2024

LATVIA'S INFORMATIVE INVENTORY REPORT

submitted under the convention
on long-range transboundary air pollution

Data sheet

Title

Latvia’s Informative Inventory Report 1990-2022
Submitted under the Convention on Long-Range Transboundary Air Pollution

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Authors

Asnate Skrebele, Vita Štelce, Laine Lupkina, Santija Treija, Intars Cakars, Lauris Siņics
Latvian Environment, Geology and Meteorology Centre

Gaidis Klāvs, Larisa Gračkova
Institute of Physical Energetics

Laima Bērziņa, Olga Šķiste
Latvia University of Life Sciences and Technologies

Andis Lazdiņš, Arta Bārdule
Latvian State Forest Research Institute “Silava”

Editing

By sectoral ministries

Cover photo

Dzintars Lapiņš

Design

Dārta Narkeviča

Contact

Asnate Skrebele
Latvian Environment, Geology and Meteorology Centre
Latgales street 165, Riga, LV-1019, Latvia
E-mail: asnate.skrebele@lvgmc.lv

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Abbreviations

CHP – Combined feat and power plants
CR – Register of Chemical Substances and Chemical Mixtures
CSB – Central Statistical Bureau of Latvia
EMEP – Co-operative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe
EMEP/CORINAIR – Atmospheric emission inventory guidebook, Co-operative Programme for Monitoring and Evaluation on the Long Range Transmission of Air Pollutants in Europe, The Core Inventory of Air Emmisions in Europe
EMEP/EEA 2016 – EMEP/EEA air pollutant emission inventory guidebook 2016
EMEP/EEA 2019 – EMEP/EEA air pollutant emission inventory guidebook 2019
EMEP/EEA 2023 – EMEP/EEA air pollutant emission inventory guidebook 2023
EU ETS – European Union Emission Trading System
GHG – Greenhouse gases
HDD – Heating degree days
HPP – Hydroelectric power plants
IPCC – Intergovernmental Panel on Climate Change
2006 IPCC Guidelines – 2006 IPCC Guidelines for National Greenhouse Gas Inventories
IPCC GPG 2000 - IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000)
IPPU – Industrial processes and Product use
KCA – Key category analysis
LEGMC – Latvian Environment, Geology and Meteorology Centre
LPG – Liquefied petroleum gas
LULUCF – Land Use, Land Use Change and Forestry
MEPRD – Ministry of the Environmental Protection and Regional Development
MMS – manure management systems
MoA – Ministry of Agriculture
NCV – Net calorific value
NECD – National Emissions Ceilings Directive
NFR – Nomenclature for Reporting
QA – Quality assurance
QC – Quality control
REBs – Regional Environmental Boards
RFO – Residual fuel oil
RTSD – Road Traffic Safety Department
SFS – State Forest Service
TERT – Technical Expert Review Team
UN – United Nations
UNECE CLRTAP – United Nations Economic Commission for Europe's Convention on Long-Range Transboundary Air Pollution
UNFCCC – United Nations Framework Convention on Climate Change

Pollutants

Main pollutants (from 1990)
NOx – nitrogen oxides, expressed as NO_2
NMVOC – non-methane volatile organic compounds
NH_3 – ammonia
SO_2 – sulphur dioxide

Other (from 1990)
CO – carbon monoxide

POPs – persistent organic pollutants (from 1990)
PCDD/PCDF–polychlorinated dibenzodioxins/furans
HCB – hexachlorobenzene
PCB – polychlorinated biphenyl
PAHs – polycyclic aromatic hydrocarbons, includes:
benzo(a)pyrene
benzo(b)fluoranthene
benzo(k)fluoranthene
indeno(1,2,3-cd)pyrene)

PM – particulate matter (from 1990)
$PM_{2.5}$ – particulate matter, particle size <2.5 µm
PM_{10} – particulate matter, particle size <10 µm
TSP – total suspended particulates
BC – black carbon

HM – heavy metals (from 1990)
Pb – lead
Cd – cadmium
Hg – mercury
As – arsenic
Cr – chromium
Cu – copper
Ni – nickel
Se – selenium
Zn – zinc

Executive summary

The Informative Inventory report of air pollution (IIR) in Latvia has been prepared by Latvian Environment, Geology and Meteorology Centre (LEGMC) in collaboration with Ministry of the Environmental Protection and Regional Development (MEPRD), Central Statistical Bureau (CSB), Institute of Physical Energetics, Latvian State Forest Research Institute "Silava", Latvia University of Life Sciences and Technologies, according to the 2014 Reporting Guidelines (hereinafter – Reporting Guidelines) and revised Gothenburg Protocol and National Emissions Ceilings Directive (NECD). IIR is submitted to the UNECE Secretariat and EEA annually.

This report includes information on the emission data from 1990 to 2022 for anthropogenic emissions of NOx, NMVOC, SO_2, NH_3 (main pollutants); CO (other); TSP, PM_{10}, $PM_{2.5}$, BC (particulate matter); Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn (heavy metals) and PCDD/PCDF, PAHs, PCB, HCB (persistent organic pollutants), compiled according to the guidelines for estimating and reporting emissions. Emission data is reported in the Nomenclature for Reporting format as requested in the Reporting Guidelines. Summary about total emissions can be found in Chapter 2. Detailed information about emission trends and pollutants produced in each sector can be found under appropriate sectors and subsectors.

Latvia's IIR Submission 2024 includes detailed information about air pollutant sectors – Energy, Industrial Processes and Product Use, Agriculture, Waste, Natural emissions and Other and their subsectors. Each subsector is described with following chapters – an overview, trends in emissions, methods, emission factors, activity data, uncertainties, QA/QC and verification, recalculations and planned improvements. Activity data used for emission calculation was obtained from CSB, European Union Emission Trading System (EU ETS), national databases "2-Air", "2-Water", "3-Waste", other different databases and directly from enterprises and institutions.

Comparing emissions between IIR Submission 2023 and IIR Submission 2024, changes in reported national totals and calculations can be detected. The recalculations are done due to updated activity data and emission factors, implementation of sector specific research and results of 2023 Comprehensive Technical Review of National Emission Inventories. Detailed information about recalculations can be found in Chapter 8.1 and in each sector appropriate subsectors chapter. Implementation status of 2023 Comprehensive Technical Review of National Emission Inventories results can be found in Chapter 8.3. Information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex IV.

1 Introduction

1.1 Background information on emission inventory

The Republic of Latvia has ratified the Convention on Long-Range Transboundary Air Pollution (Geneva, 1979) by Resolution Nr. 63 of 7 July 1994 of the Cabinet of Ministers of Latvia. Later on, Latvia has signed following Protocols of Convention:

- The 1998 Protocol on Persistent Organic Pollutants (POPs);
- The 1998 Protocol on Heavy Metals;
- The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.

On 31 December 2016 Directive (EU) 2016/2284 of the European Parliament and 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 or NEC directive entered into force. Directive[1] sets out new emission reduction commitments for Latvia regarding sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds, ammonia and fine particulate matter. The reduction commitments refer to 2005 as a base year and shown as percentage reduction (Table 1.1).

Table 1.1 Emission reduction commitments for Latvia set out in NECD

Pollutant	For any year from 2020 to 2029	For any year from 2030
SO_2	8%	46%
NO_x	32%	34%
NMVOC	27%	38%
NH_3	1%	1%
$PM_{2.5}$	16%	43%

In order to follow the progress towards attainment of emission reduction commitments, Latvia also has to provide annual national emission inventory, emission projections and IIR, which describes the emission calculations made in more detail.

National legislation acts regarding air quality monitoring:

- No. 614 of Cabinet of Ministers (02.10.2018) - Regulations for reducing and recording the total air pollutant emissions;
- No. 675 of Cabinet of Ministers (25.10.2022) - GHG inventory, projections and adaptation to climate change reporting systems.

According to the revised Guidelines for Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/125, revised 13 March 2014 hereinafter referred to as the Reporting Guidelines) Party has to annually submit emission inventory to the secretariat of the Convention on Long-Range Transboundary Air Pollution (CLRTAP).

This report is based on emission data submitted on 15 March 2024 and covers information on trends in emissions, descriptions of each NFR category, recalculations and planned improvements. It contains information on emission inventories in Latvia from 1990 to 2022 for anthropogenic emissions of:

Main pollutants: NO_x, NMVOC, SO_2, NH_3 (kt)
Other: CO (kt)
Particulate matter: TSP, PM_{10}, $PM_{2.5}$, BC (kt)
Heavy metals: Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn (t)
POPs: PCDD/PCDF (g i-Teq), PAHs (t), PCB, HCB (kg)

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.344.01.0001.01.ENG

Emission data is reported in the Nomenclature for Reporting (NFR 2019-1) format as requested in the Reporting Guidelines.

The latest recalculations in emission inventory were done for the time period from 1990 to 2021. Recalculations were done due to the change of activity data, as well as implementing recommendations received after 2023 Comprehensive Technical Review of National Emission Inventory. Detailed information about recalculations done in each sector is described in appropriate subsector.

1.2 Description of the institutional arrangements for inventory preparation

Latvian IIR Submission 2024 is prepared by LEGMC in cooperation with other institutions. The purpose of LEGMC is to collect and process environmental information, to carry out environmental monitoring and inform the public of the status of the environment, to provide geological supervision and rational use of natural resources, to implement the state policies in geology, meteorology, climatology, hydrology and air quality and to assess the impact of transboundary air pollution.

The experts of LEGMC have created emission inventory by using expert publications and evaluations in co-operation with following institutions:

- Ministry of the Environmental Protection and Regional Development;
- Central Statistical Bureau;
- Institute of Physical Energetics;
- Latvian State Forest Research Institute "Silava";
- Latvia University of Life Sciences and Technologies;
- Ministry of Agriculture;
- Ministry of Transport;
- Ministry of Economics;
- Ministry of Climate and Energy.

1.3 Description of the process of inventory preparation

The process of the inventory compilation consists of inventory planning, which includes decision making of methodological and organisational issues, and time frame for inventory preparation.

In the first stage, specific responsibilities are defined and allocated. In the second stage, the inventory preparation process, activity data, emission factors and all relevant information necessary for final emission estimation is collected.

Emission inventory of Latvia is generally based on the EMEP/EEA air pollutant emission inventory guidebook 2023 (EMEP/EEA 2023) with an exception in few sectors where previous versions of EMEP emission inventory guidebooks and methodologies from 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) are used.

NFR 2019-1 format is used to prepare inventory for 1990-2022. For most sectors supplemental databases in MS Excel format have been developed and used for emission calculations. For transport emission calculations special "Computer Programme to calculate Emissions from Road Transportation" (COPERT 5), which is proposed to be used by EEA Member Countries for the compilation of EMEP/EEA emission inventories, is used. Additional research in different source categories was made, to compile data and investigate appropriate approach to fulfil Convention obligations.

The deadline for submitting the activity data and its description for all institutions involved in inventory process is 1st of November. Deadline of data submission regarding fuel consumption is 30th of November when CSB prepares Energy balance for EUROSTAT.

More detailed information on methodologies and activity data is given in the description of sectors in Chapters 3-7.

1.4 Description of key source categories

The Key category analysis (KCA) for 1990 and 2022 was done according to the EMEP/EEA 2023 Level and Trend assessment. According to EMEP/EEA 2023, key categories are emission sources that together contribute to 80% of the total national emissions. KCA was performed for each reported pollutant separately using Approach 1 - Level assessment and Approach 1 - Trend assessment. The level assessment key categories for 1990 and 2022 are shown in Table 1.2 and Table 1.3.

Table 1.2 Level assessment key categories in 1990[2]

	Key categories (Sorted from high to low from left to right)													Total (%)
NOx	1A3biii 12.2%	1A3bi 11.5%	1A1a 10.4%	1A3c 10.2%	1A4aii 6.3%	3Da1 5.3%	1A4ai 5.1%	1A2gviii 4.5%	1A2gvii 4.4%	1A2e 4.2%	1A4cii 4.2%	1A4ciii 3.4%		81.8%
NMVOC	1A3bi 15.8%	1A4bi 14.9%	3B1a 11.2%	2D3d 6.0%	1A3biii 4.9%	1A4cii 4.6%	3Da2a 4.1%	2H2 4.0%	3B1b 3.9%	1A4ai 3.6%	1A2gvii 3.1%	1B2b 2.5%	1A3bv 2.3%	80.8%
SO_2	1A1a 35.8%	1A4ai 22.3%	1A4bi 8.4%	1A2e 8.0%	1A2gviii 7.6%									82.1%
NH_3	3Da2a 23.5%	3B1a 23.0%	3B3 16.9%	3Da1 13.8%	3Da3 5.0%									82.1%
$PM_{2.5}$	1A4bi 60.3%	1A4ai 9.6%	6A 5.2%	1A4aii 3.4%	1A1a 2.9%									81.3%
PM_{10}	1A4bi 51.3%	1A4ai 8.4%	3Dc 8.4%	6A 5.2%	1A1a 3.1%	1A4aii 2.8%	2A2 2.4%							81.6%
TSP	1A4bi 45.1%	1A4ai 7.3%	3Dc 6.7%	6A 6.7%	2A2 5.1%	1A1a 3.6%	3B3 2.7%	3B4gi 2.6%	1A4aii 2.3%					82.0%
BC	1A4bi 39.1%	1A4aii 11.9%	1A4ai 8.6%	1A2gvii 8.2%	1A4cii 7.4%	1A3biii 4.1%	1A3c 3.3%							82.6%
CO	1A3bi 41.8%	1A4bi 28.3%	1A4cii 8.0%	1A2gvii 4.7%										82.8%
Pb	2C1 69.8%	1A3bi 16.2%												86.0%
Cd	2C1 46.4%	1A4bi 29.9%	1A4ai 10.5%											86.8%
Hg	1A4ai 46.8%	1A4bi 19.2%	1A1a 12.4%	1A4ci 6.4%										84.8%
PCDD/ PCDF	1A4bi 58.7%	5E 12.8%	1A4ai 11.5%											83.0%
PAHs	1A4bi 65.8%	1A4ai 13.8%	6A 13.8%											93.4%
HCB	3Df 96.5%													96.5%
PCBs	1A4ai 62.0%	1A4bi 27.2%												89.2%

In 1990, Energy sector was a key source for the largest part of pollutants. For SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, Hg, PCDD/PCDF, PAHs and PCBs emissions the main contributor was Stationary combustion (NFR 1A1, 1A2, 1A4), especially Residential subsector (NFR 1A4b). For NO_x, NMVOC and CO emissions - Transport sector (NFR 1A3), particularly Road transport (NFR 1A3b). The main contributor for NH_3 and HCB emissions in 1990 was Agriculture sector (NFR 3), and for Pb, Cd emissions the main contributor was IPPU sector (NFR 2C).

Table 1.3 Level assessment key categories in 2022

	Key categories (Sorted from high to low from left to right)										Total (%)
NOx	1A3biii 15.6%	1A3bi 11.0%	1A2gviii 10.2%	3Da1 10.1%	1A1a 9.2%	2A1 6.1%	1A3bii 5.2%	1A4cii 5.2%	1A3c 4.5%	1A4bi 4.4%	81.5%
NMVOC	1A4bi 26.0%	2D3d 14.2%	2D3i 10.0%	3B1a 9.4%	2D3a 7.6%	2D3g 4.1%	2H2 4.0%	3B1b 3.4%	3Da2a 3.1%		81.8%
SO_2	1A1a	1A4bi	1A2gviii	1A4cii							80.6%

[2] Full list of NFR codes can be found on Annex V.

	Key categories (Sorted from high to low from left to right)						Total (%)
	28.5%	22.6%	22.0%	7.5%			
NH_3	3B1a 22.7%	3Da1 20.8%	3Da2a 19.8%	1A4bi 7.6%	3B3 5.9%	3Da3 4.8%	81.6%
$PM_{2.5}$	1A4bi 58.5%	1A1a 17.4%	1A2gviii 6.1%				82.0%
PM_{10}	1A4bi 39.1%	2D3b 16.7%	1A1a 13.2%	3Dc 11.1%			80.2%
TSP	2D3b 44.9%	1A4bi 23.7%	1A1a 8.4%	2A5a 4.5%			81.5%
BC	1A4bi 58.3%	1A3bi 7.6%	1A2gviii 5.7%	1A1a 5.1%	1A3biii 2.5%	1A3bii 2.4%	81.6%
CO	1A4bi 65.8%	1A2gviii 4.9%	1A3bi 4.5%	6A 4.1%	1A4bii 3.7%		83.0%
Pb	1A3bvi 28.1%	2G 20.1%	1A3bi 13.1%	1A4bi 10.4%	1A2gviii 9.6%		81.3%
Cd	1A4bi 42.1%	1A2gviii 34.4%	1A1a 7.0%				83.5%
Hg	1A1a 37.5%	2A1 14.5%	1A2gviii 14.3%	1A4bi 11.6%	5C1bv 6.3%		84.2%
PCDD/ PCDF	1A4bi 61.9%	5E 16.0%	1A2gviii 9.4%				87.3%
PAHs	1A4bi 74.5%	6A 12.6%					87.1%
HCB	3Df 38.4%	1A1a 21.4%	1A4bi 17.8%	1A2gviii 17.5%			95.1%
PCBs	1A1a 60.8%	1A2gviii 13.6%	1A4bi 7.6%				82.0%

Table 1.2 and Table 1.3 show that the key sources have slightly changed in 2022 in comparison with 1990. The main source for the majority of pollutants has remained Energy sector, (NFR 1) especially the Residential subsector (NFR 1A4b). Agriculture sector (NFR 3) has remained as a key category for NH_3 and HCB emissions. In comparison with key categories from 1990 main contributor for NMVOC emissions in 2022 is Residential sector (NFR 1A4b) as well as for CO emissions. For TSP emissions, main contributor is Road paving with asphalt (NFR 2D3b).

The trend assessment key categories for 2022 can be seen in Table 1.4.

Table 1.4 Trend assessment key categories in 2022

	Key categories (Sorted from high to low from left to right)													Total (%)
NOx	1A3bi 11.2%	1A3c 11.2%	1A3biii 11.0%	1A1a 10.3%	1A4aii 7.3%	1A4ai 5.5%	1A2e 5.0%	1A2gvii 5.0%	3Da1 4.0%	1A4cii 3.8%	1A4ciii 3.7%	1A2gviii 3.0%		81.2%
NMVOC	1A3bi 18.9%	3B1a 11.1%	1A4bi 10.9%	1A3biii 5.8%	1A4cii 5.5%	1A4ai 4.1%	3Da2a 4.1%	3B1b 3.9%	2H2 3.8%	1A2gvii 3.7%	2D3d 3.4%	1B2b 2.9%	1A3bv 2.7%	80.9%
SO_2	1A1a 35.9%	1A4ai 22.7%	1A4bi 8.1%	1A2e 8.1%	1A2gviii 7.3%									82.1%
NH_3	3Da2a 24.0%	3B1a 22.1%	3B3 20.6%	3Da1 10.5%	3B1b 5.0%									82.1%
$PM_{2.5}$	1A4bi 42.5%	1A4ai 12.2%	1A1a 9.8%	6A 5.2%	1A4aii 4.5%	1A2gviii 3.5%	1A2gvii 3.2%							80.8%
PM_{10}	1A4bi 29.9%	2D3b 15.3%	1A4ai 10.1%	1A1a 9.4%	6A 4.7%	1A4aii 3.5%	1A2gviii 3.3%	2A2 3.1%	3Dc 2.5%					81.9%
TSP	2D3b 55.9%	1A4bi 7.8%	1A1a 6.2%	1A4ai 5.6%	2A2 4.3%	6A 3.1%								82.9%
BC	1A4bi 26.7%	1A4aii 15.2%	1A2gvii 10.3%	1A4ai 10.3%	1A4cii 8.7%	1A3biii 4.3%	1A3c 3.9%	6A 3.0%						82.3%
CO	1A3bi 46.4%	1A4bi 21.4%	1A4cii 8.8%	1A2gvii 5.2%										81.8%
Pb	2C1	1A3bi												86.0%

	69.9%	16.1%			
Cd	2C1	1A2gviii	1A4bi		83.2%
	53.1%	17.0%	13.0%		
Hg	1A4ai	1A4bi	1A4ci	1A1a	84.1%
	52.0%	18.9%	7.1%	6.1%	
PCDD/ PCDF	1A4bi	1A4ai	5C1biii	5E	85.9%
	48.0%	14.7%	14.0%	9.3%	
PAHs	1A4bi	1A4ai	6A		91.1%
	60.3%	17.3%	13.5%		
HCB	3Df				96.2%
	96.2%				
PCBs	1A4ai	1A4bi			88.7%
	61.7%	27.0%			

In trend assessment key categories, main contributor remains Energy sector (includes public and industrial heat and power plants, as well as residential installations) and Transport. For PM_{10}, TSP, Pb and Cd main contributor is IPPU sector (NFR 2) with road paving with asphalt (NFR 2D3b) and iron and steel production (NFR 2C1) accordingly. Agriculture (NFR 3) is main contributor for NH_3 and HCB emissions.

