.42, pg. 81, Table 3.44, pg. 84.

According to the 2022 in-depth CLRTAP review, additional information on the methodology used in the residential sector was introduced in the IIR. Tier 2 methodology has been used for emission calculation from burning biomass in the residential sector. Tier 1 methodology has been used for the estimation of emissions arising from burning other fuels (natural gas, LPG, residual fuel oil and sub-bituminous coal). Particulate emissions arising from other fuels in the residential sector are negligible compared to emissions from wood burning.

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A model approach is used for the estimation of the use of wood biomass in various types of heating devices. The output of the model is a share of different hating devices. Each heating device is coupled with appropriate emission factors obtained from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, Small combustion. Emission factors correspond to various types of heating devices used.

The final, average annual particulate emission factors are derived from those Tier 2 emission factors and corresponding shares of heating technology. An annual average EF depends on the contribution of types of heating devices used.

More information on a model approach is given in EUROSTAT publication "Manual for statistics on energy consumption in households", Chapter 5.5. Country case study: Slovenia, pg. 118 (see link).
https://ec.europa.eu/eurostat/documents/3859598/5935825/KS-GQ-13-003-EN.PDF.pdf/baa96509-3f4b-4c7a-94dd-feb1a31c7291?t=1414782907000

Table 3.4.1.6 Emission factors used for wood and other biomass in residential sector for NO_x, NH_3, NMVOC, CO, PM_{10}, $PM_{2.5}$ and TSP and BC

Year	NMVOC	NH_3	NO_x	CO	$PM_{2.5}$	PM_{10}	TSP	BC
Unit	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ
2000 and before	385	72,4	75,6	3945	504	515	538	74
2001	382	72,4	76,0	3941	499	511	533	74
2002	384	71,8	75,6	3913	500	511	534	73
2003	386	71,5	75,4	3896	500	512	535	72
2004	386	71,2	75,3	3878	499	510	533	72
2005	380	71,3	76,0	3882	492	504	526	72
2006	384	70,8	75,5	3856	495	506	528	72
2007	380	71,0	76,0	3867	491	502	524	72
2008	376	70,5	76,5	3834	483	494	515	71
2009	376	70,2	76,4	3819	482	493	514	71
2010	376	69,7	76,3	3795	480	491	513	70
2011	370	69,3	76,6	3768	474	485	506	70
2012	368	68,8	76,7	3737	470	481	502	69
2013	365	68,6	76,8	3722	468	478	499	69
2014	370	68,1	76,0	3697	472	482	504	68

2015	362	67,8	76,7	3677	463	473	494	68
2016	358	67,5	77,1	3659	457	468	488	68
2017	355	67,1	77,2	3632	453	463	484	67
2018	356	66,5	76,8	3603	454	464	485	67
2019	358	66,0	76,4	3576	455	465	486	66
2020	361	65,1	75,8	3531	456	466	487	65
2021	357	65,1	76,2	3528	451	461	482	65

Table 3.4.1.7 Emission factors used for wood and other biomass in residential sector for PCB, dioxins/furans, PAHs

Year	PCB	Dioxins/ Furans	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Indeno(1,2,3-cd) pyrene
Unit	microg/GJ	ng/GJ	mg/GJ	mg/GJ	mg/GJ	mg/GJ
2000 and before	0,0588	578	118,4	52,1	64,9	15,2
2001	0,0587	574	118,2	51,1	65,2	14,3
2002	0,0581	573	116,9	52,1	63,9	15,5
2003	0,0577	573	116,1	52,7	63,1	16,3
2004	0,0573	571	115,3	52,8	62,5	16,6
2005	0,0574	565	115,5	51,1	63,3	14,9
2006	0,0568	566	114,2	52,4	61,9	16,4
2007	0,0570	563	114,7	51,2	62,8	15,1
2008	0,0563	555	113,2	50,2	62,1	14,5
2009	0,0560	553	112,5	50,3	61,6	14,8
2010	0,0556	551	111,6	50,6	60,9	15,2
2011	0,0552	545	110,8	49,6	60,7	14,4
2012	0,0547	540	109,7	49,3	60,1	14,4
2013	0,0545	538	109,2	49,0	59,9	14,2
2014	0,0541	541	108,4	50,6	58,6	15,9
2015	0,0538	532	107,7	48,9	58,9	14,4
2016	0,0535	527	107,1	47,9	58,9	13,6
2017	0,0531	522	106,2	47,4	58,5	13,4
2018	0,0526	522	105,1	48,3	57,4	14,4
2019	0,0521	522	104,1	49,2	56,3	15,5

2020	0,0513	521	102,4	50,5	54,5	17,1
2021	0,0513	517	102,3	49,4	55,0	16,1

It is unclear for solid fuels, gaseous fuel and liquid fuels whether emission factors represent filterable PM emissions or total (filterable and condensable) emissions.
TSP, PM_{10}, $PM_{2.5}$ emission factors for biomass represent total particulate emissions (filterable and condensable) emissions.

Table 3.4.1.8 Emission factors used for domestic sub-bituminous coal and lignite in commercial sector for 1980 - 2004

Pollutant	Value	Unit	References
NO_x	173	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
SO_x	*Equation 4*	[S] (% w/w) See Table 3.2.1.10	Slovene national legislation relating quality of liquid fuels
CO	931	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
NMVOC	88,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
PM_{10}	117	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
$PM_{2.5}$	108	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
TSP	124	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
BC	6,912	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Cd	1,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Pb	134	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Hg	7,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
As	4	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Cr	13,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Cu	17,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Ni	13	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Se	1,8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Zn	200	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Dioxins/ Furans	203	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Benzo(a)pyrene	45,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Benzo(b)fluoranthene	58,9	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Benzo(k)fluoranthene	23,7	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
Indeno(1,2,3-cd)pyrene	18,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36
HCB	0,62	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36

PCB	170	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.7, pg 36

Table 3.4.1.9 Emission factors used for heavy fuel oil and residual fuel oil in commercial sector for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	306	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
SO_x	*Equation 3*	[S] (% w/w) See Table 3.2.1.12	Slovene national legislation relating quality of liquid fuels
CO	93	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
NMVOC	20	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
PM_{10}	21	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
$PM_{2.5}$	18	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
TSP	21	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
BC	10,08	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Cd	0,15	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Pb	8	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Hg	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
As	0,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Cr	10	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Cu	3	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Ni	125	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Se	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Zn	18	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Dioxins/ Furans	6	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Benzo(a)pyrene	1,9	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Benzo(b)fluoranthene	15	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Benzo(k)fluoranthene	1,7	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
Indeno(1,2,3-cd)pyrene	1,5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
HCB	0,22	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38
PCB	0,13	ng/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.9, pg 38

Table 3.4.1.10 Emission factors used for natural gas, liquefied petroleum gas and gaseous biomass in commercial sector for 1980 - 2021

Pollutant	Value	Unit	References
NO_x	74	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
CO	29	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
SO_x	0,67	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
NMVOC	23	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
PM_{10}	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
$PM_{2.5}$	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
TSP	0,78	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
BC	0,0312	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Cd	0,0009	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Pb	0,011	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Hg	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
As	0,1	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Cr	0,013	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Cu	0,0026	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Ni	0,013	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Se	0,058	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Zn	0,73	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Benzo(a)pyrene	0,72	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Benzo(b)fluoranthene	2,9	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Benzo(k)fluoranthene	1,1	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Indeno(1,2,3-cd)pyrene	1,08	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37
Dioxins/ Furans	0,52	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.8, pg 37

Table 3.4.1.11 Emission factors used for wood in commercial sector for 1980 - 2005

Pollutant	Value	Unit	References
NO_x	91	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
CO	570	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
NMVOC	300	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
NH_3	37	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
SO_x	11	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39

PM_{10}	163	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
$PM_{2.5}$	160	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
TSP	170	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
BC	44,8	g/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Cd	13	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Pb	27	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Hg	0,56	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
As	0,19	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Cr	23	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Cu	6	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Ni	2	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Se	0,5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Zn	512	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Benzo(a)pyrene	10	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Benzo(b)fluoranthene	16	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Benzo(k)fluoranthene	5	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Indeno(1,2,3-cd)pyrene	4	mg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
Dioxins/ Furans	100	ng I-TEQ/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
PCB	0,06	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39
HCB	5	microg/GJ	EMEP/EEA Emission Inventory Guidebook, 2019, Small combustion, Table 3.10, pg 39

It is unclear for solid fuels, gaseous fuel and liquid fuels whether emission factors represent filterable PM emissions or total (filterable and condensable) emissions.
TSP, PM_{10}, $PM_{2.5}$ emission factors for solid biomass represent total particles (filterable and condensable).

Emissions

These two subsectors are very important sources of PAHs, CO, particulate matter, dioxins/furans and heavy metals. In 2021 these two sectors contributed 80 % of PAHs, 66 % and 59 % of CO and dioxins/furans emissions, 39 to 73 % of various particulate matter, 46 % of Zn, 43 % of Cd, 26 % of Cr and 21 % Ni national emissions. Emissions of CO, PAHs, dioxins/furans have decreased from 1990 to 2021 due to the shift in the fuel mix from solid fuels to natural gas. But the distinctive increase in all emissions, including particulate matter, was observed in 2008 due to higher use of wood biomass in the residential sector. This was a result of the economic crisis and the high price of petroleum products as well as state measures to promote renewable energy sources.

Category-Specific QA/QC and Verification

According to the 2018 in-depth EU NECD review information on biomass activity data used in

Commercial/institutional: Stationary subsector was included. This sector comprises solid biomass for the period 1980-2005 and biogas fuels for the period 2008-2017. In the 2017 submission the same amount of wood consumption have been used for the period 1990-2000. For 2018 submission we have used improved data from the SORS for the year 1990 and 2000 while the amount of wood used in the period 1991 – 1999 was interpolated. Since 2000 the data in the inventory and SORS data are the same. In the commercial/institutional sector since 2006 no wood biomass has been consumed any more. Biomass, which has been used since 2008, is biogas. In 2019 thorough examination of biomass activity data used in Residential: Stationary was performed. We obtained improved data from SORS for the period 1986-2018. Changes in activity data as well as NCV were delivered and used for emissions calculation. Data in Annex 1 was checked and corrected. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described. Recalculation were performed due to change in emission factors, NCV and activity data used. According to the 2022 in-depth CLRTAP review, detailed information on the methodology used in the residential sector was introduced in the IIR.

Recalculations

1A4bi Residential: Stationary
Recalculation of emissions in the residential sector has been performed due to changes in activity data and emissions factors used for wood combustion. Updated data on different types of technologies used for burning solid biomass have been applied for emissions calculations.

Emissions of NO_x and CO have been recalculated for the period 1980-2020, emissions of NH_3 for the period 1986-2020, emissions of NMVOC, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, dioxins and furans and PCB were recalculated for the period 1990-2020, emissions of TSP, BC, PM_{10} and $PM_{2.5}$ have been recalculated for the period 2000-2020.

Future Improvements

No improvements are planned for the next submission.

3.4.2 Mobile Combustion in manufacturing industries and construction

NFR Code 1A2gvii

Introduction

This sector includes emissions from construction land-based mobile machinery. Different types of vehicles and machinery are used in the building industry (asphalt and concrete pavers, roller, cement and mortar mixers…). Emissions originate from the combustion of fuel (diesel and gasoline) to power this equipment. The contribution of emissions to the total national inventory is of less importance. The contribution of NOx emissions is 4 % and black carbon 2 %, other pollutants contributed less than 1 % in 2021.

Methodology

To estimate exhaust emissions from off-road construction equipment the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

Data on the amount of diesel and gasoline used for non-road mobile machinery in the construction sector were obtained from SORS. The amount of diesel combusted has been much bigger than gasoline. Diesel has been used in the whole period 1980-2021, while gasoline only in the period 2007-2021. Fuel consumption for the whole period is shown in Annex 1 to the IIR (Table 1.18: Fuel Consumption in Mobile Combustion in manufacturing industries and construction).

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

Table 3.4.2.1 Emission factors for gasoline used in construction

Pollutant	Value	Unit	References
NO_x	7,117	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	770,368	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
NMVOC	18,893	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
NH_3	0,004	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
PM_{10}	0,157	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
$PM_{2.5}$	0,157	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
TSP	0,157	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
BC	0,008	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Cd	0,010	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Cu	1,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Cr	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Ni	0,07	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Se	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Zn	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Pb	0,033	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-10, pg 20
Benzo(a)pyrene	0,0400	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Benzo(b)fluoranthene	0,0400	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24

Benzo(k)fluoranthene	0,0039	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19
Indeno(1,2,3-cd)pyrene	0,0089	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19

Table 3.4.2.2 Emission factors for diesel used in construction

Pollutant	Value	Unit	References
NO_x	32,629	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	10,774	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
NMVOC	3,377	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
NH_3	0,008	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
PM_{10}	2,104	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
$PM_{2.5}$	2,104	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
TSP	2,104	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
BC	1,306	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Cd	0,0100	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Cu	1,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Cr	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Ni	0,07	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Se	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Zn	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Benzo(a)pyrene	0,0300	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Benzo(b)fluoranthene	0,0500	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Benzo(k)fluoranthene	0,0344	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19
Indeno(1,2,3-cd)pyrene	0,0079	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19

TSP, PM_{10}, $PM_{2.5}$ emission factors represent total PM emissions (filterable and condensable fractions).

Emissions

In the period 2006-2008 the highest liquid fuel consumption was observed with the peak in the year 2006. This increase is associated with the economic situation in Slovenia at that time. High economic growth in the period 2004-2008 had influenced the increase of investments into real estate. According to the SORS data, the highest number of building permits have been issued just in 2006 which means that more fuel demanding phases in the construction of buildings (excavation of construction pits) had happened in 2006. The construction of highways has been also rapidly expanding in this period.

Category-Specific QA/QC and Verification

New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described. In 2019 thorough examination of activity data used was performed. Data on fuel consumption have been checked and compared with the SORS data. We obtained improved data from SORS for the period 1986-2006. It was found out that leaded gasoline was not used in manufacturing industries and construction. Leaded gasoline was therefore excluded from that emission source. Recalculation was performed due to changes in emission factors, NCV and activity data used.

Recalculations

No recalculations have been performed since the last submission.

Future Improvements

No improvements are planned for the next submission.

3.4.3 Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

NFR Code 1A4cii

Introduction

This sector includes emissions resulting from the consumption of fuel used for off-road vehicles and other machinery in agriculture and forestry land based mobile machinery. Exhaust emissions from non-road mobile machinery arise from the combustion of diesel and gasoline in agriculture and forestry. Emissions of NOx, NMVOC, CO and particulate matter contribute up to ten per cent to the total national emissions. Contributions of other pollutants are below 1 %.

Methodology

To estimate exhaust emissions from off-road vehicles and other machinery used in agriculture and forestry the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

The consumption of fuels until the year 2000 has been calculated from data on fuel consumption in state owned agriculture enterprises and corresponding agricultural land. Data were obtained from SORS. The same energy intensity has been used to calculate the fuel used on total agricultural land. For estimation of fuel consumption in agriculture from the year 2000 onwards, we used the same energy intensity (fuel consumption/ha of land) as observed in 2000.

The consumption of fuels in the entire forestry is estimated on the basis of the consumption of fuel in state-owned logging enterprises. For the state-owned sector, data are available for the consumption of fuel and cut, for the private sector only data on cut. First, the consumption per m3 of cut in state owned logging enterprises is estimated. Based on these estimates and data on the total cut, the estimate of consumption in the whole of forestry is calculated. Before 2005 there was no separate data on the consumption of gasoline and diesel, only the total consumption. Consequently, the split is done considering the split in agriculture (10 % gasoline, 90 % diesel), presuming that the same amount of fuels is consumed per m3 of felled wood in private forestry as in state forestry.
The data needed for the estimation of the consumption of fuels in agriculture and forestry are obtained from the SORS for the entire period.

Fuel consumption in agriculture and forestry for the whole period is shown in Annex 1 to the IIR (Table 1.19: Fuel Consumption in Agriculture/Forestry/Fishing: Off-road vehicles and other machinery).

Emission factors

In calculating emissions of individual gases, the following emission factors from the new EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

Table 3.4.3.1 Emission factors for leaded and unleaded gasoline used in agriculture and forestry

Pollutant	Value	Unit	References
NO_x	2,765	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	620,793	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
NMVOC	227,289	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
NH_3	0,003	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
PM_{10}	3,762	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
$PM_{2.5}$	3,762	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
TSP	3,762	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
BC	0,188	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Cd	0,010	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Pb (Unleaded gasoline)	0,033	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-10, pg 20
Pb (Leaded gasoline)	200	g/t	Slovene national legislation relating quality of liquid fuels
Cu	1,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Cr	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Ni	0,07	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Se	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24

Zn	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Benzo(a)pyrene	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Benzo(b)fluoranthene	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Benzo(k)fluoranthene	0,0039	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19
Indeno(1,2,3-cd)pyrene	0,0089	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19

Table 3.4.3.2 Emission factors for diesel used in agriculture and forestry

Pollutant	Value	Unit	References
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	11,469	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 22
NH_3	0,008	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 22
Cd	0,010	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Cu	1,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Cr	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Ni	0,07	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Se	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Zn	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Benzo(a)pyrene	0,030	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Benzo(b)fluoranthene	0,050	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 23
Benzo(k)fluoranthene	0,0344	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19
Indeno(1,2,3-cd)pyrene	0,0079	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19

For the calculation of NO_x, NMVOC and particulate matter emissions from diesel machinery in agriculture and forestry Tier 3 emission factors were used. The vehicles population, predominantly tractors is split into different types, ages and power ranges. The baseline emission factors for regulated diesel engines and machinery are taken as the EU type approval values (expressed in g/kWh). Shares of tractors with different ages, power ranges and technology were taken into consideration for emission calculation.

According to the 2022 in-depth EU NECD review recommendations clarification on higher IEF for NOX compared to other countries is included.
The main reason for the high NO_X emission factor in the year 2005 was very old tractor stock in Slovenia. The average age of tractors was about 20 years. A large number of very old small diesel-engine powered tractors were used on the farms. Most tractors had an engine power range between 18-37 kW and 37-56 kW size classes and pre-stage I technology level. The contribution of gasoline-engine powered machinery is very small due to the predominantly use of diesel fuel in agriculture and forest activities.

Table 3.4.3.3 Emission factors for NMVOC for diesel used in agriculture and forestry for 1990-2021

Year	NMVOC	Unit	References
1990-2005	250	g/GJ	Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-6, pg 38 and expert evaluation
2006	245	g/GJ	
2007	231	g/GJ	
2008	216	g/GJ	
2009	204	g/GJ	
2010	198	g/GJ	
2011	191	g/GJ	
2012	187	g/GJ	
2013	180	g/GJ	
2014	173	g/GJ	
2015	168	g/GJ	
2016	161	g/GJ	
2017	154	g/GJ	
2018	145	g/GJ	
2019	136	g/GJ	
2020	125	g/GJ	
2021	116	g/GJ	

Table 3.4.3.4 Emission factors for NO_X for diesel used in agriculture and forestry for 1980-2021

Year	NOx	Unit	References
1980-2005	1568	g/GJ	Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-6, pg 38 and expert evaluation
2006	1536	g/GJ	
2007	1473	g/GJ	
2008	1399	g/GJ	
2009	1331	g/GJ	
2010	1287	g/GJ	
2011	1250	g/GJ	
2012	1218	g/GJ	
2013	1177	g/GJ	
2014	1141	g/GJ	

2015	1101	g/GJ	
2016	1059	g/GJ	
2017	1017	g/GJ	
2018	970	g/GJ	
2019	916	g/GJ	
2020	850	g/GJ	
2021	797	g/GJ	

Table 3.4.3.5 Emission factors for PM_{10}, $PM_{2.5}$, TSP and BC for diesel used in agriculture and forestry for 2000-2021

Year	PM2.5	PM10	TSP	BC	Unit	References
2000-2005	191	191	191	105	g/GJ	Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-6, pg 38 and expert evaluation
2006	186	186	186	103	g/GJ	
2007	175	175	175	97	g/GJ	
2008	163	163	163	91	g/GJ	
2009	152	152	152	85	g/GJ	
2010	147	147	147	82	g/GJ	
2011	141	141	141	79	g/GJ	
2012	137	137	137	77	g/GJ	
2013	131	131	131	74	g/GJ	
2014	126	126	126	71	g/GJ	
2015	121	121	121	68	g/GJ	
2016	116	116	116	65	g/GJ	
2017	110	110	110	62	g/GJ	
2018	104	104	104	59	g/GJ	
2019	96	96	96	55	g/GJ	
2020	88	88	88	50	g/GJ	
2021	81	81	81	46	g/GJ	

TSP, PM_{10}, $PM_{2.5}$ emission factors represent total PM emissions (filterable and condensable fractions).

Category-Specific QA/QC and Verification

According to the 2017 and 2018 in-depth EU NECD review recommendations, we performed an examination of gasoline-powered equipment used in agriculture and forestry. According to logging companies, all gasoline used in forestry is applied in two-stroke chain saws. No four-stroke equipment is used. Due to economic reasons, all other machinery is diesel-powered.
We put additional effort to obtain reliable information on the use of gasoline equipment in forestry. More sources were checked, including the Statistical Office of the Republic of Slovenia. No data is available on four-stroke gasoline in forestry.
Examination of gasoline-powered equipment used in agriculture was performed as well. More sources were checked, including the Statistical Office of the Republic of Slovenia. We did not get any better and more reliable information on gasoline-powered agriculture equipment. Since gasoline contributes only a very small part (7 %) to total fuel consumption and we do not have any precise and reliable data, we decided to use Tier 1 emission factors for gasoline equipment. Tier 3 EFs are applied for emissions from diesel-powered equipment, whereas Tier 1 default EFs are applied for two-stroke gasoline equipment. Examination of the vehicle fleet of tractors was performed. More precise and relevant data were obtained which resulted in improvement of emission factors. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described. According to the 2022 in-depth EU NECD review recommendations clarification on higher IEF for NO_X compared to other countries is included.

Recalculations

No recalculations have been performed since the last submission.

Future Improvements

No improvement is planned for the next submission.

3.4.4 Residential: Household and gardening (mobile)

NFR Code 1A4bii

Introduction

This sector includes emissions resulting from the consumption of fuel used for household and gardening.

Methodology

To estimate exhaust emissions from households and gardening the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

Activity data used for emission calculation are data on gasoline fuel used for household and gardening activity. Since precise data are not available assumption based on EMEP/EEA Air

Pollutant Emission Inventory Guidebook, 2019 (appendix D) was made. 1 % of total liquid fuel consumed in the Residential sector was used for emission estimation. Fuel consumption in gardening and household for the whole period is shown in Annex 1 to the IIR (Table 1.20: Fuel Consumption in Residential: Household and gardening (mobile).

Emission factors

In calculating emissions of individual gases, the following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used. Since there is no information on equipment type used we assumed that half of the machinery is two-stroke and another half-four stroke.

Table 3.4.4.1 Emission factors for gasoline used in gardening and households

Pollutant	Value two-stroke	Value four-stroke	Unit	References
NO_x	2,765	7,117	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
SO_x	Values used for road transport (Table 3.3.1.1)	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	620,793	770,368	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
NMVOC	227,289	18,893	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
NH_3	0,003	0,004	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
PM_{10}	3,762	0,157	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
$PM_{2.5}$	3,762	0,157	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
TSP	3,762	0,157	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
BC	0,188	0,008	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Cd	0,010	0,010	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Pb	0,033	0,033	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-10, pg 20
Cu	1,7	1,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Cr	0,05	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Ni	0,07	0,07	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Se	0,01	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Zn	1	1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Benzo(a)pyrene	0,04	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Benzo(b)fluoranthene	0,04	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Non-road mobile sources and machinery, Table 3-1, pg 24
Benzo(k)fluoranthene	0,0039	0,0039	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19
Indeno(1,2,3-cd)pyrene	0,0089	0,0089	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Exhaust emissions from road transport, Table 3-8, pg 19

TSP, PM_{10}, $PM_{2.5}$ emission factors represent total PM emissions (filterable and condensable fractions).

Emissions

Emissions arising from gardening contributed less than 0,5 % to the total national emissions in 2021.

Recalculations

No recalculations have been performed since the last submission.

Future Improvements

No improvements are planned for the next submission

3.4.5 Agriculture/Forestry/Fishing: National fishing

NFR Code 1A4ciii

Introduction

This sector includes emissions resulting from consumption of fuel in fishing vessels used for national fishing.

Methodology

To estimate exhaust emissions from national fishing the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

Activity data used for emission calculation are data on diesel fuel consumed for fisheries activity. Data for the period 2008-2021 have been obtained from the Fisheries Research Institute of Slovenia. Due to unavailability of published data for the period 1980-2007 estimation of activity data was performed. Estimation based on gross domestic product. Fuel consumption in national fishing for the whole period is shown in the Annex 1 to the IIR (Table 1.21: Fuel Consumption in Agriculture/Forestry/Fishing: National fishing).

Emission factors

In calculating emissions of individual gases, following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used

Table 3.4.5.1 Emission factors for diesel used in fishing

Pollutant	Value	Unit	References
NO_x	79,3	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
SO_x	Values used for road transport (Table 3.3.1.1)	kg/t	Slovene national legislation relating quality of liquid fuels
CO	7,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
NMVOC	2,7	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
PM_{10}	6,2	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
$PM_{2.5}$	5,6	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
TSP	6,2	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
BC	0,744	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Cd	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Pb	0,18	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Cu	1,25	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Hg	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Cr	0,72	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Ni	32	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Se	0,21	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
As	0,68	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Zn	1,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
HCB	0,14	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
PCB	0,57	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14
Dioxins/ Furans	0,47	microg I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, Navigation, National fishing, Table 3-1, pg 14

There is no information on whether emission factors of particulate matter include or exclude condensable components.

Emissions

Emissions arising from national fishing contributed less than 0,5 % to the total national emissions in 2021.

Recalculations

Emissions of NO_x, SO_x, CO, NMVOC, Pb, Cd, Hg, Cu, Cr, Ni, Se, Zn, As, HCB, PCB, dioxins and furans, TSP, BC, PM_{10} and $PM_{2.5}$ were recalculated for the year 2020 due to new activity data used. The data provider reported a new amount of diesel consumed in 2020.

Future Improvements

No improvements are planned for the next submission.

3.4.6 Other activities

Commercial / institutional: Mobile: NFR Code 1A4aii
Fuel used for commercial and institutional land-based mobile machinery is included 1A3b Road transport. Notation Key “IE” (included elsewhere) was therefore used for this sector.

Agriculture/Forestry/Fishing: Stationary NFR Code 1A4ci
Fuel used in stationary agriculture and forestry installations is included under 1A4bi Residential: Stationary. Notation Key “IE” (included elsewhere) was therefore used for this sector.

Other stationary (including military): NFR Code 1A5a
Fuel used in other small stationary installations is included in 1A4ai Commercial/institutional: Stationary. Notation Key “IE” (included elsewhere) was therefore

3.5 Fugitive emissions from fuels (1. B)

This chapter covers fugitive emissions from solid fuels and oil and natural gas.

Sectors covered in this chapter are:

NFR Codes:

1B1a	Fugitive emissions from solid fuels: Coal mining and handling
1B2ai	Fugitive emissions oil: Exploration, production, transport
1B2aiv	Fugitive emissions oil: Refining / storage
1B2av	Distribution of oil products
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)
1B2c	Venting and flaring (oil, gas, combined oil and gas)

3.5.1 Fugitive emissions from solid fuels: Coal mining and handling

NFR Code 1B1a

Introduction

This chapter encompasses emissions arising from the production, processing, and storage of coal from underground coal mines. The extraction and treatment of coal result mainly in emissions of greenhouse gas methane. The most important component of those emissions is CH_4 emissions that arise in mining and post-mining activities although CO_2 emissions occur as well. However, also non-methane volatile organic compounds and particulate matter are emitted. Emissions of NMVOC have been calculated for the period 1990-2021, emissions of particulate matter for the period 2000-2021. Emissions of NMVOC and particulate matter from this source contributed in 2021 a few percent to total national emissions.

Methodology

To estimate fugitive emissions from coal mining and handling the following methodology has been adopted:

$$E = m \times EF$$

E – emission (g)
m – quantity of fuel combusted (t)
EF – emission factor per quantity of fuel (g/t)

Activity data

Data on excavated quantities of coal according to individual coalmines are obtained from Statistical Office of the Republic of Slovenia (SORS). Only one coal mine has been in operations in Slovenia in the year 2021. Data on excavated quantities of coal according to individual coalmines are presented on the Table 3.5.1.1.

Table 3.5.1.1 Excavation of coal in Slovenia 1990 – 2021

Pit	1990	2000	2005	2010	2015	2018	2019	2020	2021	Closed in
Unit	kt	kt	kt	kt	kt	kt	kt	kt	kt	
Velenje	4210	3743	3945	4011	3168	3217	3143	3175	2612	
Trbovlje - Hrastnik	905	737	594	419						2013
Zagorje	244									1997
Senovo	108									1996
Kanižarica	94									1996
Laško										1990
Total Coal Excavation	5561	4480	4540	4430	3168	3217	3143	3175	2612	

Emission factors

Emission factors for $PM_{2.5}$, PM_{10} and TSP were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, Fugitive emissions, Fugitive emissions from solid fuels, Coal mining and handling, pg. 8, Table 3-1 have been used for emissions calculating.

Table 3.5.1.2 Emission factors of fugitive emissions in coal mining and handling

Pollutant	Value	Unit
$PM_{2.5}$	5	g/t
PM_{10}	42	g/t
TSP	89	g/t

There is no information whether emission factors for TSP, PM_{10}, $PM_{2.5}$ represent filterable PM emissions or total (filterable and condensable) emissions.

NMVOC emission factor is country specific emission factor based on an assessment of the emission factor for methane.

Estimates of emission factors for methane for individual coalmines in Slovenia were performed at the Ecological Research Institute (Zapušek A., Orešnik K., Avberšek F: Assessment of methane emission factors in coal excavation in 1986 and in the period 1990-1996, Velenje: ERICO - Ecological Research Institute, 1999). More information on study is presented in Slovenia's National Inventory Report 2016, pg. 110.

Category-Specific QA/QC and Verification

New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described. Since that source is not a key source, Tier 1 method was used for particulate emission calculation. According the EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 the relevant activity statistic for Tier 1 is the total mass of coal produced by underground mining and/or the total tonnage of coal produced by opencast mining. We consider this approach as an appropriate method for particulate emissions calculation. Since Tier 1 methods in general provide higher emission estimations compared to higher Tier methods, we consider that reported national emissions are therefore not underestimated and completeness of the inventory is assured.

Recalculations

No recalculations have been performed since last submission.

Future Improvements

No improvement is planned for next submission.

3.5.2 Fugitive emissions: Exploration, production and transport of oil and natural gas

NFR Codes covered in this sector:

1B2ai	Fugitive emissions oil: Exploration, production, transport
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)

Introduction

This chapter deals with the fugitive emissions from the exploration, treatment, loading and also distribution of liquid and gaseous fossil fuels. Oil and natural gas are produced by the same geological process: anaerobic decay of organic matter deep under the Earth's surface. As a consequence, oil and natural gas are often found together. In common usage, deposits rich in oil are known as oil fields, and deposits rich in natural gas are called natural gas fields. Oil and gas are found both onshore and offshore and can be used in a variety of processes, including heating of buildings, and in processes such as feedstock in chemical processes. Natural gas is increasingly being used as a fuel for power generation. The extraction and first treatment of liquid and gaseous fuels involves a number of activities, each of which represents a potential source of hydrocarbon emissions.

Emissions of NMVOC from these sources are insignificant. In 2021 only fugitive emissions from natural gas occurred and contributed 0,002 % to total national NMVOC emissions.

Methodology

To estimate fugitive emissions from production, transport and exploration of oil and natural gas the following methodology has been adopted:

$E = m \times EF$ *(for crude oil)*

E – emission (kg)
m – quantity of oil produced (t)
EF – emission factor per quantity of fuel (kg/t)

$E = m \times EF$ *(for natural gas)*

E – emission (g)
m – quantity of gas produced (m^3)
EF – emission factor per quantity of fuel (g/m^3)

Activity data

Data on amount of crude oil and natural gas produced have been obtained from SORS. Data for crude oil are given in tonnes. Data for crude oil production is available until 2002. After 2002 there was no production of crude oil. Data on natural gas production are available in the standard m^3 and they are available for the whole 1990-2021 period.

Emission factors

In calculating emissions of NMVOC emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used.

Table 3.5.2.1 Emission factors of fugitive emissions

Pollutant	Value	Unit	Reference
NMVOC (crude oil)	0,2	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, 1.B.2.a.i Exploration, production, transport, Table 3-1, pg 12
NMVOC (natural gas)	0,1	g/m^3	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, 1.B.2.b Natural gas, Table 3-2, pg 13

Category-Specific QA/QC and Verification

New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described. Since that source is not a key source, Tier 1 method was used for emission calculation. We consider this approach as an appropriate method for emission calculation. During the 2017 EU-NEDC review we provided a comparison of current estimations with the estimates resulting with NMVOC emission factors from 2006 IPCC Guidelines. The difference between reported NMVOC emissions and emissions estimated with IPCC EF was insignificant. The impact was far below the threshold of significance. We consider that reported national emissions are therefore not underestimated and completeness of the inventory is assured. We will follow TERT recommendation when EMEP/EEA Guidebook provides emission factors for all segments of natural gas system.

Recalculations

No recalculations have been performed since last submission.

Future Improvements

No improvement is planned for next submissions.

3.5.3 Fugitive emissions oil: Refining / storage

NFR Code 1B2aiv

Introduction

This chapter treats emissions from the petroleum refining industry. This industry converts crude oil into more than 2500 refined products, including liquid fuels (from motor gasoline to residual oil), by-product fuels and feedstock (such as asphalt, lubricants, gases, coke), and primary petrochemicals (for instance, ethylene, toluene, xylene). Petroleum refinery activities start with the receipt of crude for storage at the refinery, include all petroleum handling and refining operations, and terminate with storage preparatory to shipping the refined products from the refinery.

Emissions from this source were relevant in Slovenia for 1980-2001 only. Emissions were insignificant and contributed less than 0,0001 % to total national emissions. No emissions of NO_x, CO, SO_x, NMVOC, NH_3, dioxins/furans, heavy metals, particulate matter originated from this sector since 2001.

Methodology

To estimate fugitive emissions from refining and storage of oil the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of oil refined (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

Data on amount of crude oil refined have been obtained from SORS. Data for crude oil refined is available until 2001. There was only one oil refinery in Slovenia which was closed down in 2001.

Emission factors

In calculating emissions emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 1.B.2.a.iv Fugitive emissions oil: Refining / storage, Table 3-1, pg. 12 have been used.

Table 3.5.3.1 Emission factors of fugitive emissions from refining and storage

Pollutant	Value	Unit
NO_x	0,24	kg/t
CO	0,09	kg/t
NMVOC	0,20	kg/t
SO_x	0,62	kg/t
NH_3	0,0011	kg/t

PM_{10}	0,0099	kg/t
$PM_{2.5}$	0,0043	kg/t
TSP	0,016	kg/t
Cd	0,0051	g/t
Pb	0,0051	g/t
Hg	0,0051	g/t
As	0,0051	g/t
Cr	0,0051	g/t
Cu	0,0051	g/t
Ni	0,0051	g/t
Se	0,0051	g/t
Zn	0,0051	g/t
Dioxins/Furans	0,0057	microg/t

There is no information whether emission factors for TSP, PM_{10}, $PM_{2.5}$ represent filterable PM emissions or total (filterable and condensable) emissions.

Recalculations

No recalculations have been performed since last submission.

Future Improvements

No improvement is planned for next submissions.

3.5.4 Distribution of oil products

NFR Code 1B2av

This chapter includes the fugitive emissions of gasoline originating from fuel distribution system. It includes storage in dispatch stations and depots, loading into tank trucks and delivery to the service stations.

Methodology

To estimate fugitive emissions from distribution of gasoline Tier 2 methodology from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, Fugitive emissions, 1.b.2.a.v Distribution of oil products was applied.

Activity data

Data on amount of gasoline manipulated is obtained from SORS.

Emission factors

In calculating emissions of NMVOC emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, Fugitive emissions, 1.b.2.a.v Distribution of oil products, Tables 3-2 to 3-12, pg. 15-24 have been used.

Table 3.5.4.1 Emission factors of fugitive emissions in distribution of gasoline

Pollutant	Value	Unit	Technology	References
NMVOC	23	g/m3 throughput/kPa TVP	Road tanker	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, Distribution of oil products, Table 3-4, pg 16
NMVOC	11	g/m3 throughput/kPa TVP	Rail tanker	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, Distribution of oil products, Table 3-5, pg 17
NMVOC	24	g/m3 throughput/kPa TVP	Storage tank filling	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, Distribution of oil products, Table 3-8, pg 18
NMVOC	3	g/m3 throughput/kPa TVP	Storage tank breathing	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, Distribution of oil products, Table 3-9, pg 19
NMVOC	37	g/m3 throughput/kPa TVP	Automobile refuelling	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, Distribution of oil products, Table 3-10, pg 19
NMVOC	2	g/m3 throughput/kPa TVP	Automobile refuelling, drips and minor spilling	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, Distribution of oil products, Table 3-11, pg 20
NMVOC	0,06	kg/t	Gasoline storage tanks	EMEP/EEA Emission Inventory Guidebook, 2019, Fugitive emissions, Distribution of oil products, Table 3-12, pg 20

Slovenia implemented Stage I control technique in 2005. Stage II control technique in the refuelling phase was partly implemented in 2010. 51 % of service stations were equipped and operate with Stage II requirements in 2010. In the year 2013 60% of service stations had emission controls for automotive refuelling. Share of service stations with Stage II in 2021 is about 80 %. Abatement efficiencies for vapour recovery were applied for emissions calculation in 2021. For loading facilities this is 98 %, for service stations 95 % and for Stage II automotive refuelling controls 85 %. NMVOC emissions from that sector contribute about 1 % to total NMVOC emissions.