1.5 Quality assurance/Quality control

The following Quality assurance and Quality control (QA/QC) activities were carried out in the inventory preparation process:

- Processing;
- Handling;
- Documentation;
- Recalculations;
- Cross - checking.

The inventory is archived each year and it is possible to regenerate the information.

Quality Control (QC):

Quality Control (QC) is a system of routine technical activities to measure and control the quality of the inventory. The QC system is designed to:

- Provide routine and consistency checks to ensure data correctness and completeness;
- Identify and address errors and omissions;
- Document and archive inventory material.

QC activities include general methods, such as accuracy checks on data acquisition and calculations, the use of approved standardized procedures for emission calculations, measurements, estimating uncertainties, archiving information and reporting. These activities are implemented by sectoral experts and national inventory compiler.

Before submitting data to CEIP/EEA, NFR tables are checked with RepDab[3], an electronic tool to check the format, completeness and internal consistency of submissions, provided by CEIP as well as emission data are compared with data reported in National Inventory Report (NIR) under UNFCCC.

Quality meetings are held between sectoral experts in order to discuss problems and necessary improvements. Meeting together with external institutions are held in order to coordinate and adjust necessary data for reporting and introduce them with latest changes in emissions and report.

[3] https://www.ceip.at/repdab

Quality assurance (QA)

Quality Assurance (QA) activities include a system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. In the inventory preparation process, general quality control procedures have been applied.

1.6 General uncertainty evaluation

The calculation of uncertainty estimates was made according to the Tier 1 method presented in EMEP/EEA 2023. Tier 1 method is based on emission estimates and uncertainty coefficients for activity data and emission factors (Table 1.5).

Uncertainty values have been assigned based on expert judgement or on default uncertainty estimates according to IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG 2000), 2006 IPCC Guidelines, EMEP/EEA 2016, EMEP/EEA 2019 and EMEP/EEA 2023 Guidebooks. For each source the uncertainty for activity data and emission factors were estimated and presented in percentage. The uncertainty analysis was done for all the sectors: Energy, IPPU, Agriculture, Waste and LULUCF (reported as "Other" under NFR 6A). Uncertainties were estimated for main pollutants - NO_x, NMVOC, SO_2, NH_3 and CO, as well as for particulate matter ($PM_{2.5}$, PM_{10}, TSP, BC), priority heavy metals (Pb, Cd, Hg) and POPs (PCDD/F, PAHs, HCB, PCBs).

Table 1.5 Uncertainty assessment results in 2022

	Overall uncertainty, %	Trend uncertainty, %
NOx	10.67%	2.19%
NMVOC	15.76%	4.08%
SO_2	6.08%	0.19%
NH_3	19.44%	3.33%
CO	33.66%	5.45%
$PM_{2.5}$	33.21%	22.42%
PM_{10}	24.83%	29.25%
TSP	28.40%	46.51%
BC	29.82%	4.74%
Pb	10.67%	2.19%
Cd	27.73%	12.55%
Hg	21.31%	9.37%
PCDD/F	31.80%	5.66%
PAHs	46.88%	7.59%
HCB	27.82%	3.31%
PCBs	31.79%	1.29%

1.7 General assessment of the completeness

The emission inventory covers the whole territory of Latvia. Emissions from almost all sectors and subsectors have been estimated. Where this is not the case, notation keys - NE (not estimated), IE (included elsewhere), NA (not applicable) or NO (not occurred) - are used.

NE (not estimated):

"NE" is used for activity data and/or emissions by sources of pollutants that have not been estimated but for which a corresponding activity may occur (Table 1.6).

Table 1.6 Sources not estimated in 2022 (NE)

NFR14 code	Substance(s)	Reason for not estimated
1A1a Public electricity and heat production	NH_3	no methodology available, NE according to EMEP/EEA 2019
1A1c Manufacture of solid fuels and other energy industries	NH_3	no methodology available, NE according to EMEP/EEA 2019

NFR14 code	Substance(s)	Reason for not estimated
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	NH_3, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2019
1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	NH_3	no methodology available, NE according to EMEP/EEA 2019
1A2gvii Mobile Combustion in manufacturing industries and construction	Hg, As, PCDD/F, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2019
1A3ai(i) International aviation LTO (civil)	NH_3, As, Cr, Cu, Ni, Se, Zn	no methodology available, NE according to EMEP/EEA 2019
1A3aii(i) Domestic aviation LTO (civil)	NH_3, As, Cr, Cu, Ni, Se, Zn	no methodology available, NE according to EMEP/EEA 2019
1A3bvi Road transport: Automobile tyre and brake wear	Hg, PCDD/F, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, PAHs, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2019
1A3bvii Road transport: Automobile road abrasion	Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, PAHs, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2016
1A3c Railways	Pb, Hg, As	no methodology available, NE according to EMEP/EEA 2016
1A3dii National navigation (shipping)	Pb, Hg, As	no methodology available, NE according to EMEP/EEA 2016
1A4aii Commercial/institutional: Mobile	Hg, As, PCDD/F, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2019
1A4bii Residential: Household and gardening (mobile)	Hg, As, PCDD/F, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2019
1Acii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Hg, As, PCDD/F, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2019
1A4ciii Agriculture/Forestry/Fishing: National fishing	NH_3, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, PAHs	no methodology available, NE according to EMEP/EEA 2019
1A5b Other, Mobile (including military, land based and recreational boats)	NH_3, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, PAHs	no methodology available, NE according to EMEP/EEA 2019
1B1a Fugitive emission from solid fuels: Coal mining and handling	NMVOC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn	no methodology available, NE according to EMEP/EEA 2023
1B2av Distribution of oil products	SO_2, PCDD/F	no methodology available, NE according to EMEP/EEA 2023
2A1 Cement production	Pb, Cd, As, Cr, Cu, Ni, Se, Zn, benzo(a)pyrene, benzo (b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs	no methodology available, NE according to EMEP/EEA 2023
2A3 Glass production	NH_3, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB	no methodology available, NE according to EMEP/EEA 2023
2D3a Domestic solvent use including fungicides	Hg	no methodology available, NE according to EMEP/EEA 2023
2D3b Road paving with asphalt	NO_x, SO_2, CO, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB	no methodology available, NE according to EMEP/EEA 2023
2D3c Asphalt roofing	NO_x, Pb, Cd, Hg, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB	no methodology available, NE according to EMEP/EEA 2023
2H2 Food and beverages industry	$PM_{2.5}$, PM_{10}, TSP, BC	no methodology available, NE according to EMEP/EEA 2023
2I Wood processing	$PM_{2.5}$, PM_{10}, TSP, BC, As, Cu	no methodology available, NE according to EMEP/EEA 2023
5A Biological treatment of waste - Solid waste disposal on land	NH_3, CO, Hg	no methodology available, NE according to EMEP/EEA 2023

NFR14 code	Substance(s)	Reason for not estimated
5B1 Biological treatment of waste - Composting	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As,Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2023
5B2 Biological treatment of waste - Anaerobic digestion at biogas facilities	NO_x, NMVOC, SO, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, Cr, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2023
5C1bii Hazardous waste incineration	NH_3, Cr, Cu, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene	no methodology available, NE according to EMEP/EEA 2023
5C1biii Clinical waste incineration	NH_3, $PM_{2.5}$, PM_{10}, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene	no methodology available, NE according to EMEP/EEA 2023
5C1bv Cremation	BC	no methodology available, NE according to EMEP/EEA 2023
5E Other waste (please specify in IIR)	NO_x, NMVOC, SO_2, BC, CO, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2023

IE (included elsewhere):

"IE" is used for emissions by sources of pollutants that are estimated but included elsewhere in the inventory instead of under the expected source category (Table 1.7).

Table 1.7 Sources included elsewhere in 2022 (IE)

NFR14 code	Substance(s)	Included in NFR category
2I Wood processing	NO_x, NMVOC, SO_2, NH_3, CO	1A2gviii Mobile combustion in manufacturing industries and construction
3Da2a Animal manure applied to soils	NMVOC	3B Manure management
3Da3 Urine and dung deposited by grazing animals	NMVOC	3B Manure management

NA (not applicable) is used for activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant.

C (confidential) is used for emissions by sources of pollutants whose reporting could lead to the disclosure of confidential information. In case of Latvia, particular notation key is used for glass production (2A3) due to only one glass fibre production company operating in the country, for various Solvents (2D3e Degreasing, 2D3f Dry cleaning, 2D3g Chemical products, 2D3h Printing) and amount of pesticides used (3F Use of pesticides).

NO (not occurring) is used for categories or processes within a particular source category that do not occur within a Party.

The completeness is estimated taking into account the usage of notation key NE relation to total amount of the subcategories. Completeness is checked for all emissions.

2 Air pollutant emission trends

2.1 Overview

The emission estimates of air pollutants in Latvia include emissions from following gases: sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC), ammonia (NH_3), particulate matter (TSP, PM_{10}, $PM_{2.5}$), heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn), PAHs, PCBs and PCDD/F.

2.2 Main pollutants (NO_x, NMVOC, SO_2, NH_3, CO)

Sulphur dioxide, nitrogen oxides, carbon monoxide, non-methane volatile organic compounds and ammonia emission trend and the main emission sources are shown in Figure 2.1-Figure 2.5. However, detailed information about emission trends in each sector can be found in relevant chapters.

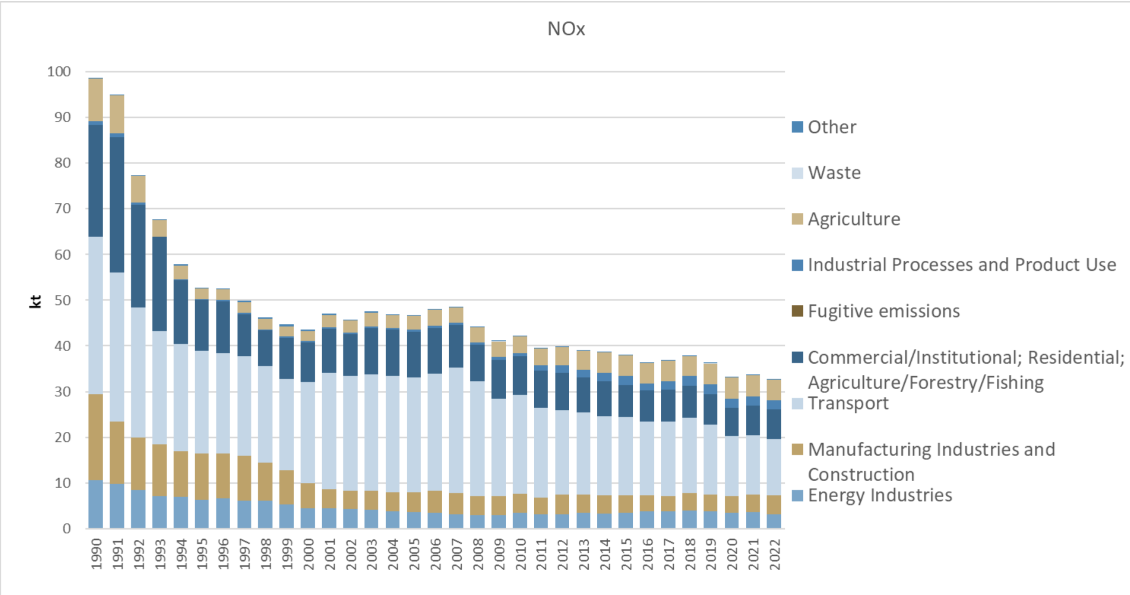

Figure 2.1 Total NO_x emissions, kt

The total NO_x emissions have decreased by 65.9% from 98.66 kt in 1990 to 32.70 kt in 2022 (Figure 2.1). Generally, the reduction is due to decrease of total fuel consumption that was caused by transformation of national economy as well as increasing of energy efficiency, especially for Transport sector. Also, replacement of solid fuels and heavy liquid fuels with natural gas and biomass fuels in Energy sector contributes to emission fluctuation.

In 2005-2022 NO_x emissions have decreased by 29.9% mainly due to the emission reduction in Energy (-22.9%) and Transport (-51.5%) sector. Meanwhile emissions in IPPU, Agriculture and Waste sector in this period have increased. In 2021-2022 total NO_x emissions have decreased by 3.0%. Emissions have decreased - Energy (1.3%), Transport (5,6%), Agriculture (2.8%) Waste (9.3%) and increased in IPPU (1.0%) and Other (6.4%).

In 2022, the main NO_x emission source is Transport (12.21 kt or 37.3%) sector, especially Road transport (NFR 1A3b), which is responsible for 31.8% of total NO_x emissions. NO_x emissions from Transport sector have decreased by 51.5% since 2005. Reason for such trend is increase in share of vehicles with higher environmental performance. A share of EURO4, EURO5 and EURO6 cars have increased for all types of vehicles, namely, passenger cars, light duty vehicles (LDV)and heavy duty vehicles (HDV).

The second largest NO_x emission source in 2022 is Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) with 6.48 kt or 19.8% of total emissions. Since 2005 emissions have decreased by 35.3% due to the implementation of energy efficiency improvements in buildings which allowed for reduction in fuel consumption and fuel switch.

Agriculture sector is the third largest NO_x emitter in 2022 with 4.55 kt or 13.9% of total emissions. Since 2005 emissions have increased by 51.2%. Amount of NO_x emission is linked to the number of produced animals and crops.

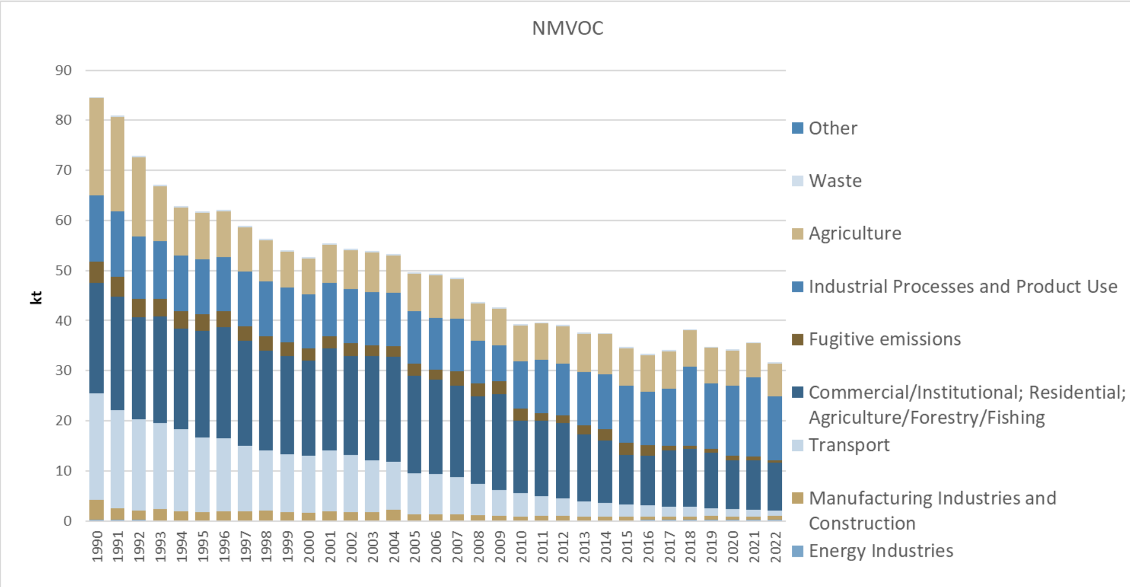

Figure 2.2 Total NMVOC emissions, kt

The total NMVOC emissions have decreased by 62.6% from 84.67 kt in 1990 to 31.71 kt in 2022 (Figure 2.2). Since 2005 emissions have decreased by 36.1% and decreased by 11.1% in 2021-2022. The overall decrease in total NMVOC emissions has happened mainly due to the Transport (94.6% decrease since 1990) and Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) (56.9% decrease since 1990).

IPPU is the largest NMVOC emission source in 2022 with 12.74 kt or 40.2% from total emissions. Main NVMOC emission source in IPPU is Other Solvent and Product Use (NFR 2D; 36.1% from total emissions) and since 2005 emissions in this sector have increased by 21.2%. Emission fluctuation in Solvent Use sector is related to the to the welfare of the economic situation of the country.

In 2022, the second largest NMVOC emission producer is Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) which is responsible for 9.50 kt or 30.0% from total emissions. Since 2005 emissions in Other Sector have decreased by 51.1% which is a result of energy efficiency improvements in buildings and fuel switch.

Agriculture sector contributes 6.57 kt or 20.7% from total NMVOC emissions in 2022. The largest part of NMVOC emissions is related to manure management – 71.5%, crop production and agricultural soils accounted for 27.9%. Since 2005 NMVOC emissions from Agriculture have decreased by 12.0%. Similar as with NO_x emissions amount of NMVOC emissions is linked to the number of produced animals and crops.

Transport sector importance to NMVOC emissions since 2005 have significantly decreased (-86.8%). In 2005 Transport sector made up 16.7% from total NMVOC emissions, but in 2022 it is 3.6%. Reason for such trend is increase in share of vehicles with higher environmental performance. A share of EURO4, EURO5 and EURO6 cars have increased for all types of vehicles, namely, passenger cars, LDV and HDV and decrease of gasoline consumption by passenger cars.

Energy Industries (NFR 1A1) and Manufacturing Industries and Construction (NFR 1A2) constitute 0.6% and 2.3% accordingly in 2022.

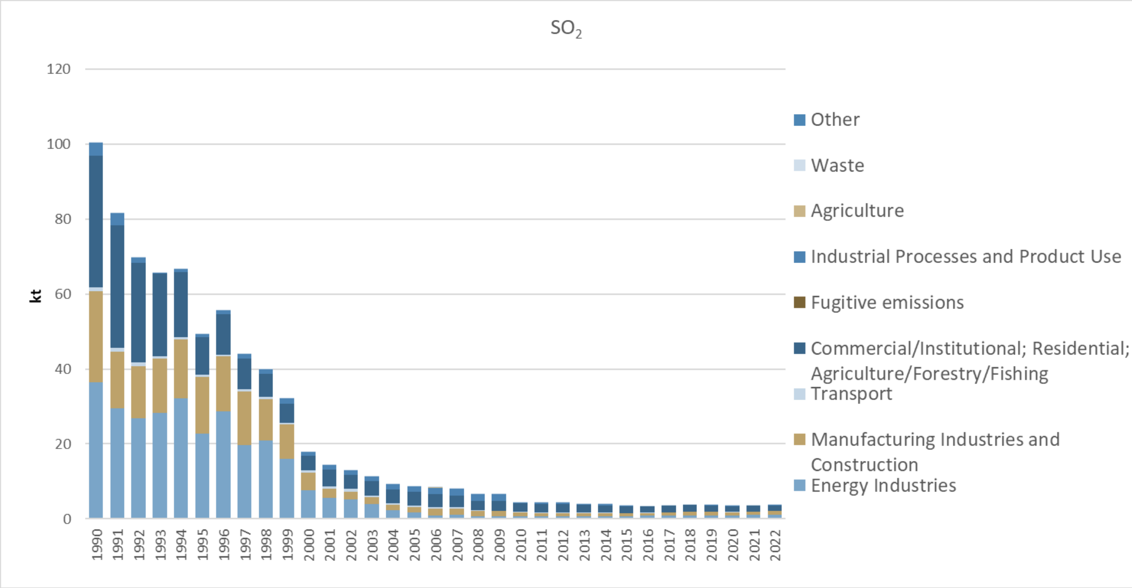

Figure 2.3 Total SO_2 emissions, kt

Since 1990, total SO_2 emissions have decreased from 100.46 kt to 3.77 kt (-96.2%) in 2022 (Figure 2.3). The reduction can be explained with use of fuels with lower sulphur content as well as fuel switching from solid and liquid types of fuel to natural gas and biomass. In 2021-2022 the total SO_2 emissions have increased by 3.4% mainly from increased activity in Energy sector.