Category-Specific QA/QC and Verification

According to the 2017 in-depth EU NECD review recommendation Tier 2 methodology was applied for emission estimation**.** Implementation of the control techniques (Stage I and Stage II) was examined and used for emission calculations. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for NMVOC emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations have been performed since last submission.

Future Improvements

No improvement is planned for next submissions.

3.5.5 Venting and flaring (oil, gas, combined oil and gas)

NFR Code 1B2c

Introduction

This chapter treats emissions from venting and flaring in the extraction and refining of oil and gas. Flaring is basically combustion of gas, but without utilisation of the energy that is released. Included are flaring during extraction and first treatment of both gaseous and liquid fossil fuels and flaring in oil refineries. Emissions from this source contributed in the year 2021 less than 0,2 % to total national emissions.

Methodology

To estimate fugitive emissions from venting and flaring the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – quantity of fuel (t)
EF – emission factor per quantity of fuel (kg/t)

Activity data

Data on natural gas produced have been obtained from SORS. Amount of gas burned is 1 % of gas produced.

Emission factors

In calculating emissions emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 1.B.2.c Venting and flaring, Flaring in oil and gas extraction, Table 3-1, pg. 7 have been used.

Table 3.5.5.1 Emission factors of fugitive emissions from venting and flaring

Pollutant	Value	Unit
NO_x	1,4	kg/t gas burned
CO	6,3	kg/t gas burned
NMVOC	1,8	kg/t gas burned
SO_x	0,013	kg/t gas burned
PM_{10}	2,6	kg/t
$PM_{2.5}$	2,6	kg/t
TSP	2,6	kg/t
BC	0,624	kg/t
Cd	20	mg/t
Pb	4,9	mg/t
Hg	4,7	mg/t
As	3,8	mg/t
Cr	1,3	mg/t
Cu	1,6	mg/t
Ni	38	mg/t
Se	0,43	mg/t
Zn	520	mg/t

There is no information whether emission factors for TSP, PM_{10}, $PM_{2.5}$ represent filterable PM emissions or total (filterable and condensable) emissions.

Category-Specific QA/QC and Verification

According to the 2017 in-depth EU NECD review recommendation proper activity data were used for NO_x, CO, SO_x and NMVOC emission calculation. Emission factors for these pollutants are referred to the gas burned, not the total gas produced. To avoid overestimation we applied new activity data for these pollutants. We have used the new EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 for emissions estimation.

Recalculations

No recalculations have been performed since last submission.

Future Improvements

No improvement is planned for next submissions.

3.5.6 Other activities

Fugitive emission from solid fuels: Solid fuel transformation: NFR Code 1B1b
Other fugitive emissions from solid fuels: NFR Code 1B1c
Other fugitive emissions from energy production: NFR Code 1B2d

Notation Key “NO” (not occurring) were used for these three sectors, since there is no other additional fugitive emissions in Slovenia. No emissions occur in these sectors.

4. INDUSTRIAL PROCESSES AND PRODUCT USE

Industrial activities not related to energy produce various air emissions. Emission sources are industrial production processes in which raw materials are chemically or physically transformed. In this transformation, many different pollutants into air are released, such as NO_x, NMVOC, CO, NH_3, SO_x, heavy metals and POPs.

Due to the intertwined nature of procedures in industry and characteristics of individual reported units, it is in certain cases difficult to distinguish if certain emissions originate from the consumption of fuels for energy purposes or from the consumption of raw materials in industrial processes. The main criterion is the purpose for which raw material or fuel is used.

This chapter also deals with the use of paints within the industrial and domestic sectors. It includes emissions arising from degreasing and dry cleaning. It also covers the emissions from the use of chemical products and other solvent use.

According to the guidelines for reporting emissions and projections data under the Convention LRTAP all emissions from industrial processes and solvent and product use are considered as a whole and reported in one chapter.

4.1 Mineral industry (2. A)

Sectors covered in this chapter are:

NFR Codes:

2A1 Cement production
2A2 Lime production
2A3 Glass production
2A5a Quarrying and mining of minerals other than coal
2A5b Construction and demolition

Mineral industry sector contributes to total national emissions with particulate matter and heavy matter emissions. The most important source of emissions of particulate matter in 2021 was construction and demolition. Glass production is the only source of heavy metals.

4.1.1 Cement Production

NFR Code 2A1

During the manufacturing process natural raw materials are finely ground and then transformed into cement clinker in a kiln system at high temperatures. The clinkers are cooled and ground together with additions into a fine powder known as cement. Cement is a hydraulic binder, i.e. it hardens when mixed with water. Cement is used to bind sand and gravel together in concrete.

The basic raw material for the production of cement is marl, which is a homogeneous mixture of limestone and clay and which originated in past geological periods through sedimentation. As there is no longer enough natural marl for mass production, the cement production mix, which must contain 75-78 % of calcium carbonate ($CaCO_3$), is prepared by mixing limestone and clay components: from such with 35 % of $CaCO_3$ to limestone with more than 95 % of $CaCO_3$. The limestone, which is a source of CaO, normally has an admixture of dolomite, which introduces MgO into the system. Clay components are bearers of SiO_2, Al_2O_3, and Fe_2O_3. Blast furnace slag, silica sand, bauxite, and gypsum are added to the homogenized mix during grinding.

Raw meal powder is fed into the cement kiln through a heat exchange unit. Natural gas, fuel oil, petroleum coke, coal dust, waste oils, and tyres are used as fuels in the clinker calcination process.

The present chapter only considers emissions of particulate matter. It comprises emissions of particulate matter from cement plants, which mainly originate from pre-and after-treatment. Emission factors used include also emissions resulting from handling and processing of the product and raw material.

Particulate emissions from combustion process are included in chapter 1.A.2.f. Stationary combustion in manufacturing industries and construction: Non-metallic minerals. As well emissions of NO_x, SO_x, CO, NMVOC and NH_3, heavy metals and persistent organic pollutants from combustion process are included in energy chapter (1.A.2.f.).
Emissions arising in combustion process are calculated from activity data on fuel combusted in cement production and emission factor for indvidual fuel and individual pollutant.
Methodology applied for combustion emission calculation is provided in IIR 2023, Chapter 3.2. Manufacturing industries and construction (1.A.2), pg. 79.

In Slovenia, there have been two cement producers until 2015. In the year 2021 only one cement plant has been in operation.

Methodology

To estimate emissions from cement production, the following methodology has been adopted for individual pollutant:

$$E = m \times EF$$

E – emission (kg)
m – amount of clinker produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of clinker. Data have been obtained from cement producers for the whole period. In 2021 only one cement plant was in operation.

Emission factors

Emission factors applied for $PM_{2.5}$, PM_{10}, TSP and BC emission calculations were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 2.A.1 Cement production, Table 3.1, pg. 10 and Table 4.1, pg. 16. Due to the introduction of abatement techniques in 2008 best available technique emission factor for TSP has been applied for the period 2008-2021. The emission factor for TSP is 25 mg/m3. Emissions for $PM_{2.5}$, PM_{10} and BC for the period 2008-2021 were calculated from the ratio of emission factors: EF $PM_{2.5}$ / EF TSP (that is 0,5) and EF PM_{10} / EF TSP (that is 0,9). 3 % of $PM_{2.5}$ emissions correspond to BC emissions.

Table 4.1.1.1 Emission factors for cement production

Pollutant	Value	Unit	References
TSP	260	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Cement production, Table 3.1, pg 10
$PM_{2.5}$	130	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Cement production, Table 3.1, pg 10
PM_{10}	234	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Cement production, Table 3.1, pg 10
BC	3,9	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Cement production, Table 3.1, pg 10

There is no information on whether emission factors of particulate matter include or exclude condensable component.

Emissions

Emissions of particulate matter have been calculated for the period 2000-2021. Emissions from cement production in 2021 contributed up to 0,4 % to total national emissions.

Category-specific QA/QC and verification

The amount of clinker produced and composition of clinker has been thoroughly examined. All data checked were correct. Activity data on clinker production obtained directly from the producers were cross checked with data obtained from verified ETS reports. We also compared data on cement production and clinker production. Clinker production does not entirely track cement production due to additional clinker imports. Cement has been produced not only from domestically produced clinker but also from imported clinker.

According to the 2018 in-depth EU NECD review information on the methodology applied for combustion emission calculation is provided. Combustion processes are calculated from activity data on fuel combusted in cement production and emission factor for particulate fuel and particulate pollutants. Particulate emissions and NO_x, SO_x, CO, NMVOC and NH_3, heavy metals and persistent organic pollutants emissions from the combustion process are included in chapter 1.A.2.f. Stationary combustion in manufacturing industries and construction: Non-metallic minerals. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations have been performed since the last submission.

Planned improvements

No improvements are planned for the next submission.

4.1.2 Lime Production

NFR Code 2A2

Lime is the high-temperature product of the calcination of limestone. The production occurs in vertical and rotary kilns fired by coal, oil or natural gas. Calcium limestone contains 97–98 % calcium carbonate on a dry basis. Atmospheric emissions in the lime manufacturing industry include particulate emissions from the mining, handling, crushing, screening and calcining of the limestone and emissions of air pollutants generated during fuel combustion in kilns. Lime is generated by heating the input raw material, i.e. limestone, to high temperature (900-1200°C).

The present chapter only considers emissions of particulate matter.
Combustion related emissions are provided in chapter 1.A.2.f. Emissions arising in combustion process are calculated from activity data on fuel combusted in lime production and emission factor for particulate fuel and particulate pollutant.

In Slovenia, there have been three lime producers until 2013. One of the lime plants had been closed down at the end of 2012. In the year 2021, only two lime plants have been in operation.

Methodology

To estimate emissions from lime production, the following methodology has been adopted for individual pollutant:

E = m x EF

E – emission (kg)
m – amount of lime produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of lime. Data have been obtained from lime producers for the whole period.

Emission factors

Emission factors applied for $PM_{2.5}$, PM_{10}, TSP and BC emission calculations were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 2.A.2 Lime production, Table 3.2, pg. 10 and Table 3.3, pg. 11. Tier 2 methodology has been used for emissions calculation. In 2008 abatement technology was introduced in the production process.

Table 4.1.2.1 Emission factors for lime production for the period 2000-2007

Pollutant	Value	Unit	References
TSP	9000	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.2, pg 10
$PM_{2.5}$	700	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.2, pg 10
PM_{10}	3500	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.2, pg 10
BC	3,22	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.2, pg 10

Table 4.1.2.2 Emission factors for lime production for the period 2008-2021

Pollutant	Value	Unit	References
TSP	400	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.3, pg 11
$PM_{2.5}$	30	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.3, pg 11
PM_{10}	200	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.3, pg 11
BC	0,138	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Lime production, Table 3.3, pg 11

There is no information on whether emission factors of particulate matter include or exclude condensable components.

Emissions

Emissions of particulate matter have been calculated for the period 2000-2021. Emissions of particulates from lime production in 2021 contributed up to 0,2 % to total national TSP emissions.

Category-specific QA/QC and verification

The amount of lime produced and the composition of lime and raw material have been thoroughly examined. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described. Activity data on lime production obtained directly from the producers were cross checked with data obtained from verified ETS reports.

Recalculations

No recalculations have been performed since the last submission.

Planned improvements

No improvements are planned for this source.

4.1.3 Glass Production

NFR Code 2A3

The present chapter concerns the process emissions released during the production of particular types of glass (flat and container glass, glass wool and Pb glass). It contains emissions for glass production, including emissions from both melting and non-melting activities.

Methodology

To estimate emissions from glass production, the following methodology has been adopted for individual pollutant:

$$E = m \times EF$$

E – emission (kg)
m – amount of glass produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of glass and Pb glass. Data have been obtained from glass producers for the period 2005-2021. For the period 1990-2004 data were obtained from SORS.

Emission factors

Emission factors applied for $PM_{2.5}$, PM_{10}, TSP, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn emission calculations were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 2.A.3 Glass production. Emission factors for flat and container glass were taken from Table 3.1, pg. 14, emission factors for lead glass from Table 3.6, pg. 20.

Table 4.1.3.1 Emission factors for glass production

Pollutant	Value	Unit	References
TSP	300	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
$PM_{2.5}$	240	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
PM_{10}	270	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
BC	0,1488	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Pb	1,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Cd	0,13	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Hg	0,003	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
As	0,19	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Cr	0,23	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Cu	0,007	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Ni	0,49	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Se	0,8	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14
Zn	0,37	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.1, pg 14

Table 4.1.3.2 Emission factors for lead crystal glass production

Pollutant	Value	Unit	References
TSP	10	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.6, pg 20
$PM_{2.5}$	8	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.6, pg 20
PM_{10}	9	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.6, pg 20
BC	0,00496	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.6, pg 20
Pb	10	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Glass production, Table 3.6, pg 20

There is no information on whether emission factors of particulate matter include or exclude condensable components.

Emissions

Emissions of particulate matter have been calculated for the period 2000-2021 and heavy metals for 1990-2021. Emissions of Pb, Cd, Cr, As, Ni, Se contributed up to 5 % to total national emissions in 2021. Emissions of particulate matter were below 0,3 %.

Category-specific QA/QC and verification

The amount of glass produced was examined for the whole period. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations were performed since the last submission.

Planned improvements

No improvements are planned for the next submission.

4.1.4 Quarrying and mining of minerals other than coal

NFR Code 2A5a

This chapter discusses the quarrying and mining of minerals other than coal, in particular of crushed rock, sand and gravel to produce aggregate. This chapter does not include emissions from the combustion of fuels in the quarry and transport machinery.

Methodology

To estimate emissions from quarrying and mining of minerals Tier 2 methodology from EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Quarrying and mining of minerals other than coal was used. A Tier 2 spreadsheet excel model was applied for emissions calculations.

https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/2-industrial-processes/2-a-mineral-products/2-a-5-a-quarrying-1/at_download/file

Activity data

Activity data used for emission calculation are data in a Tier 2 spreadsheet excel model. Data on the annual aggregates production, size distribution, types and number of quarries were obtained from European Aggregates Association (UEPG) and Geological Survey of Slovenia for the period 2010-2021. Due to the unavailability of published data for the period 2000-2009 estimation of activity data was performed for that period. Data on internal transport were estimated from national transport data and default model data. Other input data are default spreadsheet excel model data.

Emission factors

Emission factors applied for $PM_{2.5}$, PM_{10}, TSP were default Tier 2 spreadsheet excel model, EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Quarrying and mining.

There is no information on whether emission factors of particulate matter include or exclude condensable components.

Emissions

Emissions of particulate matter have been calculated for the period 2000-2021. Emissions of particulates contributed up to 3 % to total national emissions in 2021.

Category-specific QA/QC and verification

Activity data, emission factors and methodology of emission calculation were examined. A higher Tier method has been used in 2023 submission. More detailed data were obtained for emissions calculation. A model calculations were checked and compared with Tier 1 methodology calculations.

Recalculations

According to the 2022 in-depth EU NECD review recalculation of particulate emissions have been performed due to changes in the methodology used. A higher Tier method has been used. Emissions from quarrying and mining have been calculated according to a Tier 2 method. Emissions of $PM_{2.5}$, PM_{10}, TSP have been recalculated for the whole period 2000-2020.

Planned improvements

No improvements are planned for the next submission.

4.1.5 Construction and demolition

NFR Code 2A5b

The present chapter discusses emissions from the construction sector. It has long been recognized that the construction of infrastructure and buildings constitutes an important source of fugitive particulate matter emissions.
Four main types of construction are included: Residential housing (single or two family), Residential housing (apartments), Non-residential housing and Road construction.

Methodology

To estimate emissions from construction and demolition Tier 1 default approach has been adopted for individual pollutant:

$$E = \mathrm{EF} \cdot \mathrm{A}_{\mathrm{affected}} \cdot \mathrm{d} \cdot (1 - CE) \cdot \left(\frac{24}{PE}\right) \cdot \left(\frac{s}{9\%}\right)$$

E – emission (kg)
EF – emission factor (kg/m^2)
$A_{affected}$ – area affected by construction activity (m^2)
D – duration of construction (year)
CE – efficiency of emission control measures
PE – Thornthwaite precipitation – evaporation index
s – soil silt content (%

Activity data

Activity data used for emission calculation are data on the number of house built and length of constructed roads. Data for the period 2008-2021 have been obtained from SORS. Due to the unavailability of published data for the period 2000-2007 estimation of activity data was performed. Estimation based on gross domestic product.

Emission factors

Emission factors for $PM_{2.5}$, PM_{10}, TSP applied were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 2.A.5.b Construction and demolition, Tables 3.1-3.4, pg.

7 and 8. The emission factors used are shown in Table 4.1.5.1**.**

Other parameters used for emission calculation are default values obtained from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 2.A.5.b Construction and demolition as well (Table 4.1.5.2).

Table 4.1.5.1 Emission factors for construction and demolition

Types of construction	Pollutant	Value	Unit	References
Construction of houses (detached single family, detached two family)	**TSP**	0,29	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.1, pg 7
	$PM_{2.5}$	0,0086	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.1, pg 7
	PM_{10}	0,086	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.1, pg 7
Construction of apartments	**TSP**	1	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.2, pg 7
	$PM_{2.5}$	0,03	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.2, pg 7
	PM_{10}	0,3	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.2, pg 7
Non - residential construction	**TSP**	3,3	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.3, pg 8
	$PM_{2.5}$	0,1	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.3, pg 8
	PM_{10}	1	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.3, pg 8
Road construction	**TSP**	7,7	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.4, pg 8
	$PM_{2.5}$	0,23	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.4, pg 8
	PM_{10}	2,3	kg/m^2	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, Table 3.4, pg 8

Table 4.1.5.2 Parameters used for construction and demolition

Types of construction	Parameter	Value	Unit	References
Construction of houses (detached single family, detached two family)	duration of construction (d)	0,5	year	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 8
	efficiency of emission control measures (CE)	0	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	Thornthwaite precipitation-evaporation index (PE)	120	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	soil silt content (s)	20	%	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 10
	area affected ($A_{affected}$)	300 (detached single family) 188 (detached two family)	(m2/house)	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 11

Construction of apartments	duration of construction (d)	0,75	year	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 8
	efficiency of emission control measures (CE)	0	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	Thornthwaite precipitation-evaporation index (PE)	120	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	soil silt content (s)	20	%	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 10
	area affected ($A_{affected}$)	585	(m2/building)	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 12
Non - residential construction	duration of construction (d)	0,83	year	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 8
	efficiency of emission control measures (CE)	0,5	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	Thornthwaite precipitation-evaporation index (PE)	120	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	soil silt content (s)	20	%	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 10
	area affected ($A_{affected}$)	800	(m2/building)	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 12
Road construction	duration of construction (d)	1	year	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	efficiency of emission control measures (CE)	0,5	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	Thornthwaite precipitation-evaporation index (PE)	120	-	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 9
	soil silt content (s)	20	%	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 10
	area affected ($A_{affected}$)	36000	(m2/km)	EMEP/EEA Emission Inventory Guidebook, 2019, Mineral products, Construction and demolition, pg 13

There is no information on whether emission factors of particulate matter include or exclude condensable components.

Emissions

Emissions of particulate matter have been calculated for the period 2000-2021. Emissions of $PM_{2.5}$, PM_{10} and TSP contributed up to 3 %, 22 % and 36 %, respectively to the total national emissions in 2021. Construction of the road is the major contributor to particulate emissions, especially TSP emissions. Annual fluctuations in the total national TSP emissions were due to annual differences in the length of newly constructed roads.

Category-specific QA/QC and verification

Activity data, emission factors and methodology of emission calculation were checked. Data on road construction were examined. Mistakes in recording of construction data were found. Double counting of different types of roads was noticed.

Recalculations

Emissions of $PM_{2.5}$, PM_{10} and TSP have been recalculated for the period 2000-2020 due to new activity data applied. Updated data on road construction were used. Mistakes in importing data to the reporting table were found. The error was found during QA/QC procedure.

Planned improvements

No improvements are planned for the next submission

4.1.6 Other activities

Storage, handling and transport of mineral products: NFR Code 2A5c Emissions of particulate matter from this sector are included under 2A1 Cement production, 2A2 Lime production, 2A3 Glass production. Notation Key "IE" (included elsewhere) was therefore used for this sector.

Other mineral products (please specify in the IIR): NFR Code 2A6
Notation Key "NO" (not occurring) was used for this sector, since there are no other mineral products. No emissions occur in these sectors.

4.2 Chemical industry (2. B)

Sectors covered in this chapter are:

NFR Codes:

2B2	Nitric acid production
2B5	Calcium carbide production
2B6	Titanium dioxide production
2B10a	Chemical industry: Other

Emissions of SO_x from chemical industry are significant to total national inventory. They contribute 17 % to total SO_x emissions. Emissions of other pollutants are negligible. In 2021 only emissions from Titanium dioxide production and Other chemical industry appeared in Slovenia.

4.2.1 Nitric acid production

NFR Code 2B2

Nitric acid production is a large scale process in the chemical industry. The process involves the catalytic oxidation of ammonia by air (oxygen) yielding nitrogen oxide then oxidised into nitrogen dioxide (NO_2) and absorbed in water. The reaction of NO_2 with water and oxygen forms nitric acid (HNO_3) with a concentration of generally 50–75 wt.% ('weak acid'). For the production of highly concentrated nitric acid (98 wt.%), first nitrogen dioxide is produced as described above. It is then absorbed in highly concentrated acid, distilled, condensed and finally converted into highly concentrated nitric acid at high pressure by adding a mixture of water and pure oxygen.

Methodology

To estimate emissions from nitric acid production, the following methodology has been adopted for individual pollutant:

$$E = m \times EF$$

E – emission (kg)
m – amount of nitric acid produced (t)
EF – emission factor (kg/t)

Activity data

Activity data for emission calculations are the annual production of nitric acid. Data were obtained from the Statistical Office of the Republic of Slovenia (SORS). Emissions of NO_x were estimated for the period 1997 – 2005. There is no nitric acid production since 2006.

Emission factors

For calculating air emissions from nitric acid production EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 had been used.

4.2.1.1 Emission factor used for calculation of emissions from nitric acid production

Pollutant	Value	Unit	References
NO_x	7,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Nitric acid production, Table 3.11, pg 21

Emissions

Since there is no nitric acid production since 2006, no emissions of NO_x occurred in 2021 from this sector.

Recalculations

No recalculations have been performed since the last submission.

Planned improvements

No improvements are planned for the next submission.

4.2.2 Carbide production

NFR Code 2B5

Calcium carbide (CaC_2) is manufactured by heating a lime and carbon mixture up to 2100 °C in an electric arc furnace. The lime is reduced by carbon to calcium carbide and carbon monoxide.

Lime for the reaction is usually made by calcining limestone in a kiln at the plant site. The sources of carbon for the reaction are petroleum coke, metallurgical coke and anthracite coal.

Methodology

To estimate emissions from calcium carbide production the following methodology has been adopted:

E = m x EF

E – emission (kg)
m – amount of calcium carbide produced (t)
EF – emission factor (kg/t)

Activity data

Activity data for emission calculations are the annual production of calcium carbide. Data were obtained from SORS. Emissions of TSP were estimated for the period 2000 – 2008. There had been only one producer in Slovenia. This factory was closed down in the first quarter of 2008. There are no emissions from that source since 2008.

Emission factors

For calculating air emissions from calcium carbide production EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 had been used.

Table 4.2.2.1 Emission factor used for calculation of emissions from calcium carbide production

Pollutant	Value	Unit	References
TSP	100	g/t	EMEP/EEA Emission Inventory Guidebook 2019, Chemical industry, Calcium carbide production, Table 3.5, pg 16

There is no information on whether emission factors of particulate matter include or exclude condensable components.

Emissions

Since there is calcium carbide production since 2008, no emissions of TSP occurred in 2021 from this sector.

Recalculations

No recalculations have been performed since the last submission.

Planned improvements

No improvements are planned for the next submission.

4.2.3 Titanium dioxide production

NFR Code 2B6

Titanium dioxide (TiO_2) pigments are made from one of two chemical processes: the chloride route, which leads to TiO_2 products by reacting titanium ores with chlorine gas; and the sulphate route, which leads to TiO_2 products by reacting titanium ores with sulphuric acid. In both processes, pure titanium dioxide powder is extracted from its mineral feedstock after which it is milled and treated to produce a range of products designed to be suitable for efficient incorporation into different substrates. This sector represents emissions from sulphate route production in Slovenia.

Methodology

To estimate emissions from titanium dioxide production the following methodology has been adopted:

E = m x EF

E – emission (kg)
m – amount of titanium dioxide produced (t)
EF – emission factor (kg/t)

Activity data

Activity data for emission calculations are the annual production of titanium dioxide. Data were obtained from SORS until 2016. Data for 2017-2021 have been obtained from the producer.

Emission factors

For calculating NO_x and TSP emissions from titanium dioxide production EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used.

Table 4.2.3.1 Emission factors used for calculation of emissions from titanium dioxide production

Pollutant	Value	Unit	References
NO_x	0,108	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Titanium dioxide production, Table 3.20, pg 26
TSP	0,3	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Titanium dioxide production, Table 3.20, pg 26

There is no information on whether emission factors of particulate matter include or exclude condensable components.

SO_x emissions for the period 2002-2021 are direct emissions taken from REMIS database, established and handled by Slovenian Environmental Agency. These data represent plant specific values.

SO_x emissions for the period 1982-2001 were estimated. Average EF from 2002-2016 was applied for the period 1982-2001.

For the years 1980 and 1981 emission factor from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used (3,97 kg/t). Abatement technologies started in 1982 and therefore data derived from Remis database was not representative for that period.

The reason for the increase in emissions between 2003-2005 is the lower efficiency of adsorbent in the abatement system.

REMIS database is obtained in compliance with Rules on initial measurements and operational monitoring of the emission of substances into the atmosphere from the stationary pollution sources and on the conditions for their implementation (OJ RS, No. 105/08 and 44/22 – ZVO-2). Each year all obligators must provide a report on the implementation of emission monitoring of substances into air. Annual emission report includes emissions of substances into air. These emissions data are direct measurements of emissions into air and reflect plant specific values.

Emissions

Emissions of SO_x and NO_x have been calculated for the period 1980-2021, emissions of TSP for the period 2000-2021. Emissions of SO_x contributed about 4 % to total national emissions in 2021. Emissions of TSP and NO_x are below 0,1 %

Category-specific QA/QC and verification

The amount of titanium dioxide produced was examined. Methodology and emission factors of emission calculation were checked. According to the 2018 in-depth EU NECD review, direct emissions from plants were examined and used for SOx emission calculations. Abatement technologies were implemented during the 1982-2021 period. Measurements of emissions reflect this improvement, whereas a Tier 2 default emission factor applied for the whole period would not take into consideration such improvements. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculation were performed since the last submission.

Planned improvements

No improvements are planned for this source.

4.2.4 Chemical industry: Other

NFR Code 2B10a

This sector comprises emissions from formaldehyde, sulphuric acid, polyethylene and NPK (nitrogen, phosphorus, and potassium) and phosphate fertilisers production.

Methodology

To estimate emissions from other chemical industry production the following methodology has been adopted:

E = m x EF

E – emission (kg)

m – amount of formaldehyde, sulphuric acid, polyethylene or phosphate and NPK fertilisers produced (t)
EF – emission factor (kg/t)

Activity data

Activity data for emission calculations are annual production of formaldehyde, sulphuric acid, polyethylene and phosphate and NPK fertilisers. Data were obtained from SORS until 2016. Data for 2017-2021 have been obtained from the producers.

Emission factors

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used for emission calculations.

Table 4.2.4.1 Emission factors used for emissions calculation from formaldehyde production

Pollutant	Value	Unit	References
NMVOC	1,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 2B Chemical industry, Formaldehyde production, Table 3.54, pg 53
CO	0,2	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 2B Chemical industry, Formaldehyde production, Table 3.54, pg 53

Table 4.2.4.2 Emission factors used for emissions calculation from sulphuric acid production

Pollutant	Value	Unit	References
SO_x	3	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 2B Chemical industry, Sulphuric acid production, Table 3.22, pg 27

Table 4.2.4.3 Emission factors used for emissions calculation from phosphate and NPK fertilizers production

Pollutant	Value	Unit	References
TSP	0,3	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Phosphate, NPK fertilizers production, Table 3.28, pg 31,Table 3.35, pg 36,
PM_{10}	0,24	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Phosphate, NPK fertilizers production, Table 3.28, pg 31,Table 3.35, pg 36,
$PM_{2.5}$	0,18	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Phosphate, NPK fertilizers production, Table 3.28, pg 31,Table 3.35, pg 36,

Table 4.2.4.4 Emission factors used for emissions calculation from polyethylene production

Pollutant	Value	Unit	References
TSP	0,031	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Polyethylene production, Table 3.39, pg 40
NMVOC	2,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Chemical industry, Polyethylene production, Table 3.39, pg 40

There is no information on whether emission factors of particulate matter include or exclude condensable components.

Emissions

Emissions of $PM_{2.5}$, PM_{10} and TSP from fertilizers and polyethylene production have been calculated for the period 2000 to 2021. Emissions of SO_x from sulphuric acid production have been calculated for the whole period 1980-2021. Emissions of CO and NMVOC from formaldehyde production had been calculated until 2013. There is no formaldehyde production after the year 2014. Sulphuric acid production is a significant source of SO_x. It contributed about 13 % to total national emissions in 2021. Emissions of other pollutants are negligible. They were below 0,02 % of national totals.

Category-specific QA/QC and verification

According to the 2018 in-depth EU NECD review, this sector was thoroughly examined. No new emissions sources were found. There is chlorine production in Slovenia, but the process applied is a membrane cell electrolysis using NaCl. Emissions from this production have not been estimated since no emission factors are available for this type of process. This process has been used in the whole period. Notation keys were corrected. 'NE' instead of 'NA' have been used for other pollutants. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculation were performed since the last submission.

Planned improvements

No improvements are planned for the next submission.

4.2.5 Other activities

Ammonia production: NFR Code 2B1
Adipic acid production: NFR Code 2B3
Soda ash production: NFR Code 2B7
Storage, handling and transport of chemical products: NFR 2B10b

Notation Key "NO" (not occurring) was used for this sectors, since there are no ammonia, adipic acid and soda ash production in Slovenia. No emissions occur in these sectors.

4.3 Metal industry (2. C)

Sectors covered in this chapter are:

NFR Codes:

2C1 Iron and steel production
2C2 Ferroalloys production
2C3 Aluminium production
2C5 Lead production
2C6 Zinc production
2C7a Copper production

The most important source of SO_x and CO emissions is aluminium production. Steel production is an important source of heavy metals, dioxin and furans, PAHs and POPs. In 2021 contribution of metal industry to total national emissions is as follows: 34 % to Ni, 33 % to Pb, Cd and Hg with 24 and 20 %, 16 % to dioxins/furans, 12 % to Zn and less than 10 % for other pollutants.

4.3.1 Iron and Steel Production

NFR Code 2C1

Iron is produced through the reduction of iron oxide (ore) using metallurgical coke as the reducing agent in a blast furnace. Steel is then subsequently made from iron and scrap in other furnaces. The production of steel is a multiphase process, and some phases give rise to air emissions. Most emissions occur in smelting iron scrap in electric arc furnace. The furnace is first filled with steel scrap, and then limestone and/or dolomite are added to allow the slag to form. The furnace utilizes electric heating through graphite electrodes. For increased productivity in the initial phase of melting, oxygen lances and a carbon injection system are used. From a metallurgical point of view, oxygen is used to reduce the carbon content in the molten metal and for removing other undesired elements. Decarburising is performed also in secondary phases in a ladle furnace.

There has been only steel production in Slovenia in 2021. Production of pig iron took place until 1987. Since 1988 only electric arc furnace steel plants have been in operation. There have been three steel factories in operation.
Technology of iron and steel production in the period 1980-2021:
1980-1987: pig iron and steel production (integrated plants)
1988-2021: steel production (electric arc furnace)

Methodology

To estimate emissions from steel production the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – amount of steel produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of steel. For the period 1980-2004 data were obtained from the Statistical Office of the Republic of Slovenia (SORS). Data on steel produced for the period 2005-2021 have been obtained from steel producers.

Emission factors

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used for emission calculations.

Table 4.3.1.1 Emission factors used for calculation of emissions from steel production

Pollutant	Value	Unit	References
TSP	30	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
PM_{10}	24	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
$PM_{2.5}$	21	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
BC	0,0756	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
NOx	130	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
CO	1,7	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
NMVOC	46	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
SOx	60	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Pb	2,6	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Cd	0,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Hg	0,05	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
As	0,015	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Cr	0,1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Cu	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Ni	0,7	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Zn	3,6	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
PCB	2,5	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Total 4 PAHs	0,48	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40
Dioxins/furans	3	microg I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Iron and steel production, Table 3.15, pg 40

Emission factors of particulate matter represent filterable emissions only. A condensable component is excluded.

Emissions

Steel production is an important source of heavy metals and POPs. Emissions of Pb, Ni, Cd, Hg contributed up to 35 % to national total emissions, emissions of dioxins/furans about 14 %, Zn 12 %, Total 4 PAHs 7 % and PCB 5 %.

Category-specific QA/QC and verification

According to the 2018 in-depth EU NECD review recommendation transparency of type of iron and steel technologies occurring in Slovenia was improved. Methodology and emission factors of emission calculation were checked. More appropriate emission factors were used for the period 1988-1993 and recalculations of emissions were performed. Emissions of HCB were not estimated since only electric arc furnace steel plant occurred in the period 1990-2021. No emission factor for HCB is available for this type of process. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations were performed since the last submission.

Future improvements

No improvements are planned for the next submission.

4.3.2 Ferroalloys Production

NFR Code 2C2

Ferroalloys are concentrated alloys of iron and one or more metals such as silicon, manganese, chromium, molybdenum, vanadium and tungsten. These alloys are used for deoxidising and altering the material properties of steel. Ferroalloy production involves a metallurgical reduction process which results in significant carbon dioxide emissions. Emissions from the production of ferroalloys are not considered significant, since the contribution to the total national emissions is thought to be insignificant, i.e. less than 1 % of the national emissions of any pollutant.

Methodology

To estimate emissions from ferroalloys production, the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – amount of ferroalloys produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of ferroalloys. Data were obtained from ferroalloys producer for the whole period. This factory was closed down in the first quarter of 2008 and consequently the production of ferroalloys was discontinued in 2008 as well.

Emission factors

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used for emission calculations.

Table 4.3.2.1 Emission factors used for calculation of emissions from ferroalloys production

Pollutant	Value	Unit	References
TSP	1000	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Ferroalloys production, Table 3.1, pg 7
PM_{10}	850	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Ferroalloys production, Table 3.1, pg 7
$PM_{2.5}$	600	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Ferroalloys production, Table 3.1, pg 7
BC	60	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Ferroalloys production, Table 3.1, pg 7

Emission factors of particulate matter represent filterable emissions only. A condensable component is excluded.

Emissions

Emissions of particulate matter were estimated for the period 2000-2008. There are no emissions from this source since 2008.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for the next submission.

4.3.3 Aluminium Production

NFR Code 2C3

Aluminium is produced in two phases. Firstly, Al_2O_3 is extracted from bauxite ore. Aluminium is then produced in the second phase in an electrochemical process in the electrolysis cells, where alumina disintegrates into its components: aluminium and oxygen. Molten aluminium gathers at the cathode while oxygen reacts with carbon in the anode, causing the consumption of anodes, which have to be replaced. In Slovenia only the second phase is performed, when primary aluminium is produced with electrolytic reduction of alumina. In Slovenia, there is one aluminium producer. The most important pollutants emitted from the primary aluminium electrolysis process are sulphur dioxide (SO_2), carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs).

Methodology

To estimate emissions from aluminium production, the following methodology has been adopted:

$$E = m \times EF$$

E – emission (kg)
m – amount of aluminium produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of aluminium. Data have been obtained from the aluminium producer for the whole period. Data for primary and secondary aluminium production were used for emission calculation.

Emission factors

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used for primary and secondary aluminium production emission calculations for:

- $PM_{2.5}$, PM_{10},TSP, BC for the period 2000-2021,
- benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene and Indeno (1,2,3-cd) pyrene, dioxins/furans for the period 1990-2021,
- HCB for the period 1990-2001,
- SO_x, NO_x and CO for the period 1980-1999.

Direct emissions of SO_x, NO_x and CO obtained from aluminium producer were applied for the period 2000-2021.

Since abatement technologies were implemented in secondary aluminium production abatement efficiency of 99 % for dioxins/ furans emission factor in 2021 and 75 % for HCB emission factor in 2001 were used for emissions calculation.

Table 4.3.3.1 Emission factors used for calculation of emissions from aluminium production

Pollutant	Value	Unit	References
SO_x	5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
NO_x	1	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
CO	120	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
Benzo(a)pyrene	0,07	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
Benzo(b)fluoranthene	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
Benzo(k)fluoranthene	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
Indeno(1,2,3-cd)pyrene	0,01	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
TSP	0,6	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
PM_{10}	0,5	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
$PM_{2.5}$	0,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
BC	0,0092	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.2, pg 13
Dioxins/ Furans	35	microg I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.4, pg 15 and Table 3.5, pg 16
HCB	5	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Aluminium production, Table 3.4, pg 15 and Table 3.5, pg 16

Emission factors of particulate matter represent filterable emissions only. A condensable component is excluded.

According to the 2018 in-depth EU NECD review recommendations emissions of HCB and dioxins/furans from secondary aluminium production were introduced into national inventory. In Slovenia there was no use of hexachlorobenzene in secondary aluminium production in the whole period 1990-2021. But there were small amounts of hexachloroethane (HCE tablets) as a degassing agent used for removing unwanted additions in the period 1990-2001. These could cause some small unintentional emissions of HCB in the period 1990-2001. Hexachloroethane was phased out from production in 2001. HCB emissions were estimated for the period 1990-2001. Emissions of dioxins/furans were estimated for the whole period 1990-2021.

Emissions

Aluminium production is an important source of SO_x and CO. Emissions of SO_x and CO contributed 6 % and 4 % to total national emissions in 2021. Emissions of other pollutants are less important. They contribute below 0,3 % to national totals. In 2008, the modernisation of technology in the aluminium plant was performed. Technologically improved point feeding prebaked anode Pechiny has been in operation. A company also acquired the Environmental Permit, which demand the introduction of the best available techniques and lower the limit of allowed emissions to the air. For all these reasons, emission factors since 2008 are not comparable with those from years before 2008.

Category-specific QA/QC and verification

According to the 2018 in-depth EU NECD review recommendations emissions of HCB and dioxins/furans from secondary aluminium, production was introduced into national inventory. Data obtained from the aluminium producer was thoroughly examined. Possible inconsistencies were consulted with the producer expert team. We also visited the factory and observed production operation and data acquiring in person. Data on direct emissions, which are obtained from the producer, are subject to standard QC. In addition implied emission factors are compared with the default EFs from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019. In the cases when IEF is outside the 95% confidence interval, we further investigate the reason for such a deviation. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for the next submission.

4.3.4 Lead Production

NFR Code 2C5

This chapter presents information on atmospheric emissions during primary and secondary lead production. In the direct primary smelting process, the sintering step is skipped, and the lead concentrates and other materials are entered directly into a furnace in which they are melted and oxidized. The secondary production of refined lead amounts to the processing of recycled lead to prepare it for reuse. The vast majority of this recycled lead comes from scrapped lead acid batteries. The most important process emissions are SO_x, heavy metals and dust.

Methodology

To estimate emissions from lead production, the following methodology has been adopted:

$E = m \times EF$
E – emission (kg)
m – amount of lead produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of lead. Data have been obtained from SORS until 2016. Data for 2017-2021 were obtained from the producer.

Emission factors

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used for emissions calculation.

Table 4.3.4.1 Emission factors used for emissions calculations from lead production

Pollutant	Value	Unit	References
TSP	6	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
PM_{10}	5	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
$PM_{2.5}$	2,5	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
PCB	2	microg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
SO_x	2050	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
Pb	1,8	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
Cd	0,1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
Hg	0,1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
As	0,1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
Zn	0,6	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12
Dioxins/furans	4,5	microg I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Lead production, Table 3.1, pg 12

Emission factors of particulate matter represent filterable emissions only. A condensable component is excluded.

Emissions

Lead production is a minor source of air pollutant emissions. Emissions of all pollutants from lead production contributed less than 2 % to national totals in 2021.

Category-specific QA/QC and verification

New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for the next submission.

4.3.5 Zinc Production

NFR Code 2C6

Zinc is produced from various primary and secondary raw materials. The primary processes use sulphidic and oxidic concentrates, while in secondary processes recycled oxidised and metallic products mostly from other metallurgical operations are employed. The most important process emissions are SO_x, heavy metals and dust.

Methodology

To estimate emissions from zinc production, the following methodology has been adopted:

E = m x EF
E – emission (kg)
m – amount of zinc produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of zinc. Data have been obtained from SORS until 2016. Data for 2017-2021 were obtained from the producer.

Emission factors

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used for emissions calculation.

Table 4.3.5.1 Emission factors used for emissions calculations from lead production

Pollutant	Value	Unit	References
TSP	15	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
PM_{10}	13	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
$PM_{2.5}$	12	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
PCB	2	microg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
SO_x	1350	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
Pb	0,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12

Cd	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
Hg	0,04	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
As	0,03	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
Zn	5	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12
Dioxins/Furans	5	microg I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Zinc production, Table 3.1, pg 12

Emission factors of particulate matter represent filterable emissions only. A condensable component is excluded.

Emissions

Zinc production is a negligible source of air pollutant emissions. Emissions of all pollutants from zinc production contributed less than 0,05 % to national totals in 2021.

Category-specific QA/QC and verification

New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for the next submission.

4.3.6 Copper Production

NFR Code 2C7a

Secondary copper smelter is defined as any plant or factory in which copper-bearing scrap or copper-bearing materials, other than copper-bearing concentrates (ores) derived from a mining operation, is processed by metallurgical or chemical process into refined copper and copper powder (a premium product). The recycling of copper is the most comprehensive among the non-ferrous metals.

Methodology

To estimate emissions from copper production, the following methodology has been adopted:

E = m x EF
E – emission (kg)
m – amount of copper produced (t)
EF – emission factor (kg/t)

Activity data

Activity data used for emission calculation are data on the annual production of copper. Data have been obtained from SORS until 2016. Data for 2017-2021 were obtained from the producer.

Emission factors

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 has been used for emissions calculation.

Table 4.3.6.1 Emission factors used for emissions calculations from copper production

Pollutant	Value	Unit	References
TSP	320	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
PM_{10}	250	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
$PM_{2.5}$	190	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
BC	0,19	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
PCB	3,7	microg/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
SO_x	1320	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
Pb	24	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
Cd	2,3	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
As	2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
Cu	28	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
Ni	0,13	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 10
Dioxins/Furans	50	microg I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, Metal production, Copper production, Table 3.3, pg 13

Emission factors of particulate matter represent filterable emissions only. A condensable component is excluded.

Emissions

Copper production is a minor source of air pollutant emissions. Emissions contributed less than 0,5 % to total emissions.

Category-specific QA/QC and verification

New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for the next submission.

4.3.7 Other activities

Magnesium production: NFR Code 2C4
Nickel production: NFR Code 2C7b
Other metal production: NFR Code 2C7c

Notation Key “NO” (not occurring) was used for these sectors, since there have been no production magnesium, nickel and other metals in Slovenia. No emissions occur in these sectors.

Storage, handling and transport of metal products: NFR Code 2C7d

Emissions of this sector are included under 2C1 Iron and steel production, 2C2 Ferroalloys production, 2C3 Aluminium production, 2C5 Lead production, 2C6 Zinc production, 2C7a Copper production. Notation Key “IE” (included elsewhere) was therefore used for this sector.

4.4 Solvents and product use (2.D.3 – 2.G)

4.4.1 Description of source category

This chapter describes the methodology used for calculating air pollutant emissions from solvent and product use in Slovenia. The use of solvents and products containing solvents results in emissions of non-methane volatile organic compounds (NMVOC) which are emitted into the atmosphere. In addition to NMVOC emissions, this sector also includes the emissions of other air pollutants which are presented in Table 4.4.1.1.

The most common method of estimating NMVOC emissions is the use of emissions factors. The emissions are estimated based on the production or activity level of the source from which an emission level is calculated using existing Tier 1 or Tier 2 emission factors. The main database of emission factors is the **EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019 (GB 2019).**

According to this guidebook, emissions from the solvents and other product use are divided into ten sub-categories:
- Domestic solvent use including fungicides (NFR 2D3a),
- Road paving with asphalt (NFR 2D3b),
- Asphalt roofing (NFR 2D3c),
- Coating application (NFR 2D3d),
- Degreasing (NFR 2D3e),
- Dry-cleaning (NFR 2D3f),
- Chemical products (NFR 2D3g),
- Printing (NFR 2D3h),
- Other solvent use (NFR 2D3i), and
- Other product use (NFR 2G).

In 2021, the solvent and other product use category was the largest source of NMVOC emissions, accounting for 33.3% of the total NMVOC emissions in Slovenia. The main source is domestic solvent use including fungicides (43.9%), followed by chemical products (25.6%) and coating application (24.4%) while all other sub-categories have contributed only 6.1% of NMVOC emissions.

Table 4.4.1.1 Air pollutants and methodology used for calculation emissions from solvents and other product use in 2021

NFR	Description	Pollutants	Methods
2D3a	Domestic solvent use including fungicides	NMVOC,	Tier 2b
2D3b	Road paving with asphalt	NMVOC, PM	Tier 1 Tier 3
2D3c	Asphalt roofing	NMVOC, CO	Tier 3, Tier 1
2D3d	Coating applications	NMVOC	Tier 3
2D3e	Degreasing	NMVOC	Tier 3
2D3f	Dry cleaning	NMVOC	Tier 3
2D3g	Chemical products	NMVOC	Tier 1, Tier 3
2D3h	Printing	NMVOC	Tier 3
2D3i	Other solvent use	NMVOC, PM, PAHs	Tier 1, Tier 3 Tier 3 Tier 1
2G	Other product use	NMVOC, NOx, SOx, NH_3, PM, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, PAHs	All pollutants are calculated with Tier 1

Since 1990, NMVOC emissions have decreased by 37.4% (Figure 4.4.1.1, Table 4.4.1.2) and the largest contribution to this decrease has the decrease of NMVOC emissions from coating application by 4.9 kt NMVOC which is 66.9% decrease of emissions in this category. Two important factors, which have influenced the trend of NMVOC, are the economic situation and the environmental legislation.

Table 4.4.1.2 NMVOC emissions in kt in the period 1990-2021, a relative change of emissions in 2021 to emissions in 1990, and a share of NMVOC emissions from different sources in 2021

	1990	1995	2000	2005	2010	2015	2020	2021	Change 2021 to 1990	Share in 2021
2D3a	3.641	3.810	3.965	4.193	4.987	4.643	4.981	4.400	20.9%	43.9%
2D3b	0.012	0.019	0.028	0.024	0.029	0.025	0.030	0.033	166.7%	0.3%
2D3c	0.001	0.001	0.003	0.003	0.001	0.001	0.000	0.000	-64.3%	0.0%
2D3d	7.385	4.160	5.832	5.840	3.739	2.342	2.874	2.447	-66.9%	24.4%
2D3e	0.203	0.203	0.203	0.209	0.060	0.020	0.014	0.014	-93.3%	0.1%
2D3f	0.029	0.029	0.029	0.029	0.017	0.007	0.004	0.004	-85.3%	0.0%
2D3g	2.635	2.768	3.684	4.807	3.573	2.122	2.221	2.564	-2.7%	25.6%
2D3h	0.955	0.955	0.955	0.955	0.635	0.200	0.105	0.108	-88.7%	1.1%
2D3i	0.906	0.850	0.875	0.817	0.259	0.251	0.286	0.239	-73.6%	2.4%
2G	0.229	0.229	0.245	0.242	0.228	0.220	0.215	0.211	-7.8%	2.1%
Total	15.996	13.025	15.819	17.118	13.528	9.830	10.669	10.020	-37.4%	100.0%

In the period 1990-1993, a reduction in emissions was recorded due to the economic conditions at that time. Slovenian economy went through a variety of shocks in the late 1980s caused by the transformation of political and economic systems. The crisis was intensified by the loss of former Yugoslav markets. All these resulted in a fall in GDP, a fall in the employment rate and investments, and a high inflation rate. As early as 1993, the Slovenian economy began to revive. The successful economic development lasted until late 2008 when the global financial and economic crisis influenced the first decrease in GDP after 2nd quarter of 1993. In the last few years, the economic situation is improving. However, in 2020, due to the Covid epidemic, there were some changes in the emission trend.

In May 2004 Slovenia became a member of the EU and for this reason, has to implement all relevant EU environmental legislation. In the same year, the EU complemented the set of measures to reduce volatile organic matter emissions through Directive 2004/42/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products. The directive limits the maximum permissible content of volatile organic substances in certain paints and varnishes. Slovenia has implemented this directive with two decrees:

- Decree on limit values for atmospheric emissions of volatile organic compounds from installations using organic solvents (OJ RS, No. 35/15, 58/16, 54/21, 44/22 – ZVO-2 and 49/22) and
- Decree on the emission limit values of halogenated volatile organic compounds into the atmosphere from installations using organic solvents (OJ RS, No. 71/11, 44/22 – ZVO-2 and 49/22).

According to the VOC legislation every year all VOC obligators must prepare a solvent balance for the previous year, taking into account the input and output of solvents, not only through captured and fugitive emissions, but also the proportion of solvents in products and waste. Limit emission values are set for both captured and fugitive emissions of volatile organic substances. The operators from different activities may fulfil their obligations by collecting and purifying volatile organic substances or by implementing an approved plan to reduce emissions of volatile organic substances. Emission reduction plans for volatile organic substances usually involve the transition to the use of paints and varnishes containing a small proportion of volatile substances, as well as more careful solvent management. Since 2005, all data from solvent balance are available in **HOS (VOC) database** and used for the estimation of NMVOC emissions from solvent use. The administrator of this database is Slovenian Environmental Agency (SEA).
According to the VOC legislation companies belonging to 19 specific types of industries are required to report on amount of VOC and at the same time they have to prove, that they are following their emission reduction plan. Reporting is mandatory for all companies if the consumption of solvents exceeds the threshold, which is set for their type of production process.

Table 4.4.1.3 NMVOC emissions in kt in 2021 and emissions from the HOS database in these categories and the thresholds for reporting

NFR code	Category name	kt NMVOC	kt NMVOC from the HOS database	A share of emissions from the HOS database	The threshold for reporting according to the HOS legislation in tons of solvents
2D3d	Coating application	2.447	0.649	26.5	5-25
2D3e	Degreasing	0.014	0.014	100	1-2
2D3f	Dry cleaning	0.004	0.004	100	0
2D3g	Chemical production	2.564	0.072 0.440 0.089	17.1	15 - rubber processing 50 - pharmaceutical products 100 - varnishes and enamels
2D3h	Printing	0.108	0.108	100	15-30
2D3i	Other solvent use	0.239	0.113	47.1	5

Due to the threshold, which is set very low, all relevant producers are included in the HOS database and possible underestimations in categories from 2D3e to 2D3i are negligible.

The situation is slightly different in the category 2D3d Coating application. The main sources of NMVOC emissions in this category are decorative coating applications in households and construction, however, the following industrial coating applications are also included: manufacture of automobiles, car repairing, coil coating, boat building, woodworking and other industrial paint applications. For the period 2005-2010, emissions from coating applications are calculated as the sum of emissions from relevant industrial coating applications and from decorative coating applications. For the latter, the amount of paint was determined using the default parameter 6.7 kg paint/capita/year and a Tier 1 NMVOC emission factor. The use of the Tier 1 EF is associated with considerable uncertainty of NMVOC emissions, which probably far exceeds the possible underestimation of emissions in the HOS database. Since 2011, NMVOC emissions from coating applications have been determined from data on VOC from **the tax database**. This database contains data on the amount of VOC in the paints, varnishes and products for lacquering motor vehicles available in the country. These products cover the uses in industry and construction, as well as domestic use. All manufacturers or importers must declare the amount of VOC in these products if the annual quantity of products exceeds 150 kg. Data from the HOS database are therefore no longer relevant for determining NMVOC emissions from this category but are still used for QA/QC.

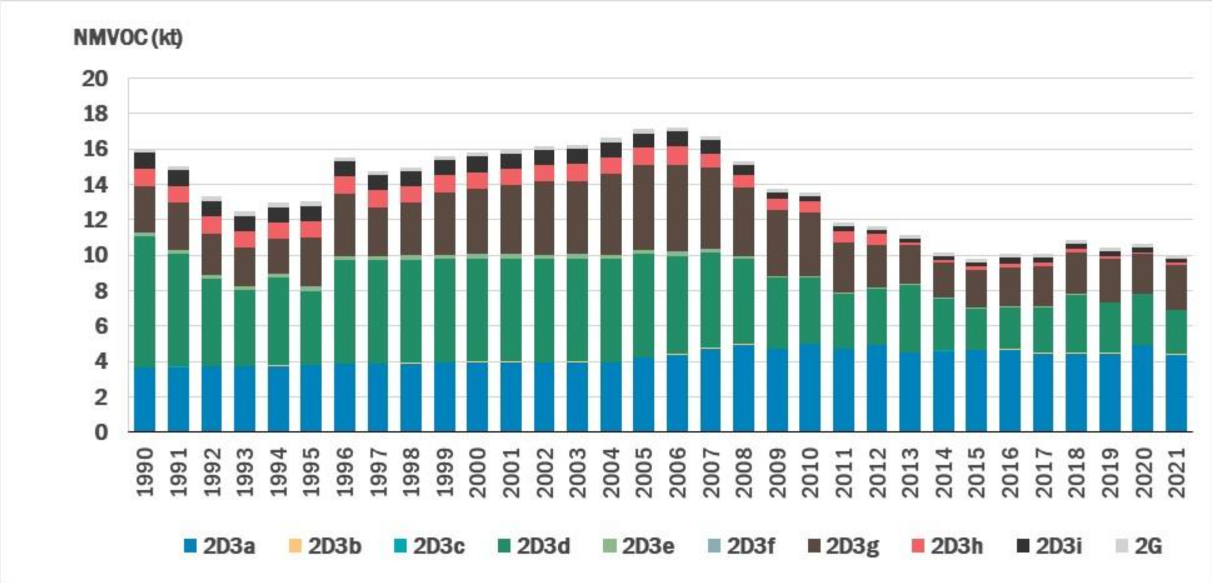

Figure 4.4.1.1 NMVOC emissions from different NFR sub-categories in kt in the period 1990-2021

Besides the HOS database, the important database that is also located at SEA is the **REMIS database.** Data in the REMIS database are obtained in compliance with Rules on initial measurements and operational monitoring of the emission of substances into the atmosphere from stationary pollution sources and on the conditions for their implementation (OJ RS, No. 105/08 and 44/22 – ZVO-2). Each year all obligators must provide a report on the implementation of emission monitoring of substances into the air. These emissions data are direct measurements of emissions into the air and reflect plant-specific emissions values. In this chapter majority of PM emissions have been taken from this source and are classified as filterable particulates. Please note that the filterable particulate also includes any material that condenses at or above the filtration temperature.

Due to the large contribution of NMVOC emissions from solvent use to total NMVOC emissions in Slovenia, the peer review of this category has been performed in late 2016. The results of the peer review and relevant recommendations from the NECD review in 2018 have been taken into account to the extent possible and many improvements have been done since then. However, there are still some improvements needed, which are more time demanding and thus are planned for future submissions. The methodology used and descriptions of recalculations are included in the chapters below under the relevant sub-category.

4.4.2 Domestic solvent use including fungicides

NFR Code 2D3a

This chapter addresses non-methane volatile organic compound (NMVOC) emissions from the use of solvent-containing products by inhabitants in their homes. NMVOCs are used in a large number of products sold for use by the public. The following product groups have been taken into consideration:

1. Cosmetics and toiletries
   Perfumes and toilet waters, Shaving preparations, Make up preparations, Manicure and pedicure preparations, Skin care preparation including sunscreens, Personal deodorants and antiperspirants, Shampoos, Hair sprays, Preparations for oral or dental hygiene

2. Household products
   Soaps, Laundry detergents, dishwashing detergents and other cleaning products, Care products for footwear, leather articles, furniture, floors, and Air fresheners

3. Car care products
   Antifreeze agents, Car waxes and polishes

4. Do it yourself (DIY)/buildings
   Adhesives, Paint thinner, paint and varnish removers, solvents, Sealants and filling agents

5. Pharmaceutical products

Emissions from the use of pesticides are included under category 2.G Other product use. This category does not include the use of decorative paints, which is covered under 2.D.3.d Coating application.

Table 4.4.2.1 NMVOC emissions in kt in the period 1990-2021 from domestic solvent use and share of different sources in 2021

	1990	2000	2005	2010	2015	2020	2021	Share in 2021
Cosmetics	**0.670**	**0.660**	**0.848**	**1.298**	**1.535**	**0.931**	**1.021**	**23.2%**
Perfumes and toilet waters	0.152	0.151	0.184	0.221	0.258	0.227	0.281	6.4%
Hair sprays	0.256	0.255	0.202	0.383	0.506	0.134	0.162	3.7%
(After) shave products	0.152	0.150	0.157	0.267	0.311	0.209	0.209	4.7%
Shampoos and dentifrices	0.007	0.007	0.005	0.005	0.005	0.005	0.005	0.1%
Deodorants / Antiperspirants	0.076	0.070	0.274	0.385	0.426	0.328	0.338	7.7%
Make-up and skin care	0.027	0.027	0.027	0.037	0.030	0.028	0.027	0.6%
Household products	**1.645**	**1.645**	**1.642**	**1.489**	**0.942**	**1.743**	**1.249**	**28.4%**
Polishes and creams	1.311	1.412	1.290	1.054	0.674	1.323	0.932	21.2%

Soap, detergents and similar	0.049	0.048	0.053	0.048	0.059	0.069	0.059	1.3%
Air fresheners	0.285	0.288	0.299	0.387	0.209	0.352	0.258	5.9%
Car care products	**0.487**	**0.824**	**0.861**	**1.339**	**1.299**	**1.326**	**1.244**	**28.3%**
Antifreeze agents	0.419	0.705	0.729	1.193	1.150	1.094	1.039	23.6%
Car waxes and polishes	0.068	0.119	0.132	0.146	0.149	0.232	0.205	4.7%
Pharmaceutical products	**0.096**	**0.096**	**0.096**	**0.098**	**0.099**	**0.101**	**0.101**	**2.3%**
Construction/DIY (adhesives)	**0.743**	**0.740**	**0.744**	**0.762**	**0.767**	**0.781**	**0.784**	**17.8%**
TOTAL	**3.670**	**3.995**	**4.217**	**5.018**	**4.670**	**4.882**	**4.400**	**100.0%**

NMVOC emissions in the period 1990-2021 from different products are presented in table 4.4.2.1. The most important sources of emissions in 2021 are household cleaning products with a share of 28.4%. The second most important sources are car care products, where the use of antifreeze agents contributed the most to emissions in the category. NMVOC emissions from domestic product use increased until the year 2010 and then started to decrease. The most relevant increase in 2020 was from household cleaning products due to the larger use of polishes and creams. It is hard to evaluate the correctness of this data at that moment. This increase could be caused by the Covid measures because people were staying at home and devoting more time to housecleaning.

In 2021 emissions from this source decreased but were still higher than before the Covid pandemic.

Methodology

When consumption data are available, emissions of NMVOC are calculated with a Tier 2b approach using the equation below:

*Emissions = Consumption * Solvent content * Emission factor*

For DIY/building and Pharmaceutical products, the activity data are not available, therefore emissions are calculated using per capita emission factors and the following equation

*Emissions = Population * Emission factor*

Activity data

All activity data have been obtained from the Statistical Office of the Republic of Slovenia (SORS).

Statistics data on the consumption of different products which are part of domestic use is not available. For this reason, the product consumption has been calculated from statistics on the sold production of domestic products and international trade data on the import and export of these products following the equation below:

Consumption = Import – Export + Sold production

Since 2000 exports and imports by 8-digit code of the Combined Nomenclature (CN) are publicly available on the SORS web page:
https://pxweb.stat.si/SiStat/en/Podrocja/Index/141/trade-and-services

Data on production in the Standard classification of activities are available but in many cases, they are in the prices unit (EUR) instead of mass unit (t). Since 2012 a lot of production data are confidential. For the inventory purpose we have obtained permission to access the production data, however, they are not included in the publicly available data on the SORS web page: https://pxweb.stat.si/SiStat/en/Podrocja/Index/167/industry

Due to the different classifications used for import, export, and production data, a linking of both data sets was not always possible. An additional error also occurred, when converting the production data in EUR to tons. Luckily in all cases, the imported amount of relevant products was much bigger than domestic production and consequently, the related error is not substantial.

For DIY/building and for Pharmaceutical products it was not possible to estimate consumption and therefore for these sources activity data was population number.

As data on import and export are available since 2000, activity data for the years before (1990-1999) have been estimated with the source-specific consumption per person in the year 2000.

Emission factors

Data on solvent content and emission factors were mostly taken from the relevant chapter of EMEP/EEA GB 2019 from Table 3.3 and Table 3.2, respectively. In cases when products are removed with water the emission factor of 3% has been used. The source for this factor is the article Release of Ethanol to the Atmosphere during Use of Consumer Cleaning Products (Wooley, 1990) and the German IIR 2019. The same emission factor has been used also in cases when the solvent-containing product was diluted in water. The values and sources for every product are available in Table 4.4.2.2.

Table 4.4.2.2 Solvent content and emission factors used for calculation of NMVOC emissions from domestic solvent use (except for DIY/buildings and Pharmaceutical products)

	Solvent content		Source: GB 2019 NFR 2.D.3.a	Emission factor		Source: GB 2019 NFR 2.D.3.a
	Value	Unit		Value	Unit	
Cosmetics						
Perfumes and toilet waters	80	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Hair sprays	90	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Shampoos	5	%	Table 3.3, pg. 11	3	%	Other sources*
Dentifrices	10	%	Table 3.3, pg. 11	3	%	Other sources*
Shaving products	80	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Deodorants / Antiperspirants	50	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Make-up and skin care	10	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Household products						
Polishes/creams for wood	45	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Metal polishes	80	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Scouring pastes/powders	80	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10
Soaps/washing preparations	5	%	Table 3.3, pg. 11	3	%	Other sources*
Air fresheners	50	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10

Car care products						
Antifreeze agents	50	%	Table 3.3, pg. 11	500	g/kg	Table 3.2, pg. 10
Car waxes and polishes	80	%	Table 3.3, pg. 11	950	g/kg	Table 3.2, pg. 10

Other sources*: John Wooley, William W. Nazaroff & Alfred T. Hodgson (1990): Release of Ethanol to the Atmosphere During Use of Consumer Cleaning Products, Journal of the Air & Waste Management Association, 40:8, 1114-1120

In the categories DIY/building and Pharmaceutical products, emissions are calculated using per capita emission factors from the relevant chapter of EMEP/EEA GB from Table 3.5 as presented in Table 4.4.2.3.

Table 4.4.2.3 Emission factors used for calculation of NMVOC emissions from DIY/buildings and Pharmaceutical products

	Value	Unit	Source: GB 2019, NFR 2.D.3.a
DIY/buildings			
Adhesives	76	g NMVOC/person	Table 3.5, pg. 15
Paint thinner	205	g NMVOC/person	Table 3.5, pg. 15
Paint and varnish removers, solvents	68	g NMVOC/person	Table 3.5, pg. 15
Sealants, filling agents	23	g NMVOC/person	Table 3.5, pg. 15
Other products			
Pharmaceutical products	48	g NMVOC/person	Table 3.5, pg. 15

Recalculations

In the present submission emissions of Hg, which were included under this category, have been excluded from the inventory, because this source is no more considered in EMEP/EEA air pollutant emission inventory guidebook due to the big uncertainty.

Future improvements

No improvements are planned for this category.

4.4.3 Road paving with asphalt

NFR Code 2D3b

Asphalt is commonly referred to as bitumen, asphalt cement, asphalt concrete or road oil and is mainly produced in petroleum refineries. Asphalt roads are a compact mixture of aggregate and an asphalt binder. Natural gravel, manufactured stone (from quarries) or by-products from metal ore refining are used as aggregates. Asphalt cement or liquefied asphalt may be used as the asphalt binder.

Methodology

To estimate emissions from the process of road paving with asphalt, the following methodology has been adopted:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
$AR_{production}$ – the activity rate for road paving with asphalt
$EF_{pollutant}$ – the emission factor for this pollutant

Activity data

Since 1998, data on asphalt production is available from the Slovenian Asphalt Pavement Association (http://www.zdruzenje-zas.si/index.php/en/production), while for the years before, SORS data have been used. In the past data from both sources were similar, but in recent years asphalt production from SORS is distinctively lower from production as reported by association; however, the later data looks much more reliable.

Emission factors

NMVOC emissions have been calculated using Tier 1 emission factors from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.3.1.

Emissions of PMs for the period 2000-2004 have been calculated using a lower value of Tier 1 emission factor from the EMEP/EEA air pollutant emission inventory guidebook 2019, as presented in Table 4.4.3.1. Since 2005 measurements of TSP from asphalt plants are available in the Remis database.

Table 4.4.3.1 Emission factors used for calculation of NMVOC and PM emissions (until 2004) from road paving with asphalt

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.b	Condensable component
NMVOC	16	g/t	Table 3.1, pg. 8	
TSP	10	g/t	Table 3.1, pg. 8. – lower value	excluded
PM_{10}	4	g/t	Table 3.1, pg. 8. – lower value	excluded
$PM_{2.5}$	1	g/t	Table 3.1, pg. 8. – lower value	excluded
BC	0.028	g/t	Table 3.1, pg. 8. – lower value	

TSP implied EF for 2005 was 8.8 g/t which is comparable with 10 g/t which is used for years before. Due to the increasing environmental standards, TSP emissions are decreasing and the calculated IEF in 2020 was 3.9 g/t.

As only TSP emissions are available from measurements, other PMs emissions have been calculated with the same ratio with TSP as for the years before 2005:

$E_{PM10} = 0.4 * E_{TSP}$, $E_{PM2.5} = 0.1 * E_{TSP}$, and $E_{BC} = 0.0028 * E_{TSP}$

Emissions of NO_x, SO_x, and CO are expected to originate mainly from combustion and are therefore reported in the category 1.A.2.g.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvement is planned for this category.

4.4.4 Asphalt roofing

NFR Code 2D3c

Asphalt felt roofing and shingle manufacture involves the saturation or coating of felt. Heated saturant and/or coating asphalt is applied through dipping and/or spraying. Key steps in the process include asphalt storage, asphalt blowing, felt saturation, coating and mineral surfacing.

Methodology

To estimate emissions from the Asphalt roofing process, the following methodology has been adopted:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
$AR_{production}$ – the activity rate for the asphalt roofing
$EF_{pollutant}$ – the emission factor for this pollutant

Activity data

There is only one plant which produces asphalt roofing products in Slovenia. They are producing asphalt felts and the production process is as follows. First, the bitumen mass is prepared, depending on the specific product. This bitumen mass is mixed in five 10 m^3 bitumen mixers, using screwed mixers. Mixing takes place at a temperature range of 150 °C to 200 °C. After the appropriate homogeneity of the bitumen mass is reached, it is pumped forward into a horizontally deposited bath, in front of which the carrier (mostly fibreglass) is prepared, winding in the bale. The carrier runs through the inflatable tub where the bitumen mass is applied to the carrier on both sides of the tape. In the end, the felt is dipped in the cooling bath filled with water.

Activity data were obtained from SORS. Data were available in m^2 and for further calculation; we have assumed that 1 m^2 of felt weight 3 kg. Since 2009 NMVOC emissions have been taken from the Remis database. In the same database, PMs are not reported as they are negligible and therefore notation key NE is used. Since 2017, emissions of CO are calculated from NMVOC emissions using the ratio between CO and NMVOC EF (9.5:46).

Emission factors

NMVOC, CO, and PM emission factors were obtained from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook, 2019**,** as presented in Table 4.4.4.1. These Tier 2 emission factors are suitable for the production process that is supposed to be in Slovenia: dip saturator, drying in drums section, wet looper, and coater.

In the 2019 GB, two options of the Tier 2 EFs are available. Tier 2 EFs from table 3.3, which are appropriate for processes where the spray is used, are identical to Tier 1 EFs. Because in the production process in Slovenia, no spray is used we have chosen Tier 2 EFs from Table 3.2 as the most appropriate one. These EFs are used until 2008. Since 2009 emissions have been taken from the Remis database

Table 4.4.4.1 Emission factor used for calculation of emissions from asphalt roofing until the year 2008

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.c
NMVOC	46	g/t shingle	Table 3.2, pg. 8

CO	9.5	g/t shingle	Table 3.2, pg. 8
$PM_{2.5}$	30	g/t shingle	Table 3.2, pg. 8
PM_{10}	150	g/t shingle	Table 3.2, pg. 8
TSP	600	g/t shingle	Table 3.2, pg. 8
BC	0.0039 (0.013% of PM2.5)	g/t shingle	Table 3.2, pg. 8

Note: There is no information in the EMEP/EEA GB 2019 whether EFs of PM include or exclude condensable components.

Recalculations

Due to the improved data in plant reports emissions of NMVOC for 2019 and 2020 have been recalculated.

Future improvements

No improvement is planned for this category.

4.4.5 Coating Application

NFR Code 2D3d

The use of paint is a major source of NMVOC emissions; they comprise more than 8% of total NMVOC emissions in the country. The use of paints is generally not considered relevant for emissions of particulate matter or heavy metals and POPs. Most paints contain an organic solvent that must be removed by evaporation after the paint is applied to the surface for the paint to dry or "cure". Unless captured and either recovered or destroyed, these solvents can be considered to be emitted into the atmosphere. Some organic solvent may be added to coatings before application, which will also be emitted. The further solvent used for cleaning coating equipment is also emitted.

The proportion of organic solvent in paints can vary considerably. Traditional solvent-borne paints contain approximately 50 % organic solvents and 5 % solids. In addition, more solvent may be added to further dilute the paint before application. High solids and waterborne paints both contain a less organic solvent, typically less than 30%, while powder coatings and solvent-free liquid coatings contain no solvent at all. NMVOC emissions, which are calculated using EF, are thus less accurate than measured emissions, which are also used in this category.

The main source of NMVOC emissions in this category is decorative coating application. It could be applied by enterprises and professional painters (SNAP activity 060103) or by private consumers (SNAP activity 060104). For inventory purposes, distinguishing between both types of uses was not possible. In this category the following industrial coating applications are also included:

Manufacture of automobiles (SNAP activity 060101)
This category refers to the coating of automobiles as part of their manufacture; it includes corrosion protection at the point of manufacture. The application of sealants as part of the manufacturing process is covered here.

Car repairing (SNAP activity 060102)
This category refers to the coating of road vehicles carried out as part of vehicle repair,

conservation or decoration outside of manufacturing sites, or any use of refinishing-type coatings where this is carried out as part of an original manufacturing process.

Coil coating (SNAP activity 060105)
This category refers to the coating of coiled steel, aluminium or copper alloy strips as a continuous process.

Boat building (SNAP activity 060106)
This category refers to all paints for the hulls, interiors and superstructures of both new and old ships and boats.

Wood (SNAP activity 060107)
Wood may be colour coated, stained or varnished and the fugitive emissions could be significant.

Other industrial paint application (SNAP activity 060108)
This category refers to all industrially applied paints for metal, plastic, paper, leather and glass substrates, which are not covered by any of the other categories described above.

Methodology

To estimate emissions from industrial coating application in the period 1990-2004 and from decorative coating application in the period 1990-2010, the following methodology has been adopted:

$$E_{pollutant} = AR_{used} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
AR_{used} – the activity rate for the use of paint
$EF_{pollutant}$ – the emission factor for this pollutant

Since 2005 NMVOC emissions from industrial sources have been taken from the HOS database and since 2011 the total NMVOC emissions in this category is determined using "the tax database".

Activity data

Activity data for NMVOC emission calculations from industrial coating applications for the period 1990 to 1996 were obtained from SORS. After the year 1996, SORS did not provide paint consumption data at all. Therefore, the emission values from the year 1996 have been used until the year 2004. Since 2005 NMVOC emissions from the HOS database have been used.

For the period 1990-2011, we used the Tier 1 approach and constant factor of 6.7 kg paint/capita/year to estimate the amount of paint used for the decorative coating application. This approach has been also recommended in the expert peer review.

Since 2010 data on the amount of VOC in different products are available. This amount has been collected for the determination of environmental tax, which is payable for paints and varnishes and products for lacquering motor vehicles (Decree on environmental tax for environmental pollution due to use of volatile organic compounds). Taxpayers are producers and acquirers from Slovenia and other EU countries or third countries if their annual quantity of acquired or produced above-mentioned products exceeds 150 kg. The tax is paid for the amount of VOC in these products and the data are available since 2010. This tax is covering all products regardless of whether they are intended for domestic use or to be used in the industry. For this reason, we have assumed that the yearly amount of VOC in these products is the same as the yearly emissions of NMVOC emissions from coating application.

To validate this assumption we have compared NMVOC emissions for 2010 using the old and the new approach and the difference was less than 3%. We have chosen the year 2010 because the amount of paint per person in the GAINS model was determined for this year. We believe that the data from the tax database are reliable and we are using them for the determination of NMVOC emissions since 2011.

Emission factors/ Emissions

Until 2010 NMVOC emissions from the decorative coating applications have been calculated using Tier 1 emission factors from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019, as presented in Table 4.4.5.1.

Table 4.4.5.1 Tier 1 NMVOC emission factor used for calculation of NMVOC emissions from coating application

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.d
NMVOC	150	g/kg paint applied (decorative)	Table 3.1, pg. 17
NMVOC	400	g/kg paint applied (industrial)	Table 3.1, pg. 17

NMVOC emission factors for industrial coating application in the period 1990 to 1996 were also obtained from EMEP/EEA air pollutant emission inventory guidebook 2019**.** Emissions of NMVOC from the year 2005 onwards have been taken from the HOS database. A detailed overview of the emission determination for each period can be found in table 4.4.5.2 below.