In 2022, the largest SO_2 emission producer is Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) which is responsible for 39.7% of the total emissions. Since 2005 SO_2 emissions in Other Sector have decreased by 59.3% as fuel consumption have also decreased due to the improvements in energy efficiency. Solid fossil fuel consumption in sector has also significantly decreased since 2005.

Energy Industries (NFR 1A1) and Manufacturing Industries and Construction (NFR 1A2) constitute 29.9% and 25.9% accordingly. SO_2 emissions from fuel combustion in these sectors have also decreased since 2005 by 30.0% and 37.5%. Solid and liquid fuels with high sulphur content were replaced with natural gas and biomass.

SO_2 emission reduction in Transport sector (-91.2% since 2005) is due to the implementation of stronger fuel quality requirements. In 2022, Transport and IPPU sectors are responsible for 1.0% and 3.4% of SO_2 emissions accordingly.

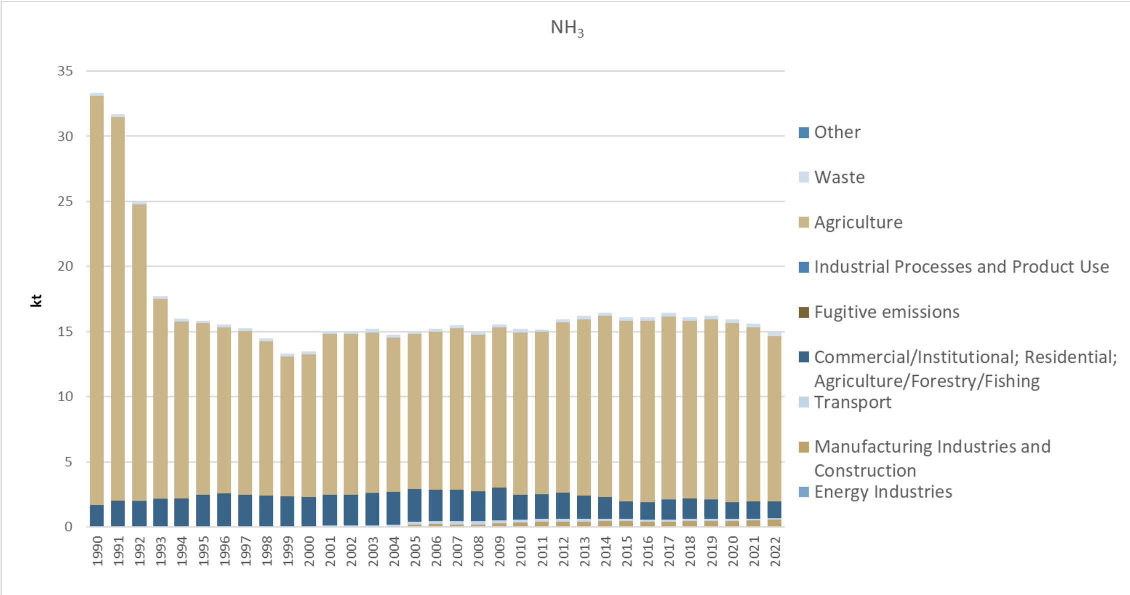

Figure 2.4 Total NH_3 emissions, kt

The total NH_3 emissions have decreased by 55.2% from 33.31 kt in 1990 to 14.94 kt in 2022 (Figure 2.4). The large decrease in the beginning of 90ties can be explained with the collapse of the Union of Soviet Socialist Republics (USSR), when many farms were closed and agricultural activities reduced. In 2021-2022 emissions have slightly decreased by 4.2%.

In 2022, the largest part – 85.1% of NH_3 emissions are produced in Agricultural sector (NFR 3). Emissions in Agriculture sector are divided into emissions from crop production and agricultural soils, as well as emissions from manure management and other sources. In 2022, emissions from crop production and agricultural soils constituted 53.5% (6.81 kt), including emissions from inorganic N-fertilizers, animal manure and other organic fertilizers which were applied to soils, urine and dung from grazing animals. Since 2005 NH_3 emissions in Agriculture have increased by 6.9%.

Second largest NH_3 emission emitter in 2022 is Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) which is responsible for 8.6%. Since 2005 emissions in Other Sector (NFR 1A4) have decreased by 48.7%, which can be explained with energy efficiency improvements in buildings.

Remaining producers of ammonia are Manufacturing Industries and Construction (NFR 1A2), Transport (NFR 1A3), and Waste (NFR 5) sector with 3.7%, 0.7% and 1.9%. Insignificant amount of NH_3 is also produced in IPPU (NFR 2) sector.

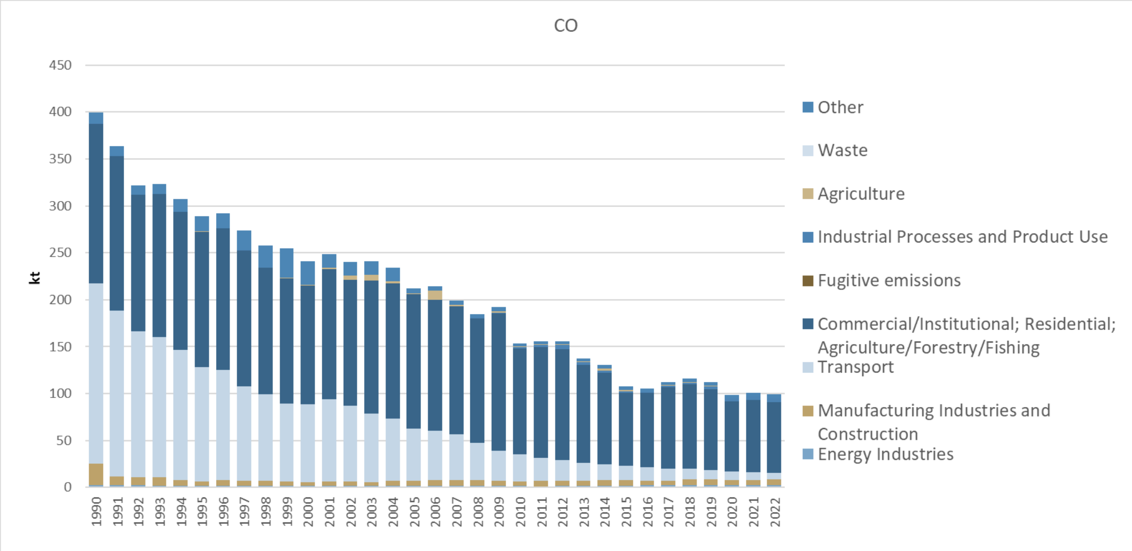

Figure 2.5 Total CO emissions, kt

Carbon monoxide (CO) emission trend shows a decrease in emissions by 75.3% from 399.53 kt in 1990 to 98.82 kt in 2022 (Figure 2.5). In 2021-2022 emissions of CO have decreased by 2.0%.

In 2022, CO emissions originate generally in the Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) with 76.4% of total emissions. Since 2005 CO emissions have decreased by 47.4%.

Second largest contributor is Transport sector (NFR 1A3) with 7.2% in 2022. Since 2005 CO emissions in Transport sector have decreased by 87.1%. The overall decrease in CO emissions mainly can be explained with better technologies used in cars that prevents gasoline from incomplete combustion.

Remaining producers of carbon monoxide are Energy Industries (NFR 1A1), Manufacturing Industries and Construction (NFR 1A2), IPPU (NFR 2) and Other (NFR 6) with 2.5%, 6.1%, 3.3% and 4.1%. Small amount of CO is also produced in Waste (NFR 5) sector.

2.3 Particulate matter ($PM_{2.5}$, PM_{10}, TSP, BC)

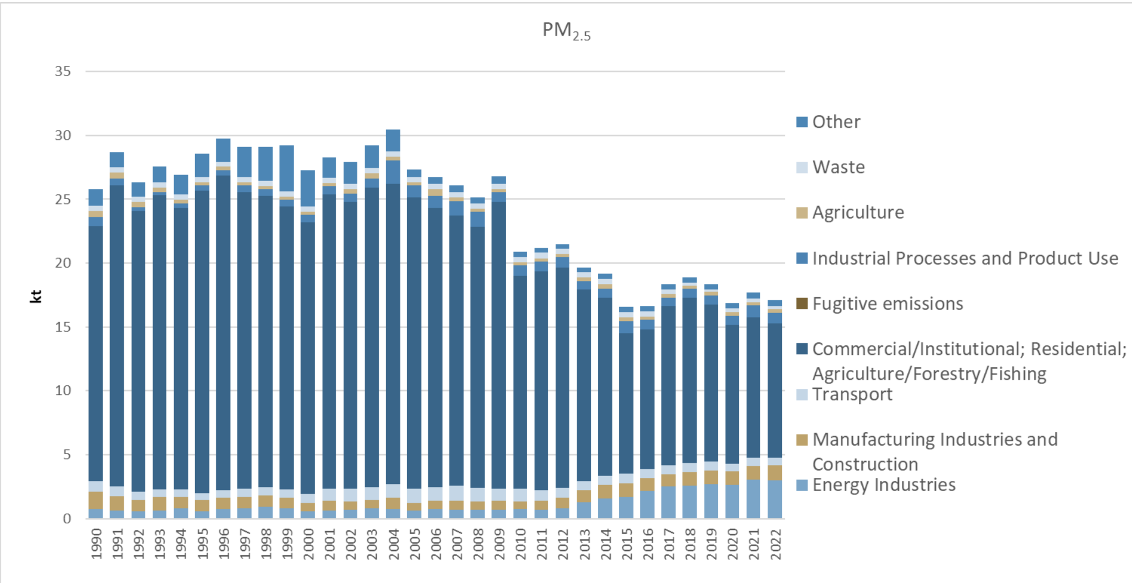

Figure 2.6 Total $PM_{2.5}$ emissions, kt

Total $PM_{2.5}$ emissions have decreased by 33.6% from 25.81 kt in 1990 to 17.13 kt in 2022. (Figure 2.6). The reduction can be explained with decrease of total fuel consumption in Energy sector. There can also be observed a fall in emissions in 2005-2022 by 37.3%, mostly due to decrease in fuel consumed in households. In 2021-2022 $PM_{2.5}$ emissions have decreased by 3.1%.

In 2022 $PM_{2.5}$ emissions are mainly produced in Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) with 61.4% from total emissions. Since 2005 emissions in Other Sector have decreased by 53.9% due to the implementation of energy efficiency improvements in buildings which promoted reduction in fuel consumption.

Second and third largest $PM_{2.5}$ emitters in 2022 are Energy Industries (NFR 1A1) and Manufacturing Industries and Construction (NFR 1A2) with 17.1% and 6.0% accordingly. Since 2005 $PM_{2.5}$ emissions in these sectors have increased mainly due to the broader use of biomass in both of these sectors.

Transport (NFR 1A3) sector contributes 3.5% of total $PM_{2.5}$ emissions in 2022, IPPU (NFR 2) – 4.7%, Agriculture (NFR 3) – 1.6%, Waste (NFR 4) - 1.6% and Other (NFR 6) - 2.8%.

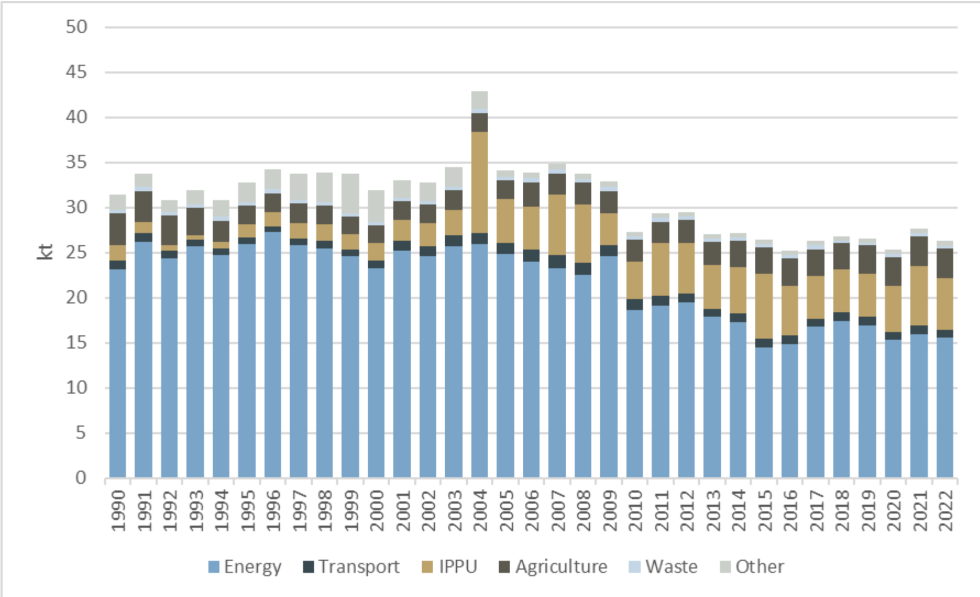

Figure 2.7 Total PM_{10} emissions, kt

PM_{10} emissions in 2022 have decreased by 16.2% since 1990 (Figure 2.7), due to the emission decrease in all sectors except IPPU, where emissions have increased almost three times. The largest part of PM_{10} emissions in 2022 are produced in Energy sector – 59.1%. Compared to 2021 emissions have decreased by 5.0%.

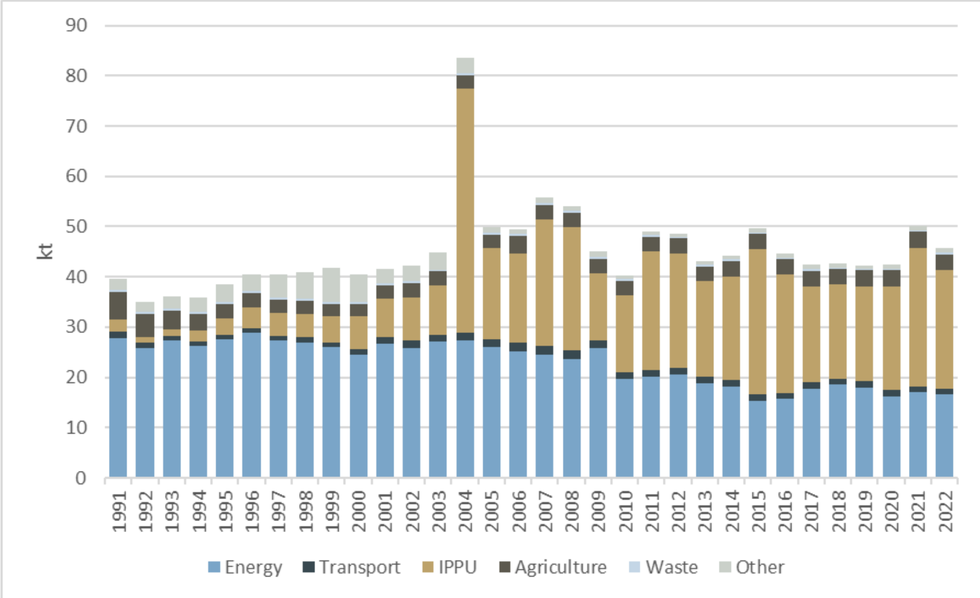

Figure 2.8 Total TSP emissions, kt

In 2022 TSP have increased by 20.4% since 1990 (Figure 2.8), due to the emission increase in IPPU, where emissions have increased more than eight times. Peak in PM_{10} and TSP emissions in 2004 can be explained with increased activities in Road paving (NFR 2D3b). *Via Baltica* (E67) that connects the capitals of all Baltic States was built in that particular year. The largest part of TSP emissions in 2022 are produced in IPPU sector – 51.8%. Compared to 2021 emissions have decreased by 9.0%.

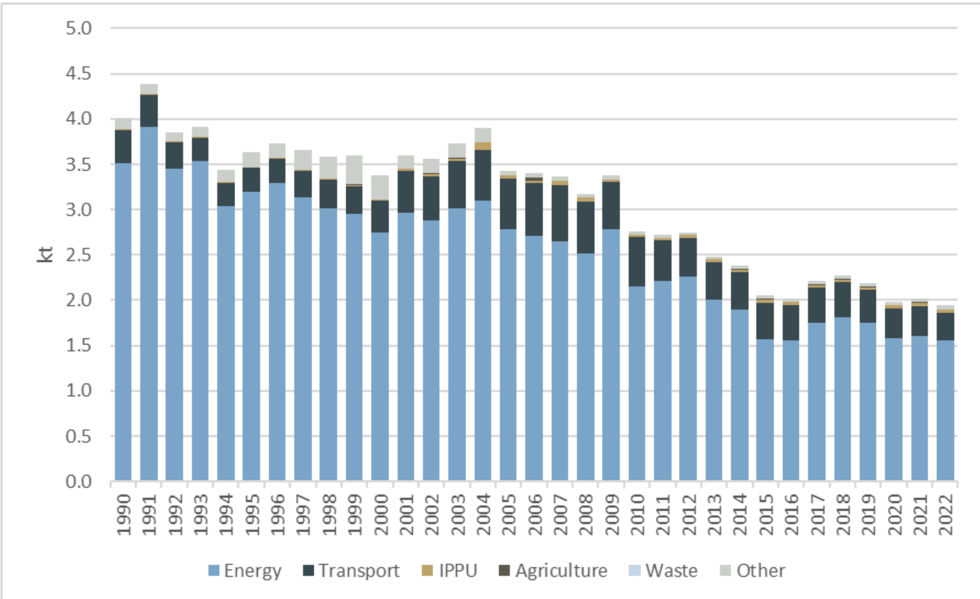

Figure 2.9 Total BC emissions, kt

BC emissions in 2022 have decreased by 51.6% since 1990 (Figure 2.9), due to the emission decrease in all sectors except IPPU and Agriculture. The largest part of BC emissions in 2022 are produced in Energy sector – 80.2%. Compared to 2021 emissions have decreased by 3.7%.

2.4 Heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn)

Emissions of heavy metals are shown in the Figure 2.10-Figure 2.12. In IIR, only priority HMs are described, but emissions for additional heavy metals can be found in NFR tables.

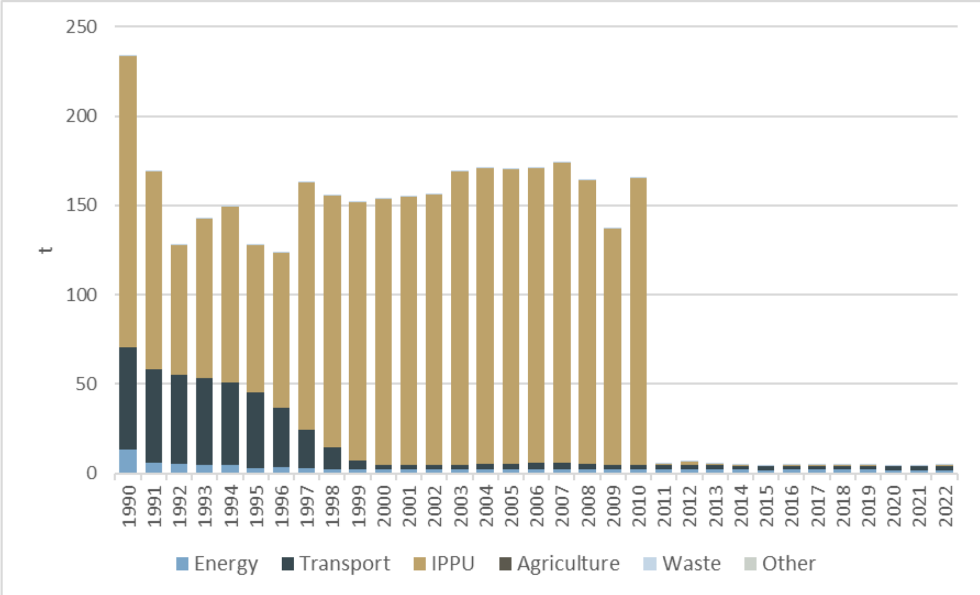

Figure 2.10 Total Pb emissions (t)

The most significant changes can be seen in lead emissions (Figure 2.10). In comparison with 1990, Pb emissions have decreased by 97.9% in 2022. The amount of Pb emitted in 2022 is 4.91 tonnes, and it has increased by 19.3% comparing with previous year's emissions. Largest Pb emitter in 2022 is Energy sector including Transport (79.9%). Significant decrease of lead emissions in Transport (NFR 1A3) sector can be seen in 1999. That can be explained with the changes in international legislation that prohibited the use of liquid fuels with high lead content. The most significant emission decrease by 97.5% happened in 2011 due to change of furnace type in the only metal production plant (NFR 2C1), other fluctuation in lead trend from IPPU sector can be explained with amount of metal produced.

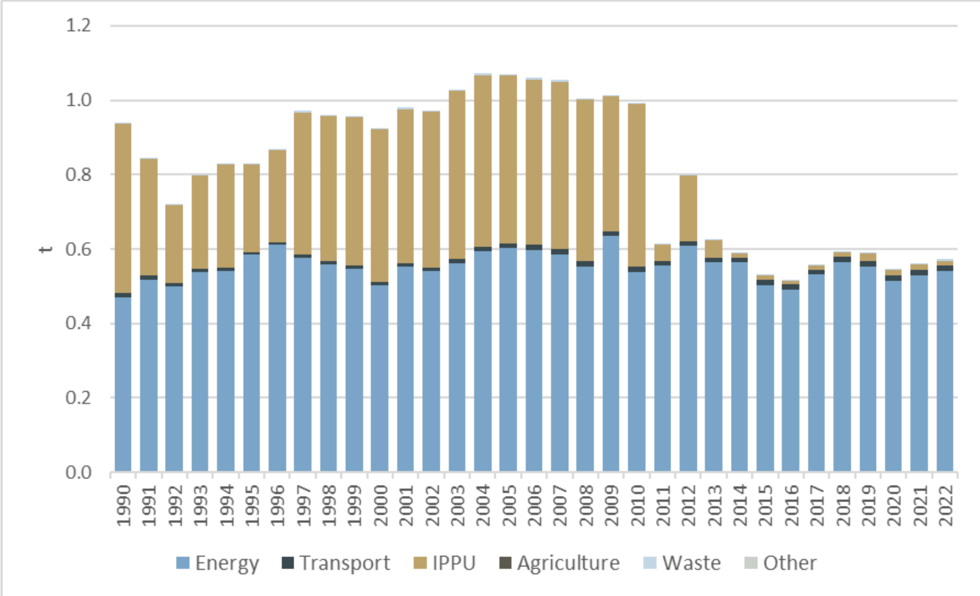

Figure 2.11 Total Cd emissions (t)

In 1990-2022, Cd emissions have decreased by 38.9%, and in 2022 total amounts of Cd emitted is 0.57 tonnes (Figure 2.11) and by 2.7% more than in 2021. Energy sector (including Transport) contributes to 96.5% of total Cd emissions in 2022. Significant decrease of emissions can be seen in IPPU (97.3%) 1990-2022 due to the bankruptcy of the local metal production company.

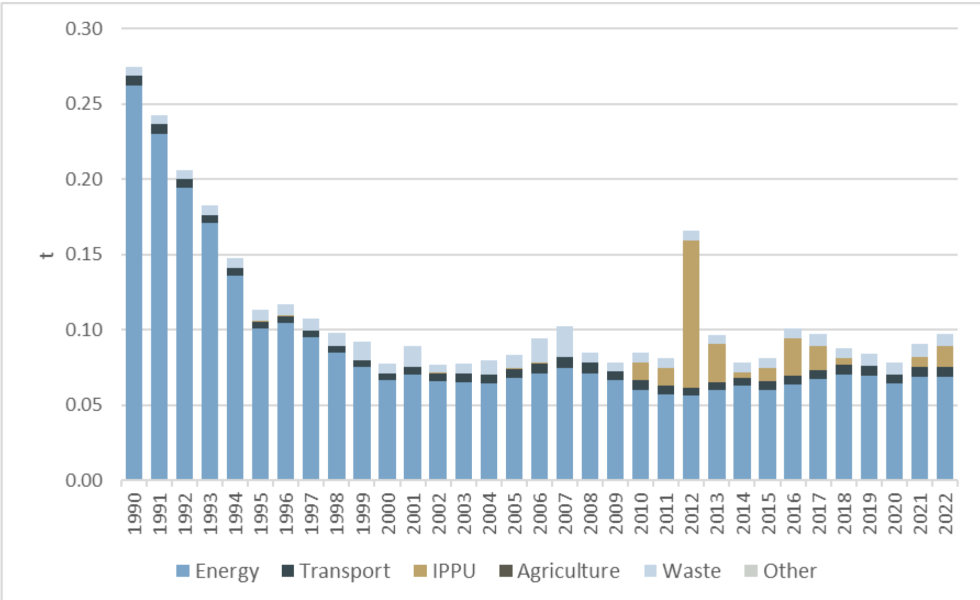

Figure 2.12 Total Hg emissions (t)

Mercury emission trend shows a decrease by 64.7% in emissions for period 1990-2022 (Figure 2.12). Hg emissions, 0.10 t in total (2022), originates generally from the Energy sector (73.6%). The decrease in Hg emissions can be mainly explained with decreasing amount of fossil fuels used in combustion. Spike of Hg emissions in 2012 in IPPU sector as well as increase of mercury emissions in later years is mainly related with the fuel quality that is used in the only Cement production company (NFR 2A1).

2.5 Persistent organic pollutants (PCDD/F, PAHs, PCB, HCB)

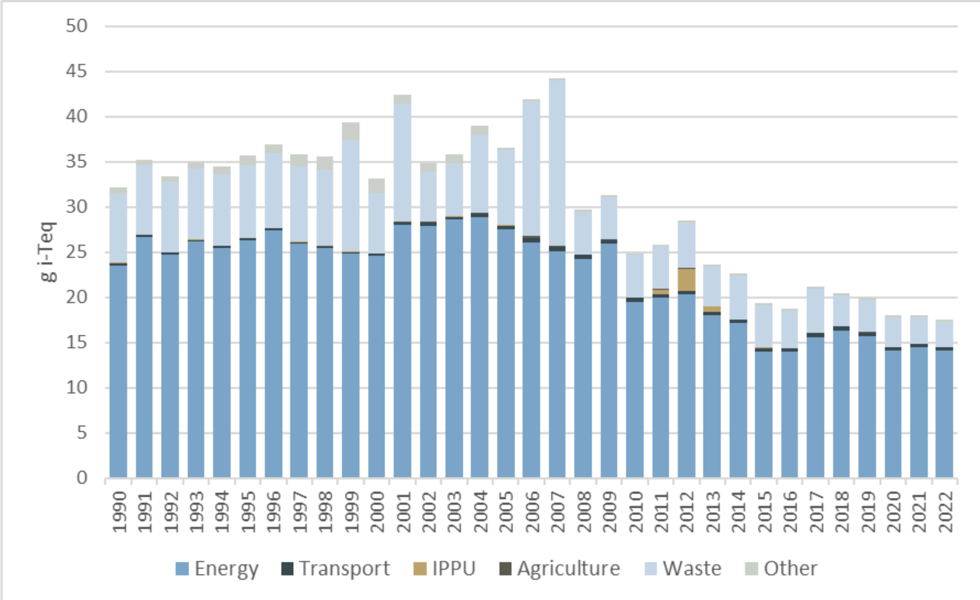

Figure 2.13 Total PCDD/F emissions (g i-Teq)

PCDD/F emissions have decreased by 45.5% in 1990-2022 (Figure 2.13). Fluctuation in emissions is connected with waste incineration processes, as well as biomass combustion. In 2022, approximately 80.4% emissions from all PCDD/F emissions are generated in the Energy sector, but the remaining part of emissions are generated in the Transport sector (NFR 1A3), Waste incineration (NFR 5C), combustion of wood harvesting residues (NFR 6A) and grassland burning (NFR 3I). In Waste incineration PCDD/F emissions are fluctuating significantly due to increased amounts of incinerated clinical waste in 2006-2007, but since 2008 the facility is closed. In the Energy sector emissions have increased due to larger amount of biomass combusted, for example, in 2021-2022 the emissions have decreased by 2.8%.

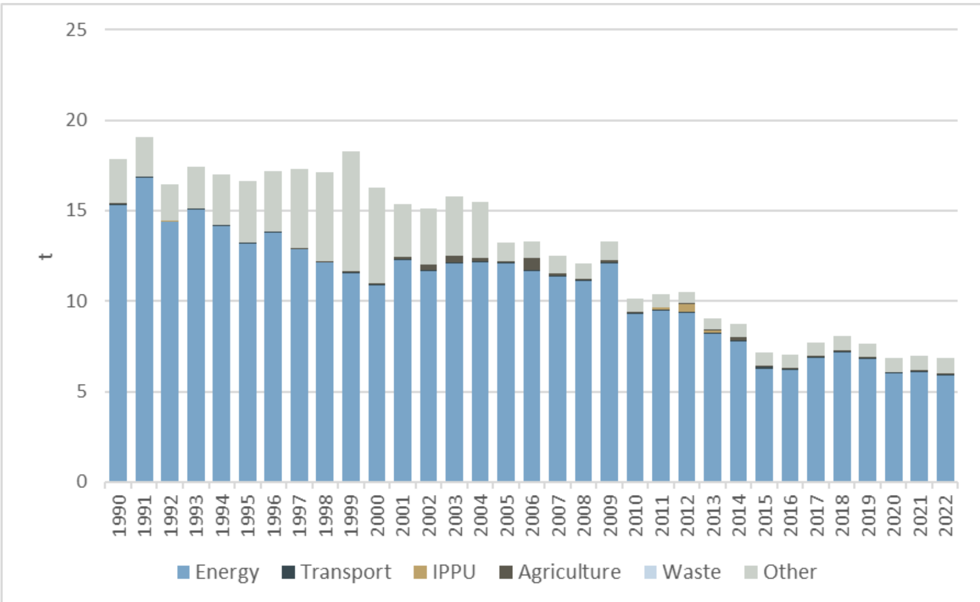

Figure 2.14 Total PAH emissions (t)

PAH emissions in 1990-2022 have decreased by 61.5%, reaching 6.87 tonnes in 2022 (Figure 2.14) and emissions have decreased by 1.9% comparing with 2021. The fluctuations through the time series can be explained with changes in national economy and also weather conditions that influenced the consumption of particular fuels. In 2022 87.0% from PAHs were generated in the Energy sector (including Transport) and mainly in solid biomass combustion processes.

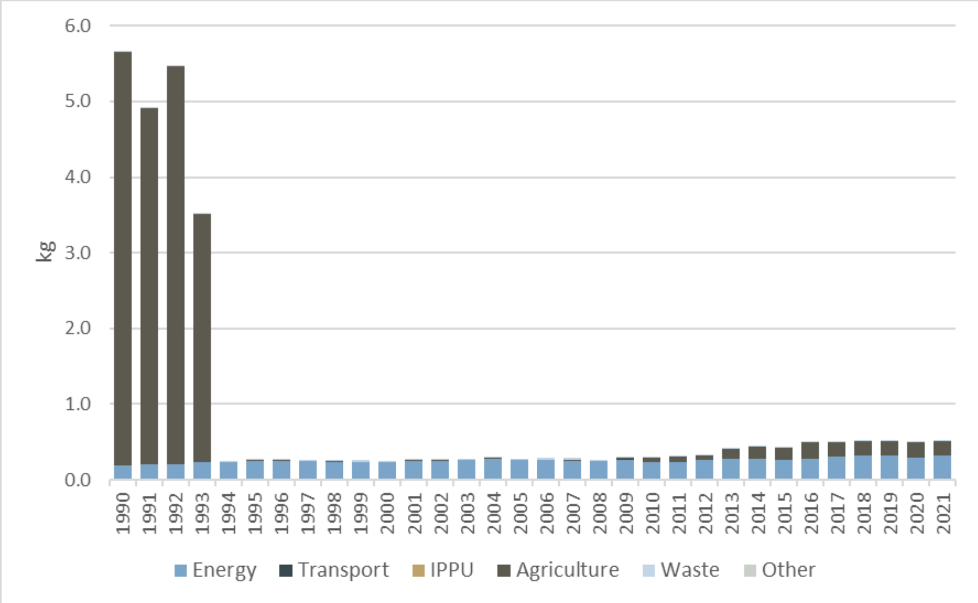

Figure 2.15 Total HCB emissions (kg)

HCB emissions have decreased by 90.8% since 1990, reaching 0.52 kg in 2022 (Figure 2.15). In 2021-2022 emissions have increased by 0.8%. HCB emissions from stationary fuel combustion are estimated only from solid fuels – coal and coke, and solid biomass combustion activities. 61.5% from HCB emissions in 2022 are generated in the Energy sector (including Transport) and 38.4% in Agriculture (NFR 3).

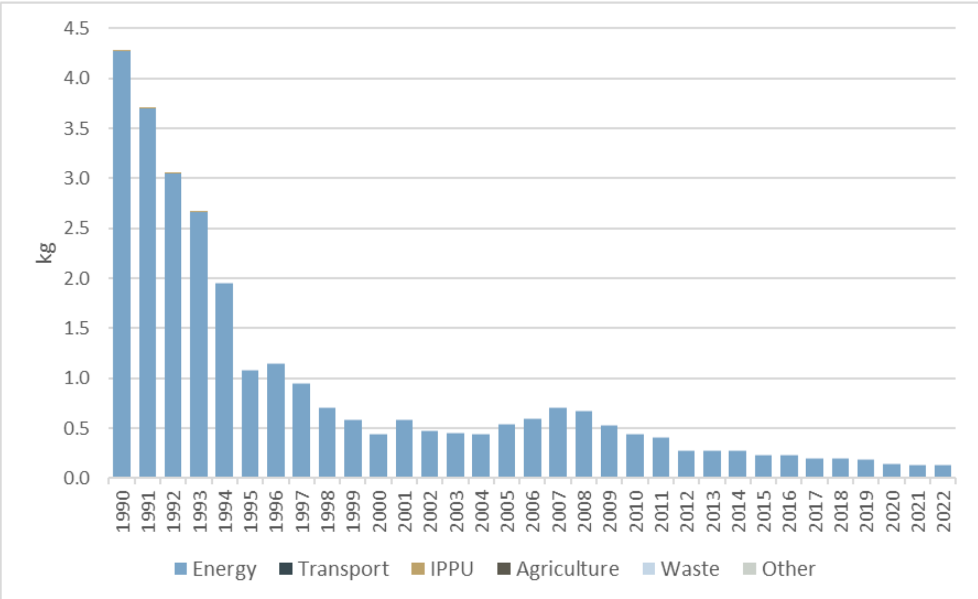

Figure 2.16 Total PCB emissions (kg)

PCB emission trend shows a decrease by 97.0% in emissions for period 1990-2022 (Figure 2.16). In 2021-2022 the emissions continue to fall reaching 0.13 kg (1.3%). In 2022, PCB emissions originate generally in the Energy sector (including Transport), contributing 98.5% from all emissions. The decrease in emissions mainly can be explained with less amount of fossil fuels used in combustion.

3 Energy sector (NFR 1)

3.1 Overview of sector

3.1.1 Quantitative overview

Both the imported (natural gas, liquid gas, oil and oil products, coal) and local fuels (wood, peat, hydro resources) are used in the Energy sector in Latvia (Table 3.1). Mainly the imported fuels (natural gas, coal) are used in combined heat and power plants (CHP) and heat generation. Smaller boiler houses burn local fuel (wood) as well as natural gas and other fuels.

Table 3.1 Consumption of energy resources in Latvia (TJ)

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022
Energy consumption	*318554*	*176156*	*143519*	*178628*	*185685*	*175926*	*180678*	*182092*	*185902*	*192458*	*171334*	*179623*	*166858*
Liquid fuels, total	*161191*	*81670*	*53513*	*68005*	*72021*	*68610*	*72017*	*73187*	*64782*	*75186*	*65226*	*67725*	*66912*
Shale Oil	NO	78	2440	157	39	NO	7	1	8	9	1	2	NO
LPG	3691	1548	2095	2552	2103	4103	4174	4226	3892	3432	3256	3088	3298
Gasoline	26752	18130	14833	15131	12666	8922	8752	8363	8032	7638	7323	7237	6238
Jet Kerosene	3068	1172	1142	2525	4929	4530	5170	5924	6462	6637	2456	3322	6107
Other Kerosene	647	432	43	NO	NO	NO	6	4	4	1	NO	NO	NO
Diesel Oil	48023	18273	20907	36712	41923	45520	47458	49399	46098	55571	51849	53454	50057
RFO	76326	41290	9462	10231	8661	5467	6258	5154	207	1822	202	539	1112
Petroleum Coke	NO	NO	NO	429	627	NO	124	44	5	NO	60	NO	NO
Other Oil Products	2684	748	2593	268	1072	67	68	71	74	75	79	83	99
Solid fuels, total	*26249*	*7225*	*2785*	*3199*	*4378*	*1950*	*1678*	*1689*	*1894*	*1644*	*966*	*719*	*470*
Anthracite	NO	NO	NO	NO	NO	NO	27	7	NO	NO	NO	NO	NO
Coal	25984	7172	2759	3145	4378	1950	1651	1679	1893	1643	966	719	470
Coke	237	53	26	54	NO	NO	NO	3	1	1	NO	NO	NO
Oil Shale	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat products, total	*3217*	*3837*	*2392*	*80*	*46*	*11*	*34*	*40*	*135*	*72*	*51*	*69*	*92*
Peat	2350	3436	2361	80	40	10	34	29	119	54	34	49	85
Peat Briquettes	867	401	31	NO	6	1	NO	11	16	18	17	20	7
Natural gas	*99517*	*41304*	*44962*	*56685*	*61044*	*45758*	*46751*	*41193*	*48494*	*45680*	*37754*	*40023*	*28638*
Biomass, total	*27501*	*42120*	*39774*	*49681*	*47655*	*58316*	*59277*	*64811*	*68946*	*68397*	*65632*	*69368*	*68990*
Wood	27501	42102	39695	49124	45375	52231	53905	59118	61890	61617	58221	62339	63768
Charcoal	NO	NO	NO	60	60	60	65	66	68	87	90	89	68
Straws	NO	NO	NO	NO	60	135	161	223	414	457	426	415	281
Biofuel	NO	NO	NO	101	1116	1013	495	450	1600	1488	1989	1994	782
Landfill Gas	NO	NO	NO	251	331	422	408	423	403	364	363	365	283
Sludge Gas	NO	18	41	95	137	85	107	101	83	90	76	81	63
Other Biogas	NO	NO	NO	NO	66	3239	3328	3463	3242	2970	2961	2353	1972
Municipal Wastes	NO	NO	37	49	510	1131	808	968	1247	1324	1506	1732	1772
Other fuels, total	*879*	*NO*	*94*	*977*	*540*	*1281*	*921*	*1172*	*1651*	*1480*	*1705*	*1719*	*1756*
Municipal Waste	NO	NO	NO	NO	320	934	736	962	1215	1086	1270	1256	1373
Industrial Waste	NO	NO	94	125	84	284	155	180	338	320	351	372	367
Other Fossil Fuels	NO	NO	NO	6	42	33	5	3	65	61	72	78	13
Waste Oil	879	NO	NO	847	95	29	25	27	33	13	12	12	NO

Liquid fossil fuels have an important place as energy resource. Its share was about 40.1% in 2022. The essential decrease of residual fuel oil (RFO) share in Energy Balance is explained with increasing fuel costs because of implementation of the EU Directive 1999/32/EC prescribing that sulphur content of heavy oil should not exceed 1%. The major part of the liquid fuel consumption contributes to diesel oil with approximately 74.8% from total liquid fuel consumption in 2022; diesel oil is mostly used in Transport sector. The total consumption of liquid fuels in 2022 has decreased by 58.5% since 1990. The reason for such a drastic decrease can be explained with the changes in technology (with the exception of Transport (NFR 1A3) sector and Other (NFR 1A5)), since the technology that uses liquid fuel is replaced with one that uses natural gas and biomass.

Total share of *solid fossil fuels* in national market is low – approximately 0.3% in 2022. The solid fuel consumption in recent years has decreased. The total consumption of solid fuels in 2022 has decreased by 98.2% since 1990. Decrease of solid fuel consumption can be explained with the technology change in combustion, when solid fuel was replaced with natural gas and biomass for heat and energy production.

Peat and *peat briquettes* are local fuels that were used in Latvia in 1990 with 1.0% of total energy consumption. However, nowadays amount of peat products used for stationary burning have decreased by 97.1% compared to 1990 and has 0.06% of total share in 2022. Peat was widely used in heat production, but now mostly biomass and gaseous fuels are used for both heat and electricity production.

The largest consumers of *natural gas* are CHP, and heat generation enterprises as well as industrial enterprises. Natural gas has a stable place in total fuel consumption where its share was 31.2% in 1990 and 17.2% in 2022. Natural gas consumption has decreased by 71.2% in 1990-2022. Decrease in natural gas use could be explained with fuel switching from natural gas to biomass as well as increased energy efficiency in buildings.