Table 4.4.5.2 Overview of determination of NMVOC emissions and sources of data in different periods

Coating application	1990-1996	1997-2004	2005-2010	Since 2011
Domestic	6.7 kg paint/cap * EF	6.7 kg paint/cap * EF	6.7 kg paint/cap * EF	Calculated: (Total - Industrial)
Industrial	Paint use (SORS) * EF	1996 emissions	Emissions from the HOS database	Emissions from the HOS database
Total 2D3d	sum	sum	sum	Amount of VOC from the TAX database

Source-specific recalculations

No recalculations have been performed since the last submission.

Source-specific planned improvements

The next step of improvement for this category would be a split of decorative coating applications between domestic use and paint use in construction and buildings. At that moment, we have no data and no reliable methodology to perform such a disaggregation. As this improvement would not affect the total emissions, it is not planned for the near future.

4.4.6 Degreasing

NFR Code 2D3e

Degreasing is a process for cleaning products from water-insoluble substances such as grease, fats, oils, waxes, carbon deposits, fluxes and tars. In most cases, the process is applied to metal products, but also plastic, fibreglass, printed circuit boards and other products are treated by the same process.

Activity data - emissions

Emissions of NMVOC from the year 2005 onwards have been taken from the HOS database. Emissions of NMVOC for the period 1990-2004 were determined to be the same as in 2005 since no data are available before the year 2005.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvement is planned for this category.

4.4.7 Dry Cleaning

NFR Code 2D3f

Dry cleaning can be defined as the use of chlorinated organic solvents, principally tetrachloroethene, to clean clothes and other textiles. In general, the process can be divided into four steps:

- Cleaning in a solvent bath,
- Drying with hot air and recovery of solvent,
- Deodorisation (final drying),
- Regeneration of used solvent after the clothes have been cleaned.

Activity data - Emissions

Emissions of NMVOC from the year 2005 onwards have been taken from the HOS database. Emissions of NMVOC for the period 1990-2004 were determined to be the same as in 2005 since no data are available before the year 2005.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for this category.

4.4.8 Chemical Products

NFR Code 2D3g

Emission sources of NMVOC in Slovenia are generated during the manufacturing of the following products:

- Polyvinyl chloride and other plastic (SNAP 060301-4)
- Rubber products (SNAP 060305)
- Pharmaceutical products (SNAP 060306)
- Paints (SNAP 060307)
- Inks (SNAP 060308)
- Glues (SNAP 060309)
- Leather tanning (SNAP 060313)

Methodology

To estimate emissions from chemical products, the following methodology has been adopted:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
$AR_{production}$ – the activity rate for the production
$EF_{pollutant}$ – the emission factor for this pollutant

Activity data

Polyvinyl chloride and other plastic

Statistical data distinguish between Plastics in primary forms (C20.16) and plastic products (C22.2). According to this data majority of primary plastics are further shaped in the plastic products, which means that the inclusion of this amount in the calculation will lead to double counting of emissions. For this reason emissions from plastics products (remaking of plastics) have been excluded from the inventory. This recommendation has been also included in the final report of the peer review in 2016 (Česen, 2016).

Data on the production of plastics has been obtained from SORS under a special memorandum and with an awareness that this is confidential data because the number of producers for every type of product is very limited. Data are available in tonnes for each code from NIP (National nomenclature of Industrial Products). More information on NIP is available on the SORS web page: (http://www.stat.si/StatWeb/en/Methods/Classifications). For determination of the NMVOC emissions, all types of plastics which are reported under code C20.16 Plastics in primary forms have been summed together and multiplied with Tier 1 EF of 10 g NMVOC/kg product.

Rubber products

Data on rubber products for the period 1990-2004 have been obtained from the SORS. Under this category, all rubber production is included. In this category, the majority of products are car tires, therefore the Tier 2 EF for the manufacture of tires has been used, while since 2005 emissions from the HOS database have been used.

Pharmaceutical products

Emissions from pharmaceutical products are included in the inventory; data since 2005 has been taken from the HOS database.

Paints, Inks, and Glues

Data on production were obtained from SORS for all years and NMVOC emissions are calculated using Tier 2 EF.

Leather tanning

Emissions from leather tanning are included in the inventory; data since 2005 has been taken from the HOS database. Since 2009 there is no more Leather tanning industry in Slovenia. The leather industry of Vrhnika (IUV) was the largest European leather factory. However, in December 2008, the company announced bankruptcy due to several unfavourable circumstances linked to the global financial crisis and domestic economic and political dynamics.

Emissions from other chemical products are not occurring in the country. There is no asphalt-blowing process in Slovenia. We have no oil refinery, and this process is not used in the asphalt processing or asphalt roofing plants in Slovenia. A total amount of the air-blown bitumen which is used in the production of asphalt roofing products is imported.

Emission factors/ Emissions

NMVOC emissions from the production of chemical products have been calculated using Tier 1 and Tier 2 emission factors from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.8.1.

Table 4.4.8.1 Emission factors used for calculation of NMVOC emissions from chemical products

	Unit	Value	Source: GB 2019, NFR 2.D.3.g
Plastics	kg/t	10	Table 3.1 (Tier 1)
Rubber products	kg/t	10	Table 3.6 (Tier 2)
Oil paints and inks	kg/t	11	Table 3.11 (Tier 2)
Glue	kg/t	11	Table 3.11 (Tier 2)

Since 2005 emissions of NMVOC from paints and rubber processing have been taken from the HOS database.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

According to the 2019 EEA/EMEP GB, only four plastic processing have to be included in the inventory: Polyester- PE, Polyvinylchloride - PVC, Polyurethane foam - PUR and Polystyrene foam - PS. In statistical data, only the production of PE and PUR is available, while data on PS and PVC are not available. There is also no Tier 2 EF for PVC production in the 2019 EMEP/EEA GB while Tier 2 EF for PE production is available for the amount of monomer used and not for PE produced. For all these reasons we didn't use Tier 2 EFs for the present submission. In further investigation, we have found out that CO_2 has been used as a blowing agent for PUR production since 1994 in one plant. On the other hand despite data on PS production are not available from the SORS there are three PS foam producers in Slovenia.

The expert in peer review recommended that measurements of NMVOC (total organic o-toluidine) from relevant processes are the best option to estimate emissions from these sources. NMVOC emissions from these plants are available since 2009. In 2016 emissions from these plants were only 0.078 kt, while emissions from the production of plastics calculated with AD (Plastics in primary forms) * Tier 1 EF was 1.45 kt. The emissions for the other years have not been obtained, yet.

For future submissions, we will investigate the possibility to use data on NMVOC (total organic o-toluidine) emissions from the Remis database since 2009 for relevant plastics production processes and asses the implementation of this methodology.

4.4.9 Printing

NFR Code 2D3h

Printing involves the use of inks, which may contain a proportion of organic solvents. These inks may then be subsequently diluted before use. Different inks have different proportions of organic solvents and require dilution to different extents. Printing can also require the use of cleaning solvents and organic dampeners, Ink solvents, diluents, cleaners and dampeners.

There is a strong decreasing trend of NMVOC emissions from printing with two sharp drops in 2007 and 2012. The first one is connected to the implementation of the VOC directive, while the second one is influenced by the decline in printed media and the increasing use of cleaning devices.

Activity data

Activity data for NMVOC emission calculations from the year 1990 to 1996 were obtained from SORS. After the year 1996, SORS did not provide paint consumption data at all. Therefore, the same NMVOC emission as in the year 1996 have been used until 2004. Since 2005, NMVOC emissions from the HOS database have been applied.

Emission factors/ Emissions

NMVOC emission factors for the period 1990 to 1996 were obtained from CORINAIR INVENTORY Default Emission Factors Handbook (second edition), 1992, (EF NMVOC, 200 kg/t).

Since 2005, all plants in the industry and private sector, which use paint and varnish or other solvents, are obliged to report their emissions annually and Slovenia considers that their data cover more than 97 % of all emissions from printing industries. For this reason, emissions of NMVOC from the year 2005 onwards have been taken from the HOS database.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for this category.

4.4.10 Other solvent and product use

NFR Codes 2D3i and 2G

Emission sources covered in this chapter can be divided into two sub-categories:
Sources of emissions from 2D3i other solvent use are:

- Mineral wool production (060402),
- Fat, edible and not edible oil extraction (060404),
- Application of glues and adhesives (060405),
- Preservation of wood (060406),

While in category 3.G other products use emissions from the following product use have been included:

- Use of fireworks (060601),
- Use of tobacco (060602),
- Use of shoes (060603),
- Other (060604) – Use of pesticides. Aeroplane de-icing.

Emissions from glass wool production (060401) are included in the category 2A3 Glass production. Emissions from the asphalt blowing do not occur in the country.

Emissions of underseal treatment and conservation of vehicles as well as vehicle dewaxing have been not estimated due to the unavailability of activity data. The expert judgement from the peer review is that emissions from this source in Slovenia are negligible.

Mineral wool production

To estimate emissions from mineral wool production the following methodology has been adopted:

$E_{pollutant} = AR_{\text{production}} \times EF_{pollutant}$

$E_{\text{pollutant}}$ – the emission of the specified pollutant

$AR_{\text{production}}$ – the activity rate for the mineral wool production

$EF_{\text{pollutant}}$ – the emission factor for this pollutant

Activity data

Activity data on the annual production of mineral wool, obtained from SORS, are confidential.

Emission factors/ Emissions

NMVOC emissions from the mineral wool production have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.10.1.

Table 4.1.10.1 Emission factor used for calculation of NMVOC emissions from Mineral wool production

Pollutant	EF	Unit	Source: GB 2019, NFR 2.D.3.i, 2.G
NMVOC	300	g/t	Table 3.3

Fat, edible and not edible oil extraction and Application of glues and adhesives

Emissions of NMVOC from Fat, edible and not edible oil extraction and Application of glues and adhesives from the year 2005 onwards have been taken from the HOS database.

In addition, PM emissions from the grain handling process in oil production have been included. Since 2005, emissions of TSP have been taken from the Remis database, while for the period 2000 to 2004 the 2005 value has been used.

Only emissions of TSP are available from measurements. Thus other PM emissions have been calculated with the same ratio as TSP as presented in Table 3.4 in EMEP/EEA air pollutant emission inventory guidebook 2019, 2D3i, 2G Other solvent and product use:

$E_{PM10} = 0.9/1.1 * E_{TSP}$, $E_{PM2.5} = 0.6/1.1 * E_{TSP}$, and BC emissions are not estimated (NE).

Preservation of wood

To protect wood against wood decay fungi and insects and also against weathering, wood preservatives that fully penetrate the wood, need to be applied. In practice, wood preservatives are applied only by brushing. There are three main types of preservatives: creosote, organic solvent-based (often referred to as 'light organic solvent-based preservatives) and water-borne. Creosote is oil prepared from coal tar distillation. Creosote contains a high proportion of aromatic compounds such as polycyclic aromatic hydrocarbons (PAHs). Levels of benzo(a)pyrene in some types of creosote are restricted in the EU to 500 ppm as well in Slovenia for industrial use (14th amendment to the Marketing and Use Directive — Creosote (96/60/EEC)).

To estimate emissions from the preservation of wood the following methodology has been adopted:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
$AR_{production}$ – the activity rate for the production
$EF_{pollutant}$ – the emission factor for this pollutant

Activity data

In the past activity data (consumption of creosote oil) was obtained from a wood-impregnating plant on a personal agreement, while since 2010 the SORS data on import of creosote oil has been used.

Emission factors

NMVOC and PAH emissions from the preservation of wood have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019 for creosote preservative type**,** as presented in Table 4.4.10.2.

Table 4.4.10.2 Tier 2 emission factors used for calculation of NMVOC and PAH emissions from wood preservation

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.i, 2.G
NMVOC	105	kg/t	Table 3-5
Benzo(a)pyrene	1.05	g/t	Table 3-5
Benzo(b)fluoranthene	0.53	g/t	Table 3-5
Benzo(k)fluoranthene	0.53	g/t	Table 3-5
Indeno(1,2,3-cd)pyrene	0.53	g/t	Table 3-5

Use of fireworks

Activity data

The quantity of fireworks in Slovenia (Table 4.4.10.3) is estimated by the import and export data (CN codes 36041000 and 36049000) available from Eurostat Database and since 2016 the consumption has been calculated from the import and export data obtained from SORS. There is no production of fireworks in Slovenia. Data regarding import and export are not available for the years 1990-1998 and emissions for this period are estimated to be similar to those in 1999.

Table 4.4.10.3 Activity data for fireworks

Year	Fireworks (t)	Year	Fireworks (t)
1990-1998	250.0	**2010**	628.8
1999	243.0	**2011**	456.1
2000	203.8	**2012**	720.7
2001	265.8	**2013**	307.8
2002	317.1	**2014**	183.0
2003	407.7	**2015**	467.8
2004	493.8	**2016**	442.6
2005	926.0	**2017**	290.8
2006	629.6	**2018**	800.1
2007	464.2	**2019**	310.7
2008	773.4	**2020**	14.9
2009	181.3	**2021**	263.6

Emission factors

Air pollutant emissions from the use of fireworks have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.10.4.

Table 4.4.10.4 Emission factors used for calculating pollutant emissions from the use of fireworks

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.i, 2.G
SOx	3,020	g/t	Table 3-14
NOx	260	g/t	Table 3-14
CO	7,150	g/t	Table 3-14
TSP	109,830	g/t	Table 3-14
PM10	99,920	g/t	Table 3-14
PM2.5	51,940	g/t	Table 3-14
As	1.33	g/t	Table 3-14
Cd	1.48	g/t	Table 3-14
Cr	15.6	g/t	Table 3-14
Cu	444	g/t	Table 3-14
Hg	0.057	g/t	Table 3-14
Ni	30	g/t	Table 3-14
Pb	784	g/t	Table 3-14
Zn	260	g/t	Table 3-14

Note: There is no information in the EMEP/EEA GB 2019, on whether EF of PM includes or exclude condensable component.

Tobacco combustion

Activity data

The quantity of tobacco combusted in Slovenia (Table 4.4.10.5) has been taken from the WHO study Tobacco taxation policy in Slovenia and since 2016 the consumption has been calculated from the import and export data obtained from SORS. There is no tobacco industry in the country.

Table 4.4.10.5 Use of tobacco in tons.

Year	Tobacco (t)	Year	Tobacco (t)
1990-2001	3,750.0	**2012**	3,900.0
2002	3,600.0	**2013**	3,975.0
2003	3,487.5	**2014**	4,077.4
2004	3,375.0	**2015**	3,832.7
2005	3,412.5	**2016**	3,722.7
2006	3,675.0	**2017**	4,368.0
2007	3,450.0	**2018**	4,238.6
2008	3,750.0	**2019**	3,771.2
2009	3,900.0	**2020**	4,058.7
2010	3.750.0	**2021**	3.545.8
2011	3,825.0	**2022**	

Emission factors

Air pollutant emissions from tobacco combustion have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.10.6.

Table 4.4.10.6 Emission factors used for calculating pollutant emissions from tobacco combustion

Pollutant	Value	Unit	Source: GB 2017, NFR 2.D.3.i, 2.G
NMVOC	4.84	kg/t tobacco	Table 3-15
NOx	1.80	kg/t tobacco	Table 3-15
CO	55.1	kg/t tobacco	Table 3-15
NH3	4.15	kg/t tobacco	Table 3-15
TSP	27.0	kg/t tobacco	Table 3-15
PM10	27.0	kg/t tobacco	Table 3-15
PM2.5	27.0	kg/t tobacco	Table 3-15
BC	0.45	% of PM1.8	Table 3-15
PCDD/F	0.1	μg I-TEQ/t tobacco	Table 3-15
Benzo(a)pyrene	0.111	g/t tobacco	Table 3-15
Benzo(b)fluoranthene	0.045	g/t tobacco	Table 3-15
Benzo(k)fluoranthene	0.045	g/t tobacco	Table 3-15
Indeno(1,2,3-cd)pyrene	0.045	g/t tobacco	Table 3-15
Cd	5.4	g/t tobacco	Table 3-15
Ni	2.7	g/t tobacco	Table 3-15
Zn	2.7	g/t tobacco	Table 3-15
Cu	5.4	g/t tobacco	Table 3-15

Note: There is no information in the EMEP/EEA GB 2019 whether EF of PM includes or exclude condensable component.

Use of shoes

Activity data

It is not clear from the guidebook what should be used as activity data for use of shoes; are these all pairs of shoes, bought in one year or all pairs of shoes used in one year? We decided to use population numbers as no one can use more than one pair of shoes at a time.

Emission factors

NMVOC emissions from the use of shoes have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.10.7.

Table 4.4.10.7 Emission factors used for calculating NMVOC emissions from the use of shoes

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.i, 2.G
NMVOC	60	g/pair	Table 3-16

Other - Airplane de-icing

Activity data

Activity data on the use of de-icing agents since 2009 has been obtained from the Airport Ljubljana while the data for the years before was estimated taking into account the number of flights and climate conditions. Since 2009 de-icing agents used were Kilfrost DF Plus (Type I) and Kilfrost ABC-S Plus (Type IV). The amount of de-icing agents used since 1990 is available in Table 4.4.10.8.

Table 4.4.10.8 Amount of de-icing agent used in tons

Year	De-icing agent (t)	Year	De-icing agent (t)	Year	De-icing agent (t)
1990	65.012	**2001**	116.200	**2012**	148.930
1991	35.176	**2002**	114.284	**2013**	128.187
1992	35.444	**2003**	126.948	**2014**	78.674
1993	51.592	**2004**	142.008	**2015**	93.996
1994	63.284	**2005**	151.068	**2016**	92.761
1995	71.472	**2006**	163.964	**2017**	160.636
1996	72.760	**2007**	186.068	**2018**	160.840
1997	81.116	**2008**	191.704	**2019**	84.256
1998	102.892	**2009**	189.663	**2020**	24.314
1999	108.876	**2010**	167.864	**2021**	58.736
2000	119.860	**2011**	116.081		

Emission factors

NMVOC emissions from the use of de-icing agents have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.10.9.

Table 4.4.10.9 Emission factors for calculating NMVOC emissions from the aeroplane de-icing

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.i, 2.G
NMVOC	53,000	g/t	Table 3-13

Other - use of pesticides

Activity data

Activity data on pesticides used in the country has been obtained from the SORS and is available in Table 4.4.10.10.

Table 4.4.10.10 Amount of pesticides used in tons

Year	Pesticides (t)	Year	Pesticides (t)	Year	Pesticides (t)
1990-1997	1,267.143	**2006**	1,280.980	**2015**	1,046.822
1998	1,115.851	**2007**	1,155.221	**2016**	1,156.192
1999	1,605.972	**2008**	1,218.151	**2017**	1,087.286
2000	1,468.110	**2009**	1,162.873	**2018**	1,171.820
2001	1,398.268	**2010**	1,134.370	**2019**	999.920
2002	1,164.089	**2011**	1,121.873	**2020**	992.792
2003	1,361.003	**2012**	1,016.069	**2021**	932.291
2004	1,557.980	**2013**	917.483		
2005	1,313.967	**2014**	1,009.912		

Emission factors

NMVOC emissions from the use of pesticides have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.4.10.11.

Table 4.4.10.11 Emission factors used for calculating NMVOC emissions from the use of pesticides

Pollutant	Value	Unit	Source: GB 2019, NFR 2.D.3.i, 2.G
NMVOC	69,000	g/t	Table 3-17

Recalculations

All relevant emissions (SO_2, CO, NO_x, TSP, PM10, $PM_{2.5}$, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn) since 2010 have been recalculated due to the improved data on fireworks use, which were obtained from national statistics and due to the use of a more-years average when yearly data on import was too low or too high. Special circumstances like the Covid epidemic were also taking into account. In addition emissions of NMVOC and PAHs have been recalculated since 2010 due to the improved data on creosote oil, which were obtained from national statistics instead from a plant.

Future improvements

No improvements are planned for this category.

4.5 Other industry production (2. H)

Emission sources covered in this chapter are:
2H1 Pulp and paper industry
2H2 Food and beverages industry

No other relevant industrial production has occurred in Slovenia and notation key NO has been used for category 2H3.

4.5.1 Pulp and paper industry

NFR Code 2H1

Paper is essentially a sheet of cellulose fibres with many added constituents to affect the quality of the sheet and its fitness for intended end use. The pulp for papermaking may be produced from virgin fibre by chemical or mechanical means or by the re-pulping of recovered paper. In the pulping process, the raw cellulose-bearing material is broken down into its fibres. Wood is the main raw material but straw, hemp, grass, cotton and other cellulose-bearing materials can be used as well. The precise composition of the wood will vary according to the type and species but the most important constituents are cellulose, hemicelluloses and lignin. In Slovenia, there were five pulp and paper plants and some of them were closed for operation for some years.

Methodology

To estimate emissions from pulp and paper, the following methodology has been adopted:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
$AR_{production}$ – the activity rate for the production
$EF_{pollutant}$ – the emission factor for this pollutant

Activity data

Activity data on pulp production until 2005 were obtained from SORS, while since then the measurements of emissions have been used.

Emission factors

For calculating air pollutant emissions from pulp and paper until 2005 we have used Tier 2 EFs from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.5.1.1. These EFs are suitable for the Kraft pulping process, which was abolished in 2006 and since then the pulp is produced with a process called thermo-mechanical pulp production, while for bleaching a sulphite or peroxide has been used. No emission factors are available for this type of production in the EMEP/EEA GB 2019, hence since 2006, NMVOC emissions are taken from the Remis database as a sum of emissions of TOC from five pulp and paper producers, while for other pollutants notation keys NA or NE are used.

Table 4.5.1.1 Emission factors used for calculation of emissions from pulp and paper 1990-2005

Pollutant	Value	Unit	Source: GB 2019, NFR 2.H.1
NO_x	1.0	kg/t	Table 3-2
CO	5.5	kg/t	Table 3-2
NMVOC	2.0	kg/t	Table 3-2

SO_x	2,0	kg/t	Table 3-2
$PM_{2.5}$	0.6	kg/t	Table 3-2
PM_{10}	0.8	kg/t	Table 3-2
TSP	1.0	kg/t	Table 3-2
BC	0.0156	kg/t	Table 3-2

Note: There is no information in the EMEP/EEA GB 2019 whether EFs of PM include or exclude condensable components.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for this category.

4.5.2 Food and beverages industry

NFR Code 2H2

Food manufacturing may involve the heating of fats and oils and foodstuffs containing them, the baking of cereals, flour and beans, fermentation in the making of bread, the cooking of vegetables and meats, and the drying of residues. These processes may occur in sources varying in size from domestic households to manufacturing plants. When making any alcoholic beverage, sugar is converted into ethanol by yeast. This is fermentation. The sugar comes from fruit, cereals or other vegetables. These materials may need to be processed before fermentation. To make spirits, the fermented liquid is then distilled. Alcoholic beverages, particularly spirits and wine, may be stored for several years before consumption.

Emissions may occur during any of the four stages, which may be needed in the production of an alcoholic beverage. During the preparation of the feedstock, the most important emissions appear to occur during the roasting of cereals and the drying of solid residues. During fermentation, alcohol and other NMVOCs are carried out with carbon dioxide as it escapes to the atmosphere. In some cases, the carbon dioxide may be recovered, reducing the emission of NMVOC as a result.

Methodology

To estimate emissions from food and drink, the following methodology has been adopted:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
$AR_{production}$ – the activity rate for the production
$EF_{pollutant}$ – the emission factor for this pollutant

Activity data

Activity data for emission calculations were obtained from SORS.

The relevant activity statistics are based on the national production figures including:

- Production of bread, cakes and biscuits,

- Processed meat, fish, and poultry,
- Sugar production (until 2004),
- Production of margarine and solid cooking fats,
- Production of animal feed,
- Production of coffee,
- Production of wine (distinguish between red and white),
- Total production of beer,
- Total production of spirits (other than Whisky and Brandy).

Emission factors/ Emissions

NMVOC emissions from the food and beverage industry have been calculated using the Tier 2 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.5.2.1.

Table 4.5.2.1 Emission factors used for calculation of NMVOC emissions from food and drink

	Value	Unit	Source: GB 2019, NFR 2.H.2
Bread	4.5	kg/t	Table 3-11 - Bread (typical) Europe
Cakes and biscuits	1	kg/t	Table 3-18
Meat, fish, and poultry	0.3	kg/t	Table 3-19
Sugar	10	kg/t	Table 3-20
Margarine	10	kg/t	Table 3-21
Animal feed	1	kg/t	Table 3-22
Coffee roasting	0.55	kg/t	Table 3-23
Wine - red	0.08	kg/hl	Table 3-25
Wine - white	0.035	kg/hl	Table 3-26
Beer	0.035	kg/hl	Table 3-27
Spirits	0.4	kg/hl alcohol	Table 3-32 – other spirits

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for this category.

4.6 Other production and consumption (NFR 2.I – 2.L)

Emission sources covered in these chapters are:
2I Wood processing
2K Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)

Emissions from 2J Production of POPs and 2L Other production, consumption, storage, transportation or handling of bulk products do not occur in Slovenia and notation key NO has been used.

4.6.1 Wood processing

NFR Code 2I

The present chapter addresses emissions of dust from the processing of wood. This includes the manufacture of plywood, reconstituted wood products and engineered wood products. This source category is important for particulate emissions only.

Activity data - emissions

Emissions of TSP from wood products have been taken from the REMIS database, while emissions of other PM are not estimated.

Recalculations

No recalculations have been performed since the last submission.

Future improvements

No improvements are planned for this category.

4.6.2 Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)

NFR Code 2K

Production of electrical equipment containing PCB (transformers and capacitors) in Slovenia was terminated in January 1985. A study "A Concept of Handling the PCB/PCT in Slovenia" was made in 1999. PCB-containing equipment has to be registered with the Slovenian environment Agency - a competent authority. It is also obligatory for the proprietors/owners of the PCB equipment to report to the competent authority, whether, when and how the PCB equipment was disposed of and where it was sent according to the principles of shipment of hazardous waste.
Electrical equipment, containing PCB in Slovenia:

- capacitor
- transformer

Methodology

To estimate emissions from the consumption of POPs, the following methodology has been adopted:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

$E_{pollutant}$ – the emission of the specified pollutant
$AR_{production}$ – the activity rate for the production
$EF_{pollutant}$ – the emission factor for this pollutant

Activity data

Activity data for PCB emission calculations are obtained from Slovenian Environment Agency, Waste sector.

Emission factors

PCB emissions from the electrical equipment have been calculated using the Tier 3 emission factor from the relevant chapter of the EMEP/EEA air pollutant emission inventory guidebook 2019**,** as presented in Table 4.6.2.1.

Table 4.6.2.1 Emission factors used for calculation of PCB emissions from Consumption of POPs and heavy metals – electrical equipment

	Value	Unit	Source: GB 2019, NFR 2.K
Capacitor	1.6	kg/t	Table 3.4
Transformer	0.06	kg/t	Table 3.4

Recalculations

No recalculations have been performed in this category.

Future improvements

No improvements are planned for this category.

5 AGRICULTURE

This chapter considers the emissions from manure management, application of inorganic N-fertilizers, animal manure and sewage sludge applied to soils, urine and dung deposited by grazing animals and farm-level agricultural operations including storage, handling and transport of agricultural products.

5.1 Manure management (3. B)

Sectors covered in this chapter are:

NFR Codes:

3B1a	Manure management - Dairy cattle
3B1b	Manure management - Non-dairy cattle
3B2	Manure management - Sheep
3B3	Manure management - Swine
3B4d	Manure management - Goats
3B4e	Manure management - Horses
3B4gi	Manure management - Laying hens
3B4gii	Manure management - Broilers
3B4giii	Manure management - Turkeys
3B4giv	Manure management - Other poultry
3B4h	Manure management - Other animals

Introduction

Ammonia (NH_3) emissions which arise from excreta of farm animals are by far the most important source of ammonia emissions in Slovenia. It contributes 43 % of total emissions. High emissions are not only due to high emission factors, which are characteristic for animal production, but also due to specific structure of Slovenian agriculture. As a consequence of fact that about two thirds of utilized agricultural area is covered by grasslands, relatively high animal population, especially cattle, is maintained. Excreta of farm animals contribute also to emissions of nitric oxides (NO_x), non-methane volatile organic compounds (NMVOC) and particulate matter ($PM_{2.5}$, PM_{10}, TSP). They contributed 0,4 %, 13 %, 1 %, 2 % and 5 % of total NO_x, NMVOCs, $PM_{2.5}$, PM_{10} and TSP emissions, respectively.

This chapter considers the emissions of ammonia, nitric oxide, NMVOCs and particulate matter from animal housing and manure storage. Description of calculation procedure for emissions from anaerobic digestion of animal manures at biogas facilities and emissions due to application of manures and grazing animals is also a part of this chapter. However, emissions due to grazing and application of animal manures are reported under Crop production and agricultural soils chapter (NRF sector 3D) while emissions from anaerobic digestion of animal manures at biogas facilities are reported under the Biological treatment of waste (NFR sector 5.B.2).

Ammonia and nitric oxide

Methodology

The detailed (Tier 2) approach suggested by EMEP/EEA air pollutant emission inventory guidebook 2019 was used to assess the emissions of ammonia and nitric oxide. The methodology is based on principles of total ammonia nitrogen (TAN) fluxes through the manure management system. The model starts out with TAN excretions followed by emissions of NH_3, N_2O, NO and N_2 from animal housing and manure stores. It was taken into account that only the nitrogen that was not lost from animal houses and manure stores is retained in animal manures. Therefore, emissions at each stage depend on the extent of emissions during the preceding stages. In case of slurry based systems mineralization of non -TAN N was taken into account and in the case of farmyard manure it was taken into account that a part of TAN is immobilised into organic matter.

Emissions of nitrogen compounds from digestion of animal manures at anaerobic digesters were also calculated in frame of general nitrogen flow (described above). These emissions are reported under NFR 5.B.2 (Biological treatment of waste – anaerobic digestion at biogas facilities). At a certain stage, i.e. after deduction of N losses from the animal houses, the nitrogen flow is diverted to biogas plants, where the emissions are calculated according to the EMEP / EEA 2019 methodology for biological treatment of waste (Chapter 5.B.2). Thereafter, the digestate is redirected again to the agricultural model, where emissions from fertilization are calculated. It means that the concept of mass-flow approach, including the information of TAN content of digestate, is retained. It should be emphasized that only emissions from livestock manure are estimated under this methodology. All emission factors, including those for emission from anaerobic digesters, are presented in Tables 5.1.7 and 5.1.9.

Activity data

The majority of activity data were obtained from the Statistical Office of the Republic of Slovenia (SORS). Data from 1991 are available on the SI-STAT data portal, under Environment and natural resources:
http://pxweb.stat.si/pxweb/Database/Environment/Environment.asp.
Data include the number of cattle, pigs, sheep, goats, horses, poultry and rabbits as well as average milk production per cow. Data for 1990 were obtained from old printed version of statistical yearbook. Data for some sub-categories of domestic animal species are missing for the certain years before the year 2000. Animals were distributed to these sub-categories based on the proportions in nearest years for which the data are available. For the rabbits no information on their number is available before the year 1997. Rounded value for 1997 was used for this period. There is also no information on the numbers of turkeys, ducks and geese for the period before 2000. These animals were treated in the frame of broilers for this period.

Table 5.1.1 Number of farm animals in thousands

Animal category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cattle - total	**532,9**	**483,9**	**503,8**	**477,5**	**477,4**	**495,5**	**486,2**	**445,7**	**453,1**
Dairy cows	225,3	205,7	213,0	203,7	197,4	197,1	154,7	147,6	146,5
Suckling cows	0,0	5,0	6,0	8,0	10,0	15,2	32,0	35,0	34,7
Other cattle	307,6	273,2	284,8	265,9	270,0	283,2	299,5	263,1	271,9
Pigs - total	**587,8**	**529,0**	**601,8**	**591,5**	**570,8**	**592,0**	**552,3**	**578,2**	**592,4**
Sows	57,7	51,9	55,5	55,1	55,9	56,2	47,9	52,8	52,2
Other breeding pigs*	10,7	9,3	10,6	10,4	9,9	9,9	10,2	11,6	10,1
Piglets	134,1	136,5	165,9	161,2	161,6	178,4	159,0	170,3	174,8
Fattening pigs**	453,7	392,6	436,0	430,3	409,2	413,6	393,3	407,9	417,6
Small ruminants	**30,2**	**38,5**	**32,0**	**37,2**	**39,8**	**51,1**	**55,8**	**65,8**	**89,2**
Sheep - total	20,3	28,5	22,0	26,6	29,1	39,1	43,2	51,9	72,4
Ewes	11,6	12,7	13,5	15,9	19,6	23,1	28,1	32,8	46,0
Other sheep	2,7	9,1	1,4	1,8	1,6	2,7	2,6	3,2	4,2
Lambs	6,0	6,7	7,1	8,9	7,9	13,3	12,5	15,9	22,2
Goats	10,0	10,0	9,9	10,6	10,7	11,9	12,6	13,9	16,8
Breeding female goats	6,7	6,7	6,7	6,9	7,8	8,3	9,5	10,2	11,4
Other goats	1,3	1,3	1,3	1,5	1,2	1,5	1,3	1,5	1,9
Kids	2,0	2,0	2,0	2,2	1,8	2,2	1,9	2,2	3,5
Horses	**10,4**	**10,8**	**8,9**	**8,5**	**8,1**	**8,0**	**8,5**	**9,9**	**12,1**
Poultry - total	**9753,2**	**10034,4**	**8734,0**	**6192,0**	**5794,0**	**4920,0**	**5573,0**	**7057,6**	**6407,1**

Laying hens	2340,5	2440,3	2323,0	1858,0	1840,0	1653,0	1615,0	1773,0	1695,2
Broilers	7412,7	7594,0	6411,0	4334,0	3954,0	3267,0	3958,0	5284,6	4711,9
Other chickens	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Turkeys	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Geese	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ducks	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Other poultry	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rabbits-total	**181,0**	**181,0**	**181,0**	**181,0**	**181,0**	**181,0**	**181,0**	**181,0**	**180,8**
Does	31,0	31,0	31,0	31,0	31,0	31,0	31,0	31,0	29,9
Other rabbits	150,0	150,0	150,0	150,0	150,0	150,0	150,0	150,0	150,8

* Boars, gilts not yet covered
** Including young breeding pigs

(continued)

Animal category	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cattle - total	**471,4**	**493,7**	**477,1**	**473,2**	**450,2**	**451,1**	**452,5**	**454,0**	**479,6**
Dairy cows	149,1	140,2	135,8	140,0	130,7	134,0	120,3	112,5	116,4
Suckling cows	36,5	53,9	52,8	55,0	55,2	48,1	57,0	60,5	61,2
Other cattle	285,8	299,5	288,5	278,3	264,4	269,1	275,3	281,0	301,9
Pigs - total	**558,5**	**603,6**	**599,9**	**655,7**	**620,5**	**534,0**	**547,4**	**575,1**	**542,6**
Sows	51,2	57,0	55,6	57,6	55,8	47,3	47,3	48,0	42,1
Other breeding pigs*	8,8	10,5	10,5	8,2	8,5	6,9	7,2	5,7	6,4
Piglets	161,8	178,3	181,2	179,0	182,2	158,0	159,4	161,6	154,0
Fattening pigs**	396,6	425,3	418,7	476,6	438,4	376,0	388,1	413,5	388,6
Small ruminants	**87,2**	**118,3**	**114,0**	**129,4**	**129,0**	**142,3**	**154,8**	**159,3**	**159,4**
Sheep - total	72,5	96,2	94,1	107,4	105,7	119,3	129,4	131,5	131,2
Ewes	50,8	66,3	66,0	75,9	72,1	84,4	89,7	89,1	90,8
Other sheep	3,4	5,3	5,1	5,3	4,9	5,3	5,5	6,2	6,2
Lambs	18,3	24,6	22,9	26,2	28,7	29,6	34,1	36,2	34,2
Goats	14,6	22,0	19,9	22,0	23,3	23,0	25,5	27,8	28,2
Breeding female goats	11,4	16,1	14,8	16,7	17,0	16,1	17,8	20,2	19,0
Other goats	1,3	2,4	2,3	2,1	2,1	2,1	2,4	2,7	2,6
Kids	1,9	3,6	2,8	3,1	4,2	4,9	5,3	4,9	6,6
Horses	**14,3**	**14,4**	**15,2**	**16,1**	**16,9**	**16,9**	**19,2**	**19,2**	**19,6**
Poultry - total	**5756,5**	**5105,9**	**5216,7**	**5265,7**	**4533,7**	**3268,0**	**3176,9**	**3056,7**	**4558,8**
Laying hens	1617,3	1539,5	1404,6	1401,1	1248,6	999,6	1085,3	1119,7	1338,4
Broilers	4139,2	2759,9	2879,9	2919,8	2523,8	1753,6	1598,5	1566,7	2837,4
Other chickens	0,0	483,0	589,4	446,4	503,7	336,5	312,1	232,4	177,9
Turkeys	0,0	252,1	251,0	417,3	209,3	130,2	135,4	110,1	158,0
Geese	0,0	2,5	4,0	3,3	3,1	3,5	3,4	1,9	2,6
Ducks	0,0	14,9	17,6	23,7	20,2	20,0	14,3	12,5	13,7
Other poultry	0,0	54,0	70,1	54,2	25,0	24,7	28,0	13,3	30,7
Rabbits-total	**180,5**	**180,3**	**166,5**	**152,7**	**139,0**	**134,5**	**130,1**	**122,8**	**115,6**
Does	28,8	27,7	27,0	26,3	25,6	24,7	23,8	23,0	22,2
Other rabbits	151,7	152,5	139,5	126,4	113,3	109,8	106,3	99,8	93,4