Biomass fuels are wood and wood products, straw, charcoal, liquid biofuels (bioethanol and biodiesel), biogas (landfill gas, sludge gas, other biogas). In the total fuel consumption, the share of firewood and other wood products is substantial – 38.3% of total energy consumption in 2022, while in 1990 all biomass fuels in total made up only 8.6% from total energy consumption. Such fuels as straws have an increasing trend in the past few years.

Industrial and *municipal waste*[4] was also consumed and in 2022 reached 1.1% share from the total energy consumption. In 2022, consumption increased by 4.5% compared to 2021. Waste oils are reported as other fuels.

Hydroelectric power plants (HPP) and CHP produce part of the electrical power, while also part is imported (Table 3.2, Table 3.3). Volume of electricity generation in HPP directly depends on the through-flow of the river Daugava. Also, the import and export of electricity from other countries has a significant role in the internal electricity market in Latvia.

Table 3.2 Heat production and consumption in Latvia (TJ)

	Production	Own use and losses	Final consumption		
			NFR 1A2	NFR 1A4	TOTAL
1990	99439	15171	32929	51339	84268
1995	46112	7156	1969	36987	38956
2000	31867	6815	659	24393	25052
2005	31144	5886	684	24574	25258
2010	28662	4590	387	23685	24072
2011	25000	4104	268	20628	20896
2012	26857	4464	259	22134	22393
2013	26249	4551	479	21219	21698
2014	25747	4608	890	20249	21139
2015	25459	4358	1450	19651	21101
2016	28967	4635	2506	21826	24332
2017	29989	4668	3291	22030	25321
2018	29688	4494	3781	21413	25194

[4] For reporting purposes municipal waste has been divided into fossil and non-fossil fractions, but in the particular paragraph it is described as whole.

	Production	Own use and losses	Final consumption		
			NFR 1A2	NFR 1A4	TOTAL
2019	28612	4288	3324	21000	24324
2020	27010	3782	2932	20296	23228
2021	31202	4261	2937	24004	26941
2022	27781	4145	2822	20814	23636

Table 3.3 Electricity production and consumption in Latvia (TJ)

	Production	Own use and losses	Import	Export	Final consumption			
					NFR 1A2	NFR 1A3	NFR 1A4	TOTAL
1990	23933	6883	25700	12798	11484	918	17550	29952
1995	14324	6371	9529	1408	5130	677	10267	16074
2000	14890	5203	7589	1159	5159	547	10411	16117
2005	17658	4766	10278	2545	6120	533	13972	20625
2010	23857	4626	14303	11160	5724	453	16197	22374
2011	21938	4133	14432	9950	6012	446	15829	22287
2012	22202	3636	17766	11678	7175	464	17015	24654
2013	22352	3556	18018	13140	6509	446	16719	23674
2014	18500	3138	19221	10883	6003	421	17276	23700
2015	19921	3215	18888	12330	6130	384	16750	23264
2016	23129	3513	17382	13662	6005	378	16953	23336
2017	27111	3535	14662	14893	6345	377	16623	23345
2018	24210	3498	18625	15353	6630	374	16980	23984
2019	23178	3312	16599	12574	6646	363	16882	23891
2020	20609	2976	15024	9172	6709	339	16437	23485
2021	21047	3167	16799	10417	7005	351	16906	24262
2022	17990	3047	19110	10788	6636	365	16264	23265

Types of fuels used for combustion in Latvia:

Liquid fuels are mainly imported from Latvia's neighbouring countries (Lithuania, Belarus, Russian Federation), Scandinavian countries and others:

- shale oil;
- liquefied petroleum gas (LPG);
- motor gasoline and aviation gasoline;
- kerosene type jet fuel;
- other kerosene;
- gasoline type jet fuel;
- motor diesel oil and heating gas oil;
- RFO;
- other liquids;
- petroleum coke.

Solid fuels - coal and coke are mainly imported from Russian Federation, Kazakhstan and Ukraine;

Peat products - peat and peat briquettes are mainly domestic;

Gaseous fuels (natural gas) are imported from Estonia, Finland Lithuania and Russian Federation;

Biomass fuels:

- solid biomass – wood and other wood products, charcoal, straw and are mainly domestic,
- biogas that is produced domestic – landfill gas that is used since 2002 when first landfill started to collect and combust biogas with energy recovery, sludge gas that is combusted with energy recovery since 1993 largest sewage purification plant, and other biogases that are produced from agriculture crops, animal slurries, breweries and other agro-food industries from anaerobic fermentation,

- liquid biofuels – biogasoline and biodiesel, are mainly imported from Latvia's neighbouring countries.

Other fuels are municipal waste and industrial waste – used tires, different types of industrial fuel collected by and combusted in cement production plant in Latvia, as well as waste oils.

3.2 Fuel Combustion (NFR 1.A)

3.2.1 Source category description

Emissions from fuel combustion comprise all in-country fuel consumption for heat and electricity production purposes and to provide operation of transport vehicles. These emissions include point sources, transport and other fuel combustion. Emissions from fuel combustion in the Energy sector are divided into following subcategories:

- NFR 1A1 – Energy Industries;
- NFR 1A2 – Manufacturing Industries and Construction;
- NFR 1A3 – Transport;
- NFR 1A4 – Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/ Fisheries);
- NFR 1A5 – Other (Not elsewhere specified).

Source categories and methods used are listed in Table 3.4, emissions are reported in Table 3.5.

Table 3.4 Source categories and methods in Fuel combustion

NFR code	Description	Method	AD	EF
1A1a	Public electricity and heat production	Tier 1, 2	NS[5]	D[6]
1A1c	Manufacture of solid fuels and other energy industries	Tier 1	NS	D
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Tier 1	NS	D
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Tier 1	NS	D
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Tier 1	NS	D
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Tier 1	NS	D
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Tier 1	NS	D
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Tier 1	NS, PS[7]	D
1A2g	Stationary and mobile combustion in manufacturing industries and construction: Other	Tier 1, 2	NS	D
1A3a	Domestic and international Civil aviation	Tier 1, 2	NS	D
1A3b	Road transport	Tier 3	NS	D
1A3c	Railways	Tier 2	NS	D
1A3d	National navigation and international maritime navigation	Tier 1	NS	D
1A4a	Commercial/Institutional	Tier 1, 2	NS	D
1A4b	Residential	Tier 1, 2	NS	D
1A4c	Agriculture/Forestry/Fishing	Tier 1, 2	NS	D
1A5b	Other, Mobile (including military, land based and recreational boats)	Tier 1	NS	D

Table 3.5 Reported emissions in Energy sectors in 2022

NFR code	Emissions
1A1a	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A1b	NO
1A1c	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB

[5] National statistics
[6] Default EF from EMEP/EEA 2019
[7] Plant specific (AD – data obtained from plant)

NFR code	Emissions
1A2a	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A2b	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A2c	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A2d	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A2e	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A2f	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A2g	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A3ai(i)	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg
1A3aii(i)	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg
1A3bi	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3bii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3biii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3biv	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3bv	NMVOC
1A3bvi	$PM_{2.5}$, PM_{10}, TSP, BC
1A3bvii	$PM_{2.5}$, PM_{10}, TSP
1A3c	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Cr, Cu, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs
1A3di(ii)	NA, NE
1A3dii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs, indeno(1,2,3-cd)pyrene, total PAHs
1A3ei	NO
1A4ai	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A4aii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs
1A4bi	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A4bii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs
1A4ci	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCB
1A4cii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs
1A4ciii	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, HCB, PCB
1A5b	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, HCB, PCB

3.2.2 Key sources

In 2022, in stationary combustion the Energy Industries (NFR 1A1) was the most important source for Hg, As, Ni and Se, Transport (NFR 1A3) was the most important sector for NOx, Pb and Cu, Other Sectors (commercial/institutional, residential, agriculture/forestry/fishery; NFR 1A4) for NMVOCs, SO_2, NH_3, PMs, CO, Cd, Cr, Se, Zn, PCDD/F, PAHs, HCB and PCBs emissions Figure 3.1

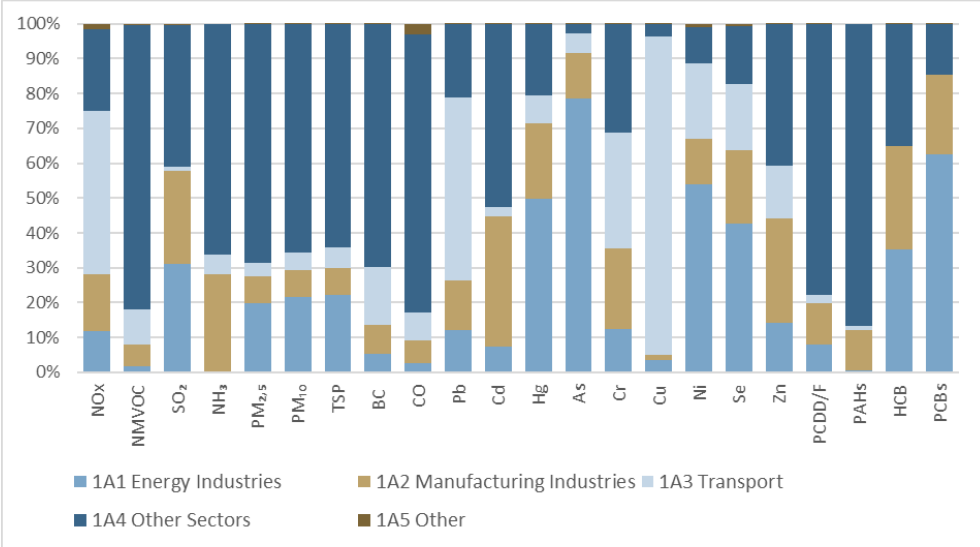

Figure 3.1 Distribution of emissions from Fuel combustion in 2022, %

Main pollutants

NO_x emissions generated in fuel combustion made up 79.6% from total emissions generated in Latvia in 2022. The largest part was produced in 1A3 Transport (46.9%) sector. **SO_2** emissions from fuel combustion were 96.5% from total SO_2 emissions in 2022, and 1A4 Other Sector was the most significant with 40.7%. **NMVOC** emissions from Energy sector contributed to 36.5% of the total Latvia's NMVOC emissions in 2022. 1A4 Other Sector contributed to the largest part with 81.5%. The most important source for NMVOC emissions from stationary fuel combustion is solid biomass combustion in Residential sector. The largest part of **NH_3** emissions in fuel combustion are produced in 1A4 Other Sector – in 2022 8.6% of total NH_3 emissions or 66.2% from fuel combustion. In EMEP/EEA 2019, there are no emission factors for NH_3 emission estimation in 1A1 sector, therefore notation key NE in the particular sector was used.

In 2022, fuel combustion sectors accounted for 92.2% of the total **CO** emissions in Latvia. 1A4 Other Sector was the largest emission source accounting for 79.7% of fuel combustion emissions.

Particulate matter

Fuel combustion generated 89.3% of **$PM_{2.5}$** emissions, 62.3% of **PM_{10}** emissions, 38.6% of **TSP** emissions and 96.0% of total **black carbon** emissions in 2022. The largest part of PM emissions is generated in 1A4 Other Sectors (around 60-70%). Mainly particulate matter emissions are produced in biomass combustion process.

Heavy metals

Lead emissions from fuel combustion were 79.9% from total Pb emissions in 2022, and 1A3 Transport was the one with the highest contribution 52.4%. **Cadmium** emissions from fuel combustion account for 96.5% from total emissions, and 1A4 Other Sector is the biggest producer of cadmium emissions with 52.7% from total Cd emissions in the energy sector. In 2022 fuel combustion accounted for 77.4% of the total **mercury** emissions. Mercury emissions from fuel combustion are mainly emitted in solid fuels and biomass combustion, and the largest part of emissions are produced in 1A1 Energy Industries (49.8%).

POPs

Fuel combustion is the main producer of POPs emissions in Latvia – **PCDD/F** (82.5%), **PAHs** (87.0%), **HCB** (61.5%) and **PCB** (98.7%). 1A4 Other Sector is the largest sector of HCB emissions with 34.9% of total fuel combustion emissions. Solid biomass combustion is the main source of PAHs emissions in 2022, and 1A4 Other Sector is the largest contributor to PAH emissions with 86.8% from fuel combustion respectively. In fuel combustion, 1A4 Other Sectors is 77.7% for the PCDD/F emissions where solid biomass and solid fuels are the main emitters for the particular emissions.

3.2.3 Trends in emissions

Table 3.6 Reported emissions from fuel combustion in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2019	2020	2021	2022	*Change in 1990 - 2022, %*	*Change in 2005 - 2022, %*
NOx	kt	88.31	50.04	40.79	43.07	37.80	31.47	29.49	26.50	26.93	26.03	***-70.5***	***-39.6***
NMVOC		47.46	37.94	31.94	29.00	20.04	13.17	13.66	12.13	12.08	11.58	***-75.6***	***-60.1***
SOx		96.89	48.45	16.82	7.26	4.12	3.31	3.58	3.31	3.50	3.64	***-96.2***	***-49.9***
NH_3		1.67	2.47	2.27	2.90	2.46	1.98	2.09	1.91	1.94	1.94	***15.9***	***-33.3***
$PM_{2.5}$		22.92	25.70	23.21	25.11	18.98	14.52	16.75	15.15	15.73	15.30	***-33.3***	***-39.1***
PM_{10}		24.07	26.68	24.06	26.07	19.80	15.41	17.84	16.18	16.84	16.37	***-32.0***	***-37.2***
TSP		25.89	28.41	25.51	27.65	21.08	16.54	19.17	17.40	18.13	17.63	***-31.9***	***-36.2***
BC		3.87	3.46	3.10	3.34	2.69	1.97	2.12	1.91	1.93	1.86	***-51.9***	***-44.3***
CO		387.60	272.37	215.11	205.89	148.32	100.76	104.71	91.82	93.18	91.12	***-76.5***	***-55.7***
Pb	t	70.43	44.99	4.55	5.25	4.65	4.17	4.27	3.95	4.05	3.92	***-94.4***	***-25.3***
Cd		0.48	0.59	0.51	0.61	0.55	0.52	0.57	0.53	0.55	0.55	***15.0***	***-9.7***
Hg		0.27	0.11	0.07	0.07	0.07	0.07	0.08	0.07	0.08	0.08	***-72.0***	***1.6***
PCDD/F	g I-Teq	23.77	26.49	24.84	27.90	19.91	14.42	16.11	14.48	14.84	14.44	***-39.3***	***-48.3***
PAHs	t	15.37	13.22	10.91	12.11	9.36	6.34	6.86	6.07	6.16	5.97	***-61.2***	***-50.7***
HCB	kg	0.19	0.25	0.23	0.26	0.23	0.26	0.31	0.30	0.32	0.32	***71.7***	***22.5***
PCBs		4.27	1.07	0.44	0.54	0.44	0.22	0.18	0.14	0.12	0.13	***-97.0***	***-76.4***

The majority of total emissions from stationary fuel combustion have decreased in 1990-2022, with exception of NH_3, Cd and HCB emissions (Table 3.6). A particular emission increase is directly related to the increased use of biomass.

SO_2 emissions have the biggest decrease (96.2%) in 1990-2022. The emission decrease can be explained with fuel switch from heavy liquid fuels and solid fuels to natural gas and biomass use and to meet the commitments of EU ETS.

There is also a large decrease (70.5%) in NO_x emissions, that can be explained with change in fuel types – solid fossil fuels widely used previously were changed to biomass that have lower emission factor, therefore NO_x emissions decreased.

NH_3 emissions have increased by 15.9% in 1990-2022, mainly because of increased use of biomass. NH_3 emissions are calculated only from biomass burning processes in sectors 1A2 Manufacturing Industries and Constructions and 1A4 Other Sector.

Particulate matter emissions have decreased by approximately 30% in 1990-2022. Since 2005 particulate matter emissions have decreased due to the decrease of total fuel consumption (decrease in solid fuel use and increase use of gaseous fuels).

Heavy metal emissions have decreased by 70-95% in 1990-2022, except Cd, which has increased by 15.0%. Decrease of emissions can be explained with a decrease of total fuel consumption in early nineties due to the economic crisis in the country. In recent years heavy metal emissions decreased due to fuel switch from heavy liquid and solid fossil fuels to natural gas and biomass consumption, except for Cd, which has relatively high emission factor for biomass.

From 1990 to 2022 PAH emissions have decreased by 61.2%, HCB emissions increased by 71.7% and PCDD/F emissions decreased by 39.3%, which can be explained with sharp increase of solid biomass consumption and decrease of fossil fuel consumption. The decrease of PCB emissions by 97.0% can be explained with decrease of solid fuel consumption – solid fossil fuels have significantly higher emission factor than solid biomass therefore the decrease of first mentioned has a bigger effect.

3.2.4 Energy Industries (NFR 1A1)

3.2.4.1 Overview

NFR 1A1 Energy Industries sector includes emissions from fuel combustion in point sources in energy and heat production. According to the 2006 IPCC Guidelines, emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity) are assigned to the sector where they were generated and not under NFR 1A1 (included in sectors NFR 1A2, NFR 1A4a and NFR 1A4c).

Emissions from combustion installations with NACE 2 codes 35.11 and 35.30 are reported in NFR 1A1a sector. There are no petroleum refineries in Latvia therefore in NFR 1A1b notation key „NO" is used. NFR 1A1 sector also includes the emissions from on-site use of fuel in the energy production facilities and emissions from manufacturing of solid fuels (peat briquettes and charcoal production plants) – these emissions are reported under 1A1c Manufacture of solid fuels and other energy industries sector.

3.2.4.2 Trends in emissions

Table 3.7 Trends in emissions from 1A1 Energy Industries sector in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2019	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	10.640	6.249	4.404	3.607	3.384	3.433	3.850	3.372	3.650	3.098	***-70.9***	***-14.1***
NMVOC	kt	0.220	0.123	0.116	0.122	0.125	0.165	0.216	0.197	0.221	0.202	***-8.3***	***65.7***
SO_x	kt	36.393	22.829	7.635	1.612	0.685	0.635	0.997	0.927	1.112	1.128	***-96.9***	***-30.0***
$PM_{2.5}$	kt	0.753	0.564	0.563	0.652	0.750	1.704	2.721	2.607	3.044	3.016	***300.3***	***362.8***
PM_{10}	kt	0.994	0.728	0.683	0.762	0.874	1.984	3.170	3.036	3.546	3.516	***253.8***	***361.4***
TSP	kt	1.376	0.970	0.810	0.860	0.975	2.200	3.518	3.369	3.935	3.905	***183.7***	***354.1***
BC	kt	0.041	0.027	0.021	0.022	0.025	0.056	0.090	0.086	0.100	0.100	***145.9***	***347.8***
CO	kt	2.654	1.387	1.558	1.659	1.420	1.931	2.450	2.326	2.604	2.433	***-8.3***	***46.7***
Pb	t	0.238	0.177	0.138	0.103	0.118	0.263	0.422	0.403	0.471	0.471	***98.2***	***356.5***
Cd	t	0.056	0.034	0.020	0.011	0.011	0.023	0.037	0.035	0.041	0.041	***-26.5***	***279.8***
Hg	t	0.037	0.023	0.020	0.011	0.013	0.023	0.035	0.032	0.038	0.037	***2.2***	***226.1***
PCDD/F	g I-Teq	0.176	0.163	0.216	0.242	0.285	0.643	1.025	0.982	1.146	1.135	***543.9***	***368.9***
PAHs	t	0.002	0.002	0.004	0.005	0.007	0.016	0.025	0.024	0.028	0.028	***1669.7***	***402.5***
HCB	kg	0.032	0.038	0.034	0.023	0.030	0.064	0.103	0.098	0.114	0.113	***258.9***	***383.0***
PCB	kg	0.002	0.004	0.011	0.015	0.019	0.044	0.071	0.068	0.080	0.079	***5031.8***	***416.4***

Part of emissions from NFR 1A1 Energy Industries sector have decreased in 1990-2022, but emissions have increased of PMs, Pb, PAHs and dioxins, as well as HCB and PCB emissions (Table 3.7). These changes in emissions can mainly be explained with decrease of liquid and solid fuels consumption and increased use of biomass consumption in the sector.

3.2.4.3 Methods

Tier 1 and Tier 2 method were used to calculate emissions from the stationary fuel combustion. Calculation of all emissions from fuel combustion is done in MS Excel database. Tier 2 methodology was used to calculate emissions form natural gas use in sector NFR 1A1aii for period 2005-2022.

The general method for emission calculation:

$$Em = EF \times B_q$$

where:
Em – total emissions (kt)
EF – emission factor (t/TJ)
B_q – amount of fuel in thermal units (TJ)

3.2.4.4 Emission factors

The main source for emission factors is EMEP/EEA 2019 (emission factors used for Energy sector are presented in Annex I, Table 1). Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex IV: Summary Information on Condensable in PM.

SO_2 emission factors were calculated by formula taken from EMEP/EEA 2019 and were calculated by national expert considering physical characterization of fuel types used in Latvia and taking into account national and international legislation. Percentage amount of sulphur content in used fuels is taken from the national database "2-Air" where polluters report the sulphur content data for certain types of fuels (Annex I, Table 3).

Emission factors for SO_2 are calculated by using the following equation:

$$EF = 2 \times \left(\frac{s}{100}\right) \times \frac{1}{Q} \times 10^6 \times \left(\frac{100-r}{100}\right) \times \left(\frac{100-n}{100}\right)$$

where:

EF – emission factor (kg/TJ)
2 – SO_2 / S (kg/kg)
s – sulphur content in fuel (%)
r – retention of sulphur in ash (%)
Q – net calorific value (TJ/kt)
10^6 – (unit) conversion factor
n – efficiency of abatement technology and/or reduction efficiency (%).

The default emission factors used in emission estimations were taken from EMEP/EEA 2019 (Annex I, Table 1). Emission factors for sludge gas, landfill gas and other biogas were equalized to natural gas emission factors due to unavailability of particular emission factors for biogas. Emission factors for biodiesel were equalized to diesel emission factor.

3.2.4.5 Activity data

Emissions from fuel combustion are mainly calculated using fuel consumption data from the CSB Energy Balance, prepared by CSB. Data on fuel consumption in NFR 1A1 sector is presented in Annex II.

The CSB data collection system is based on detailed compulsory survey 2-EK (annual). Form 2-EK "Survey on acquisition and consumption of energy resources" is collected from about 6000 enterprises and organizations (with all kinds of economic activity) included in the lists of suppliers of statistical information.

Approximately 5000 respondents were surveyed - all enterprises of the local and public administration employing 10 or more persons, other enterprises employing 80 and more persons, as well as enterprises with largest statistical units with turnover of 50% of total industry, and other enterprises that CSB considers to be significant enough to include in the CSB Energy Balance, for example, with large imports of coal and oil products as well as wooden briquettes and chip pellets manufacturers. Enterprises and organizations that are not included in the above mentioned selection were surveyed by random sampling and the acquired results were extrapolated afterwards. Survey 2–EK represents the basic tool for creating energy balance at a country level. The amount of methane from combusted landfill gas is described in Chapter 6.3 Solid waste disposal and is consistent with numbers of recovered amounts of landfill gas in Waste sector (NFR 5A). The amount of methane from combusted sludge gas is given by the only Sludge gas combustion enterprise and is consistent with numbers of gas, recovered from Wastewater handling sector (NFR 5D).

Fuel consumption by fuel types in 1990-2022 in Energy Industries sector can be seen in Figure 3.2. Gaseous fuels are mostly used in Energy Industries in this time period. Liquid fuels were mostly used in the beginning of 1990-ties and in the beginning of 2000 the use of them notably decreased. The amounts of biomass consumed is constantly increasing, while the consumption of solid fossil fuels and peat have decreased.

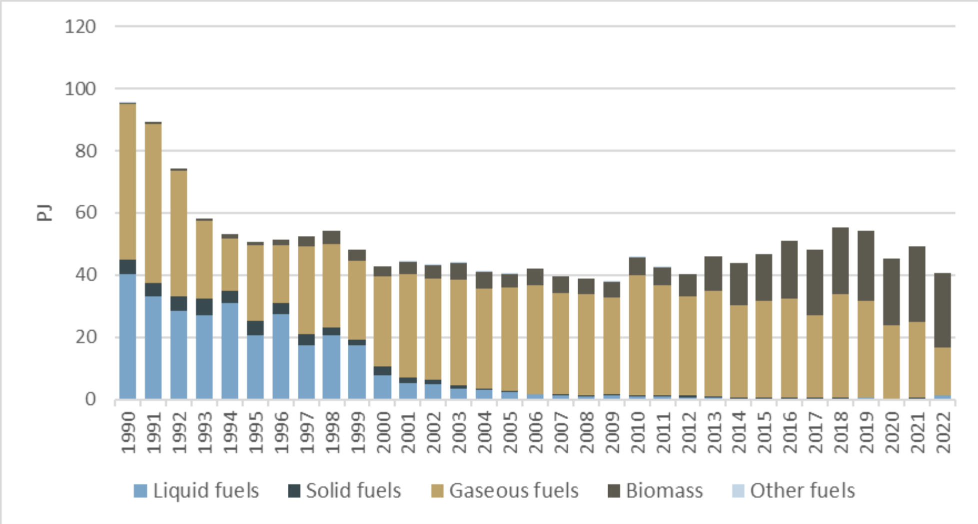

Figure 3.2 Fuel consumption in NFR 1A1 Energy Industries in 1990-2022, PJ

The largest decrease in 1990–2022 for the two sub-sectors of 1A1 Energy Industries sector was for liquid fuel (by 97.2%). It can be explained with fuel switching when liquid fuels were switched to cheaper fuels. Also, a stronger legislation contributed fuel switch to the type of fuels with lower level of emissions. It also explains why consumption of solid fuels have decreased (by 98.7%). Use of peat decreased by 97.5% and gaseous fuels by 69.0% in comparison with 1990. In 2021-2022 fuel consumption increased for liquid fuels (almost 3 times), peat (130.4%), but decreased for solid fuel (58.3%) and natural gas (36.3%). Consumption of biomass fuel has significantly increased in 1990–2022 for more than 50 times. Solid biomass is a local fuel and has lower costs therefore liquid and solid fuels were replaced with it. And due to biomass CO_2 neutrality, enterprises switched from fossil fuels to biomass. In 2022, biomass consumption has decreased by 1.7% compared to 2021.

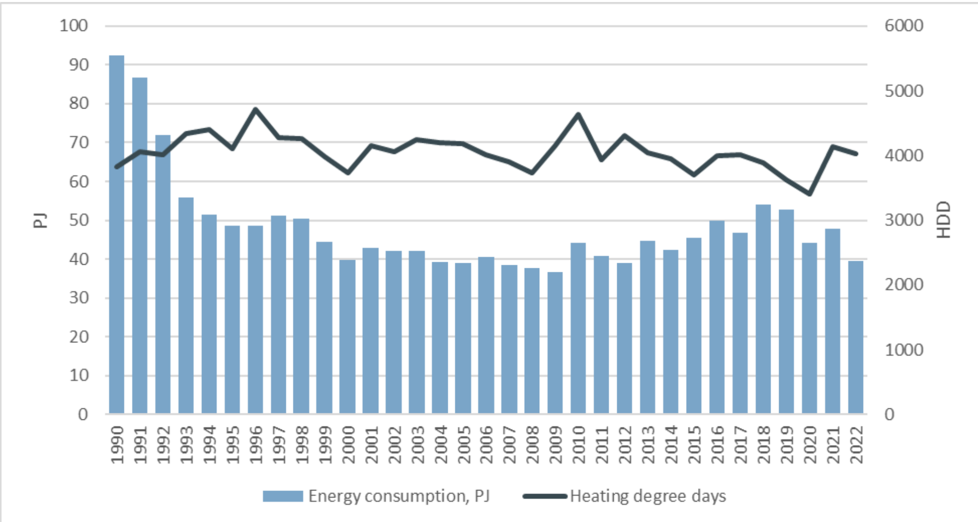

Figure 3.3 Fuel consumption in NFR 1A1a Public electricity and heat production and heating degree days in Latvia

As it can be seen in Figure 3.3 the fuel consumption in 1.A.1.a sector can be related with HDD with an exception of the beginning of 1990s when Soviet Union collapsed and reorganizations took place in Latvia. From 1997 to 2002 in years where energy consumption reduced, the HDD were also reduced. In 2006-2008 average temperature had quite high therefore the fuel consumption of combined heat plants and heat plants for heat production decreased as there was limited need for heat production. In 2009-2010 the average temperature was lower and the use of fuel consumption increased. However, in 2011 the fuel consumption decreased because of a relatively warm winter, and in 2012 the consumption of fuel continued to decrease despite the fall of average temperature (hence the decrease in HDDs), that could be explained with the better heat insulation installed in houses and therefore less heat needed.

3.2.4.6 Uncertainties

Uncertainty of activity data for fuel combustion in NFR 1A1 is ±2% in 2022. CSB gives approximately 2% statistical sample error for statistical data. According to CSB, since data is obtained using information given by respondents, this number is a variation coefficient which characterizes selection of respondents. Total variation coefficient for energy balance is within 2-3%. In Latvia all fossil fuels (oil, natural gas and coal) are imported and import and export statistics are fairly accurate.

Uncertainty of activity data for solid biomass was assigned 1% as biomass activity data was collected by CSB with questionnaires sent by enterprises consumed biomass. Uncertainty for peat combustion activity data was assigned 2%. Uncertainty of sludge gas stationary combusted in enterprises covered by 1A1 Energy Industries sector was assumed rather low – 2% because the combusted fuel amount is obtained directly from wastewater treatment plant that has a precise measurement equipment for accounting combusted fuel. The same applies to landfill gas.

Emission factor uncertainty is assumed 50%, as these are default emission factors taken from EMEP/EEA 2019.

3.2.4.7 QA/QC and verification

Disaggregated data at the finest level possible is presented in the corresponding Annex II. Data completeness has been explained in the previous subchapter.

Activity data is checked with the data provider – CSB, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data is received, the sectoral expert responsible for the emission estimation and reporting is comparing all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

To verify the emissions, logical mistakes are checked, which is done by checking the time series of the activity data, emission factors and emission consistency to display all significant and illogical changes in the activity data and emissions. The emissions from substances reported also under UNFCCC as an indirect GHGs are cross-checked for verification purposes.

3.2.4.8 Recalculations

No recalculations were made.

3.2.4.9 Planned improvements

Continue work on developing Tier 2 calculation methodology for sector NFR 1A1a biomass combustion.

3.2.5 Manufacturing Industries and Construction (NFR 1A2)

3.2.5.1 Overview

NFR 1A2 Manufacturing industries and construction sector includes emissions from fuel combustion in combustion installations for industrial production including emissions from off–road. NFR 1A2 sector also includes the emissions from on-site use of fuel in the industrial production facilities (autoproducers) – these emissions are reported under particular sub-sectors of NFR 1A2 according to the 2006 IPCC Guidelines.

Under NFR 1A2g Other sector emissions from following industrial sectors are reported:

- Manufacturing of Machinery;
- Manufacturing of Transport equipment;
- Mining and Quarrying;

- Wood and Wood Products;
- Construction;
- Textiles and Leather;
- Other non-specified (Industry).

3.2.5.2 Trends in emissions

Table 3.8 Trends in emissions from NFR 1A2 Manufacturing Industries and Construction sector in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2019	2020	2021	2022	Change in 1990-2022, %	Change in 2005-2022, %
NO_x	kt	18.73	10.11	5.47	4.30	4.23	3.76	3.62	3.73	3.87	4.24	***-77.3***	***-1.3***
NMVOC		3.92	1.65	1.46	1.14	0.78	0.61	0.71	0.72	0.68	0.73	***-81.3***	***-35.7***
SO_x		24.33	15.08	4.70	1.56	0.99	0.84	0.86	0.87	0.85	0.98	***-96.0***	***-37.5***
NH_3		0.00	0.00	0.00	0.16	0.33	0.42	0.45	0.46	0.49	0.55	***31520.5***	***241.8***
$PM_{2.5}$		1.38	0.86	0.65	0.59	0.61	1.07	1.04	1.08	1.07	1.18	***-14.3***	***100.2***
PM_{10}		1.39	0.88	0.66	0.61	0.63	1.16	1.12	1.16	1.16	1.27	***-8.5***	***109.6***
BC		1.41	0.90	0.68	0.63	0.66	1.25	1.20	1.25	1.24	1.37	***-2.7***	***116.2***
TSP		0.63	0.35	0.24	0.15	0.14	0.14	0.15	0.15	0.15	0.16	***-75.4***	***1.7***
CO		22.82	4.65	3.72	5.29	4.92	5.52	5.83	5.47	5.46	6.00	***-73.7***	***13.4***
Pb	t	3.26	0.31	0.26	0.59	0.46	0.58	0.59	0.49	0.50	0.57	***-82.6***	***-4.0***
Cd		0.012	0.033	0.036	0.074	0.126	0.162	0.175	0.181	0.186	0.207	***1557.8***	***180.4***
Hg		0.025	0.013	0.009	0.017	0.013	0.016	0.015	0.015	0.015	0.016	***-35.8***	***-7.0***
PCDD/F	g I-Teq	0.42	0.40	1.59	2.42	1.05	1.40	1.49	1.53	1.56	1.73	***309.1***	***-28.7***
PAHs	t	0.85	0.54	0.30	0.44	0.47	0.59	0.61	0.63	0.63	0.70	***-17.3***	***57.7***
HCB	kg	0.004	0.012	0.021	0.038	0.049	0.078	0.080	0.082	0.085	0.094	***2233.1***	***148.8***
PCB		0.26	0.11	0.04	0.17	0.06	0.03	0.04	0.04	0.02	0.03	***-89.0***	***-82.5***

As it can be seen in Table 3.8, the largest part of emissions with an exception of NO_x, SO_2, CO, Pb, Hg, PAHs and PCB have decreased in 1990-2022. Emissions from NFR 1A2 Manufacturing Industries and Construction are decreasing in the latest years with a fluctuating trend. The increase in 2000-ties were due to sharp development of nation economy and industry as well as increase of demand of industrial production and improvement of well-being of population. Increase of emissions is also caused by constant increase of solid fuels – coal, and other fuels (used tires) consumption, which is mostly combusted in Mineral and Steel production industry. Decrease of emissions in 2007-2008 was influenced by the features of national economy development when in-country industrial production had started to decrease due to increase of costs of the production and dominance of imported products. Crisis in national economy in the second half of 2008 also caused a decrease of total emissions.

3.2.5.3 Methods

Tier 1 and Tier 2 methods were used to calculate emissions from the fuel combustion. Calculation of all emissions from fuel combustion was done in MS Excel database. Tier 2 methodology was used to calculate emissions for widely used fuels in the sector - form natural gas, solid fuel and biomass use in sector NFR 1A2gviii for period 1990-2022 also emissions from mobile combustion in sector NFR 1A2gvii are calculated using Tier 2 methodology.

The general method for emission calculation:

$$Em = EF \times B_q$$

where:

Em – total emissions (kt)
EF – emission factor (t/TJ)
B_q – amount of fuel in thermal units (TJ)

Fuel combustion emissions from Non-metallic Minerals (NFR 1A2f) are calculated using Tier 1 methodology from 1990-2022. But in 2009 cement production plant "SIA SCHWENK Latvija" changed technology from wet to dry process kiln and in 2010 started automatically measuring and reporting emissions in national database "2-Air". Due to that emission calculation in NFR 2A1 Cement production switched from Tier 1 methodology to Tier 3 and emissions are taken from national database "2-Air" directly since 2010. Emissions are measured in the main chimney and it is impossible to separate emissions that should be reported in IPPU to the ones, that should be reported in Energy sector. Therefore, to avoid double counting since 2010 total emissions from this cement production plant is reported in IPPU NFR 2A1.

Detailed information about emissions from Cement production (NFR 2A1) is available in Chapter 4.2.2.3.

Emissions from mobile combustion were calculated using methodology described in EMEP/EEA 2019 1.A.2.g.vii Non-road mobile sources and machinery Chapter 3.3 "Tier 2 technology-dependant approach".

3.2.5.4 Emission factors

The main source of emission factors is EMEP/EEA 2019 (emission factors used for Energy sector are presented in Annex I, Table 3). Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex IV: Summary Information on Condensable in PM.

SO_2 emission factors are calculated using the same methodology as for NFR 1A1 sector, using Tier 2 (see chapter 3.2.4.4).

The default emission factors used in estimation of emissions were taken from EMEP/EEA 2019 (Annex I). Emission factors for biodiesel were equalized to diesel emission factor.

The municipal waste consumption is reported in NFR 1A2f, and the emission factors are taken from Waste sector after 3rd Stage in-depth review in 2013 where Energy expert suggested Latvia to use emission factors from particular sector.

3.2.5.5 Activity data

Emissions from fuel combustion are calculated mainly using fuel consumption data from the national Energy Balance, prepared by CSB. The data collection system for NFR 1A2 sector is the same as for NFR 1A1 sector. Data on fuel consumption in NFR 1A2 sector is presented in Annex II, Table 2.

Autoproducers data prepared by CSB is taken into account calculating emissions from NFR 1A2 sector according to the 2006 IPCC Guidelines.

Gasoline combustion is reported as off-roads in NFR 1A2 sector. Also, total diesel oil combustion is reported as off-road in NFR 1A2 sector, with exception for sectors: NFR 1A2a (stationary combusted 35% from total diesel oil combustion), NFR 1A2gi (stationary combusted 1% from total diesel oil combustion) and NFR 1A2gv (stationary combusted 1% form total diesel oil combustion).

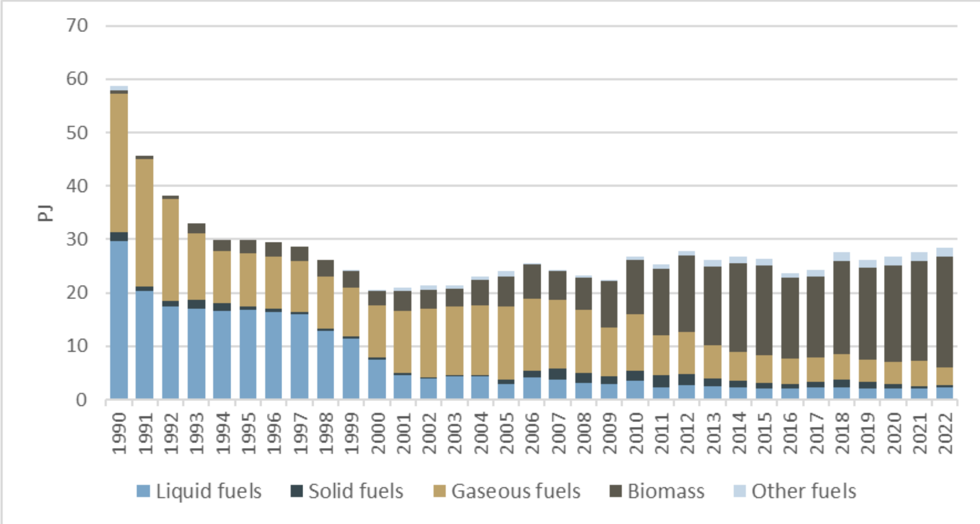

Figure 3.4 Fuel consumption in NFR 1A2 Manufacturing Industries and Construction in 1990-2022, PJ

The most of the fuel types with an exception of biomass and other fossil fuels have decreased in 1990-2022 (Figure 3.4). Liquid fuels have the biggest decrease 92.0%. It is explained with fuel switching processes when liquid fuels were replaced with other cheaper fuels. Also, stronger legislation contributed fuel replacement to the type of fuels with lower level of emissions. Decrease of natural gas (-87.2%) reflects the total decrease of industrial production if compared with 1990.

Since 1990 solid fuel consumption have decreased by 77.0% and by 33.0% in comparison with previous year mainly due to decreased fuel consumption in NFR 1A2f Non-metallic mineral sector.

During the 1990s natural gas consumption started to decrease steadily with some minor exceptions due to fuel replacement processes and development of national economy or due to the changes in demand. In 1990-2022 natural gas consumption have decreased by 87.2% and in 2021-2022 consumption have decreased by 30.5%.

Consumption of biomass have increased significantly by more than 30 times compared to 1990. Large availability of the fuel in-country as well as development of EU ETS were reasons for liquid and solid fuels' replacement with biomass and natural gas.

Consumption of used tires and municipal waste in Mineral production (information about waste burnt in cement production company taken from „SIA SCHWENK Latvija", the only company which combusts used tires and municipal waste for energy purposes) reported as other fossil fuels have increased by approximately 50 times since 1999. The increase was influenced by intensified cement production caused by increased demand of construction materials and sharp development of construction sector. In the category other fossil fuels waste oils are also reported, and the amount of this fuel is fluctuating over the years with a decreasing trend in recent years. But in 2021-2022 consumption increased by 6.8%.