* Boars, gilts not yet covered
** Including young breeding pigs

(continued)

Animal category	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cattle - total	**470,0**	**472,9**	**470,2**	**462,3**	**460,1**	**460,6**	**468,3**	**484,2**	**488,6**
Dairy cows	113,4	113,1	109,5	109,1	111,0	109,6	107,8	112,8	107,8
Suckling cows	62,6	61,0	63,9	61,7	56,5	56,2	60,5	57,0	63,5
Other cattle	294,0	298,8	296,8	291,6	292,5	294,8	299,9	314,3	317,3
Pigs - total	**432,0**	**415,2**	**395,6**	**347,3**	**296,1**	**288,4**	**281,3**	**271,4**	**265,7**
Sows	36,3	33,6	29,6	25,5	20,3	20,1	18,6	18,1	17,2
Other breeding pigs*	6,8	5,8	5,4	4,3	4,1	3,6	3,1	3,0	3,0
Piglets	121,7	108,6	99,0	81,6	66,0	67,5	63,6	59,5	57,5
Fattening pigs**	310,3	306,6	296,6	265,7	230,1	220,9	217,7	211,9	208,2
Small ruminants	**163,2**	**168,0**	**156,0**	**146,6**	**140,5**	**130,0**	**135,1**	**136,4**	**142,3**
Sheep - total	139,0	138,1	129,8	120,0	114,2	108,8	113,6	109,4	119,8
Ewes	95,0	95,2	90,9	81,5	77,3	73,4	78,0	75,2	81,5
Other sheep	6,7	7,3	6,4	6,1	6,0	5,5	5,4	5,5	6,9
Lambs	37,3	35,5	32,5	32,4	30,9	29,8	30,2	28,7	31,5

Goats	24,2	29,9	26,2	26,6	26,4	21,2	21,4	27,0	22,4
Breeding female goats	16,8	21,9	19,4	19,1	16,8	14,7	15,2	18,4	14,7
Other goats	2,4	2,8	2,4	2,6	2,8	2,1	2,2	2,5	2,3
Kids	5,0	5,3	4,4	4,9	6,8	4,5	4,0	6,1	5,4
Horses	**19,6**	**19,6**	**22,7**	**22,7**	**22,7**	**21,8**	**21,8**	**21,8**	**19,5**
Poultry - total	**4575,3**	**5211,9**	**4618,2**	**4006,7**	**4839,4**	**4907,0**	**5258,6**	**5753,9**	**6115,8**
Laying hens	1377,8	1553,2	1504,0	1365,2	1145,5	1380,0	1358,1	1458,1	1717,5
Broilers	2392,7	2944,6	2528,8	2154,8	3171,9	2827,2	3280,9	3479,2	3639,3
Other chickens	616,9	590,5	480,1	349,0	377,0	576,0	476,1	668,7	567,7
Turkeys	144,6	94,5	68,9	95,8	110,9	96,2	121,4	108,1	156,2
Geese	2,9	2,7	2,1	1,9	2,2	2,8	1,7	3,1	3,4
Ducks	11,6	9,9	10,1	12,2	10,5	10,5	9,9	14,2	14,5
Other poultry	29,0	16,4	24,2	27,8	21,4	14,2	10,5	22,6	17,3
Rabbits-total	**105,4**	**95,2**	**85,1**	**88,8**	**92,5**	**96,2**	**100,7**	**105,2**	**109,8**
Does	20,6	19,0	17,4	18,6	19,8	21,0	22,3	23,6	24,9
Other rabbits	84,8	76,3	67,7	70,2	72,7	75,2	78,4	81,6	84,8

* Boars, gilts not yet covered
** Including young breeding pigs

(continued)

Animal category	2017	2018	2019	2020	2021
Cattle - total	**479,6**	**476,8**	**483,1**	**485,6**	**482,6**
Dairy cows	108,8	102,7	100,8	99,2	100,9
Suckling cows	59,9	63,5	65,1	67,7	64,5
Other cattle	310,9	310,6	317,1	318,7	317,2
Pigs - total	**257,2**	**259,1**	**240,1**	**229,5**	**215,7**
Sows	20,6	18,7	16,6	15,6	14,2
Other breeding pigs*	3,1	2,9	2,7	2,6	2,2
Piglets	58,7	58,0	51,3	50,4	41,9
Fattening pigs**	198,6	201,1	188,8	179,0	173,9
Small ruminants	**134,0**	**134,5**	**134,6**	**139,4**	**145,0**
Sheep - total	108,8	109,8	110,3	113,7	119,3
Ewes	77,9	76,5	75,9	77,3	82,5
Other sheep	5,0	6,0	5,7	4,7	5,0
Lambs	25,9	27,4	28,7	31,7	31,8
Goats - total	25,2	24,7	24,4	25,7	25,7
Breeding female goats	18,1	17,8	17,9	18,4	18,2
Other goats	2,6	2,7	2,9	2,1	2,2
Kids	4,6	4,2	3,6	5,2	5,4
Horses	**19,1**	**18,7**	**18,4**	**18,0**	**18,0**
Poultry - total	**6410,1**	**6695,9**	**6645,3**	**6340,0**	**6525,0**
Laying hens	1764,2	1870,2	1805,3	1547,2	1713,4
Broilers	3866,0	4028,4	4162,4	4000,2	3954,0
Other chickens	594,0	617,1	503,7	635,8	717,3
Turkeys	147,6	148,8	145,8	121,2	104,0
Geese	2,9	2,3	2,4	1,3	3,9
Ducks	17,4	18,7	11,0	10,8	16,0
Other poultry	18,0	10,5	14,6	23,4	16,3
Rabbits-total	**90,0**	**70,2**	**50,5**	**30,7**	**30,7**
Does	22,0	19,2	16,3	13,4	13,4
Other rabbits	68,0	51,0	34,2	17,3	17,3

* Boars, gilts not yet covered
** Including young breeding pigs

Emission factors

In the first step nitrogen excretion from farm animals was estimated. It was obtained by multiplying the number of farm animals and nitrogen excretion rates on the level of individual animal species and categories. The nitrogen excretion rates, which were taken into account, are presented in Table 5.1.2. In dairy cows the nitrogen excretion has been linked to productivity, i.e. milk production (M). The equation proposed by Menzi et al. (1997) was used:

N excretion (kg/year) = 52,5 + 0,0105 × M (kg/year) (eq. 1)

Table 5.1.2 Nitrogen excretion rates for the calculation of ammonia emissions from animal production

Animal category	N excretion (kg/year)	Source
Cattle		
Dairy cows	81-119,2	Equation 1
Suckling cows	41	EMEP/EEA (2019)
Calves, fattening cattle, heifers	41	EMEP/EEA (2019)
Pigs		
Sows[a]	36	EMEP/CORINAIR (2002)
Fattening pigs	14	EMEP/CORINAIR (2002)
Small ruminants		
Sheep[b]	15,5	EMEP/EEA (2019)
Goats[c]	15,5	EMEP/EEA (2019)
Horses	47,5	EMEP/EEA (2019)
Poultry		
Laying hens	0,77	EMEP/EEA (2019)
Broilers	0,36	EMEP/EEA (2019)
Turkeys	1,64	EMEP/EEA (2019)
Geese	0,55	EMEP/EEA (2019)
Ducks	1,26	EMEP/EEA (2019)
Rabbits[d]	8,1	IPCC (2006)

[a] Sows and pregnant gilts; the value includes N excretion in piglets and boars
[b] Adult sheep (including breeding female sheep and other adult sheep, like rams and barren sheep); the excretion value includes N excretion in lambs
[c] Adult goats (including breeding female goats and other adult goats, like he goats and barren goats); the excretion value includes N excretion in kids
[d] The excretion value applies for does; the value includes excretion in other rabbit categories

In case of dairy cows, where the N excretion was related to productivity, the value ranged from 81,6 to 119,2 kg of N per cow and year. Milk production and nitrogen excretion rates are presented in Table 5.1.3.

Table 5.1.3 Milk production and nitrogen excretion (Nex) rates for dairy cattle in kg/head/year

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Milk production (kg/year)	2775	3252	2835	2800	3014	3170	3831	3975	4091	4252
Nex (kg N per animal per year)	81,6	86,6	82,3	81,9	84,1	85,8	92,7	94,2	95,5	97,1
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Milk production (kg/year)	4625	4807	5198	5062	4853	5479	5708	5726	5764	5531
Nex (kg N per animal per year)	101,1	103,0	107,1	105,7	103,5	110,0	112,4	112,6	113,0	110,6
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Milk production (kg/year)	5517	5516	5593	5435	5717	5598	6024	5954	6123	6178
Nex (kg N per animal per year)	110,4	110,4	111,2	109,6	112,5	111,3	115,8	115,0	116,8	117,4
	2020	**2021**								

Milk production (kg/year)	6356	6341							
Nex (kg N per animal per year)	119,2	119,1							

In the case of pigs, the N excretion rates of EMEP/CORINAIR (2002) were used. The decision was made on the basis of the reporting mode on the number of pigs in Slovenia. The N excretion rates of EMEP/CORINAIR (2002) refer to fattening pigs weighing 20 kg or more and sows, which also include piglets weighing up to 20 kg. The same categories are reported by SORS. The EMEP/EEA categories for 2019 are not harmonised with the categories used in Slovenia (piglets up to 8 kg body weight) and are therefore not applicable without adjustments.

For comparison purposes, the 2018 excretion rates from EMEP/CORINAIR (2002) were compared to values obtained using the IPCC (2006) method, which is the basis for the EMEP/EEA (2019) default excretion rates. Based on 2017 herd structure data, the excretion rates from EMEP/CORINAIR (2002) resulted in an average excretion rate of 12.2 kg N per pig per year. The corresponding value from the IPCC (2006) methodology (values for Western European countries) was 13.3 kg. It was decided to stay with the EMEP/CORINAIR (2002) excretion rates, which are tailored to reporting on pig populations in Slovenia.

In certain species of domestic animals, nitrogen excretions of some animal categories (mostly young animals like piglets, lambs and kids or male breeding animals like boars) are considered to be covered by excretion factors of other categories, like sows, does, adult sheep or adult goats. As a result, average excretion rates reported in CRF differ from those given in Table 5.1.2. Average excretion rates which were calculated by dividing the total N excretion by total number of animals are given in Table 5.1.4. Due to variation in proportions of individual categories within animal species the average excretion rates differ slightly among years.

Table 5.1.4 Average nitrogen excretion (Nex) rates for animal species in which nitrogen excretions of some animal categories are considered to be covered by other categories. The values refer to total population (kg N/head/year)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Pigs	12,7	12,3	11,9	12,0	11,9	11,6	11,6	11,6	11,6	11,7
Sheep	10,9	11,9	10,5	10,3	11,3	10,2	11,0	10,8	10,7	11,6
Goats	12,4	12,4	12,4	12,3	12,9	12,7	13,2	13,0	12,3	13,5
Rabbits	1,39	1,39	1,39	1,39	1,39	1,39	1,39	1,39	1,34	1,29
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Pigs	11,7	11,6	11,9	11,7	11,6	11,6	11,8	11,6	11,7	11,9
Sheep	11,5	11,7	11,7	11,3	11,7	11,4	11,2	11,5	11,3	11,5
Goats	13,0	13,3	13,3	12,7	12,2	12,3	12,8	11,9	12,3	12,8
Rabbits	1,25	1,32	1,40	1,49	1,49	1,48	1,52	1,56	1,58	1,61
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Pigs	12,0	12,2	12,2	12,1	12,1	12,2	12,2	12,2	12,1	12,2
Sheep	11,6	11,3	11,3	11,3	11,4	11,4	11,4	11,8	11,6	11,5
Goats	12,9	12,6	11,5	12,2	12,6	12,0	11,7	12,8	12,7	13,2
Rabbits	1,65	1,70	1,73	1,77	1,80	1,82	1,84	1,98	2,21	2,61
	2020	**2021**								
Pigs	12,1	12,4								
Sheep	11,2	11,4								
Goats	12,4	12,3								

Rabbits	3,52	3,52								

Emissions from animal housing, manure stores, anaerobic digestion and due to fertilization with animal manures in cattle production

Emission factors, which tell us how much of N from animal excreta is lost to the atmosphere in the form of ammonia, depend on manure management systems. Factors, along with some basic information on manure management systems in cattle production, are presented in Table 5.1.7. Generally, EMEP/EEA (2019) factors were used. In case of introduction of abatement techniques the basic emission factors were multiplied by (1- efficiency coefficient). Efficiency coefficients were obtained either from EMEP/EEA (2019) manual or from Draft revised United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions (ECE/EB AIR/2014/8). The fraction of individual manure management systems was estimated on the basis of the results of farm census data from 1991 and 2000. Since manure management systems were not reported in the census, data on size and structure of cattle-breeding farms were used for rough estimates. It was considered that all farms with less than 10 head of bovine animals had solid manure storage systems, that 30 % of farms with 10-19 head of animals practiced liquid manure storage and 70 % of them solid manure storage, and that all farms with 20 cows or more had liquid manure storage systems. Linear regression was used to estimate the changes in manure management systems in the period 1990-2000. After 2000, data on farm size and structure were reported by the Statistical Office for the years 2003, 2005, 2007, 2010, 2013, 2016 and 2020. For the years with missing values the proportions of various manure storage systems were obtained by interpolation. For the years which exceed the available time series we used the last available estimate. In 2005, the estimates based on farm structure were tested using the information on manure management that was collected in the frame of milk recording service on a large number of dairy farms (Babnik and Verbič, 2007; about 70% of total dairy cows were covered). Based on farm structure, it was estimated that 55,6% of dairy cows were kept on liquid systems (if grazing is not taken into account). The corresponding value based on farm questionnaires was only slightly lower (53,2%). It proves that the estimates based on farm structure can be considered reliable. Animals kept in liquid systems were further divided into animals kept in liquid manure storage with natural crust cover, animals kept in liquid manure storage below animal confinements and animals from which the excreta was treated in anaerobic digesters. Based on information on manure management that was collected in the frame of milk recording service on a large number of dairy farms in 2005 (Babnik and Verbič, 2007) it was estimated that the ratio between slurry stored in stores with natural crust and slurry stored below animal confinements is 0,46:0,54. Based on information from the same source the solid manure was divided into farmyard manure stored in heaps and deep bedding (0,90:0,10). The proportion of slurry treated in anaerobic digesters was estimated on the basis of data collected from biogas plants by the means of interview (data provided by Poje, unpublished). Based on above mentioned data and data on total number of cattle it was estimated that during the period 2006-2010 the proportion of digested cattle manures increased from 0,03 to 0,36 %. Anaerobic digesters were not markedly spread thereafter and therefore the same value was used for the period 2011-2021.

Data on animal husbandry and manure storage practices from the 2020 Census were published in July 2023 (SORS, 2023). From the published data, it is not possible to obtain appropriate information for estimating emissions of nitrogen compounds from manure storage facilities. The problem is mainly the following:

- the data are aggregated and refer to the sum of the most represented animal species (cattle, pigs, sheep, goats, poultry),
- the data refer to farms and do not take into account the number of animals in these farms. Since the type of animal husbandry is related to the size of the farm, it is not possible to estimate the amount of manure kept in different systems,

- slurry and the liquid fraction generated on farms with farmyard manure are considered together, so it is not possible to quantify the share of slurry systems.

Due to fact that there are no adequate data on agricultural production methods it was decided to preserve the consistency of time series and to retain estimates based on farm structure. It would make sense to check whether it is possible to obtain relevant information by processing the raw data collected by SURS.

The fraction of grazing bovine animals for 1990 has been estimated on the basis of data on grazing animals on mountain pastures and expert estimate on the scale of grazing on intensive grasslands (Verbič et al., 1999). In 2000, all grazing animals on mountain and other pastures were recorded. This census showed that in 2000, one way or another, 21 % of animals were grazing. This data have been corrected with regard to the length of the grazing season, considering the fact that animals on mountain pastures will graze for 141 days on the average, and on other pastures for 210 days. As result, the corrected proportion of grazed animals for 2000 was estimated to be 0,117. The same procedure was used for the data obtained by sample survey on agricultural production methods in 2010. It showed that the corrected proportion of grazed animals increased to 0,126.

The estimate for 1990 was used for the period 1985-1990. For the period 1991-1999, the data on grazing were obtained by linear regression which was calculated on the basis of data for the years 1990 and 2000 and for the period 2001-2009 the estimates obtained by linear regression for the years 2000 and 2010. The 2020 census did not collect data on the number of animals kept on pasture. Extrapolated values based on the 2000-2010 period were used for the years through 2020. This resulted in a slight increase in the percentage of grazed animals (from 12.6% in 2010 to 13.6% in 2020). Grazing is supported by some measures of agricultural policy (organic farming, animal welfare measures), so it is assumed that the share of grazing animals in 2020 is not overestimated. For 2021, the same value as for 2020 was used. It has been estimated that the fraction of grazing animals and the fraction of liquid manure management systems have increased while the fraction of bovine animals in straw based systems has decreased. Detailed information on grazing and distribution of manure management systems is given in Table 5.1.6.

It has to be pointed out, that in case of farmyard manure system, one part of excreta is stored as solid (faeces + bedding) while the other part (urine + manure effluents) is stored as liquid. It was taken into account that cattle excrete 57 % of N in urine and 43 % in faeces. It is incorporated into calculation process. As a result, the proportion of manure storage systems in CRF is not equal to proportions of manure management systems reported in Table 5.1.6. An example is given in a Table 5.1.5.

Table 5.1.5 Example of conversion of proportions of various animal rearing systems into proportions of manure storage systems

Rearing system	Proportion	N distribution into storage systems	Storage system		
			Liquid	Solid	Grazing
Slurry	0,568	100 % liquid	0,568	0,000	0,000
Farmyard manure	0,303	57 % liquid 43 % solid	0,173	0,130	0,000
Grazing	0,129	100 % grazing	0,000	0,000	0,129
Total	**1,000**		**0,741**	**0,130**	**0,129**

Table 5.1.6 Distribution of various manure management systems in cattle production. In farmyard manure system part of N is retained in solid and part in liquid fraction

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Grazing										
Dairy cows	0,059	0,065	0,071	0,076	0,082	0,088	0,094	0,100	0,105	0,111
Other cows	0,059	0,065	0,071	0,076	0,082	0,088	0,094	0,100	0,105	0,111
Other cattle	0,066	0,071	0,076	0,081	0,086	0,092	0,097	0,102	0,107	0,112
Farmyard manure										
Dairy cows	0,593	0,579	0,565	0,551	0,537	0,523	0,509	0,495	0,481	0,467
Other cows	0,593	0,579	0,565	0,551	0,537	0,523	0,509	0,495	0,481	0,467
Other cattle	0,588	0,575	0,561	0,548	0,534	0,521	0,507	0,494	0,480	0,467
Slurry*										
Dairy cows	0,348	0,356	0,365	0,373	0,381	0,389	0,397	0,405	0,414	0,422
Other cows	0,348	0,356	0,365	0,373	0,381	0,389	0,397	0,405	0,414	0,422
Other cattle	0,346	0,354	0,363	0,371	0,380	0,388	0,396	0,404	0,413	0,421
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Grazing										
Dairy cows	0,117	0,118	0,119	0,120	0,121	0,122	0,122	0,123	0,124	0,125
Other cows	0,117	0,118	0,119	0,120	0,121	0,122	0,122	0,123	0,124	0,125
Other cattle	0,117	0,118	0,119	0,120	0,121	0,122	0,122	0,123	0,124	0,125
Farmyard manure										
Dairy cows	0,453	0,435	0,418	0,400	0,395	0,390	0,373	0,356	0,341	0,325
Other cows	0,453	0,435	0,418	0,400	0,395	0,390	0,373	0,356	0,341	0,325
Other cattle	0,453	0,435	0,418	0,400	0,395	0,390	0,373	0,356	0,341	0,325
Slurry*										
Dairy cows	0,430	0,447	0,463	0,480	0,484	0,488	0,505	0,521	0,535	0,550
Other cows	0,430	0,447	0,463	0,480	0,484	0,488	0,505	0,521	0,535	0,550
Other cattle	0,430	0,447	0,463	0,480	0,484	0,488	0,505	0,521	0,535	0,550
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Grazing										
Dairy cows	0,126	0,127	0,127	0,128	0,129	0,130	0,131	0,132	0,133	0,133
Other cows	0,126	0,127	0,127	0,128	0,129	0,130	0,131	0,132	0,133	0,133
Other cattle	0,126	0,127	0,127	0,128	0,129	0,130	0,131	0,132	0,133	0,133
Farmyard manure										
Dairy cows	0,308	0,305	0,302	0,299	0,288	0,277	0,266	0,260	0,253	0,247
Other cows	0,308	0,305	0,302	0,299	0,288	0,277	0,266	0,260	0,253	0,247
Other cattle	0,308	0,305	0,302	0,299	0,288	0,277	0,266	0,260	0,253	0,247
Slurry*										
Dairy cows	0,566	0,568	0,570	0,572	0,583	0,593	0,603	0,609	0,614	0,620
Other cows	0,566	0,568	0,570	0,572	0,583	0,593	0,603	0,609	0,614	0,620
Other cattle	0,566	0,568	0,570	0,572	0,583	0,593	0,603	0,609	0,614	0,620
	2020	**2021**								
Grazing										
Dairy cows	0,134	0,134								
Other cows	0,134	0,134								

Other cattle	0,134	0,134								
Farmyard manure										
Dairy cows	0,240	0,240								
Other cows	0,240	0,240								
Other cattle	0,240	0,240								
Slurry*										
Dairy cows	0,625	0,625								
Other cows	0,625	0,625								
Other cattle	0,625	0,625								

* including anaerobic digesters

Table 5.1.7 Emission factors and basic information on manure management systems for the calculation of NH_3, N_2O, NO and N_2 emissions in cattle production (Sources for emission factors: Menzi et al., 1997, EMEP/EEA air pollutant emission inventory guidebook, 2019, ECE/EB AIR/2014/8)

		Tied housing system		**Loose housing system**
	Grazing	**Farmyard* manure**	**Liquid* fraction (urine)**	**Slurry**
Proportion of TAN at the level of excretion (in kg/kg total N)*	0,60	0,30	0,825***	0,60
Basic information				
Proportion of covered manure stores	/	0,00	0,90	0,50
Proportion of manure incorporation (for arable land only)	/	0,20	0,20	0,20
Bedding material (kg per animal per year)	0	Cows: 730 kg Other cattle: 240 kg	0	0
N added in bedding (kg per animal per year)	0,00	Cows: 2,92 kg Other cattle: 0,96 kg	0,00	0,00
Mineralization of non-TAN N during storage (proportion of total non-TAN N)	/	0,00	0,00	Slurry: 0,10 Anaer. dig.: 0,32
Immobilization of TAN during storage (proportion of TAN)	/	0,0067	0,0000	0,0000
Emission factors (kg NH_3-N/kg TAN)				
From animal houses or during grazing (proportion of excreted TAN)	0,14	0,09	0,09	0,24
Emissions from uncovered manure stores (proportion of TAN entering the stores)	/	0,32	0,25	Slurry: 0,25 Anaer. dig.: 0,0266**
Emissions from covered manure stores (proportion of TAN entering the stores)	/	/	0,050	Slurry: 0,05 Anaer. dig.: 0,0266**
Emissions due to manure application – basic coefficients (proportion of TAN leaving the stores)	/	0,68	0,55	0,55
Emissions due to manure application – coefficients for manure incorporation (proportion of TAN leaving the stores)	/	0,408	0,33	0,33
Emission factors (kg N_2O-N/kg TAN)				

Emissions from manure stores (proportion of TAN entering the stores)	/	0,020	0,000	Slurry: 0,01 Anaer. dig.: 0,000
Emission factors (kg NO-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	/	0,010	0,0001	Slurry: 0,0001 Anaer. dig.: 0,000
Emission factors (kg N_2-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	/	0,300	0,003	Slurry: 0,003 Anaer. dig.: 0,000

* in farmyard manure system it was taken into account that 0,43 of N was retained in solid and 0,57 in liquid fraction

** emission factor as suggested by EMEP/EEA, 2019, Chapter 5.B.2, Biological treatment of waste, EF refers to total N

*** The value proposed by Menzi et al. (1997) is 0,7 and the use of this value implies that the total amount of TAN excreted in the manure system is less than in the grazing or slurry based system. To harmonize the total amount of TAN excreted, we used a value of 0,825, which is close to the upper limit of the range given in the EMEP / EEA 2019.

Based on expert estimate it was assumed for the entire reporting period that 20 % of animal manures used on arable land were incorporated into the soil within about 12 to 24 hours after application (Table 5.1.7). It was assumed that basic emission coefficients for the above mentioned practice are reduced by 40 % (mean value for incorporation within 12 and within 24 hours, ECE/EB AIR/2014/8). For the period 2015-2018 it was also taken into account that a certain part of slurry was applied by the means of low emission techniques (9,5, 11, 11,2 11,6, 11,5, 11,4 and 11,4% for arable land and 0,21, 0,21, 0,21, 0,22, 0,21, 0,13 and 0,13 % for grasslands in years 2015, 2016, 2017, 2018, 2019, 2020 and 2021 respectively). The information is based on the area supported by Rural development programme (operation "low emission fertilization"). It was considered that low emission techniques were distributed into trailing hoses (70%) and trailing shoe (30 %). The estimates are based on information on investments in low emission equipment which was supported by the Rural development programme. For the efficiency of low emission techniques the values proposed by ECE/EB AIR/2014/8 were taken into account.

Emissions from animal housing, manure stores, anaerobic digestion and due to fertilization with animal manures in pig production

To obtain reliable estimates on the manure management systems in pig production the population was disaggregated into three categories:
a) commercial pig farms,
b) market oriented family farms, and
c) small scale family farms.

Data published by the SORS allow a breakdown of the entire herd into commercial pig farms and family farms for the period 1986-2002. Family farms were further divided into market oriented and small scale farms. In 1986, the estimate of production for market oriented family farms was based on the data on acquisition of pigs from market oriented family farm production, which was published by the SORS. The number of swine in small scale family farm production has been estimated from the difference between the entire herd and market oriented production (commercial and market oriented family farms). For 2000, the number of pigs in the small scale family farm production has been estimated on the basis of the census of agricultural holdings. Pigs kept on farms with up to 10 pigs have been considered as small scale family farm production, pigs on family farms which kept more than 10 pigs have been considered as market oriented family farm production. From 1986 to 2000, the fraction of pigs in small scale family farm production kept diminishing. In the period between 1986 and 2000, the proportion of small scale production was obtained by interpolation. After 2000, data on farm structure for the years

2003, 2005, 2007, 2010, 2013, 2016 and 2020 have been reported by the SORS. These data were used to estimate the number of pigs on small scale family farms. For the years with non-existing data on farm structure (2001, 2002, 2004, 2006, 2008, 2009, 2011, 2012, 2014, 2015, 2017, 2018, 2019) the numbers of pigs on small scale family farms were obtained by interpolating the values for neighbouring years. For the year 2021 the same proportion as for 2020 was used. For the period after the year 2002 the number of pigs on commercial farms could not be obtained directly from the data reported by SORS. Therefore, it was estimated using the data on farm structure for the years 2003, 2005, 2007, 2010, 2013, 2016 and 2020. The estimate is based on the number of pigs which are kept on farms with more than 399 pigs. The pigs belonging to this category (pigs kept on farms with more than 399 pigs) were allocated among commercial and market oriented family farms on the basis of their proportion in the year 2000. The pigs kept on farms with 10 to 399 pigs were entirely allocated to market oriented family farms.

For market oriented family farm production, it was considered that 95 % of animal excreta were collected in the form of liquid manure and 5 % in the form of solid manure. For small scale family farm production, it was estimated that 95 % of pigs is reared in solid manure storage systems and 5 % in liquid manure systems. For the big commercial pig farms old-style separators were characteristic for the period 1985 to 1994. App. 20 % of solids was separated from liquid manure by the use of these separators. The remainder (80 %) was either treated in lagoons (75 %) or spread as liquid manure (25 %). The time from 1995 to 1999 was a period of introducing new separators and the beginning of operation of anaerobic digesters. Introducing new separators on commercial farms increased the estimated portion of separated solid phase to 40 %.

Detailed information on manure management systems are given in Table 5.1.8. Emission factors for pig production are given in Table 5.1.9.

Table 5.1.8 Distribution of various manure management systems in pig production

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Slurry	0,281	0,250	0,345	0,360	0,355	0,351	0,341	0,366	0,374	0,401
Farmyard manure	0,355	0,375	0,323	0,315	0,311	0,287	0,291	0,266	0,246	0,245
Separation (solid fraction)	0,091	0,094	0,083	0,081	0,084	0,197	0,200	0,201	0,207	0,238
Anaerobic lagoons	0,274	0,281	0,249	0,244	0,251	0,148	0,150	0,151	0,155	0,064
Anaerobic digestion	0,000	0,000	0,000	0,000	0,000	0,016	0,017	0,017	0,017	0,051
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Slurry	0,503	0,494	0,536	0,525	0,507	0,488	0,486	0,490	0,489	0,499
Farmyard manure	0,221	0,213	0,209	0,201	0,199	0,197	0,184	0,171	0,182	0,192
Separation (solid fraction)	0,187	0,198	0,173	0,185	0,199	0,212	0,159	0,153	0,127	0,128
Anaerobic lagoons	0,050	0,053	0,046	0,050	0,053	0,057	0,043	0,041	0,034	0,034
Anaerobic digestion	0,040	0,042	0,037	0,040	0,043	0,046	0,129	0,144	0,169	0,147
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Slurry	0,541	0,547	0,554	0,560	0,553	0,545	0,538	0,542	0,546	0,551
Farmyard manure	0,202	0,211	0,220	0,229	0,228	0,226	0,224	0,205	0,186	0,168
Separation (solid fraction)	0,126	0,118	0,109	0,101	0,106	0,111	0,116	0,124	0,131	0,188
Anaerobic lagoons	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Anaerobic digestion	0,131	0,124	0,117	0,109	0,114	0,118	0,122	0,129	0,136	0,143
	2020	**2021**								
Slurry	0,555	0,555								
Farmyard manure	0,149	0,149								
Separation (solid fraction)	0,146	0,146								
Anaerobic lagoons	0,000	0,000								
Anaerobic digestion	0,150	0,150								

Emissions from animal housing, manure stores and due to fertilization with animal manures in poultry production

Emissions in poultry production were calculated as a sum of emissions for broilers, layers, ducks, turkeys and geese. For broilers, turkeys, geese and ducks exclusively floor system on bedding was assumed. For laying hens, combined floor system (1/4) and battery-cage systems (3/4) were assumed for 1990. Assumption was made on the basis of expert estimate. It was also assumed that in 50 % the manure is removed daily and stored in tanks (liquid system) while in 50 % it is collected under the batteries (i.e. poultry manure without bedding). After introduction of dung drying system to certain farms, new estimates were obtained for 2002. Layers which were assumed to be kept in floor system, in system where manure is collected under the batteries and in dung drying system were allocated to solid system. Layers which were assumed to be kept in system where the manure is removed daily and stored in tanks was allocated to liquid systems. Emission factors for poultry rearing are given in Table 5.1.10.

Table 5.1.9 Emission factors and basic information on manure management systems for the calculation of NH_3, N_2O, NO and N_2 emissions in pig production (Sources for emission factors: EMEP/EEA air pollutant emission inventory guidebook, 2019, EPA, 2004)

	Farmyard manure and solid*	**Slurry**	**Anaerobic lagoon**	**Anaerobic fermenter**
Proportion of TAN at the level of excretion (in kg/kg total N)*	0,70	0,70	0,70	0,70
Basic information				
Proportion of covered manure stores	0,00	0,50	0,00	1,00
Proportion of manure incorporation (for arable land only)	0,20	0,20	/	0,20
Bedding material (kg per animal per year)	FP: 200 S: 600	0	0	0
N added in bedding (kg per animal per year)	FP: 0,8 S: 2,4	0	0	0
Mineralization of non-TAN N during storage (proportion of total non-TAN N)	0	0,1	1	0,32
Immobilization of TAN during storage (proportion of TAN)	0,0067	0,000	0,000	0,000
Emission factors (kg NH_3-N/kg N)				
From animal houses (proportion of excreted TAN)	FP: 0,23 S: 0,24	FP: 0,27 S: 0,35	FP: 0,27 S: 0,35	FP: 0,27 S: 0,35
Emissions from uncovered manure stores (proportion of TAN entering the stores)	0,29	0,11	0,71	0,0266**
Emissions from covered manure stores (proportion of TAN entering the stores)	/	0,028	/	0,0266**

Emissions due to manure application – basic coefficients (proportion of TAN leaving the stores)	0,45	FP: 0,40 S: 0,29	/	FP: 0,40 S: 0,29
Emissions due to manure application – coefficients for immediate manure incorporation (proportion of TAN leaving the stores)	0,27	FP: 0,24 S: 0,174	/	FP: 0,24 S: 0,174
Emission factors (kg N_2O-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	0,01	0,00	0,00	0,00
Emission factors (kg NO-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	0,01	0,0001	0,0001	0,000
Emission factors (kg N_2-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	0,300	0,003	0,290	0,000

* solid fraction extracted from slurry during the separation process
** emission factor as suggested by EMEP/EEA, 2019, Chapter 5.B.2, Biological treatment of waste, EF refers to total N
Abbreviations: FP – Fattening pigs, S – Sows, FYM – farmyard manure

For the low emission application techniques and their effectiveness the same assumptions as for cattle manures were used.

Table 5.1.10 Emission factors for the calculation of NH_3, N_2O, NO and N_2 emissions in poultry production (Source for emission factors: EMEP/EEA air pollutant emission inventory guidebook, 2019)

	Laying hens - solid	Laying hens - liquid	Broilers	Ducks	Turkeys	Geese
Proportion of TAN at the level of excretion (in kg/kg total N)*	0,70	0,70	0,70	0,70	0,70	0,70
Basic information						
Proportion of manure incorporation (for arable land only)	0,20	0,20	0,20	0,20	0,20	0,20
Bedding material (kg per animal per year)	0*	/	0*	0*	0*	0*
N added in bedding (kg per animal per year)	0*	/	0*	0*	0*	0*
Mineralization of non-TAN N during storage (proportion of total non-TAN N)	0,00	0,10	0,00	0,00	0,00	0,00
Emission factors (kg NH_3-N/kg N)						
From animal houses (proportion of excreted TAN)	0,41	0,41	0,21	0,24	0,35	0,57
Emissions from manure stores (proportion of TAN entering the stores)	0,14	0,14	0,30	0,24	0,24	0,16
Emissions due to manure application – basic coefficients (proportion of TAN leaving the stores)	0,690	0,690	0,38	0,540	0,540	0,450
Emissions due to manure application – coefficients for immediate manure incorporation (proportion of TAN leaving the stores)	0,414	0,414	0,228	0,324	0,324	0,270

Emission factors (kg N_2O-N/kg TAN)						
Emissions from manure stores (proportion of TAN entering the stores)	0,002	0,000**	0,002	0,002	0,002	0,002
Emission factors (kg NO-N/kg TAN)						
Emissions from manure stores (proportion of TAN entering the stores)	0,010	0,0001	0,010	0,010	0,010	0,010
Emission factors (kg N_2-N/kg TAN)						
Emissions from manure stores (proportion of TAN entering the stores)	0,30	0,003	0,30	0,30	0,30	0,30

* Sawdust; considered to contain no available N and to have no TAN immobilization potential

** EMEP/EEA 2019 guidebook does not propose any emission factor for liquid poultry manure. Therefore, emission factor which is given for liquid manure of other animal species was used.

Emissions from animal housing, manure stores and due to fertilization with animal manures in small ruminants, horses and rabbits

Ammonia emissions in goats, sheep, horses and rabbits were estimated using the information presented in Table 5.1.11. The proportions of grazing animals were estimated by the means of expert opinion. It was estimated that during the grazing season all sheep, 80 % of goats and 50 % of horses were grazed. Two hundred and fifty days of grazing season has been considered for sheep and 210 for goats and horses. For the remaining period it has been considered that these animals were kept in straw based systems. It was considered that rabbits are not grazed.