3.2.5.6 Uncertainties

Uncertainty for activity data of fuel combustion in NFR 1A2 sector is ±2% in 2022. CSB gives approximately 2% statistical sample error for statistical data. According to CSB, as data is obtained using information given by respondents, this number is a variation coefficient which characterizes selection of respondents. Total variation coefficient for energy balance is within 2-3%. In Latvia all fossil fuels (oil, natural gas and coal) are imported and import and export statistics are fairly accurate.

Uncertainty of activity data for solid biomass was assigned 1% as biomass activity data was collected by CSB with questionnaires sent by enterprises consumed biomass. Uncertainty for peat combustion activity data was assigned 2%.

Uncertainty of other fuel consumption – municipal and industrial waste used in mineral production is assumed also low as 2% as the activity data is obtained from only one producer within EU ETS therefore the data is verified by accredited verifier and Regional Environmental Board.

Emission factor uncertainty is assumed as 50% as emission factors are taken from EMEP/EEA 2019.

3.2.5.7 QA/QC and verification

Disaggregated data at the finest level possible is presented in the corresponding Annex II. Data completeness has been explained in the previous subchapter.

Activity data is checked at the data provider – CSB, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data is received, the sectoral expert responsible for the emission estimation and reporting is comparing all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

To verify the emissions, logical mistakes are checked. It is done by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogical changes in the activity data and emissions. The emissions from substances reported also under UNFCCC as indirect GHGs are cross-checked with for verification purposes.

3.2.5.8 Recalculations

No recalculations were made for this sector.

3.2.5.9 Planned improvements

No improvements planned.

3.2.6 Transport (NFR 1A3)

3.2.6.1 Overview of sector

3.2.6.1.1 Source category description

Transport sector is a major contributor to the national NO_x emissions and it is an important source of the national CO and $PM_{2.5}$ emissions in 2022. The sector includes domestic and international aviation, road transport, railways, national navigation. Road Transport includes all types of vehicles on roads: passenger cars, light duty vehicles, buses, heavy-duty vehicles, motorcycles and mopeds. Railway Transport includes railway transport operated by diesel locomotives. Domestic Aviation (civil) includes helicopters, airplanes with turbojet engine and airplanes with piston engines. Aircrafts that are not included in Domestic Aviation are included in Other (NFR 1A5b). National Navigation comprises for miscellaneous vessels (tugs, barges, towboats, icebreakers), recreational crafts and personal boats. Emissions from fishing boats are included in NFR 1A4ciii sector. Only the emissions from LTO mode (domestic and international civil aviation) are included in the total national emissions. In its turn, emissions from the cruise mode are included in the memo items.

Table 3.9 shows the methods and source for activity data and emission factors used for emission calculating in Transport sector Table 3.10 shows list of pollutants, which are produced and calculated in Transport sector.

Table 3.9 Source categories and methods for Transport sector

NFR code	Description	Method	AD	EF
1A3a	Domestic and international Civil aviation	Tier 1, 2	NS[8]	D[9]
1A3b	Road transport	Tier 2, 3	NS	D

[8] National Statistics
[9] Default emission factor from guidelines

NFR code	Description	Method	AD	EF
1A3c	Railways	Tier 2	NS	D
1A3d	National navigation and international maritime navigation	Tier 1	NS	D

Table 3.10 Reported emissions in Transport sector in 2022

NFR code	Emissions
1A3ai(i)	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg
1A3aii(i)	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg
1A3bi	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3bii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3biii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3biv	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs
1A3bv	NMVOC
1A3bvi	$PM_{2.5}$, PM_{10}, TSP, BC
1A3bvii	$PM_{2.5}$, PM_{10}, TSP
1A3c	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Cr, Cu, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs
1A3di(ii)	NA, NE
1A3dii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs, indeno(1,2,3-cd)pyrene, total PAHs

3.2.6.1.2 Key sources

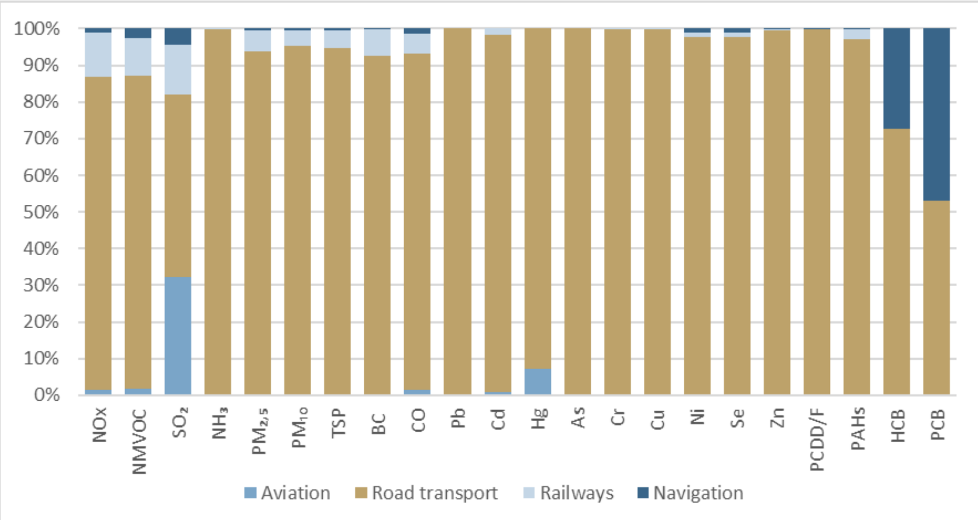

Figure 3.5 Distribution of emissions in Transport sector by subsectors in 2022, %

Road transport takes up the biggest part of Transport sector emissions followed by Railways (Figure 3.5). Domestic and international civil aviation (LTO mode) and national navigation contribute just a small part of transport emissions. Exception is SO_2 emissions where domestic and international aviation (32.2%), railway (13.5%) and navigation (4.5%), in addition to road transport (49.8%), are significant sources of emissions in transport sector. In HCB and PCB emissions, road transport accounts for 72.7% and 53.0% respectively, while navigation accounts for 27.3% and 47.0% respectively.

3.2.6.1.3 Trends in emissions

Table 3.11 Fuel consumption in Transport sector in 2021 and 2022 (TJ)

	Liquid fuel		Change in	Biomass		Change in	Gaseous Fuels		Change in
	2021	2022	2021-2022, %	2021	2022	2021-2022, %	2021	2022	2021-2022, %
Aviation (LTO)	404.5	612.0	51.3	NO	NO	NO	NO	NO	NO

	Liquid fuel		Change in	Biomass		Change in	Gaseous Fuels		Change in
	2021	2022	2021-2022, %	2021	2022	2021-2022, %	2021	2022	2021-2022, %
Road transport	41867.4	40797.9	-2.6	1920.2	634.3	-67.0	55.0	86.0	56.4
Railways	1021.0	963.0	-5.7	38.00	37.00	-2.6	NO	NO	NO
Navigation	107.0	74.0	-30.8	NO	NO	NO	NO	NO	NO

In 2022, total fuel consumption in the Transport sector (excluded off-road), compared to 2021, has decreased by 4.9% (Table 3.11). In different subsectors various changes have taken place in 2022. The main impact to changes in total fuel consumption related to decreasing of fuel consumption in road transport where the fuel consumption has decreased by around 5.3% and railway where the fuel consumption has decreased by around 5.6%. In contrast, fuel consumption in civil aviation has increased by 1.4 % due to the increase in the number of flights in international aviation.

In total, Road transport consumes around 96.1%, railway – around 2.3%, civil aviation – around 1.4% (including domestic and international LTO), national navigation – the remaining share of fuel (0.2%).

Diesel oil is the major fuel type in the transport sector and it constitutes around 79.6%, and is followed by gasoline – 13.8%, but LPG constitutes 3.5% and biofuels (biodiesel and bioethanol) 1.6% of the total fuel consumption in the transport sector. Biofuel includes biodiesel and bioethanol and it mainly is used in road transport but small portion is consumed in railway as well.

Table 3.12 Trends in emissions from Transport sector in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	34.58	22.13	25.15	21.66	17.28	13.09	12.93	12.21	***-64.7***	***-51.5***
NMVOC		21.29	11.48	8.30	4.61	2.47	1.37	1.33	1.15	***-94.6***	***-86.2***
SO_x		1.05	0.55	0.42	0.17	0.05	0.03	0.03	0.04	***-96.5***	***-91.2***
NH_3		0.02	0.07	0.24	0.24	0.21	0.14	0.13	0.11	***553.6***	***-55.1***
$PM_{2.5}$		0.80	0.71	1.07	0.98	0.74	0.62	0.63	0.59	***-25.8***	***-44.9***
PM_{10}		0.97	0.85	1.28	1.21	0.97	0.86	0.88	0.83	***-14.9***	***-35.5***
TSP		1.23	1.03	1.53	1.48	1.23	1.11	1.13	1.07	***-13.3***	***-30.2***
BC		0.37	0.35	0.56	0.54	0.41	0.32	0.33	0.31	***-16.8***	***-45.1***
CO		191.92	83.5	55.3	28.6	15.18	8.75	8.42	7.14	***-96.3***	***-87.1***
Pb	t	56.833	2.44	2.83	2.71	2.27	2.19	2.24	2.05	***-96.4***	***-27.5***
Cd		0.011	0.008	0.012	0.014	0.014	0.014	0.015	0.014	***29.9***	***16.1***
Hg		0.006	0.004	0.006	0.007	0.006	0.006	0.006	0.006	***-5.2***	***0.2***
As		0.011	0.009	0.013	0.015	0.015	0.016	0.017	0.016	***48.6***	***18.2***
Cr		0.38	0.32	0.47	0.53	0.53	0.57	0.59	0.56	***46.9***	***18.2***
Cu		8.74	7.37	10.78	12.18	12.02	12.91	13.38	12.73	***45.6***	***18.1***
Ni		0.10	0.08	0.12	0.14	0.13	0.14	0.15	0.14	***35.7***	***17.5***
Se		0.0124	0.010	0.014	0.017	0.016	0.017	0.018	0.017	***36.0***	***17.5***
Zn		2.918	2.45	3.61	4.09	4.03	4.32	4.48	4.27	***46.2***	***18.2***
PCDD/F	*g I-Teq*	0.266	0.23	0.36	0.46	0.41	0.39	0.39	0.36	***34.1***	***0.3***
PAHs	t	0.0502	0.037	0.057	0.067	0.067	0.074	0.078	0.074	***48.0***	***31.3***
HCB	kg	0.00021	0.00020	0.00033	0.00084	0.00064	0.00055	0.00056	0.0005	***123.8***	***41.4***
PCBs		0.00007	0.00005	0.00008	0.00028	0.00020	0.00016	0.00016	0.0001	***74.2***	***69.0***

Generally, most of emissions have decreased in 1990-2022 (Table 3.12) with an exception of NH_3, Cr, Cu and PAHs and some other metal emissions. Most of emissions from heavy metal species (Pb, Cr, Cu, Ni, Zn and other) create automobile tyre and brake wear. Consequently, emissions have increased mainly due to increase of road transport activities (number of cars, total vehicle-kilometres). NH_3 emissions are likely to increase due to the increasing number of vehicles equipped with catalytic systems for combustion gas treatment. However, the amounts of ammonia produced in Transport sector are very small, that the significant increase in Transport sector has no impact on national total NH_3 emissions. Development and introduction of technologies for emission abatement especially in road transport have ensured decreasing of NO_x, CO, PM, TSP and BC emissions. Whereas implementation of stronger requirement for fuel quality have decreased SO_2 and Pb emissions.

3.2.6.2 Civil aviation (NFR 1A3a)

3.2.6.2.1 Overview

Civil aviation includes emissions both from domestic and international aviation LTO cycles. This category does not include military aviation, which is reported under 1A5b sector. In Latvia, emissions from international aviation account for around 99% of total civil aviation emissions. The aviation gasoline is mainly used by small-sized propeller planes but jet kerosene is used by airplanes with turbo jets and turbo props engines.

3.2.6.2.2 Trends in emissions

Table 3.13 Trends and emissions in Civil aviation in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	0.116	0.041	0.043	0.093	0.185	0.200	0.098	0.122	***59.3***	***98.7***
NMVOC		0.074	0.026	0.028	0.013	0.021	0.022	0.011	0.013	***-73.1***	***55.7***
SO_x		0.013	0.005	0.005	0.006	0.013	0.013	0.007	0.008	***-6.7***	***87.8***
$PM_{2.5}$		0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	***-12.2***	***53.3***
PM_{10}		0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	***-12.2***	***53.3***
TSP		0.00161	0.00057	0.00061	0.00092	0.00156	0.00160	0.00078	0.00093	***-12.2***	***53.3***
BC		0.00077	0.00027	0.00029	0.00044	0.00075	0.00077	0.00037	0.00045	***-12.2***	***53.3***
CO		0.242	0.086	0.090	0.075	0.155	0.138	0.072	0.077	***-54.5***	***46.4***

Different trend tendencies during the time span 1990-2022 have to be noted for emissions in domestic and international civil aviation (Table 3.13). Until 2005 most emissions have decreased due to decrease activities in civil aviation (number of flights and fuel consumption). After 2005 there is an increase of emissions mainly due to rather rapid increase of international flights to and from Riga airport (international landing and take-off emissions are included in emissions' calculation). Number of international flights has increased more than 2 times to 2005. Due to the pandemic of Covid-19, the number of international flights from and to the airport "Riga" has decreased by 59.2% in 2020 compared to 2019, while fuel consumption in the LTO cycle by 42.5%. Since 2021 was slightly relieved by travel restrictions related to COVID-19, the number of aircraft flights increased. In 2022, the number of arriving and departing international flights have increased by around 43%, compared to 2021, fuel consumption and emissions also increased.

3.2.6.2.3 Methods

EMEP/EEA 2019 Tier 1 and Tier 2 approaches have been applied. Tier 2 approach with split in LTO and cruise cycles has been applied for jet kerosene emission calculation for time period 2004-2021. Tier 1 approach has been applied for aviation gasoline emission calculation.

3.2.6.2.4 Emission factors

Default emission factors for Civil aviation are taken from EMEP/EEA 2019. Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex IV: Summary Information on Condensable in PM.

Using Tier 2 approach for jet kerosene, emissions for LTO (landing/take off) and cruise are calculated individually. Prior to the emission calculation, representative aircraft type was chosen, for which the fuel consumption and emission data exist in the EMEP/EEA 2019. The calculated average specific fuel consumption of LTO have been compared and verified with Eurocontrol's emission data for time span 2004-2022.

3.2.6.2.5 Activity data

The data about fuel consumption in domestic and international civil aviation is derived from the CSB. CSB has started to collect data for domestic aviation since 2004 (Figure 3.6). For the time period 1990-2003 the data is used from the study "Evaluation of fuel consumption for domestic aviation and navigation" (IPE, 2004). For 2004 onwards, air flight statistics are provided by CSB.

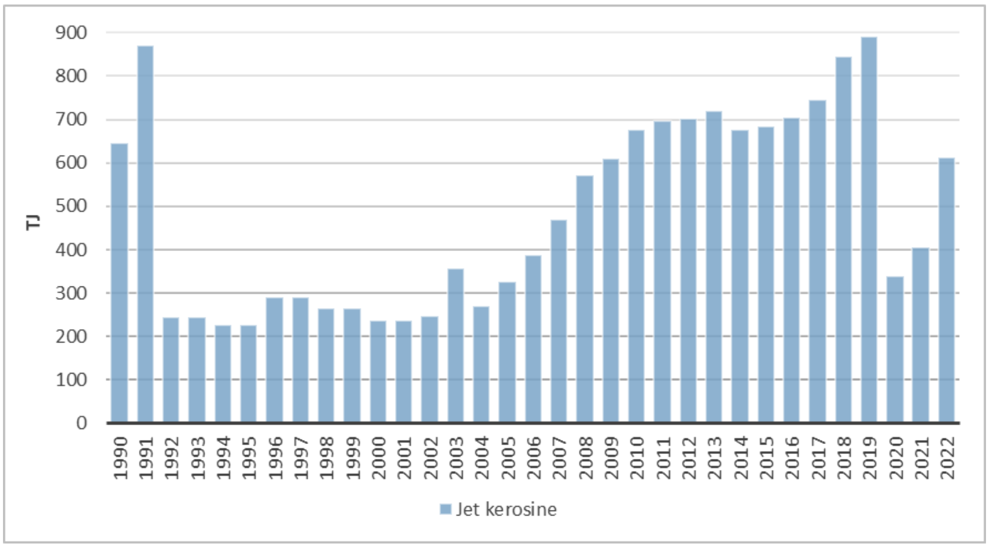

Figure 3.6 Fuel consumption in Civil aviation (domestic and international LTO), TJ

3.2.6.2.6 Uncertainties

CSB gives approximately 2% statistical sample error for statistical data. Considering this uncertainty in total fuel consumption for 2004-2022 is ±2%. As fuel consumption for LTO and cruise cycle was calculated based on assumptions concerning representative aircraft model, assumed uncertainty for fuel consumption in LTO and cruise cycle is ±10%. For the rest of time period uncertainty of activity data of fuel consumption is ±20%. Taking into account that it is used representative emission factors for LTO and cruise activities the uncertainty of EF lies between 20-45%.

3.2.6.2.7 QA/QC and verification

Assessment of trends were performed. Estimated emissions verification:

- All estimations of the emissions done for a transport sector are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.
- Emissions are checked using time series consistency check for the estimated IEF and all IEF changes in time series are double-checked and reasonable explanation for IEF changes has to be found. The calculated air transport emissions have been compared and verified with Eurocontrol's emission data for 2004-2021. The calculated activity data for fuel consumption of LTO and cruise mode and emissions were comparable and very close to those estimated by Eurocontrol.

3.2.6.2.8 Recalculations

All emissions for time period 2004 – 2021 have been recalculated due to the correction of jet fuel consumption.

3.2.6.2.9 Planned improvements

No improvements are planned for the next submission.

3.2.6.3 Road transport (NFR 1A3b)

3.2.6.3.1 Overview

Road transport is producing the greatest part of emissions in Transport sector (Figure 3.5). The main source of emissions are passenger cars, LDV and HDV, but buses and mopeds and motorcycles account for less emissions from total emissions on road transport. In the source category emissions also from gasoline evaporation, automobile road abrasion and automobile tyre and brake wear are calculated.

3.2.6.3.2 Trends in emissions

Table 3.14 Trends and emissions in Road transport in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	24.37	17.96	18.17	20.08	17.06	12.82	11.25	11.14	***-57.3***	***-48.2***
NMVOC		20.40	14.52	11.13	7.88	4.25	2.11	1.21	1.15	***-95.2***	***-87.6***
SO_x		0.36	0.28	0.29	0.09	0.02	0.02	0.02	0.02	***-94.9***	***-78.5***
NH_3		0.01	0.03	0.07	0.24	0.24	0.20	0.14	0.13	***626.7***	***-55.1***
$PM_{2.5}$		0.59	0.47	0.63	0.97	0.88	0.65	0.58	0.60	***-6.0***	***-42.8***
PM_{10}		0.75	0.59	0.76	1.17	1.11	0.87	0.82	0.84	***5.3***	***-32.7***
TSP		0.90	0.71	0.90	1.36	1.33	1.08	1.04	1.08	***12.4***	***-25.8***
BC		0.23	0.20	0.29	0.49	0.48	0.35	0.30	0.31	***21.4***	***-42.1***
CO		188.89	120.86	82.35	53.82	27.31	13.91	8.18	7.82	***-96.5***	***-87.8***
Pb	t	56.83	42.27	2.43	2.83	2.71	2.27	2.19	2.24	***-96.4***	***-27.5***
Cd	t	0.009	0.007	0.008	0.011	0.013	0.013	0.014	0.015	***52.0***	***22.0***
PCDD/F	g I-Teq	0.266	0.204	0.230	0.355	0.459	0.410	0.389	0.388	***34.1***	***0.2***
PAHs	t	0.037	0.028	0.032	0.050	0.062	0.062	0.071	0.075	***97.1***	***44.5***

Despite the total fuel consumption in road transport in 2022 was per 24.6% higher, compared to 1990, all main emissions have decreased in 1990-2022 with an exception of NH_3 and PM_{10} TSP, BC and Cd (Table 3.14). NH_3 emission increase is likely due to the increasing number of vehicles equipped with catalytic systems for combustion gas treatment.