Table 5.1.11 Emission factors and basic information on manure management systems for the calculation of NH_3, N_2O, NO and N_2 emissions in sheep, goats, horses and rabbits (Source for emission factors: EMEP/EEA air pollutant emission inventory guidebook, 2019)

	Sheep	Goats	Horses	Rabbits
Proportion of TAN at the level of excretion (in kg/kg total N)*	0,50	0,50	0,60	0,50[a]
Basic information				
Proportion of manure incorporation (for arable land only)	0,20	0,20	0,20	0,20
Bedding material (kg per animal per year)	91	91	1460	3,65
N added in bedding (kg per animal per year)	0,365	0,365	5,84	0,015
Immobilization of TAN during storage (proportion of TAN)	0,0067	0,0067	0,0067	0,0067
Emission factors (kg NH_3-N/kg N)				
From animal houses (proportion of excreted TAN)	0,22	0,22	0,22	0,22[a]
During grazing (proportion of excreted TAN)	0,09	0,09	0,35	/
Emissions from manure stores (proportion of TAN entering the stores)	0,32	0,28	0,35	0,32[a]
Emissions due to manure application – basic coefficients (proportion of TAN leaving the stores)	0,90	0,90	0,90	0,90
Emissions due to manure application – coefficients for immediate manure incorporation (proportion of TAN leaving the stores)	0,54	0,54	0,54	0,54
Emission factors (kg N_2O-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	0,020	0,020	0,020	0,020[b]

Emission factors (kg NO-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	0,010	0,010	0,010	0,010
Emission factors (kg N_2-N/kg TAN)				
Emissions from manure stores (proportion of TAN entering the stores)	0,30	0,30	0,30	0,30

[a] There are no emission factors in EMEP/EEA air pollutant emission inventory guidebook; values for sheep were used

Non-methane volatile organic compounds (NMVOCs)

Methodology

With exception of rabbits, the detailed (Tier 2) approach suggested by EMEP/EEA air pollutant emission inventory guidebook, 2019 was used to assess the emissions of NMVOCs. For cattle the methodology based on gross energy intake and for other animal species methodology based on excretion of volatile substance was used. Total NMVOC emissions were estimated as a sum of emissions from silage stores, from the silage feeding, from housing, from manure stores, from manure application and from grazing. Country specific data for gross energy intake were used to estimate emissions in cattle production. The information was obtained from national UNFCCC reporting. Based on information that high dry matter grass and maize silages which are characterised by low concentrations of volatile fatty acids are produced in Slovenia (Verbič et al., 2011) the suggested emission factors for silage storage and feeding (EMEP/EEA air pollutant emission inventory guidebook, 2019) were reduced correspondingly. For rabbits, default emission factor which was suggested by EMEP/EEA (2019) was used. Emissions due to grazing and application of animal manures are reported under Crop production and agricultural soils chapter (NFR sector 3D).

Activity data

The activity data were obtained from the SORS. They include the number of cattle, pigs, sheep, goats, horses, poultry and rabbits (see Table 5.1.1).

Emission factors

Emissions in cattle production

Emissions in cattle were estimated on the basis of gross energy intake which was reported to UNFCC. The gross energy intake depends on several factors among which the most important are milk production in dairy cows and growth rate in fattening cattle. As a result of increased productivity the estimated gross energy intake in dairy cows and other cattle increased considerably during the period 1985 – 2021 (Table 5.1.12). The fraction of silage in diet was estimated on the basis of survey which was performed in 2005 (Verbič et al., 2006) and the fact that silage making in Slovenia became an important forage preservation method after the year 1970. For the period 1985 - 2004 the proportions of silage in diet was obtained by interpolation of data taken into account that there was no silage in the diets in the year 1970 and that its proportion in 2005 was 0,55. The estimate for 2005 was used also for the period after 2005. For the proportion of time spent on grazing the same data was used as for emissions of ammonia and nitric oxide.

Emission factors for calculation of NMVOC emissions are given in Table 5.1.12. The emissions from silage stores were calculated by multiplying the values for silage feeding by a fixed value of 0,25 as suggested by EMEP/EEA air pollutant emission inventory guidebook, 2019. The emissions from manure stores and emissions due to manure application were also estimated indirectly on the basis of emissions from animal houses. It was supposed that the relation between NMVOC emissions from animal houses on the one hand and emissions from manure stores and application of manure on the other is the same as for ammonia.

Table 5.1.12 Emission factors and basic information used for calculation of NMVOC emissions in cattle (Source for emission factors: EMEP/EEA air pollutant emission inventory guidebook, 2019)

	Dairy cows	Suckling cows	Other cattle
Basic information			
Gross energy intake (MJ yr^{-1} per animal)	78549 - 109117	73716-74272	40408 - 44744
Time spent in animal houses (proportion of total)	0,866 – 0,941	0,866 – 0,941	0,866 – 0,934
Fraction of silage in diet (proportion of maximal possible dry matter quantity in the diet)	0,31 – 0,55	0,31 – 0,55	0,31 – 0,55
The share of the emission in silage store compared to the emission from the feeding table	0,25	0,25	0,25
Emission factors			
Emissions due to silage feeding (kg NMVOC MJ^{-1} gross energy intake from silage)*	0,0002002	0,0002002	0,0002002
Emissions from housing (kg NMVOC MJ^{-1} gross energy intake in animal houses)	0,0000353	0,0000353	0,0000353
Emissions from grazing (kg NMVOC MJ^{-1} gross energy intake during grazing)	0,0000069	0,0000069	0,0000069

* EF which was suggested by EMEP/EEA air pollutant emission inventory guidebook, 2019 was reduced by 40 % due to high dry matter silages which are characterised by restricted fermentation.

Emissions in pigs, sheep, goats, horses, poultry and rabbits

Emissions in small ruminants, horses, pigs and poultry were estimated on the basis of volatile solids excretion using the same values as reported to UNFCC (i.e. default values according to IPCC, 2006). It was assumed that no silage is given to these animals. For the proportion of time spent on grazing the same data was used as for emissions of ammonia and nitric oxide.

The emissions from animal houses and from grazing areas were calculated on the basis of emission factors which are given in Table 5.1.13. The emissions from manure stores and emissions due to manure application were also estimated indirectly on the basis of emissions from animal houses. It was supposed that the relation between NMVOC emissions from animal houses on the one hand and emissions from manure stores and application of manure on the other is the same as for ammonia. For rabbits, a default EMEP/EEA (2019) emission factor was used (0,059 kg per animal and year).

Table 5.1.13 Emission factors and basic information used for calculation of NMVOC emissions in small ruminants, horses, pigs and poultry (Source for emission factors: EMEP/EEA air pollutant emission inventory guidebook, 2019)

	Volatile solids (VS) (kg yr^{-1} per animal)	Time spent in animal houses (proportion of total)	EF housing (kg NMVOC kg^{-1} VS excreted)	EF grazing (kg NMVOC kg^{-1} VS excreted)
Sheep	146	0,315	0,0016140	0,00002349
Goats	110	0,540	0,0016140	0,00002349
Horses	777	0,712	0,0016140	0,00002349
Fattening pigs	110	1,000	0,0017030	/
Sows	168	1,000	0,0070420	/
Layers	7,30	1,000	0,0056840	/
Broilers	3,65	1,000	0,0091470	/
Turkeys	25,55	1,000	0,0056840	/

Particulate matter ($PM_{2.5}$, PM_{10}, TSP)

Methodology

The methodology suggested by EMEP/EEA air pollutant emission inventory guidebook, 2019 was used to assess the emissions of particulate matter. Due to opinion that a scientific literature as a whole does not support the use of Tier 2 methodology (EMEP/EEA, 2019) it was decided to use a Tier 1 approach.

Activity data

The activity data were obtained from the SORS. They include the number of cattle, pigs, sheep, goats, horses and poultry (see Table 5.1.1). For cattle, pigs and poultry the emissions were estimated on the level of subcategories.

Emission factors

Emission factors are presented in Table 5.1.14. They apply to housed animals only. The number of housed animals was calculated by multiplying the total number of animals by the fraction of housed animals. The latest was obtained from information on proportion of grazing animals as described in methodology which was used for calculation of emissions of ammonia and nitric oxide.

Table 5.1.14 Emission factors used for calculation of TSP, PM_{10} and $PM_{2.5}$ emissions from livestock husbandry (housing) (Source: EMEP/EEA air pollutant emission inventory guidebook, 2019)

Livestock	TSP (kg/head)	PM_{10} (kg/head)	$PM_{2.5}$ (kg/head)
Dairy cattle	1,38	0,63	0,41
Non-dairy cattle (including young cattle, beef cattle and suckling cows)	0,59	0,27	0,18
Non-dairy cattle (calves)	0,34	0,16	0,1
Sheep[a]	0,14	0,06	0,02
Pigs (fattening pigs)	1,05	0,14	0,006
Pigs (weaners)	0,27	0,05	0,002
Pigs (sows)	0,62	0,17	0,01
Goats[b]	0,14	0,06	0,02
Horses	0,48	0,22	0,14
Laying hens[c]	0,19	0,04	0,003
Broilers	0,04	0,02	0,002
Other poultry (chickens)	0,04	0,02	0,002
Turkeys	0,11	0,11	0,02
Ducks	0,14	0,14	0,02
Geese	0,24	0,24	0,03
Other poultry	0,04	0,02	0,002

[a] adult sheep, including barren sheep and rams
[b] adult goats, including barren goats and he goats
[c] including parents of broilers

There is no information whether emission factors of particulate matter include or exclude condensable component.

Recalculations

The SORS released rabbit census data and final horse census data for 2020. The new data were used in estimating emissions. We also corrected the data for 2017-2019, for which we used interpolated values between the 2016 and 2020 census years.

Based on the newly published 2020 cattle and swine farm size structure data (SORS), we revised the 2017-2020 data on rearing methods and livestock manure collection. Recalculation affected ammonia emissions from manure management. It also affected emissions from biological treatment of waste (NFR 5B2 – Anaerobic digestion at biogas facilities).

An error was found in the estimate of ammonia emissions from cattle manure storage facilities for the period 2013-2020 (too high percentage of covered storage facilities was taken into account).

Emission factors for ammonia emissions from sheep and rabbit manure storage were harmonized with EMEP/EEA (2019) for the entire reporting period (from 0,28 to 0,32).

Future improvements

It will be considered whether relevant information on manure storage practices can be obtained by processing the raw data collected as part of the 2020 Census.

5.2 Crop production and agricultural soils (3. D)

Sectors covered in this chapter are:

NFR Codes:

3Da1	Inorganic N-fertilizers (includes also urea application)
3Da2a	Animal manure applied to soils
3Da2b	Sewage sludge applied to soils
3Da2c	Other organic fertilizers applied to soils
3Da3	Urine and dung deposited by grazing animals
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products
3De	Cultivated crops
3Df	Use of pesticides

Agricultural soils are source of ammonia (NH_3), nitric oxides (NO_x), non-methane volatile organic compounds (NMVOCs) and particulate matter. They contributed 50 %, 9 % and 6 % of total NH_3, NO_x and NMVOCs emissions, respectively. Contribution of $PM_{2.5}$ and PM_{10} were 0,1 % and 1,2 %. Use of pesticide contributed 0,4 % to total HCB emissions. The main sources of ammonia are application of animal manures, inorganic N-fertilizers and nitrogen which is excreted by grazed farm animals. Small quantities of ammonia are emitted also due to application of urban composts, digestates and sewage sludge. Six sources of NO emissions from agricultural soils were identified, i.e. application of synthetic N-fertilizers, application of animal manures, nitrogen deposited to soils by grazed farm animals and application of urban composts, digestates and sewage sludge, the latest being almost negligible. Crop production is also source of particulate matter and NMVOCs which are emitted due to animal grazing, application of animal manures and direct emissions from cultivated crops.

5.2.1 Inorganic N-fertilizers

NFR Code 3Da1

Ammonia

Methodology

Ammonia emissions due to use mineral fertilizers were assessed according to EMEP/EEA air pollutant emission inventory guidebook, 2019 methodology. They were obtained by multiplying data on consumption of nitrogen from mineral fertilizers and emission factors for three main groups of fertilizers.

Activity data

The consumption of nitrogen from mineral fertilizers in agriculture has been obtained from Statistical office of the republic of Slovenia (SORS). There is a sharp increase in sales of mineral fertilizers observed in 1992. The reasons for increase of activity data and consequently strong increase in NH_3 emission between 1991 and 1992 are:

- poor economic situation and war for independence in 1991 which causes considerable lower sales of mineral fertilizers than during the previous years,
- independence and improved economic situation in 1992,
- high inflation in 1992 which stimulated farmers to renew stocks of mineral fertilizers (well established practice from the times of high inflation in Yugoslavia was to invest in material resources),
- main supplier of mineral fertilizers in Slovenia was (and it still is) a company from Croatia. The fear that due to political situation in Croatia there will be a disturbance in mineral fertilizers supply forced farmers to increase stocks of mineral fertilizers.

Table 5.2.1.1 Consumption of mineral fertilizers according to fertilizer type (in tonnes of N)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	27169	23758	38938	33376	33944	32235	31296	33999	34801	34380
CAN	10866	9477	15491	13242	13467	12269	12576	13338	13716	13545
Urea	5437	4805	7957	6891	7010	7697	6145	7323	7369	7290
NP, NPK	10866	9477	15491	13242	13467	12269	12576	13338	13716	13545
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total	34159	34765	33412	34501	30264	29169	30383	29613	25039	28202
CAN	13365	13607	13022	14060	11868	11814	11473	13260	10115	12013
Urea	7429	7552	8134	8094	6749	7309	6954	6600	4645	8456
NP, NPK	13365	13607	12256	12347	11647	10047	11956	9753	10279	7733
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total	27486	27134	26300	27263	28612	28319	27097	27084	27293	28048
CAN	11730	13027	11349	12794	14615	14528	13353	13810	12908	14743
Urea	6964	6032	7051	6492	5911	5485	5932	5207	6596	6516
NP, NPK	8792	8075	7900	7977	8086	8306	7812	8067	7788	6789
	2020	**2021**								
Total	27692	29143								
CAN	13340	12968								

Urea	7397	5921								
NP, NPK	6955	10254								

Emission factors

Emission factors 0,008, 0,155 and 0,050 kg NH_3 per kg of N were used for calcium ammonium nitrate (CAN), urea and other mineral (NP and NPK) fertilizers respectively. Data for urea consumption for the period 1994-2021 were obtained from SORS (personal communication, data not officially published, Table 5.2.1.1). For the period 1985-1993 the proportion of urea in total mineral-N fertilizer consumption was estimated by extrapolation based on 1994-2013 period. The allocation of the rest of mineral-N fertilizes between CAN and other (NP and NPK) fertilizers for the period before the year 2002 was done on the basis of expert judgement (50:50). From 2002 the data for CAN consumption are also available (SORS, personal communication, data not published in national statistics, Table 5.2.1.1). Fertilizers which are characterized by high emission factors are not in use (anhydrous ammonia) or even prohibited (ammonium carbonate fertilizers). For 2016, 2017, 2018, 2019 and 2020, it was considered that low-emission application techniques were used for urea on 8,8, 11,8, 14,7, 17,6 and 20,1% of arable land, respectively. It was considered that 60 % of urea is used on arable land and that urea incorporation reduces ammonia emissions by 65 % (mean value from UNECE, 2015). The decision was made on the basis of the fact that investments in machinery which enables urea incorporation are supported by the Rural development programme.

Recalculations

No recalculations were done since the previous report.

Future improvements

No further improvements are planned until the next submission.

Nitric oxide

Methodology

Nitric oxide emissions due to use mineral fertilizers were assessed according to EMEP/EEA air pollutant emission inventory guidebook, 2019 methodology. No Tier 2 methodology is available and therefore Tier 1 methodology was used. The emissions were obtained by multiplying data on consumption of nitrogen from mineral fertilizers and emission factor.

Activity data

The consumption of nitrogen from mineral fertilizers in agriculture has been obtained from the SORS.

Emission factors

An uniform emission factor, i.e. 0,040 kg NO_2 per kg of N applied in form of synthetic fertilizers, was used (EMEP/EEA air pollutant emission inventory guidebook, 2019).

Recalculations

No recalculations were done since the previous report.

Future improvements

No further improvements are planned until the next submission.

5.2.2 Animal manure applied to soils

NFR sector 3Da2a

<u>Ammonia</u>

Emissions of ammonia following the application of animal manure are reported under this chapter. Calculation methods are presented in the frame of chapter Manure management (3B). The amount of total nitrogen and total ammonia nitrogen (TAN) in animal manure is given in Table 5.2.2.1.

Table 5.2.2.1 The amount of total nitrogen and total ammonia nitrogen (TAN) in animal manure (in tonnes of N). The values refer to animal manure leaving the stores

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total N	30472	28566	28769	26806	26527	27338	26105	25263	25436	26258
TAN	20076	19420	18932	16914	16687	16784	16485	16870	17045	17394
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total N	27366	26721	27996	25982	24877	24976	25192	26206	25008	24934
TAN	18424	18122	19293	17676	16605	16858	17107	18366	17786	18078
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total N	24470	23681	23437	23167	23544	24185	24436	24126	23902	23789
TAN	17603	16793	16772	16595	17018	17575	17977	17914	17950	17826
	2020	**2021**								
Total N	23599	23624								
TAN	17486	17694								

Recalculations

The SORS released rabbit census data and final horse census data for 2020. The new data were used in estimating the amount of nitrogen in animal manures. We also corrected the data for 2017-2019, for which we used interpolated values between the 2016 and 2020 census years.

An error was found in the considered estimates for the share of low-emission slurry application techniques in years 2019 and 2020. The recalculations affecting ammonia emissions were performed for these two years.

The estimates of nitrogen amount in animal manures were also affected by revised estimates of nitrogen losses from animal houses and manure stores. Details on these recalculations are given in Chapter 5.1.

Future improvements

Official data on manure management practices, including application techniques, were collected by SORS in 2020. The data were published in July 2023 (SORS, 2023). From the published data, it is possible to obtain information on the number of farms using a particular manure application technique. However, the data are aggregated by animal species (cattle, pigs, sheep, goats, poultry). In addition, there is no information on the number of animals kept on the farms, so it was not possible to estimate the amount of manure applied by different application methods. It will be considered whether relevant information on manure application techniques can be obtained by processing the raw data collected as part of the 2020 Census.

<u>Nitric oxide</u>

Methodology

Nitric oxide which is released from soils due to fertilization with animal manures is reported under this chapter. Emissions were assessed according to EMEP/EEA emission inventory guidebook, 2019 methodology. No Tier 2 methodology is available and therefore Tier 1 methodology was used. Emissions were obtained on the basis of data on nitrogen which is returned to soil by the means of animal manures and adequate emission factor.

Activity data

Data on nitrogen which is returned to soil in form of animal manures were calculated within methodology described in chapter Manure management (NFR sector 3B). Data are presented in Table 5.2.2.1.

Emission factors

An emission factor 0,040 kg NO_2 per kg of nitrogen which is applied to soil in form of animal manures was used (EMEP/EEA air pollutant emission inventory guidebook, 2019).

Recalculations

The SORS released rabbit census data and final horse census data for 2020. The new data were used in estimating the amount of nitrogen in animal manures. We also corrected the data for 2017-2019, for which we used interpolated values between the 2016 and 2020 census years. The estimates of nitrogen amount in animal manures were also affected by revised estimates of nitrogen losses from animal houses and manure stores. Details on these recalculations are given in Chapter 5.1.

Future improvements

No further improvements are planned until the next submission.

<u>Non-methane volatile organic compounds (NMVOCs)</u>

Methodology

NMVOCs emissions due to application of animal manures were calculated within methodology described in chapter Manure management (NFR sector 3B). The emissions are reported under this chapter.

Activity data

For activity data regarding the emissions due to application of animal manures see chapter on Manure management (NFR sector 3B).

Emission factors

Procedure for calculation of the emissions due to application of animal manures is given in chapter on Manure management (NFR sector 3B).

Recalculations

The NMVOC estimates are based on the proportions of ammonia emissions from animal houses on the one hand and emissions from manure application on the other. Therefore, some minor corrections were made to the NMVOC emission estimates resulting from corrections to the estimates of ammonia emissions from the barns and from application of animal manures.

Future improvements

No further improvements are planned until the next submission.

5.2.3 Sewage sludge applied to soils

NFR Code 3Da2b

Ammonia

Methodology

Default emission factor, as suggested by EMEP/EEA air pollutant emission inventory guidebook (2019) was used.

Activity data

Since 2000, data on sewage sludge application to the agricultural soils have been obtained from the reports prepared under the Sewage sludge directive (Environment Agency of the Republic of Slovenia). Data for 1995 and 1998 were obtained from environmental reports. It was assumed that the same proportion of sewage sludge (30 %) have been deposited to agricultural land for the period before 1995. Data for 1996, 1997 and 1999 were estimated by interpolation. Due to rigorous restrictions the application of sewage sludge to agricultural land is extremely small.

Table 5.2.3.1 Application of sewage sludge to agricultural soils (in tonnes of N)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Sewage sludge	78	78	78	78	78	78	70	62	55	33
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Sewage sludge	12	20	43	18	5	3	1	1	0,4	0,4
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Sewage sludge	18	0,04	0,04	0,04	7,18	0,51	18,31	0,00	0,00	0,00
	2020	**2021**								
Sewage sludge	0,00	0,00								

Emission factors

An emission factor 0,13 kg of ammonia nitrogen per kg of total nitrogen applied by sewage sludge was used (EMEP/EEA 2019). For the nitrogen content in sewage sludge the value 3,9 % (on dry matter basis) was used.

Recalculations

No recalculations were performed since last submission.

Future improvements

No further improvements are planned until the next submission.

Nitric oxide

Emissions of nitric oxide following the application of sewage sludge are more or less negligible. It can happen that the use of sewage sludge in agriculture will increase in future and therefore the source was not neglected.

Methodology

The Tier 1 approach suggested by EMEP/EEA air pollutant emission inventory guidebook, 2019 was used to assess the emissions of nitric oxide.

Activity data

Data sources on sewage sludge application to the agricultural soils are described in the frame of ammonia methodology (see text above).

Emission factors

An emission factor 0,040 kg NO_2 per kg of nitrogen which is applied to soil in form of sewage sludge was used as suggested by EMEP/EEA air pollutant emission inventory guidebook, (2019).

Recalculations

No recalculations were done since the previous report.

Future improvements

No further improvements are planned until the next submission.

5.2.4 Other organic fertilizers applied to soils

NFR Code 3Da2c

Two sources of other organic fertilizers to soils were identified, i.e. urban composts and digestates from biogas facilities.

Ammonia

Methodology

Tier 1 approach, as suggested by EMEP/EEA air pollutant emission inventory guidebook (2019) was used.

Activity data

Data on urban compost application to the agricultural soils have been obtained from the reports submitted by urban compost facilities to Environment Agency of the Republic of Slovenia. Data for the period 2014-2021 are available. For the period 1990-2013 the average value from the period 2014-2018 was considered. It was estimated that composts contained 14 kg of N per tonne. The estimate is based on the analyses of compost which were performed in the frame of monitoring programme for the period 2014-2018.

Data on digestates have been obtained from the reports submitted by biogas production plants to Environment Agency of the Republic of Slovenia. Biogas production from non-manure substrates started in 2006, however only the data for the period 2015-2021 are available. For the period 2006-2014 the quantities were estimated by linear regression taken into account zero value in 2005. In order to avoid double counting of N from animal manures, the latest was subtracted from the total estimate. From the information which was gathered from biogas plants in 2010 and some recent information it was estimated that animal manures represent 1/3 of substrate which is used for biogas production. It was estimated that digestates contained 2,5 kg of N per tonne. The estimate is based on the analyses of digestates during the period 2014-2018. It refers to a mixture of solid and liquid digestates as produced by biogas plants.

The estimated quantities of N which is applied to agricultural soils by urban composts and digestates are presented in Table 5.2.4.1.

Table 5.2.4.1 Application of urban composts and digestates (non manure sources) to agricultural soils (in tonnes of N)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Urban composts	52,56	52,56	52,56	52,56	52,56	52,56	52,56	52,56	52,56	52,56
Digestates	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Urban composts	52,56	52,56	52,56	52,56	52,56	52,56	52,56	52,56	52,56	52,56
Digestates	0,00	0,00	0,00	0,00	0,00	0,00	15,83	31,66	47,49	63,32
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Urban composts	52,56	52,56	52,56	52,56	55,51	52,59	49,66	38,89	66,19	52,90
Digestates	79,15	94,98	110,80	126,63	142,46	158,29	174,12	138,68	221,52	176,88
	2020	**2021**								
Urban composts	43,04	72,40								
Digestates	225,29	229,72								

Emission factors

Default emission factor, as suggested by EMEP/EEA air pollutant emission inventory guidebook (2019) was used (0,08 NH_3 per kg of N applied to soils).

Recalculations

No recalculations were done since the previous report.

Future improvements

No further improvements are planned until the next submission.

Nitric oxide

Methodology

The Tier 1 approach suggested by EMEP/EEA air pollutant emission inventory guidebook, 2019 was used to assess the emissions of nitric oxide.

Activity data

Data sources on urban composts and digestates application to the agricultural soils are described in the frame of ammonia methodology (see text above).

Emission factors

An emission factor 0,040 kg NO_2 per kg of nitrogen which is applied to soil in form of urban composts or digestates was used as suggested by EMEP/EEA air pollutant emission inventory guidebook (2019).

Recalculations

No recalculations were done since the previous report.

Future improvements

No further improvements are planned until the next submission.

5.2.5 Urine and dung deposited by grazing animals

NFR sector 3Da3

Ammonia

Introduction

Ammonia emissions due to nitrogen in animal excreta deposited during grazing is minor source of ammonia emissions. They contribute about 3 % of total emissions.

Methodology

Ammonia emissions due to N excretion on pasture were calculated within methodology described in chapter Manure management (NFR sector 3B). The emissions are reported under this chapter.

Activity data

For activity data regarding the emissions due to nitrogen in animal excreta deposited during grazing see chapter on Manure management (NFR sector 3B).

Emission factors

Emission factors used for calculation of the emissions due to nitrogen in animal excreta deposited during grazing are given in chapter on Manure management (NFR sector 3B) (Tables 5.1.7, 5.1.9 and 5.1.11).

Recalculations

Data on the percentage of cattle grazed were revised for the 2017-2020 period. The corrections are described in the chapter on manure management (NFR sector 3B).

Future improvements

No further improvements are planned until the next submission.

Nitric oxide

Methodology

Nitric oxide emissions due to nitrogen deposited to agricultural soils by grazing animals were assessed according to EMEP/EEA air pollutant emission inventory guidebook, 2019 methodology. No Tier 2 methodology is available and therefore Tier 1 methodology was used. Emissions were obtained by multiplying the amount of nitrogen returned to soils by grazed farm animals by an adequate emission factor.

Activity data

Data on nitrogen which is returned to soil by grazing farm animals were calculated within methodology described in chapter Manure management (NFR sector 3B).

Emission factors

An emission factor 0,040 kg NO_2 per kg of N returned to soils by grazing farm animals was used (EMEP/EEA air pollutant emission inventory guidebook, 2019).

Recalculations

Data on the percentage of cattle grazed were revised for the 2017-2020 period. The corrections are described in the chapter on manure management (NFR sector 3B).

Future improvements

No further improvements are planned until the next submission.

Non-methane volatile organic compounds (NMVOCs)

Methodology

NMVOCs emissions due to grazing were calculated within methodology described in chapter Manure management (NFR sector 3B). The emissions are reported under this chapter.

Activity data

For activity data regarding the emissions due to grazing see chapter on Manure management (NFR sector 3B).

Emission factors

Emission factors used for calculation of the emissions due to grazing are given in chapter on Manure management (NFR sector 3B) (Tables 5.1.12 and 5.1.13).

Recalculations

Data on the percentage of cattle grazed were revised for the 2017-2020 period. The corrections are described in the chapter on manure management (NFR sector 3B).

Future improvements

No further improvements are planned until the next submission.

5.2.6 Farm-level agricultural operations including storage, handling and transport of agricultural products

NFR Code 3Dc

Particulate matter ($PM_{2.5}$, PM_{10})

Methodology

The detailed (Tier 2) approach suggested by EMEP/EEA air pollutant emission inventory guidebook, 2019 was used to assess the emissions of particulate matter from crop production. Emissions from soil cultivation, harvesting, cleaning and drying of crops were estimated.

Activity data

The activity data were obtained from the SORS. They include the areas of arable land as well as temporary and permanent grasslands. Some cereals which are characterised by a specific emission factors (wheat and spelt, rye and triticale, barley, oat) were treated separately.

Emission factors

Emission factors for PM_{10} and $PM_{2.5}$ are presented in Tables 5.2.6.1 and 5.2.6.2. These factors refer to wet climate conditions. With the exemption of grasslands it was considered that each operation is carried out once a year. In case of temporary grasslands it was considered that cultivation appears once per two years only. It was also considered that 30 % of grasslands (temporary and permanent) is harvested as a hay and that harvesting is carried out twice a year. The areas of crop types which were used for assessment of PM_{10} and $PM_{2.5}$ are presented in Table 5.2.6.3.

Table 5.2.6.1 Emission factors used for calculation of PM_{10} emissions from crop production (Source: EMEP/EEA air pollutant emission inventory guidebook, 2019)

Crop	Soil cultivation (kg/ha per year)	Harvesting (kg/ha per year)	Cleaning (kg/ha per year)	Drying (kg/ha per year)
Wheat (including spelt)	0,25	0,49	0,19	0,56
Rye (including triticale)	0,25	0,37	0,16	0,37
Barley	0,25	0,41	0,16	0,43
Oat	0,25	0,62	0,25	0,66
Other arable	0,25	NC	NC	NC
Temporary grasslands	0,125[a]	0,15[b]	0	0
Permanent grasslands	0	0,15[b]	0	0

[a] given that permanent grasslands are cultivated once per two years (estimate) EMEP/EEA (2019) factor (0,25 kg/ha per operation) was divided by two
[b] factor based on estimate that 30% of meadows are harvested as a hay and that hay making is performed twice a year. EMEP/EEA (2019) factor (0,25 kg/ha per operation) was multiplied by 0,3 and 2 (0,25×0,3×2=0,15).

Table 5.2.6.2 Emission factors used for calculation of $PM_{2.5}$ emissions from crop production (Source: EMEP/EEA air pollutant emission inventory guidebook, 2019)

Crop	Soil cultivation (kg/ha per year)	Harvesting (kg/ha per year)	Cleaning (kg/ha per year)	Drying (kg/ha per year)
Wheat (including spelt)	0,015	0,02	0,009	0,168
Rye (including triticale)	0,015	0,015	0,008	0,111
Barley	0,015	0,016	0,008	0,129
Oat	0,015	0,025	0,0125	0,198
Other arable	0,015	NC	NC	NC
Temporary grasslands	0,0075[a]	0,006[b]	0	0
Permanent grasslands	0	0,006[b]	0	0

[a] given that permanent grasslands are cultivated once per two years (estimate) EMEP/EEA (2019) factor (0,015 kg/ha per operation) was divided by two
[b] factor based on estimate that 30% of meadows are harvested as a hay and that hay making is performed twice a year. EMEP/EEA (2019) factor (0,01 kg/ha per operation) was multiplied by 0,3 and 2 (0,01×0,3×2=0,006)

The PM2.5 and PM10 emission factors represent filterable PM emissions.

Table 5.2.6.3 Areas of various crop types in Slovenia in 000 ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Wheat (including spelt)	43,50	39,43	36,41	37,17	35,88	36,78	35,16	33,43	35,03	31,62
Rye (including triticale)	2,63	2,74	2,69	2,64	2,10	2,29	2,28	1,78	1,71	1,55
Barley	7,49	7,86	8,15	9,09	12,65	12,72	12,54	10,83	10,87	10,94
Oat	2,74	2,37	2,38	2,39	2,59	1,87	1,89	1,82	1,79	2,41
Other arable	162,35	178,42	172,38	173,40	171,16	166,36	163,89	155,90	155,87	154,55
Temporary grasslands	28,38	23,99	23,58	23,21	21,31	24,68	21,63	21,06	20,37	20,86
Permanent grasslands	310,37	334,33	333,30	330,36	319,11	308,67	300,81	289,99	287,47	296,59
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Wheat (including spelt)	38,26	39,34	35,73	35,59	32,39	30,06	32,08	32,04	35,41	34,53
Rye (including triticale)	1,51	1,97	2,28	2,45	3,23	3,31	3,64	3,91	3,96	4,29
Barley	11,57	12,66	12,39	13,79	15,32	15,45	17,04	18,53	19,23	20,09
Oat	2,25	1,92	2,01	1,96	1,85	2,73	2,47	2,33	1,89	1,77
Other arable	157,52	152,50	149,93	157,82	153,61	156,49	154,00	151,66	152,60	148,27
Temporary grasslands	16,76	23,63	24,03	24,19	27,65	27,70	29,21	30,22	33,93	36,48
Permanent	308,20	307,04	307,18	308,35	286,83	304,91	285,00	297,28	285,97	267,30

grasslands										
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Wheat (including spelt)	31,95	29,67	34,59	31,76	33,12	30,73	31,46	28,02	27,82	26,73
Rye (including triticale)	4,27	4,16	4,54	4,98	5,87	5,73	6,26	6,11	6,97	6,98
Barley	18,73	17,48	17,97	17,31	18,48	20,11	19,18	20,37	20,99	21,14
Oat	1,77	1,84	1,37	1,20	1,36	1,51	1,33	1,45	1,25	1,21
Other arable	143,26	142,71	147,96	149,20	150,84	147,57	150,79	151,86	149,57	149,0
Temporary grasslands	35,50	34,30	32,96	34,42	32,56	30,37	31,78	32,48	34,16	32,37
Permanent grasslands	285,71	262,60	281,16	277,48	279,92	278,68	276,25	279,22	277,17	277,76
	2020	**2021**								
Wheat (including spelt)	27,29	26,79								
Rye (including triticale)	6,43	5,79								
Barley	22,21	21,86								
Oat	0,95	1,20								
Other arable	154,69	154,22								
Temporary grasslands	34,25	35,96								
Permanent grasslands	279,59	275,60								

Recalculations

SORS subsequently corrected some of the 2020 crop acreage data, and the corrected data were used to estimate 2020 emissions.

Source-specific planned improvements

No improvements are planned for this source.

5.2.7 Cultivated crops

NFR Code: 3De

<u>Non-methane volatile organic compounds (NMVOCs)</u>

Methodology

NMVOCs emissions due to cultivation of agricultural crops were calculated according to tier 1 methodology as suggested by EMEP/EEA air pollutant emission inventory guidebook (2019).

Activity data

The activity data were obtained from the SORS. They include the areas of arable land excluding fallow land.

Emission factors

An emission factor 0,86 kg NMVOC per ha was used (EMEP/EEA air pollutant emission inventory guidebook, 2019).

Recalculations

SORS subsequently corrected some of the 2020 crop acreage data, and the corrected data were used to estimate 2020 emissions.

Future improvements

No further improvements are planned until the next submission.

5.2.8 Use of pesticide

NFR Code 3Df

Pesticide emissions originate mainly from their use in the agricultural and forest sectors. Since 1981 HCB has no longer been used in Slovenia as a pure substance. However, it can be present as an impurity or as a by-product in some authorized active ingredients in pesticide products certain pesticides or certain chemicals.

Methodology

To estimate emissions from use of pesticide the following methodology has been adopted for individual pollutant:

E = m x EF
E – emission (mg)
m – amount of active substance (kg)
EF – emission (impurity) factor (mg/kg)

Activity data

Activity data applied for emission calculation are data on active substances sold in agriculture. Chlorothalonil has been used in Slovenia since 1990, but there was no sale of chlorothalonil in 2021. Clopyralid has been applied since 2008. Picloram was registered for the first time in 2019. There was no sale of picloram in previous years. Data have been obtained from the Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection for the period 2007-2021. Due to the unavailability of data for the period 1990-2006 estimation of activity data for chlorothalonil was performed for that period. According to the 2020 in-depth EU NECD review recommendations detailed activity data were included in IIR (Table 5.2.8.1 and Table 5.2.8.2).

Table 5.2.8.1 Amount of active substances (1)

Active substance	Year	Amount of active substance (kg)	Year	Amount of active substance (kg)	Year	Amount of active substance (kg)
Chlorothalonil	1990-1996	8000	2005	8875	2014	5182
	1997	7953	2006	8040	2015	2474
	1998	7004	2007	7251	2016	1245
	1999	10080	2008	8997	2017	348
	2000	9215	2009	10504	2018	1185
	2001	8776	2010	16660	2019	1150
	2002	7306	2011	4889	2020	42
	2003	8542	2012	4970	2021	0
	2004	9779	2013	5016		

Table 5.2.8.2 Amount of active substances (2)

Active substance	Year	Amount of active substance (kg)
Clopyralid	2008	16
	2009	9
	2010	10
	2011	29
	2012	11
	2013	40
	2014	0,4
	2019	20
	2020	7
	2021	35
Picloram	2019	47
	2020	38
	2021	31

Emission factors

Emission factors applied for HCB emission calculations were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 2 3.D.f, 3.I Agriculture other including use of pesticides, Table 4, pg. 15. Maximum HCB concentration (impurity factor) was used for calculation (Table 5.2.8.3).

Table 5.2.8.3 HCB emission factors for use of pesticide

Active substance	Period	Value	Unit
Chlorothalonil	1990-1995	300	mg/kg
	1996-2020	40	mg/kg
Clopyralid	2008-2021	2,5	mg/kg
Picloram	2019-2021	50	mg/kg

Emissions

Emissions of HCB have been calculated for the period 1990-2021. Emissions of HCB contributed about 0,4 % to total national emissions in 2021.

Category-specific QA/QC and verification

EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emission estimation. Activity data, emission factors and methodology of emissions calculation were checked.

Use of the pesticides as pure substances listed in the Aarhus Protocol on Persistent Organic Pollutants (POPs) and the Stockholm Convention has already been prohibited: Aldrin, banned 1977; Chlordane, banned 1972; Dieldrin, banned 1972, Endrin, banned 1988, Heptachlor, banned 1974; Hexachlorobenzene, banned 1981; Mirex, it was not used in Slovenia; Hexachlorobenzene, banned 1983; Polychlorinated biphenyls, banned 1985; DDT, banned 1972.

Recalculations

No recalculations have been performed since last submission.

Planned improvements

No improvements are planned for the next submission.

5.2.9 Field burning of agricultural residues

NFR Code: 3F

Burning of agricultural residues is banned for all recipients of CAP payments. It has also not been practiced before the ban. The main reason is shortage of bedding material. About two thirds of total agricultural area is covered by grasslands. In addition, a lot of forage crops are produced on arable land. Cereals cover only about 13 % of total agricultural area and a demand on the local market is high. The price of straw (up to 0.2 € per kg in 2018) is close to price of cereal grains. Maize stover and other residues which are not used for bedding is incorporated into soil. Notation Key “NO” (not occurring) was used for this activity.

5.2.10 Other activities

Manure management - Buffalo: NFR Code 3B4a
Manure management - Mules and asses: NFR Code 3B4f
Agriculture other: NFR Code 3I

Notation Key “NO” (not occurring) was used for these sectors, since no activity or process exist within a country. No emissions originate from these sectors.

6 WASTE

This chapter covers emissions resulting from solid waste disposal on land, treatment of liquid wastes and waste incineration. Waste management and treatment of industrial and municipal wastes are minor sources of air pollutant emissions.

Sectors covered in this chapter are:

NFR Codes:

5A	Biological treatment of waste - Solid waste disposal on land
5B1	Biological treatment of waste - Composting
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities
5C1a	Municipal waste incineration
5C1bii	Hazardous waste incineration
5C1biii	Clinical waste incineration
5C1bv	Cremation
5D1	Domestic wastewater handling
5D2	Industrial wastewater handling
5E	Other waste

6.1 Biological treatment of waste - Solid waste disposal on land

NFR Code 5A

Introduction

This chapter treats emissions from solid waste disposal on land. This source is only a minor source of air pollutant emissions. Major emissions from waste disposal are emissions of greenhouse gases, predominantly CH_4.

Methodology

To estimate emissions of particulate matter from waste disposal the following methodology has been adopted:

$$E = q \times EF$$

E – emission (g)
q – quantity of total waste disposed (t)
EF – emission factor (g/t)

To estimate emissions of NMVOC from waste disposal the following methodology has been adopted:

$$E = q \times EF$$

E – emission (g)
q – quantity of landfill gas (m^3)
EF – emission factor (g/m^3)

Activity data

Relevant activity data for calculation of particulate matter emissions from solid waste disposal on land is total amount of waste handled including mineral waste such as construction and demolition waste.

Activity data used for calculation of NMVOC emissions is emitted amount of landfill gas.

Detailed description on activity data used for calculation is presented in National Inventory Report 2022, chapter CH_4 Emissions from Solid Waste Disposal sites, pg. 311.
[National Inventory Submissions 2022 | UNFCCC]

Quantities of total landfilled waste and generated amount of emitted landfill gas in the period 1990-2021 are presented in Table 6.1.1 and Table 6.1.2.

Table 6.1.1 Quantity of total waste disposed (including mineral waste handled)

Year	Amount of waste disposed (t)	Year	Amount of waste disposed (t)
2000	1294831	**2011**	763991
2001	1307961	**2012**	457369
2002	1392261	**2013**	313147
2003	1618459	**2014**	284257
2004	1228525	**2015**	275388
2005	1705214	**2016**	137596
2006	1566947	**2017**	159117
2007	2361539	**2018**	157154
2008	1870555	**2019**	169049
2009	1290335	**2020**	177024
2010	1153649	**2021**	172722

Table 6.1.2 Volume of emitted landfill gas

Year	Volume of landfill gas (Mm3)	Year	Volume of landfill gas (Mm3)
1990	41,4	**2006**	50,4
1991	42,2	**2007**	46,3
1992	41,0	**2008**	39,4
1993	40,2	**2009**	33,8
1994	39,7	**2010**	33,2
1995	39,2	**2011**	34,4
1996	41,5	**2012**	33,7
1997	45,1	**2013**	31,7
1998	47,7	**2014**	27,8
1999	50,3	**2015**	28,4
2000	52,8	**2016**	30,2
2001	54,1	**2017**	29,0
2002	54,2	**2018**	26,0
2003	55,1	**2019**	25,0
2004	55,7	**2020**	22,9
2005	54,1	**2021**	20,5

Emission factors

A default emission factors for NMVOC, $PM_{2.5}$, PM_{10} and TSP were used for emissions calculation. Emission factors were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 5A Biological treatment of waste - Solid waste disposal on land, Table 3-1, pg. 5.

Table 6.1.3 Emission factors for solid waste disposal on land

Pollutant	Value	Unit	References
NMVOC	5,65	g/m3	EMEP/EEA Emission Inventory Guidebook, 2019, 5A Biological treatment of waste - Solid waste disposal on land, Table 3-1, pg 5, notes
$PM_{2.5}$	0,033	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5A Biological treatment of waste - Solid waste disposal on land, Table 3-1, pg 5
PM_{10}	0,219	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5A Biological treatment of waste - Solid waste disposal on land, Table 3-1, pg 5
TSP	0,463	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5A Biological treatment of waste - Solid waste disposal on land, Table 3-1, pg 5

There is no information whether emission factors of particulate matter include or exclude condensable component.

Emissions

Very small quantities of NMVOC and particulates are emitted from solid waste disposal on land. The contribution of this activity to the total NMVOC is 0,4 %. Emissions of particulate matter are negligible.

NMVOC emissions are dependent on total annual amount of municipal waste and the fraction of landfilled municipal waste. The quantities of municipal waste have marked a decrease in recent years. Possible explanations is that the quantities in previous years have mostly been arrived at by estimation, whereas in the last years we had at our disposal very accurate data from all solid waste disposal sites. At the same time, the area where waste is collected separately and then recycled is getting ever wider. NMVOC, $PM_{2.5}$, PM_{10} and TSP emissions for the period 1990-2021 are presented in Figures 6.1.1 - 6.1.4.

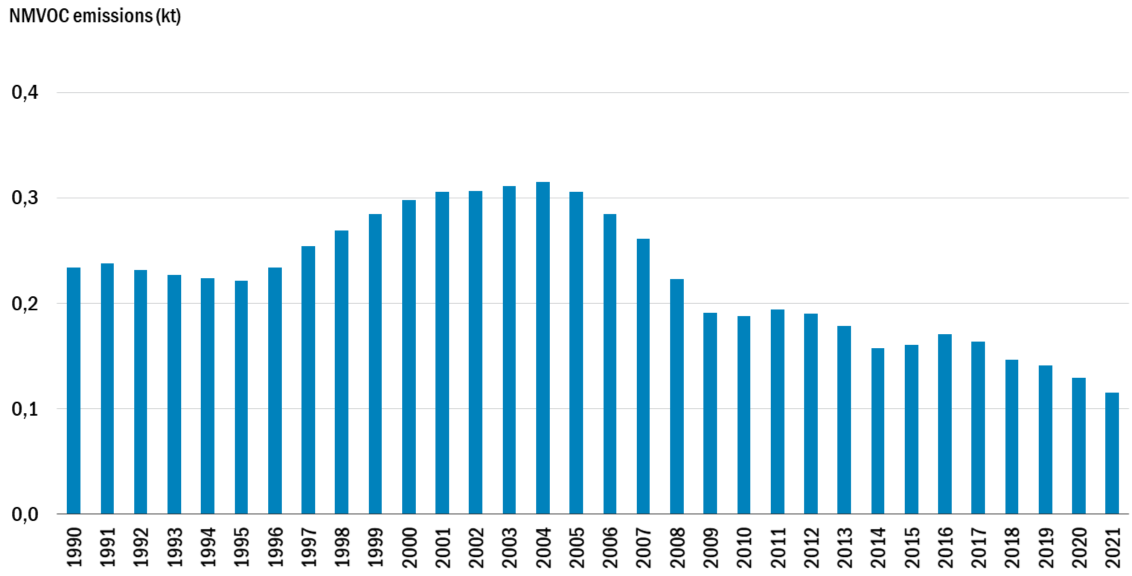

Figure 6.1.1 NMVOC emissions from solid waste disposal on land

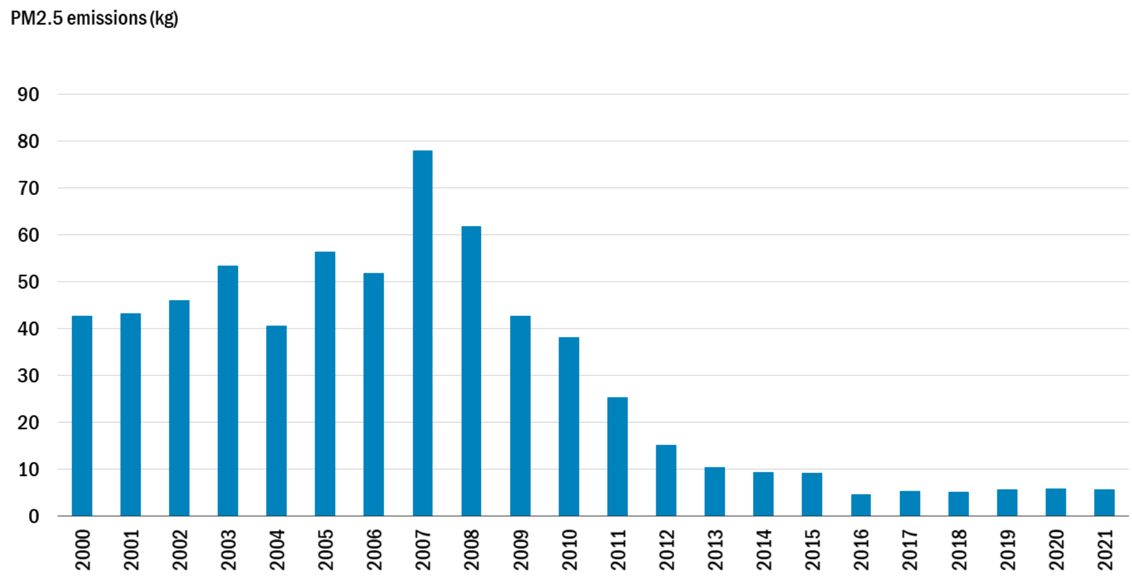

Figure 6.1.2 $PM_{2.5}$ emissions from solid waste disposal on land

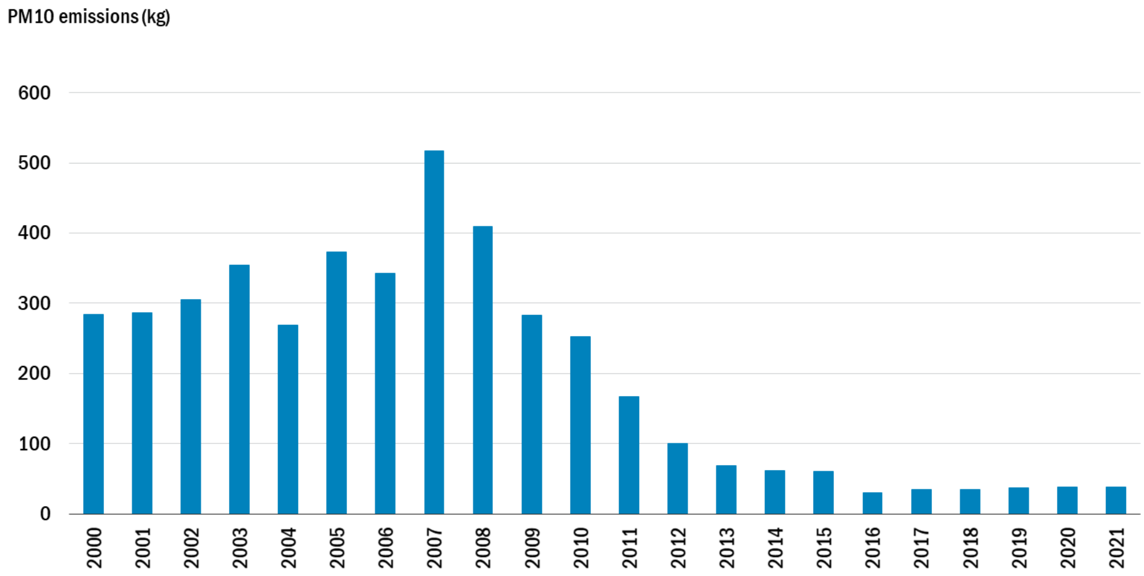

Figure 6.1.3 PM_{10} emissions from solid waste disposal on land

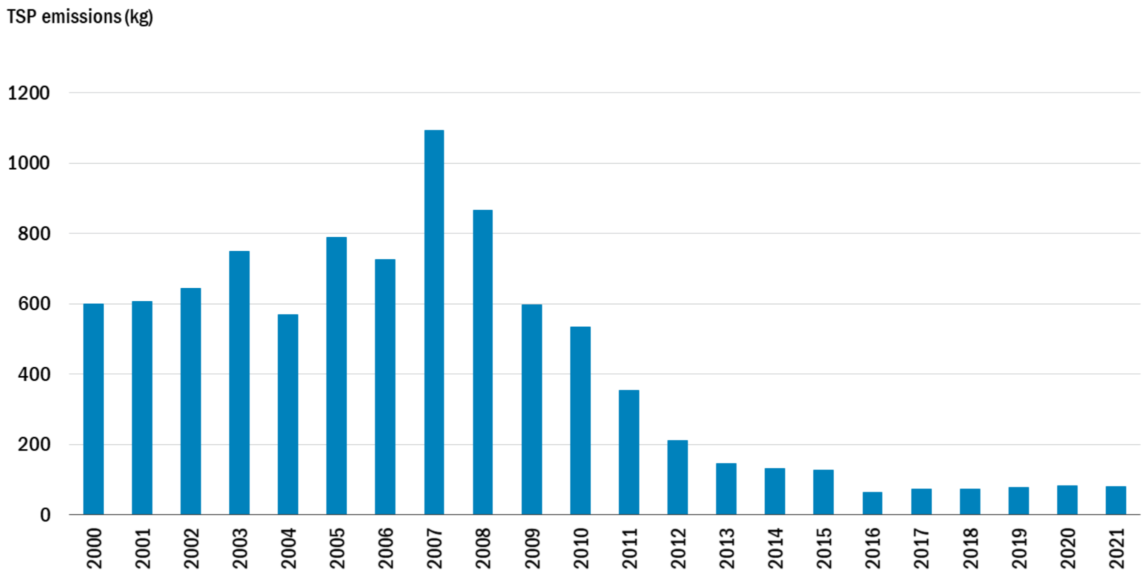

Figure 6.1.4 TSP emissions from solid waste disposal on land

Category-specific QA/QC and verification

According to the 2020 in-depth EU NECD review recommendations activity data used for emissions calculation have been thoroughly examined. Data on total amount of waste disposed including mineral waste were applied for particulate emissions estimation. Data were obtained from Statistical Office of the Republic of Slovenia. Activity data applied for NMVOC emission estimation were checked as well. Data on CH_4 emitted instead of CH_4 generated were used for NMVOC emission calculation. Emission factors applied were checked as well. EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emission calculations. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations have been performed since last submission.

Future Improvements

No improvement is planned for this category.

6.2 Biological treatment of waste – Composting

NFR Code 5B1

Introduction

This chapter covers the emissions from the biological treatment of waste – composting. This source is not significant on a national level for any pollutant, only a small amount of ammonia is produced.

Methodology

To estimate emissions of NH_3 from waste composting the following methodology has been adopted:

$$E = q \times EF$$

E – emission (g)
q – quantity of waste composted (t)
EF – emission factor (g/t)

Activity data

For calculation of NH_3 emissions from composting the relevant activity data is an annual amount of total organic waste composted in wet weight. Activity data were obtained from Statistical Office of the Republic of Slovenia for the period 2002-2021. Data for the period 1995-2001 were estimated due to unavailability of precise annual data for years before 2002. There was no composting prior the year 1995.

Table 6.2.1 Quantity of organic waste composted

Year	Waste composted (t)	Year	Waste composted (t)
1995-2001	31542	**2012**	49000
2002	31542	**2013**	66215
2003	31803	**2014**	70395
2004	23367	**2015**	72366
2005	14930	**2016**	74355
2006	11537	**2017**	97860
2007	14867	**2018**	106378
2008	18196	**2019**	109094
2009	22896	**2020**	113128
2010	26671	**2021**	131319
2011	49763		

Emission factors

Emission factor for NH_3 was taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019, 5.B.1 Biological treatment of waste - composting, compost production, Table 3-1, pg. 5. The value for NH_3 emission factor is 0,24 kg/t organic waste.

Emissions

Very small quantities of NH_3 are emitted from composting. The contribution of this activity to the total NH_3 emissions in the year 2021 is below 0,2 %.

Recalculations

No recalculations were performed since last submission.

Future Improvements

No improvement is planned for this category.

6.3 Municipal waste incineration

NFR Code 5C1a

Introduction

This sector includes emissions from domestic and commercial refuse, often referred to as 'municipal solid waste' (MSW). Municipal solid waste is the unwanted material collected from households and commercial organisations. It consists of a mix of combustible and non-combustible materials, such as paper, plastics, food waste, organic waste from home gardens, glass, defunct household appliances and other non-hazardous materials. The quantity produced per person varies with the effectiveness of the material recovery scheme in place and with the affluence of the neighbourhood from which it is collected.

Methodology

To estimate emissions from the incineration of municipal wastes the following methodology has been adopted for individual pollutant:

$$E = m \times EF$$

E – emission (kg)
m – amount of waste combusted (t)
EF – emission factors (kg/t)

Activity data

Amount on municipal waste incinerated has been obtained from Environmental Agency of the Republic of Slovenia. The data are available from the year 2002 only.

Table 6.3.1 Amount of waste incinerated

Year	Amount of waste (t)
2002	260

2003	235
2004	126
2005	294
2006	349
2007	686
2008	566
2009	649
2010	53
2011	260
2012	232
2013	141
2014	38
2015	53
2016	72
2017	135
2018	100
2019	172
2020	271
2021	247

Emission factors

In calculating emissions of individual gases, following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used.

Table 6.3.2 Emission factors for municipal waste incineration and references

Pollutant	Value	Unit	References
NO_x	1071	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
SO_x	87	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
CO	41	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
NMVOC	5,9	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
NH_3	3	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
$PM_{2.5}$	3	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
PM_{10}	3	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
TSP	3	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
BC	0,105	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Cd	4,6	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Hg	18,8	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Pb	58	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9

As	6,2	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Cr	16,4	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Cu	13,7	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Ni	21,6	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Se	11,7	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Zn	24,5	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Dioxins/ Furans	52,5	ng/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Benzo(a)pyrene	0,0084	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Benzo(b)fluoranthene	0,0179	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Benzo(k)fluoranthene	0,0095	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
Indeno(1,2,3-cd)pyrene	0,0116	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
HCB	0,0452	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9
PCB	3,4	ng/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.a Municipal waste incineration, Table 3-1, pg 9

There is no information whether emission factors of particulate matter include or exclude condensable component.

Emissions

Emissions from municipal waste incineration are extremely low for all pollutants. Contribution to total national emissions for all pollutants is below 0,002 %.

Recalculations

No recalculations were performed since last submission.

Future Improvements

No improvements are planned for next submission.

6.4 Hazardous waste incineration

NFR Code 5C1bii

Introduction

This sector comprises the atmospheric emissions from the incineration of hazardous wastes. The composition of hazardous waste varies considerably. It includes any unwanted hazardous/chemical waste such as acids and alkalis, halogenated and other potentially-toxic compounds, fuels, oils and greases, used filter materials…

Methodology

To estimate emissions from the incineration of hazardous wastes the following methodology has been adopted for individual pollutant:

$$E = m \times EF$$

E – emission (kg)
m – amount of waste combusted (t)
EF – emission factors (kg/t)

Activity data

Amount on hazardous waste incinerated has been obtained from Environmental Agency of the Republic of Slovenia. The data are available for individual plant from yearly reports for the period 1990 - 2021.

Table 6.4.1 Amount of waste incinerated

Year	Amount of waste (t)	Year	Amount of waste (t)
1990	815	**2006**	1616
1991	815	**2007**	1987
1992	815	**2008**	2091
1993	815	**2009**	2585
1994	456	**2010**	2836
1995	268	**2011**	2860
1996	389	**2012**	2994
1997	73	**2013**	6883
1998	335	**2014**	8235
1999	1031	**2015**	11110
2000	1261	**2016**	8993
2001	1190	**2017**	10906
2002	946	**2018**	8310
2003	1382	**2019**	8215
2004	1366	**2020**	7703
2005	1325	**2021**	5553

Emission factors

In calculating emissions of individual gases, following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used.

Table 6.4.2 Emission factors for hazardous waste incineration and references

Pollutant	Value	Unit	References
NO_x	0,87	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
SO_x	0,047	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10

CO	0,07	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
NMVOC	7,4	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
$PM_{2.5}$	0,004	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
PM_{10}	0,007	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
TSP	0,01	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
BC	0,00014	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
Cd	0,1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
Hg	0,056	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
Pb	1,3	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
As	0,016	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
Ni	0,14	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
Dioxins/ Furans	1	µg I-TEQ/t	Plant specific
Total 4 PAHs	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10
HCB	0,002	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge, Table 3-1, pg 10

There is no information whether emission factors of particulate matter include or exclude condensable component.

Emissions

Hazardous waste incinerators are not significant source of emissions. However, they are likely to be more significant emitters of dioxins, cadmium and mercury than many other sources. This depends on the type of waste, the combustion efficiency and the degree of abatement. Contribution of HCB emissions to total national emissions is 2,4 %, for other pollutants is below 0,3 %. Only incineration of waste without energy recovery is included in the NFR sector 5C.

Category-specific QA/QC and verification

According to the general 2019 in-depth EU NECD review recommendation EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emission calculations. Activity data was checked as well. Only incineration of waste without energy recovery is included in the NFR sector 5C. Incineration of waste with energy recovery is included in NFR sector 1A1a Public electricity and heat production as described in the IIR 2022 in the Chapter 3.1.1. New EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 was used for emissions calculation. We have checked for potential changes in emission factors and methodology described.

Recalculations

No recalculations were performed since last submission.

Future Improvements

No improvements are planned for next submission.

6.5 Clinical waste incineration

NFR Code 5C1biii

Introduction

This sector comprises the atmospheric emissions from the incineration of hospital wastes. Hospital waste includes human anatomic remains and organ parts, waste contaminated with bacteria, viruses and fungi, and larger quantities of blood.

Methodology

To estimate emissions from the incineration of hospital wastes the following methodology has been adopted for individual pollutant:

$$E = m \times EF$$

E – emission (kg)
m – amount of waste combusted (t)
EF – emission factors (kg/t)

Activity data

Amount on clinical waste incinerated has been obtained from Slovenian Environment Agency. The data are available for individual plant from yearly reports for the period 1994 - 2021. There is no data available before that period.

Table 6.5.1 Amount of waste incinerated

Year	Amount of waste (t)	Year	Amount of waste (t)
1994	132	**2008**	148
1995	0	**2009**	193
1996	0	**2010**	671
1997	214	**2011**	660
1998	205	**2012**	578
1999	85	**2013**	524
2000	109	**2014**	267

2001	280	**2015**	195
2002	441	**2016**	299
2003	534	**2017**	245
2004	138	**2018**	238
2005	113	**2019**	276
2006	108	**2020**	266
2007	160	**2021**	467

Emission factors

In calculating emissions of individual gases, following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used.

Table 6.5.2 Emission factors for clinical waste incineration and references

Pollutant	Value	Unit	References
NO_x	2,3	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
SO_x	0,54	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
CO	0,19	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
NMVOC	0,7	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
TSP	17	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
BC	0,391	kg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
Cd	8	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
Hg	54	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-2, pg 10, Table 3-3, pg 11
Pb	62	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
As	0,2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
Cr	2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
Cu	98	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
Ni	2	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
Dioxins/ Furans	1	µg I-TEQ/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
Total 4 PAHs	0,04	mg/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
HCB	0,1	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8
PCB	0,02	g/t	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.iii Clinical waste incineration, Table 3-1, pg 8

There is no information whether emission factors of particulate matter include or exclude condensable component.

Emissions

The most significant pollutants from waste incineration process are heavy metals. A variety of organic compounds, including dioxin, furans, chlorobenzenes, chloroethylenes and polycyclic aromatic hydrocarbons are also present in hospital waste or can be formed during the combustion and post-combination processes. Organics in the flue gas can exist in the vapour phase or can be condensed or absorbed on fine particulate. The relative proportion of emissions contributed by hospital waste incineration varies among pollutants. Emissions of HCB contribute about 10 %. Contributions of other pollutants are below 0,3 %.

Recalculations

No recalculations have been performed since last submission.

Future Improvements

No improvements are planned for next submission.

6.6 Cremation

NFR Code 5C1bv

Introduction

This sector comprises the atmospheric emissions from the incineration of human bodies in a crematorium. Incineration of animal carcass is not included.

Methodology

To estimate emissions from cremation the following methodology has been adopted for individual pollutant:

$$E = N \times EF$$

E – emission (kg)
N – number of human bodies cremated
EF – emission factor (kg/body)

Activity data

Activity data used for emission calculation is a number of cremations per year. The data on human bodies cremated have been obtained from two crematories operating in Slovenia. Share of cremations has been growing steadily and represents almost 80 % of deceased in Slovenia.

Table 6.6.1 Number of cremations per year

Year	Number of cremations	Year	Number of cremations
1990	5600	**2006**	12476
1991	5700	**2007**	13132
1992	5800	**2008**	13720
1993	5942	**2009**	14343
1994	6003	**2010**	14567
1995	6599	**2011**	14792
1996	6889	**2012**	15609

1997	7595	**2013**	15944
1998	8337	**2014**	15671
1999	9175	**2015**	16592
2000	9572	**2016**	16241
2001	9917	**2017**	17001
2002	10665	**2018**	17188
2003	11843	**2019**	17228
2004	12025	**2020**	20030
2005	12688	**2021**	20291

Emission factors

In calculating emissions of individual gases, following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used.

Table 6.6.2 Emission factors for cremation and references

Pollutant	Value	Unit	References
NO_x	0,825	kg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
SO_x	0,113	kg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
CO	0,140	kg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
NMVOC	0,013	kg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
TSP	38,56	g/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
PM_{10}	34,7	g/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
$PM_{2.5}$	34,7	g/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Cd	5,03	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Hg	1,49	g/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Pb	30,03	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
As	13,61	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Cr	13,56	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Cu	12,43	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Ni	17,33	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Se	19,78	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Zn	160,12	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Dioxins/ Furans	0,027	µg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Benzo(a)pyrene	13,20	µg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Benzo(b)fluoranthene	7,21	µg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9 EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9 EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v

			Cremation, cremation of human bodies, Table 3-1, pg 9
Benzo(k)fluoranthene	6,44	µg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
Indeno(1,2,3-cd)pyrene	6,99	µg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
HCB	0,15	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9
PCB	0,41	mg/body	EMEP/EEA Emission Inventory Guidebook, 2019, 5.C.1.b.v Cremation, cremation of human bodies, Table 3-1, pg 9

There is no information whether emission factors of particulate matter include or exclude condensable component.

Emissions

The contribution of Hg emissions from cremation to the total national emissions is significant (16 %). Other pollutants are of less importance. They contributed less than 0,7 % to national totals. Although the number of cremations has grown considerably in recent years, emissions still do not affect significantly on the total national inventory.

Category-specific QA/QC and verification

According to the 2021 in-depth EU NECD review recommendation incineration of animal carcasses are investigated. In Slovenia, there is no incineration of animal carcasses. Since 2005 all animal carcasses have been processed to the fuel. That fuel has been mostly exported, just a minor part has been combusted for energy purposes. Emissions arising from fuel combusted have been reported in 1A1a Public electricity and heat production. In the period before 2005, there was the incineration of animal carcasses. Emissions from animal carcasses incineration were included in NFR 5C1biii Clinical waste incineration. There is no information available on the share of animal carcasses to the total amount of clinical waste. This is a reason why emissions from animal carcasses incineration could not be separately reported under NFR 5C1bv Cremation. Due to lack of information shifting of those emissions to NFR Cremation is not possible.

Recalculations

No recalculations were performed since last submission.

Future Improvements

No improvements are planned for next submission.

6.7 Wastewater handling

Sectors covered in this chapter are:

NFR Codes:

5D1 Domestic wastewater handling
5D2 Industrial wastewater handling

Introduction

This sector covers emissions from domestic and industrial waste water handling. Activities considered within this sector are biological treatment plants and latrines (storage tanks of human excreta, located under naturally ventilated wooden shelters).

Methodology

To estimate emissions of NH_3 from latrines (domestic waste water handling) the following methodology has been adopted:

$$E = N \times EF$$

E – emission (kg)
N – number of persons using latrines
EF – emission factor (kg/person/year)

To estimate emissions of NMVOC from domestic and industrial waste water treatment the following methodology has been adopted:

$$E = q \times EF$$

E – emission (mg)
q – quantity of waste water (m^3)
EF – emission factor (mg/m^3 waste water)

Activity data

For calculation of NH_3 emissions from latrines the relevant activity data is a number of inhabitants who use latrines. It is assumed that tenants of country houses with no water-flushed toilet have to use latrines outside the house. In 2021, about 0,1 % of Slovene population were not connected to any way of waste water treatment. Data on inhabitants included into various types of domestic wastewater treatment were obtained from Statistical Office of the Republic of Slovenia and the database on municipal wastewater treatment plants collected by the Slovenian Environment Agency. Number of inhabitants who use latrines is presented in Table 6.7.1.

Table 6.7.1 Number of inhabitants who use latrines

Year	Number of inhabitants	Year	Number of inhabitants	Year	Number of inhabitants	Year	Number of inhabitants
1990	442553	**1998**	310159	**2006**	60311	**2014**	8251
1991	427672	**1999**	305732	**2007**	40517	**2015**	6193
1992	408996	**2000**	294223	**2008**	20324	**2016**	4132
1993	390473	**2001**	284307	**2009**	18423	**2017**	4134
1994	376694	**2002**	271466	**2010**	16402	**2018**	4162
1995	363635	**2003**	259018	**2011**	14388	**2019**	4192
1996	346510	**2004**	119855	**2012**	12353	**2020**	4218
1997	330596	**2005**	80134	**2013**	10305	**2021**	4214

For calculation of NMVOC emissions from industrial waste water handling, the relevant activity data is the amount of industrial wastewater output. Data on amount of industrial waste water for the period 2004-2021 were obtained from database of monitoring industrial effluents collected by the Slovenian Environment Agency. For the period 1990 - 2005 values of quantity of waste water were estimated as described in National Inventory Report 2012, chapter Industrial waste water, pg 252-256. Wastewater output with regard to various industries is presented in Table 6.7.2.

According to the 2019 in-depth EU NECD review recommendation emissions of NMVOC from domestic waste water handling were calculated and introduced to the national inventory for the first time. For calculation of NMVOC emissions from domestic waste water handling, the relevant activity data is the amount of domestic waste water handled in centralized aerobic waste water treatment plants (Table 6.7.3). Data on amount of domestic waste water handled for the period 1998 - 2021 were obtained from database of centralized aerobic waste water treatment plants collected by the Slovenian Environment Agency. Data for the period 1990-1997 were estimated.

Table 6.7.2 Wastewater output with regard to various industries

Year	Production of pulp and paper	Production of leather	Production of soft drinks and alcohol beverage	Production of food	Production of milk	Production of meat	Production of organic chemical industry	Production of pharmaceutical industry
	Wastewater output (m^3)							
1990	17785835	909674	1993106	378570	1054778	1070278	2616783	775146
1991	15813639	778661	1897174	369069	1034204	1059647	1632471	483572
1992	13167759	736567	1773698	245566	921828	764296	2540141	752443
1993	12056736	686178	1812219	272168	767155	650592	2339726	693076
1994	13879156	678212	1906083	296905	835621	634050	3021457	895019
1995	15431625	459865	1879191	304715	911369	574572	4238305	1255475
1996	14369458	529332	1881993	300437	885387	662932	3926516	1163117
1997	16266638	496348	1941510	282961	926754	663706	3948196	1169539
1998	18163843	463364	2001042	265483	968119	664480	4864277	1440901
1999	20061023	430379	2060559	248007	1009486	665255	5294039	1568206
2000	21397736	397395	2120086	230529	1050850	666029	5954235	1763770
2001	22734450	364411	2179603	213054	1092218	666803	5133504	1520652
2002	24071163	331427	2239130	195578	1133582	667578	5255464	1556779
2003	25407851	298442	2298652	178100	1174950	668352	5943503	1760591
2004	27675000	274700	1970685	136140	1133980	662367	5327103	1578000
2005	26950000	233185	1362038	178400	1230000	1420996	5024194	1368600
2006	21120000	238400	2074000	164100	986700	1143262	5530843	1545000
2007	12233000	281863	1771724	185000	985000	1393753	5205447	1488000
2008	16500000	228651	1572889	191900	982000	1334951	5404169	1523000
2009	15881919	11617	1533764	223853	901292	1162973	5405131	1765726
2010	13596494	9224	1431036	167710	865144	1268351	5406094	1633612
2011	12514742	22597	1507163	213732	871805	1161579	5005424	1560375
2012	12773572	39893	1319973	297757	820968	1119638	4867181	1465488
2013	10408933	44994	1238251	343151	835151	1074228	5250133	1528190
2014	11206175	47428	1267076	320628	838646	1144594	5586674	1578317
2015	11456759	40083	1166442	301864	750391	1307631	5265902	1684019
2016	11491537	35961	1048714	232644	805551	1346137	5466717	1747853
2017	11387032	45468	1031081	246433	854688	1457879	5798674	1783843
2018	11464901	49773	1162256	235111	909694	1405198	5505064	1793415
2019	11675106	46431	1352696	201818	1008039	1359105	5782326	1752544
2020	10795758	40085	1146404	207140	1057467	1325690	5855693	1580681
2021	9382489	56996	1315717	223076	1077120	1347185	5529978	1616169

Table 6.7.3 Amount of domestic wastewater handled

Year	Wastewater handled (m3)	Year	Wastewater handled output (m3)
1990	95605959	**2006**	109677320
1991	95556577	**2007**	113190070
1992	95325778	**2008**	126248280
1993	95102245	**2009**	131654270
1994	95105543	**2010**	145660620
1995	95143261	**2011**	119957600
1996	94986606	**2012**	130858000
1997	94887842	**2013**	150370330
1998	94572860	**2014**	156579770
1999	99678170	**2015**	133115090
2000	101579260	**2016**	149535720
2001	92241460	**2017**	150295000
2002	99326350	**2018**	162060000
2003	88098820	**2019**	158192000
2004	105150080	**2020**	152965000
2005	120834080	**2021**	154860000

Emission factors

A default emission factors for NH_3 and NMVOC were used for emission calculation. Emission factors were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019.

Table 6.7.4 Emission factors for latrines and waste water handling

Pollutant		Value	Unit	References
NH_3	Latrines	1,6	kg/person/year	EMEP/EEA Emission Inventory Guidebook, 2019, 5D Waste water handling, Table 3-2, pg 8
NMVOC	Waste water treatment in industry	15	mg/m^3 waste water	EMEP/EEA Emission Inventory Guidebook, 2019, 5D Waste water handling, Table 3-3, pg 9
NMVOC	Waste water treatment in residential and commercials sectors	15	mg/m^3 waste water	EMEP/EEA Emission Inventory Guidebook, 2019, 5D Waste water handling, Table 3-3, pg 9

Emissions

Latrines are generally only a minor source of NH_3 emissions. The contribution of this activity to the total ammonia emissions in the year 2021 is only 0,04 %. Drop of emissions in 2004 was due to wider inclusion of Slovene population into public sewage system in the last decade. More precise data are available for that period as well (Figure 6.7.1).

Biological treatment plants are only of minor importance for emissions into air, and the most important of these emissions are greenhouse gases. Industrial waste water treatment is of even less importance regarding air pollutants.Contribution of air pollutants to the total emissions is insignificant. Only very small quantities of NMVOC are emitted from domestic and industrial wastewater handling (below 0,01 %) (Figures 6.7.2 and 6.7.3).

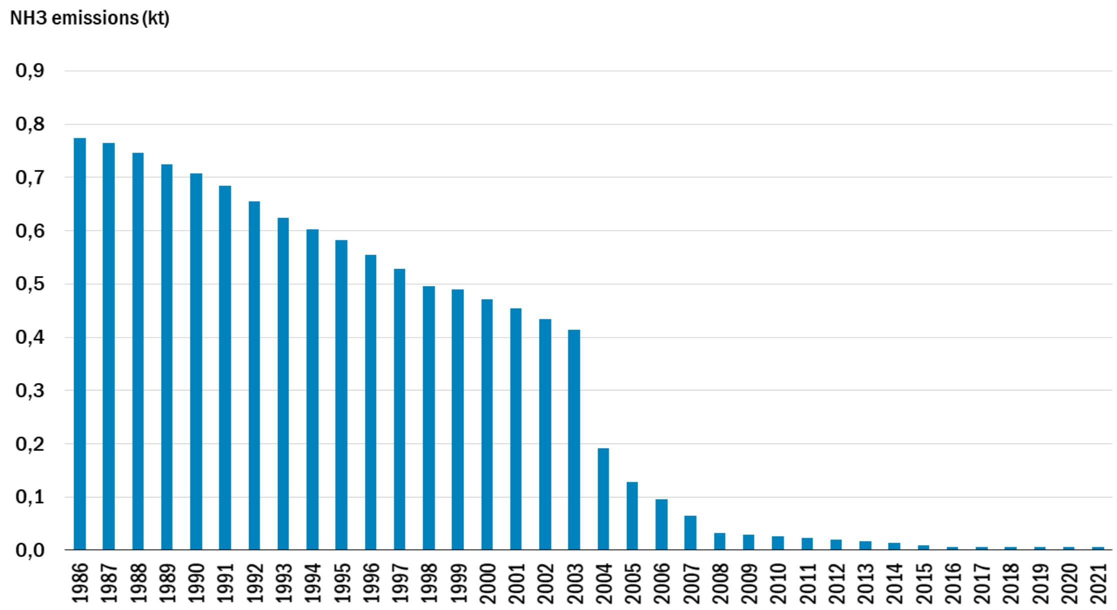

Figure 6.7.1 NH_3 emissions from latrines

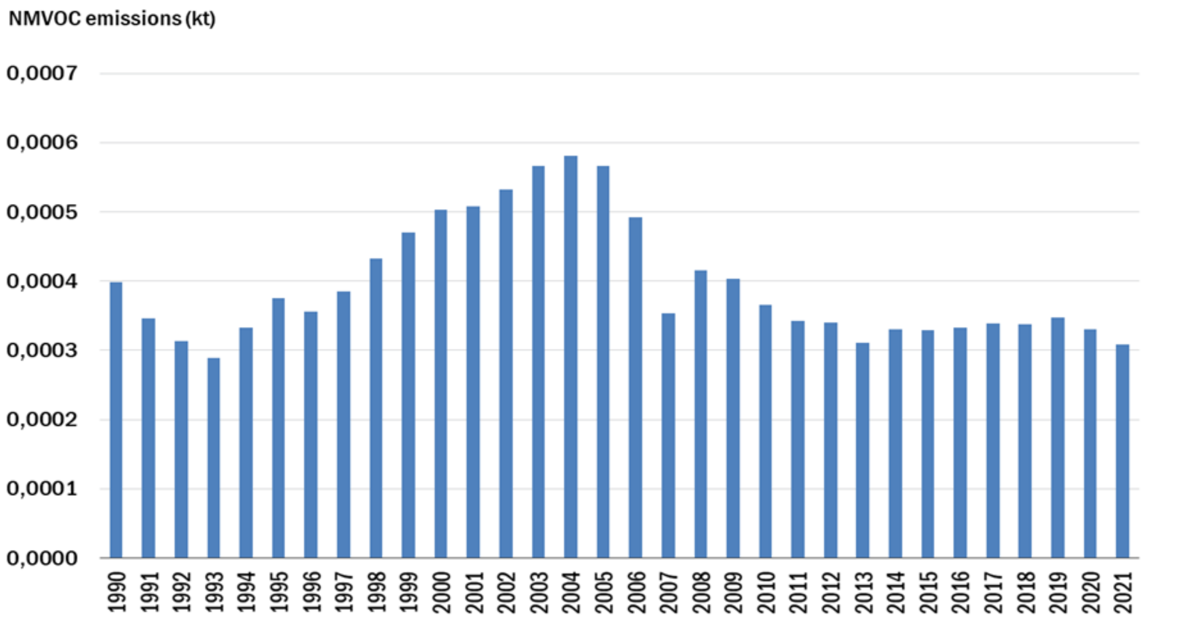

Figure 6.7.2 NMVOC emissions from industrial waste water treatment

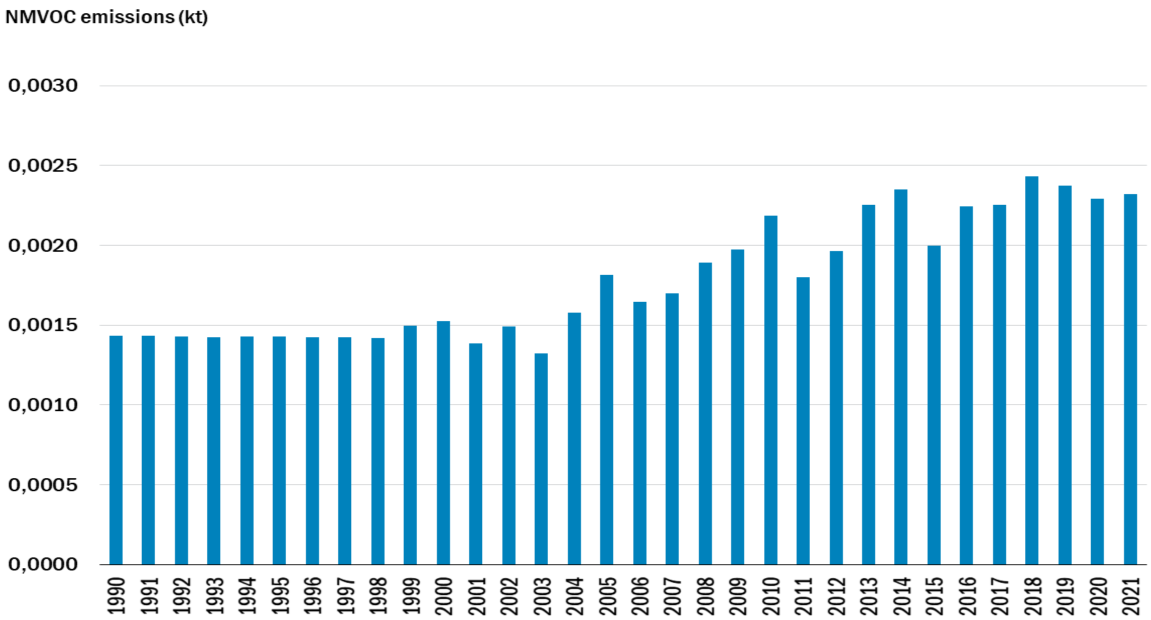

Figure 6.7.3 NMVOC emissions from domestic waste water treatment

Recalculations

<u>Domestic wastewater handling (5D1)</u>
Emissions of NMVOC were recalculated for the year 2012 and the period 2017-2020 due to new activity data applied. Updated data on the amount of domestic wastewater handled was obtained from Slovenian Environment Agency.

Future Improvements

No improvement is planned for this category.

6.8 Other waste

NFR Code 5E

Introduction

This sector comprises emissions from car, house and industrial building fires. A limited amount of sludge was spread on the agriculture land and corresponding emissions have been included in the agriculture sector in category 3Da2b. There is no other evidence of sludge spreading in Slovenia.

Methodology

To estimate emissions from fires the following methodology has been adopted for individual pollutant:

E = N x EF

E – emission (kg)
N – number of fires
EF – emission factor (kg/fire)

Activity data

Activity data used for emission calculation is a number of fires per year. Activity data (car and building fires) for the period 2005-2021 has been provided by Administration for Civil Protection and Disaster Relief of the Republic of Slovenia. Data for the period 1990-2004 was estimated. Value of 2005 was used for emission calculation for the period 1990-2004. Various types of house fires were estimated. To make an approximation for the different house types, the disaggregation of buildings across the country was applied to the housing fire statistics.

Table 6.8.1 Number of car, industrial building and house fires per year

Year	Number of car fires	Number of industrial buildings fires	Number of detached house fires	Number of undetached house fires	Number of apartment buildings fires
1990-2004	508	25	1285	163	592
2005	508	25	1285	163	592
2006	566	3	1349	171	621
2007	544	9	1346	171	619
2008	552	8	1286	163	592
2009	456	15	1282	163	590
2010	394	125	1072	136	494
2011	412	207	1223	155	563
2012	371	169	1208	153	556
2013	361	164	1147	146	528
2014	370	159	1091	138	502
2015	368	151	1186	151	546
2016	368	162	1242	158	572
2017	441	184	1407	179	648
2018	433	169	1257	160	579
2019	438	140	1129	143	520
2020	407	76	1155	147	532
2021	404	79	1232	156	567

Emission factors

In calculating emissions of individual gases, following emission factors from EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 have been used:

- for car fire: Table 3-2, pg 6, for $PM_{2.5}$, PM_{10}, TSP, dioxins/furans,
- for house fire: Tables 3-3, 3-4, 3-5, pg 7 and 8, for $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, dioxins/furans,
- for industrial building fire: Table 3-6, pg 8, for $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, dioxins/furans.

Table 6.8.2 Emission factors for fires

Car fires	Pollutant	Value	Unit	References
Car fires	**TSP**	2,3	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-2, pg 6
	PM_{10}	2,3	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-2, pg 6
	$PM_{2.5}$	2,3	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-2, pg 6
	Dioxins/ Furans	0,048	mg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-2, pg 6
Detached house fire	**TSP**	143,82	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	PM_{10}	143,82	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	$PM_{2.5}$	143,82	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	Dioxins/ Furans	1,44	mg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	Cd	0,85	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	Hg	0,85	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	Pb	0,42	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	As	1,35	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	Cr	1,29	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
	Cu	2,99	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-3, pg 7
Undetached house fire	**TSP**	61,62	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	PM_{10}	61,62	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	$PM_{2.5}$	61,62	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	Dioxins/ Furans	0,62	mg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	Cd	0,36	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	Hg	0,36	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	Pb	0,18	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	As	0,58	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	Cr	0,55	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
	Cu	1,28	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-4, pg 7
Apartment building fire	**TSP**	43,78	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	PM_{10}	43,78	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	$PM_{2.5}$	43,78	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	Dioxins/ Furans	0,44	mg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	Cd	0,26	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	Hg	0,26	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8

	Pb	0,13	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	As	0,41	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	Cr	0,39	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
	Cu	0,91	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-5, pg 8
Industrial building fires	**TSP**	27,23	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	PM_{10}	27,23	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	$PM_{2.5}$	27,23	kg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	Dioxins/ Furans	0,27	mg/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	Cd	0,16	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	Hg	0,16	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	Pb	0,08	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	As	0,25	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	Cr	0,24	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8
	Cu	0,57	g/fire	EMEP/EEA Emission Inventory Guidebook, 2019, 5E Other waste, Table 3-6, pg 8

There is no information whether emission factors of particulate matter include or exclude condensable component.

Emissions

The contribution of emissions from fires to total national emissions is about 15 % for dioxins/ furans and 2 % for particulate matter. Contributions of heavy metals are less than 0,7 %.

Recalculations

According to the 2022 in-depth EU NECD review recalculation of emissions from fires were performed. Disaggregation of buildings on detached house, undetached house and apartment building were used for emissions calculation from house fires.

Emissions of Pb, Cd, Hg, As, Cu, Cr, dioxins and furans were recalculated for the period 1990-2020, and emissions of TSP, PM_{10} and $PM_{2.5}$ for the period 2000-2020.

Future Improvements

No improvements are planned for next submission.

6.9 Other activities and Additional information

NFR Code 5B2
Biological treatment of waste - Anaerobic digestion at biogas facilities

Explanation of NH_3 emission estimations is given in paragraph 5.1 of IIR 2023 (Manure management (3. B)). NH_3 emissions from anaerobic digestion at biogas facilities were calculated and introduced to the national inventory for the first time in the 2021 submission. Emissions of NH_3 were estimated for 1995-2021.

According to the 2022 in-depth EU NECD review to improve transparency explanation on NH_3 emissions reported in NFR 5B2 are included.

NH_3 emissions reported in NFR 5B2 arose only from the anaerobic digestion of manure. No additional source of NH_3 emissions is reported in that NFR code. Emissions of NH_3 from waste were not reported since all mechanical biological treatment facilities in Slovenia are very new and modern, and all emissions from these facilities to the air are considered to be zero. In 2016, the largest biological treatment plant started to operate, where more than a third of Slovenian waste is treated. A good technical specification of this unit can be found on the link below https://www.wtert.net/bestpractice/14/MBT-Ljubljana-In-Slovenia-arises-one-of-the-largest-and-most-modern-plants-in-Europe.html

Recalculations

Recalculations of NH_3 emissions were performed for 2017-2020 due to new activity data obtained. Based on the newly published 2020 cattle and swine farm size structure data (SORS), we revised the 2017-2020 data on rearing methods and livestock manure collection. Recalculation affected ammonia emissions from manure management. It also affected emissions from the biological treatment of waste.

NFR Code 5C2
Open burning of waste

According to the 2021 in-depth EU NECD review recommendation investigation of open burning of waste was performed. In Slovenia, there has been no open burning of waste. Therefore emissions from this source have not been considered in the national emissions report. Notation Key "NO" is correct. Open burning of waste has not been practised in Slovenia. It is prohibited by law since 2005. But also before the year 2005, there were no such activities. Forest and orchard residues have been left on spot to enrich the area with organic matter.

Industrial waste incineration: NFR Code 5C1bi
Sewage sludge incineration: NFR Code NFR 5C1bi
Other waste incineration (please specify in the IIR): NFR Code 5C1bvi
Open burning of waste: NFR Code 5C2
Other wastewater handling: NFR Code 5D3

Notation Key "NO" (not occurring) were used for these sectors, since they are not sources of any additional emissions in Slovenia. No emissions occur in these sectors.

7 RECALCULATIONS AND IMPROVEMENTS

In general, considerable work has been carried out in the last few years to improve the inventory. New investigations and research carried out in Slovenia and abroad were, as far as possible, included as the basis for the emission estimates and included as data in the inventory databases. Furthermore, the updates of the EMEP/EEA air pollutant emission inventory guidebook and the work in the Task Force on Emission Inventories and Projections and its expert panels are followed closely in order to be able to incorporate the best scientific information as the basis for the inventories. Further important references in this regard are the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Implementation of new results in inventories is made in a way so that improvements better reflect Slovenia conditions and circumstances. In improving the inventories, care is taken to consider the implementation of improvements for the whole time-series of inventories, to promote consistency. Such efforts lead to recalculation of previously submitted inventories.

In the last two years, IIR was improved with better transparency of emission factors and activity data used and methodology applied. Our main goal was to calculate emissions according to the 2023 Guidelines for reporting emissions and projections data under the Convention and ensure completeness of the inventory. We have focused great attention on the introduction of new sources. We made a thorough examination of all emission factors used. We also pay special attention to notation keys used. NFR tables were corrected and filled with appropriate notation keys.

We applied the methodology and emission factors from the new EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019 for all sectors. Recalculation of emissions from all sectors was performed due to the use of a new guidebook and in-depth EU NECD review recommendations.

In 2022 our national inventory was subjected to the in-depth EU NECD and CLRTAP reviews. We improved our inventory with most TERT expert review team recommendations. We have estimated uncertainty for the NO_x, SO_x, NH_3, NMVOC and $PM_{2.5}$.

Information on a condensable component of particulate matter was introduced into IIR 2023. A table summarising whether PM_{10} and $PM_{2.5}$ emission factors for each source sector include or exclude the condensable component and references for their emission factors are presented in Annex 2 to the IIR 2023. Indication of particulate information in the methodology sections of IIR is included as well.

7.1 Recalculations

Recalculations in following sectors have been done since last submission to improve inventory:

Energy

<u>Public electricity and heat production (1A1a)</u>
Emissions of $PM_{2.5}$, PM_{10}, TSP and BC have been recalculated for the period 2008-2020 due to mistakes found in importing data to the reporting tables. The error was found during QA/QC procedure.

<u>Road transport (1A3b)</u>
Recalculation of all emissions for the entire period was performed due to an application of a new version of COPERT 5 model. The newest version of COPERT 5 (version 5.6.1) was used for emissions calculation. Emissions of SO_x, NO_x, CO have been recalculated for the period

1980-2020, emissions of NH_3 for the period 1986-2020, emissions of $PM_{2.5}$, PM_{10}, TSP, BC for the period 2000-2020, emissions of Pb, Cd, Ni, Se, Zn, Cr, Cu, Hg, As, dioxins/furans, indeno(1,2,3-cd)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, HCB, PCB for the period 1990-2020. Additional recalculations were performed due to the introduction of gasoline heavy duty trucks into the national fleet for the period 1980-1991.

Domestic aviation LTO (civil) (1A3aii(i))
Emissions of SO_x, NO_x, CO, NMVOC, $PM_{2.5}$, PM_{10}, TSP and BC have been recalculated for the year 2020 due to new activity data applied. A mistake in the amount of jet kerosene was found due to a mistake in importing data to the reporting table. The error was found during QA/QC procedure.

Residential: Stationary (1A4bi)
Recalculation of emissions in the residential sector has been performed due to changes in activity data and emissions factors used for wood combustion. Updated data on different types of technologies used for burning solid biomass have been applied for emissions calculations. Emissions of NO_x and CO have been recalculated for the period 1980-2020, emissions of NH_3 for the period 1986-2020, emissions of NMVOC, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, dioxins and furans and PCB were recalculated for the period 1990-2020, emissions of TSP, BC, PM_{10} and $PM_{2.5}$ have been recalculated for the period 2000-2020.

Agriculture/Forestry/Fishing: National fishing (1A4ciii)
Emissions of NO_x, SO_x, CO, NMVOC, Pb, Cd, Hg, Cu, Cr, Ni, Se, Zn, As, HCB, PCB, dioxins and furans, TSP, BC, PM_{10} and $PM_{2.5}$ were recalculated for the year 2020 due to new activity data used. The data provider reported a new amount of diesel consumed in 2020.

Industrial processes and solvent use

Quarrying and mining of minerals other than coal (2A5a)
According to the 2022 in-depth EU NECD review recommendation recalculation of particulate emissions have been performed due to changes in the methodology used. A higher Tier method has been used. Emissions from quarrying and mining have been calculated according to a Tier 2 method. Emissions of $PM_{2.5}$, PM_{10}, TSP have been recalculated for the whole period 2000-2020.

Construction and demolition (2A5b)
Emissions of $PM_{2.5}$, PM_{10}, TSP have been recalculated for the period 2000-2020 due to new activity data applied. Updated data on road construction were used. Mistakes in importing data to the reporting table were found. The error was found during QA/QC procedure.

Domestic solvent use including fungicides (2D3a)
In the present submission emissions of Hg, which were included under this category, have been excluded from the inventory, because this source is no more considered in EMEP/EEA air pollutant emission inventory guidebook due to the big uncertainty.

Asphalt roofing (2D3c)
Due to the improved data in plant reports emissions of NMVOC for 2019 and 2020 have been recalculated.

Other solvent use (2D3i)
All relevant emissions (SO_2, CO, NOx, TSP, PM_{10}, $PM_{2.5}$, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn) since 2010 have been recalculated due to the improved data on fireworks use, which were obtained from national statistics and due to the use of a more-years average when yearly data on import was too low or too high. Special circumstances like the Covid epidemic were also taking into

account. In addition emissions of NMVOC and PAHs have been recalculated since 2010 due to the improved data on creosote oil, which were obtained from national statistics instead from a plant.

Agriculture

Manure management (3B)
The SORS released rabbit census data and final horse census data for 2020. The new data were used in estimating emissions. We also corrected the data for 2017-2019, for which we used interpolated values between the 2016 and 2020 census years.
Based on the newly published 2020 cattle and swine farm size structure data (SORS), we revised the 2017-2020 data on rearing methods and livestock manure collection. Recalculation affected ammonia emissions from manure management. It also affected emissions from biological treatment of waste (NFR 5B2 – Anaerobic digestion at biogas facilities).
An error was found in the estimate of ammonia emissions from cattle manure storage facilities for the period 2013-2020 (too high percentage of covered storage facilities was taken into account).
Emission factors for ammonia emissions from sheep and rabbit manure storage were harmonized with EMEP/EEA (2019) for the entire reporting period (from 0,28 to 0,32).

Animal manure applied to soils (3Da2a)
The SORS released rabbit census data and final horse census data for 2020. The new data were used in estimating the amount of nitrogen in animal manures. We also corrected the data for 2017-2019, for which we used interpolated values between the 2016 and 2020 census years.
An error was found in the considered estimates for the share of low-emission slurry application techniques in years 2019 and 2020. The recalculations affecting ammonia emissions were performed for these two years.
The estimates of nitrogen amount in animal manures were also affected by revised estimates of nitrogen losses from animal houses and manure stores. Details on these recalculations are given in Chapter 5.1.

The SORS released rabbit census data and final horse census data for 2020. The new data were used in estimating the amount of nitrogen in animal manures. We also corrected the data for 2017-2019, for which we used interpolated values between the 2016 and 2020 census years.
The estimates of nitrogen amount in animal manures were also affected by revised estimates of nitrogen losses from animal houses and manure stores. Details on these recalculations are given in Chapter 5.1.

The NMVOC estimates are based on the proportions of ammonia emissions from animal houses on the one hand and emissions from manure application on the other. Therefore, some minor corrections were made to the NMVOC emission estimates resulting from corrections to the estimates of ammonia emissions from the barns and from application of animal manures.

Urine and dung deposited by grazing animals (3Da3)
Data on the percentage of cattle grazed were revised for the 2017-2020 period. The corrections are described in the chapter on manure management (NFR sector 3B). Recalculation have been performed for NH_3, NO_x and NMVOC.

Farm-level agricultural operations including storage, handling and transport of agricultural products (3Dc)
SORS subsequently corrected some of the 2020 crop acreage data, and the corrected data were used to estimate 2020 emissions.

Cultivated crops(3De)
SORS subsequently corrected some of the 2020 crop acreage data, and the corrected data were used to estimate 2020 emissions.

Waste

Biological treatment of waste - Aerobic digestion at biogas facilities (5B2)
Recalculations of NH_3 emissions were performed for 2017-2020 due to new activity data obtained. Based on the newly published 2020 cattle and swine farm size structure data (SORS), we revised the 2017-2020 data on rearing methods and livestock manure collection. Recalculation affected ammonia emissions from manure management. It also affected emissions from the biological treatment of waste.

Domestic wastewater handling (5D1)
Emissions of NMVOC were recalculated for the year 2012 and the period 2017-2020 due to new activity data applied. Updated data on the amount of domestic wastewater handled was obtained from Slovenian Environment Agency.

Other waste (please specify in the IIR) (5E)
According to the 2022 in-depth EU NECD review recommendation recalculation of emissions from fires were performed. Disaggregation of buildings on detached house, undetached house and apartment building were used for emissions calculation from house fires. Emissions of Pb, Cd, Hg, As, Cu, Cr, dioxins and furans were recalculated for the period 1990-2020, and emissions of TSP, PM_{10} and $PM_{2.5}$ for the period 2000-2020.

Memo

Domestic aviation cruise (civil) (1A3aii(ii))
Emissions of SO_x, NO_x, CO, NMVOC, $PM_{2.5}$, PM_{10}, TSP and BC have been recalculated for the year 2020 due to new activity data applied. A mistake in the amount of jet kerosene was found due to a mistake in importing data to the reporting table. The error was found during QA/QC procedure.

Table 7.1.1 Changes due to recalculations of main pollutants emissions between 2023 and 2022 inventory submission for inventory year 2020

Sector	Main Pollutants				Other
	NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	CO
	kt	kt	kt	kt	kt
1A1 Energy industries	0	0	0	NE	0
1A2 Manufacturing industries and construction	0	0	0	0	0
1A3 Transport	0,244	0,483	0,000	-0,001	0,201
1A4 Small combustion and non-road mobile sources and machinery	-0,005	0,060	0,000	0,002	0,150
1A5 Other	0	0	0	NE	0
1B Fugitive emissions from fuels	0	0	0	NE	0
2A Mineral industry	NA	NA	NA	NA	NA

2B Chemical industry	0	0	0	NE	NE
2C Metal industry	0	0	0	NE	0
2D-2L Other solvent and product use	0	0,067	0	0	0,000
3B Manure management	-0,005	0,077	NA	0,402	NA
3D-3I Crop production and agricultural soils	-0,018	-0,042	NA	-0,090	NA
5A Biological treatment of waste - Solid waste disposal on land	NA	0	NA	NE	NE
5B Biological treatment of waste – Composting, Anaerobic digestion at biogas facilities	NE	NE	NE	-0,002	NE
5C Waste incineration	0	0	0	0	0
5D Wastewater handling	NA	0,000	NA	0	NA
5E Other waste	NE	NE	NE	NE	NE

Table 7.1.2 Changes due to recalculations of particulate matter emissions between 2023 and 2022 inventory submission for inventory year 2020

Sector	Particulate Matter			
	$PM_{2.5}$	PM_{10}	TSP	BC
	kt	kt	kt	kt
1A1 Energy industries	-0,0157	-0,0176	-0,0196	-0,0002
1A2 Manufacturing industries and construction	0	0	0	0
1A3 Transport	0,034	0,080	0,082	0,036
1A4 Small combustion and non-road mobile sources and machinery	0,077	0,079	0,084	0,002
1A5 Other	0	0	0	0
1B Fugitive emissions from fuels	0	0	0	0
2A Mineral industry	-0,125	-1,414	-4,074	-0,125
2B Chemical industry	0	0	0	NE
2C Metal industry	0	0	0	0
2D-2L Other solvent and product use	0	0	-0,038	0
3B Manure management	0,000	-0,001	-0,002	NA
3D-3I Crop production and agricultural soils	0,000	0,000	NA	NA
5A Biological treatment of waste - Solid waste disposal on land	0	0	0	NA
5B Biological treatment of waste – Composting, Anaerobic digestion at biogas facilities	NE	NE	NE	NE
5C Waste incineration	0	0	0	0
5D Wastewater handling	NE	NE	NE	NE
5E Other waste	0,085	0,085	0,085	NE

Table 7.1.3 Changes due to recalculations of heavy metals emissions between 2023 and 2022 inventory submission for inventory year 2020

Sector	Priority Heavy Metals		
	Pb	Cd	Hg
	t	t	t
1A1 Energy industries	0	0	0
1A2 Manufacturing industries and construction	0	0	0
1A3 Transport	1,188	0,005	0,000
1A4 Small combustion and non-road mobile sources and machinery	0,000	0,000	0,000
1A5 Other	NE	NE	NE
1B Fugitive emissions from fuels	0	0	0
2A Mineral industry	0	0	0
2B Chemical industry	NE	NE	NE
2C Metal industry	0	0	0
2D-2L Other solvent and product use	0	0	-0,012
3B Manure management	NA	NA	NA
3D-3I Crop production and agricultural soils	NA	NA	NA
5A Biological treatment of waste - Solid waste disposal on land	NA	NA	NE
5B Biological treatment of waste – Composting, Anaerobic digestion at biogas facilities	NA	NA	NA
5C Waste incineration	0	0	0
5D Wastewater handling	NE	NE	NE
5E Other waste	0,000	0,001	0,001

Table 7.1.4 Changes due to recalculations of heavy metals emissions between 2023 and 2022 inventory submission for inventory year 2020

Sector	Aditional Heavy Metals					
	As	Cr	Cu	Ni	Se	Zn
	t	t	t	t	t	t
1A1 Energy industries	0	0	0	0	0	0
1A2 Manufacturing industries and construction	0	0	0	0	0	0
1A3 Transport	0,014	0,444	9,752	0,068	0,008	3,064
1A4 Small combustion and non-road mobile sources and machinery	0,000	0,000	0,000	0,001	0,000	0,000
1A5 Other	NE	NE	NE	NE	NE	NE
1B Fugitive emissions from fuels	0	0	0	0	0	0
2A Mineral industry	0	0	0	0	0	0
2B Chemical industry	NE	NE	NE	NE	NE	NE
2C Metal industry	0	0	0	0	NE	0

2D-2L Other solvent and product use	0	0	0	0	NE	0
3B Manure management	NA	NA	NA	NA	NA	NA
3D-3I Crop production and agricultural soils	NA	NA	NA	NA	NA	NA
5A Biological treatment of waste - Solid waste disposal on land	NA	NA	NA	NA	NA	NA
5B Biological treatment of waste – Composting, Anaerobic digestion at biogas facilities	NA	NA	NA	NA	NA	NA
5C Waste incineration	0	0	0	0	0	0
5D Wastewater handling	NE	NE	NE	NE	NE	NE
5E Other waste	0,001	0,001	0,002	NE	NE	NE

Table 7.1.5 Changes due to recalculations of POPs emissions between 2023 and 2022 inventory submission for inventory year 2020

Sector	POPs							
	PCDD/ PCDF (dioxins/ furans)	PAHs					HCB	PCBs
		benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4		
	g I-TEQ	t	t	t	t	t	kg	kg
1A1 Energy industries	0	0	0	0	0	0	0	0
1A2 Manufacturing industries and construction	0	0	0	0	0	0	0	0
1A3 Transport	-0,006	0,000	0,000	0,000	0,000	0,000	0,000	0,000
1A4 Small combustion and non-road mobile sources and machinery	0,074	0,006	0,015	-0,002	0,013	0,032	0,000	0,000
1A5 Other	NE	NE	NE	NE	NE	NE	NA	NA
1B Fugitive emissions from fuels	NA	NA	NA	NA	NA	NA	NA	NA
2A Mineral industry	NA	NA	NA	NA	NA	NA	NA	NA
2B Chemical industry	NA	NA	NA	NA	NA	NA	NA	NA
2C Metal industry	0	0	0	0	0	0	NE	0
2D-2L Other solvent and product use	0	0,001	0,000	0,000	0,000	0,002	NE	-0,010
3B Manure management	NA	NA	NA	NA	NA	NA	NA	NA
3D-3I Crop production and agricultural soils	NA	NA	NA	NA	NA	NA	0	NA
5A Biological treatment of waste - Solid waste disposal on land	NA	NA	NA	NA	NA	NA	NA	NA
5B Biological treatment of waste – Composting, Anaerobic digestion at biogas facilities	NA	NA	NA	NA	NA	NA	NA	NA
5C Waste incineration	0	0	0	0	0	0	0	0
5D Wastewater handling	NA	NA	NA	NA	NA	NA	NA	NA
5E Other waste	0,852	NE	NE	NE	NE	NE	NE	NE

7.2 Planned improvements

<u>Coating application (2D3d)</u>

The next step of improvement for this category would be a split of decorative coating applications between domestic use and paint use in construction and buildings. At that moment, we have no data and no reliable methodology to perform such a disaggregation. As this improvement would not affect the total emissions, it is not planned for the near future.

Chemical products (2D3g)
According to the 2019 EEA/EMEP GB, only four plastic processing have to be included in the inventory: Polyester- PE, Polyvinylchloride - PVC, Polyurethane foam - PUR and Polystyrene foam - PS. In statistical data, only the production of PE and PUR is available, while data on PS and PVC are not available. There is also no Tier 2 EF for PVC production in the 2019 EMEP/EEA GB while Tier 2 EF for PE production is available for the amount of monomer used and not for PE produced. For all these reasons we didn't use Tier 2 EFs for the present submission. In further investigation, we have found out that CO_2 has been used as a blowing agent for PUR production since 1994 in one plant. On the other hand despite data on PS production are not available from the SORS there are three PS foam producers in Slovenia.

The expert in peer review recommended that measurements of NMVOC (total organic o-toluidine) from relevant processes are the best option to estimate emissions from these sources. NMVOC emissions from these plants are available since 2009. In 2016 emissions from these plants were only 0.078 kt, while emissions from the production of plastics calculated with AD (Plastics in primary forms) * Tier 1 EF was 1.45 kt. The emissions for the other years have not been obtained, yet.

For future submissions, we will investigate the possibility to use data on NMVOC (total organic o-toluidine) emissions from the Remis database since 2009 for relevant plastics production processes and asses the implementation of this methodology.

Manure management (3B)
It will be considered whether relevant information on manure storage practices can be obtained by processing the raw data collected as part of the 2020 Census.

Animal manure applied to soils (3Da2a)
Official data on manure management practices, including application techniques, were collected by SORS in 2020. The data were published in July 2023 (SORS, 2023). From the published data, it is possible to obtain information on the number of farms using a particular manure application technique. However, the data are aggregated by animal species (cattle, pigs, sheep, goats, poultry). In addition, there is no information on the number of animals kept on the farms, so it was not possible to estimate the amount of manure applied by different application methods. It will be considered whether relevant information on manure application techniques can be obtained by processing the raw data collected as part of the 2020 Census.

8 TABLE FOR TRACKING IMPLEMENTATION of NECD REVIEW FINDINGS

Table 8.1 All findings for NO_X, NMVOC, SO_2, NH_3, PM2.5 and PM10, including those made during the 2022 NECD inventory review and those not implemented from previous reviews

EMRT-NECD Observation	Improvement made/planned	Reference into IIR
SI-2A5a-2022-0001	Revised emission estimates were included in NFR tables and a methodological description was added in the IIR 2023.	NFR tables, IIR Chapter 4.1.4
SI-5E-2022-0001	Revised emission estimates were included in NFR tables and a methodological description was added in the IIR 2023.	NFR tables, IIR Chapter 6.8
SI-0A-2021-0001	The assessment of the uncertainty was performed and included in the IIR.	IIR Chapter 1.6, Annex 3
SI-1A4cii-2022-0002	The explanation was added in the IIR 2023.	IIR Chapter 3.4.3
SI-2D-2022-0001	The explanation was added in the IIR 2023.	IIR Chapter 4.4.1
SI-3B-2020-0001	Data on animal husbandry and manure storage practices from the 2020 Census were published in July 2023. From the published data, it is not possible to obtain appropriate information for estimating emissions of nitrogen compounds from manure storage facilities. It would make sense to check whether it is possible to obtain relevant information by processing the raw data collected by SURS (see Future improvements).	IIR Chapter 5.1
SI-3D-2022-0001	The appropriate notation keys (NE) were applied in NFR.	NFR tables
SI-5B2-2022-0001	The explanation was added in the IIR 2023.	IIR Chapter 6.9

9 PROJECTIONS

Air pollutant emissions projections reported in the 2023 submission are the same as were reported in the 2021 submission. Updated projections will be available for the next projection reporting round.
Greenhouse gases and air pollutants projections have been based on the same database and assessment models. The projection database is used as the common basis for reporting on emission projections under the NEC directive and CLRTAP as well as under GHG reporting obligations.

The methodology used for preparing air pollutant emissions projections is explained in IIR 2021, Chapter 8 Projections, pg 285-304 (file: IIR_2021_Slovenia_SI_May_2021.pdf).
https://cdr.eionet.europa.eu/si/eu/nec_revised/iir/envykz2iw/

10 ABBREVATIONS

AD	activity data
Al_2O_3	aluminium oxide
As	arsenic
BC	black carbon
BAT	best available techniques
C	confidential
CaO	calcium oxide
$CaCO_3$	calcium carbonate
Cd	cadmium
CDR	Central Data Repository (of the EEA's Eionet Reportnet)
CEIP	Centre on Emission Inventories and Projections
CH_4	methane
CLRTAP	(UNECE) Convention on Long-range Transboundary Air Pollution
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
CORINAIR	COoRdination of INformation on AIR emissions
Cr	chromium
CRF	common reporting format (for greenhouse gases, UNFCCC)
CAS	Chemical Abstracts Service
COPERT	model and methodology for determination of road transport emission
CS	country specific
Cu	copper
D	default value
EC	European Commission
EEA	European Environment Agency
EF	emission factor
EIONET	European environmental information and observation network
EMEP	European Monitoring and Evaluation Programme
ETS	Emission Trading Scheme
EU	European Union
EURO	European emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU
EUROSTAT	Statistical Office of the European Communities
GHG	greenhouse gases
GB	EMEP/EEA Air Pollutant Emission Inventory Guidebook
FGD	device for the desulphurization of flue gases
Fe_2O_3	iron (III) oxide
HCB	hexachlorobenzene
HCE	hexachloroethane
HOS database	Slovenian database with plant specific emission values
Hg	mercury
HM(s)	heavy metal(s)
IE	included elsewhere
IEA	International Energy Agency
IED	Industrial Emissions Directive
IIR	Informative Inventory Report
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated pollution prevention and control (EU Directive)
ISEE	Slovenian emission inventory information system
I-TEQ	international toxic equivalents

JQ	Joint Questioner, statistics data
KCA	key category analysis
LEG	annual energy statistics of the energy sector
LPG	liquefied petroleum gas
LRTAP	Long-range Transboundary Air Pollution
LTO	landing and take-off cycle, aviation
M	model
MgO	magnesium oxide
MSW	municipal solid waste
N	nitrogen
NCV	net caloric value
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NECD	National Emission Ceilings Directive (EU Directive)
NFR	nomenclature for reporting (air pollutants, UNECE)
NH_3	ammonia
Ni	nickel
NIR	National Inventory Report
NK	notation kye
NMVOC(s)	non-methane volatile organic compound(s)
NO	not occurring
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NR	not relevant
O_3	ozone
PAH(s)	polycyclic aromatic hydrocarbon(s)
Pb	lead
PCB(s)	polychlorinated biphenyl(s)
PCDD/F(s)	polychlorinated dibenzodioxin(s)/dibenzofuran(s)
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
PCT	polychlorinated terphenyls
PM	particulate matter
PM_{10}	coarse particulate matter (particles measuring 10 μm or less)
$PM_{2.5}$	fine particulate matter (particles measuring 2.5 μm or less)
POP(s)	persistent organic pollutant(s)
PS	plant specific
QA	quality assurance
QC	quality control
REMIS database	Slovenian database with plant specific emission values
RS	Republic of Slovenia
SCA	Standard Classification of Activities
S	suplhur
Se	selenium
SEA	Slovenian Environment Agency
SiO_2	silicon dioxide
SNAP	Selected Nomenclature for reporting of Air Pollutants
SORS	Statistical Office of the Republic of Slovenia
SO_2	sulphur dioxide
SO_x	sulphur oxides
T	tier (method)
TERT	Technical Expert Review Team
TAN	total ammonia nitrogen
TFEIP	Task Force on Emission Inventories and Projections

TSPs	total suspended particulates
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VOC	volatile organic compound
Zn	zinc

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