Development of PM emissions during the time span 1990-2022 determined two main trends. First, a sharp increase in number of vehicles and vehicle kilometres travelled (VKT) by passenger cars, LDV and HDV increase non-exhaust emissions (automobile tyre and brake wear). Second, increase in the share of diesel passenger cars since 2010 and, at the same time, development of requirements and technologies concerning exhaust of particles.

Increase of Cd emissions is determined mainly by increase in number of vehicles and vehicle kilometres travelled by all types of vehicles and corresponding increase in emissions from automobile tyre and brake wear.

The main reason for decrease of emissions is also a steady improvement of car technologies and introduction of stronger requirements for fuel quality (SO_2 and Pb).

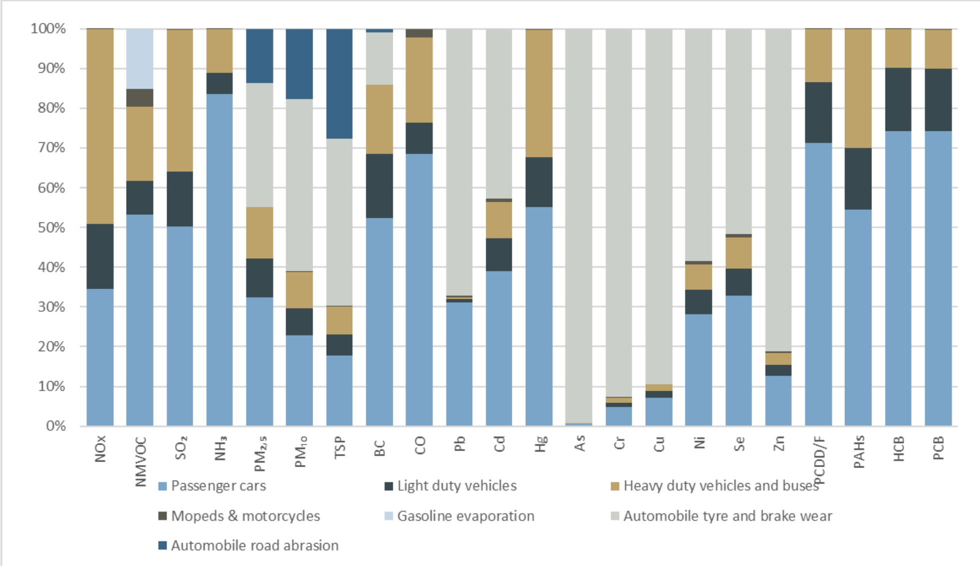

Figure 3.7 Emissions in Road transport, 2022

When analysing the development of emissions in road transport in 2022 following trends could be mentioned:

- Compared to 2021, NOx emissions have decreased by 6.6% and CO emissions have decreased by 16.2% in 2022. The changes in NOx emissions on the one hand were affected by a decrease in fuel consumption, while on the other, an increase in share of vehicles with higher environmental performance. A share of EURO4, EURO5 and EURO6 cars have increased for all types of vehicles, namely, passenger cars, LDV and HDV. Detailed analysis of the vehicle fleet's structure is provided below;
- Compared to 2021 in 2022 $PM_{2.5}$ emissions in road transport have decreased by 9.0%. It has happened due to two reasons. First, due to decrease of road transport activities (VKT) non-exhaust emissions (automobile tyre and brake wear) has decreased by 4.6%. Second, due to a decrease in fuel consumption of 5.3%, exhaust $PM_{2.5}$ emissions decreased by 9.0%.
- NMVOC emissions in 2022 have decreased by around 14.9% in comparison with 2021, which is mainly due to decrease in gasoline consumption.

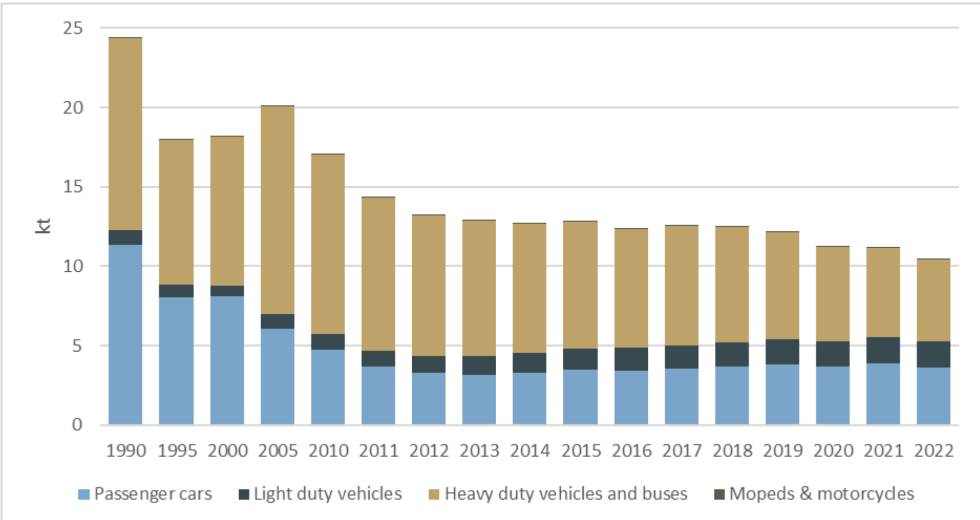

Figure 3.8 Development of NOx emissions in Road transport, kt

Characterising emissions breakdown by types of road transport vehicles the following has to be noted:

- The main sources of NO_x emissions are HDV and buses (49%) followed by passenger cars (34.5%) and LDV (16.4%);
- The main sources of NMVOC emissions are passenger cars - around 53.2%, HDV and busses 18.7%, LDV 8.4%, gasoline evaporation is responsible for 15.1% and mopeds and motorcycles 4.5% of total NMVOC emissions;
- The main sources of SO_2 emissions are passenger cars - around 50.2%, HDV and busses - around 35.7% and LDV - around 13.3%.
- The major part of CO emissions in road transport are created by passenger cars, - 68.5%, followed by HDV and busses – 21.5% and LDV – 7.8%.;
- In total $PM_{2.5}$ emissions automobile tyre and break wear and automobile road abrasion (non-exhaust emissions) contributed to 44.8%, passenger cars to 32.3%, HDV and busses to 12.9%, LDV to 9.8%.

Though total NO_x emissions in road transport in 2022 are per 48.2% lower, compared to 2005, emissions related to passenger cars during this period have decreased per 40.8%. On the one hand, the positive impact has been caused due to increased share of EURO4, EURO5 and EURO6 passenger cars from 0 % (in 2005) up to 55.1% in 2022. On the other hand, the negative impact on total amount of emissions has been created by increase of the share of diesel fuel passenger cars: this share has increased from 24.2% (in 2005) up to 67.4% in 2022, important is also to note that large share of them is ten and more years old.

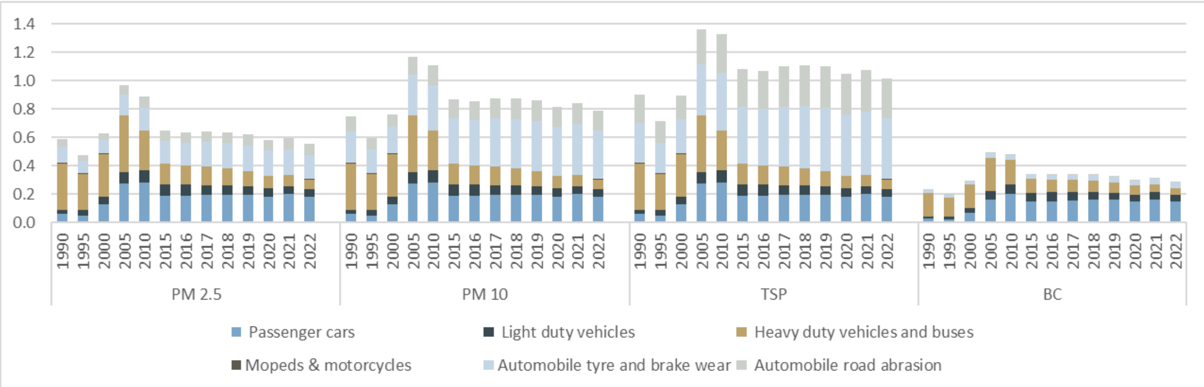

Figure 3.9 Distribution of solid particle emissions by sources in Road transport, kt

3.2.6.3.3 Methods

Emission calculation from Road transport is performed using the "Computer Programme to calculate Emissions from Road Transportation" (COPERT 5), which is proposed to be used by EEA member countries for the compilation of CORINAIR emission inventories. COPERT 5 methodologies can be applied for the calculation of traffic emission estimates at a relatively high aggregation level. Calculation of emissions is based on fuel consumption of road vehicles and on average mileage of vehicles and the fixed emission factors. Road traffic vehicles use five different fuels – gasoline, diesel oil, LPG, CNG and biofuel. Before emission calculation COPERT 5 model was calibrated to be consistent with actual consumed fuel (energy balance - statistics). Deviation between fuel consumption in COPERT model and statistics is less than 0.1%. Thus, we can say that all emission calculation is based on actual consumed fuel in road transport.

Corresponding to the COPERT 5 fleet classification, all vehicles in the Latvia fleet are grouped into vehicle classes, subclasses and layers. The layer classification is a further division of vehicle sub-classes into groups of vehicles with the same average fuel consumption and emission factors, according to EU emission legislation levels.

In COPERT 5, fuel consumption and emission simulation can be made for operationally hot engines, considering gradually tighten emission standards and emission degradation due to catalyst wear. Furthermore, the emission effects of cold-start and evaporation are simulated. Estimation of evaporative emissions of hydrocarbons and the inclusion of cold start emission effects are dealt with in the Latvian inventory by using LEGMC meteorological input data for ambient temperature variations during months; the distribution of evaporate emissions in the driving modes are used as a default by COPERT 5 model. Trip-speed dependent basis factors for fuel consumption and emissions are implemented. The fuel consumption and emission factors used in the Latvian inventory are from the COPERT 5 model. Calculated and reported $PM_{2.5}$ exhaust emissions for road transport include condensable components.

3.2.6.3.4 Activity data

As a basis for model input information, CSB data have been used considering the actual fuel consumption calibration with statistical fuel consumption, Road Traffic Safety Directorate (RTSD) collected and published data was used considering stock of road transport in Latvia. Total mileage data for passenger cars, light duty trucks, heavy duty trucks and buses produced by the RTSD was used for the years 1996-2022 and can be seen on Annex I, Table 4. Lubricant consumption in vehicles with 2-stroke engines and corresponding calculated emissions have been reported under 1A3biv (mopeds and motorcycles). Lubricant consumption is calculated based on VKT of 2-stroke engines and corresponding fuel (gasoline) consumption and implemented ratio for lubricant consumption.

To ensure efficient growth of the share of renewables in the transport sector, the mandatory 4.5-5% volume of bioethanol mix for the gasoline and mandatory 4.5-5% volume of biodiesel mix for the diesel fuel were introduced in Latvia from 01.01.2010. From 01.01.2020 the mandatory mix share for biofuels have been increased - at least 9.5% (volume) of bioethanol mix for the gasoline of "95" trademark and mandatory 6.5% (volume) of biodiesel mix for the diesel fuel[10]. Thus, all biofuel is used in blend with fossil fuel and all calculation of emissions have been performed for blend fuel.

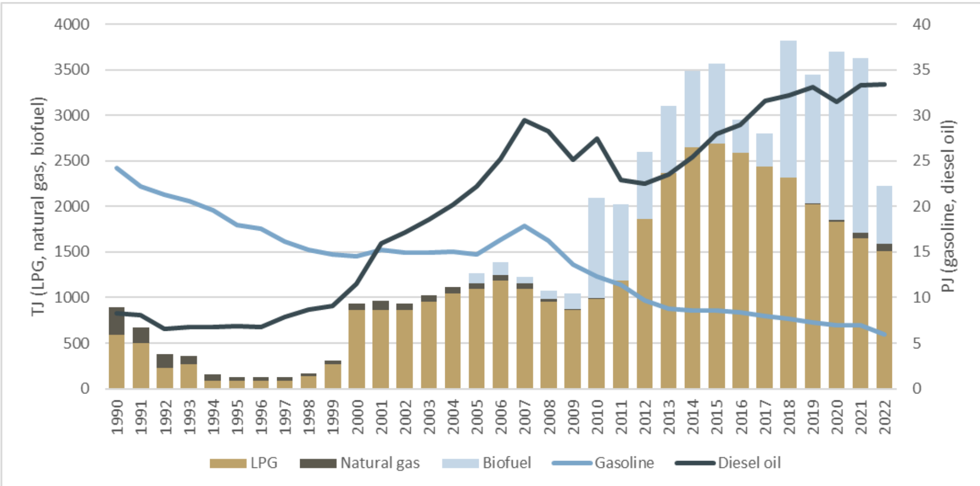

Figure 3.10 Development of fuel consumption in Road transport, TJ

As seen in Figure 3.10 the fuel consumption has changed essentially in 1990-2022. Gasoline consumption from the highest consumption in 1990 has decreased so that until 1999, it reached the lowest consumption and after six-year stabilization period an increase was seen in 2006 and 2007. Consumption of gasoline had decreased in 2022 by 14.2% compared to 2021. Whereas diesel fuel consumption starting from 1997 has increased gradually till 2007. While it decreased in 2008 and 2009 mainly due to economic recession. Diesel fuel consumption has increased in 2022 by 0.3% compared to 2021. Substantial LPG consumption increase in road transport was observed starting from 2011 but from 2017 onwards there is a continuous decrease in consumption. Consumption of biofuel had decreased in 2022 by 67.0% compared to 2021.

[10] Cabinet of Minister's Regulation No. 332 (2000, with amendments) "Requirements for Conformity Assessment of Petrol and Diesel Fuel"

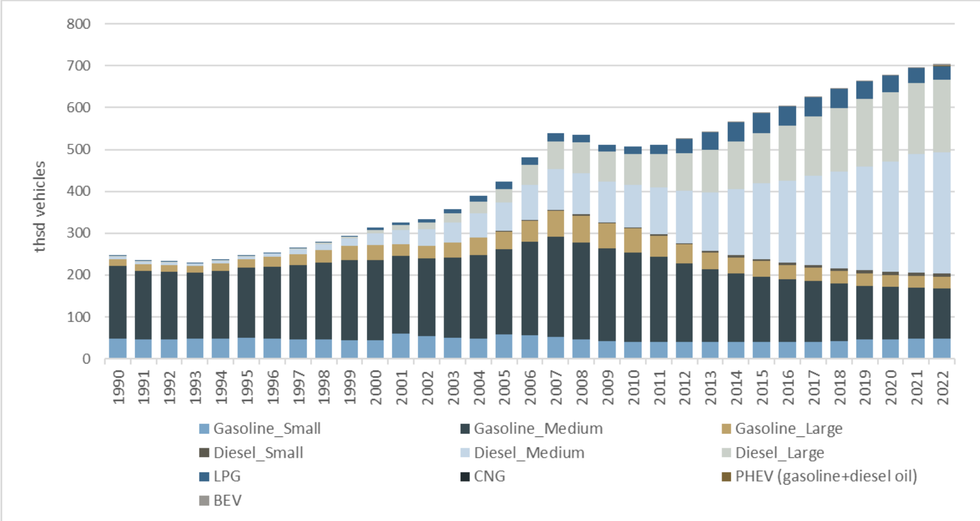

Figure 3.11 Distribution of passenger cars fleet by sub-classes

Analysing the development of the passenger car fleet in 1990-2022, following features can be noted (Figure 3.11, Figure 3.12, Figure 3.13):

- Cars with a diesel engine of a capacity 1.4l - 2.0l (Medium) constitute the major part (41.1%) but the second leading group (24.5%) are cars with a diesel engine of a capacity > 2.0l (Large-SUV-Executive); cars with a gasoline engine of a capacity 1.4l - 2.0l (Medium) -16.9%;
- Cars with a gasoline engine of a capacity <1.4l during the whole period have small changes and constitute approximately 6.9% in year 2022 from total passenger cars;
- Cars with a gasoline engine of a capacity >2.0l starting from 2010 have a small decreasing in their share of total passenger cars and they constitute around 3.9% in 2022;
- The number of BEV and PHEV has been increasing in recent years, with a share of 0.7% in 2022.
- As of 2000, the number of cars with diesel engines, both, <2.0l and >2.0l, grow rapidly and their share is 66.1% from the total number of passenger cars in 2022;
- As of 2005, in the car fleet with a gasoline engine, the number of EURO4, EURO5 and EURO6 cars grows gradually. In 2022 a share of EURO4 and EURO5 and EURO6 cars constitutes around 58.8%;
- As of 2005, in the car fleet with a diesel engine, the number of EURO 4 and EURO 5 cars grows gradually. In 2022 a share of EURO4, EURO5 and EURO6 cars constitute around 53.6%.

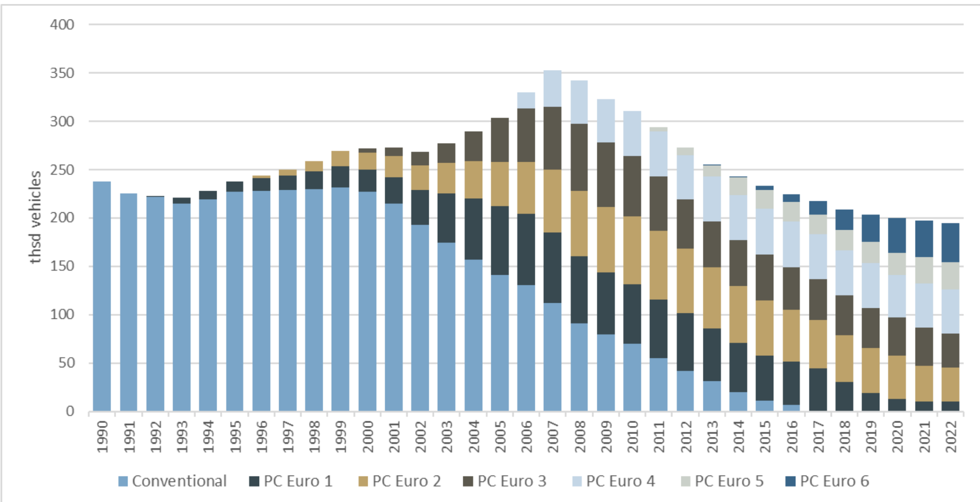

Figure 3.12 Distribution of gasoline passenger cars fleet by layers

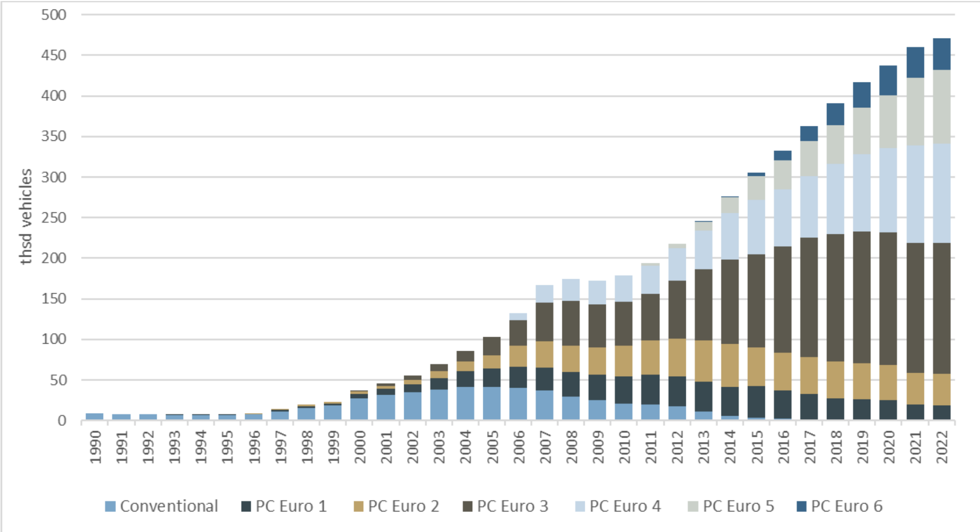

Figure 3.13 Distribution of diesel oil passenger cars fleet by layers

Analysing the development of LDV fleet (Figure 3.14, Figure 3.15) in the following time period, major features can be noted:

- As of 1996, the number of cars with a gasoline engines have decreased;
- As of 2000, the number of cars with a diesel engine rapidly increases. In 2022 the share of diesel cars is 95.4%;
- As of 2005, the number of EURO4 and EURO5 and EURO6 cars have increased. In 2022 the share of EURO4, EURO5 and EURO6 cars constitute 74.9%;

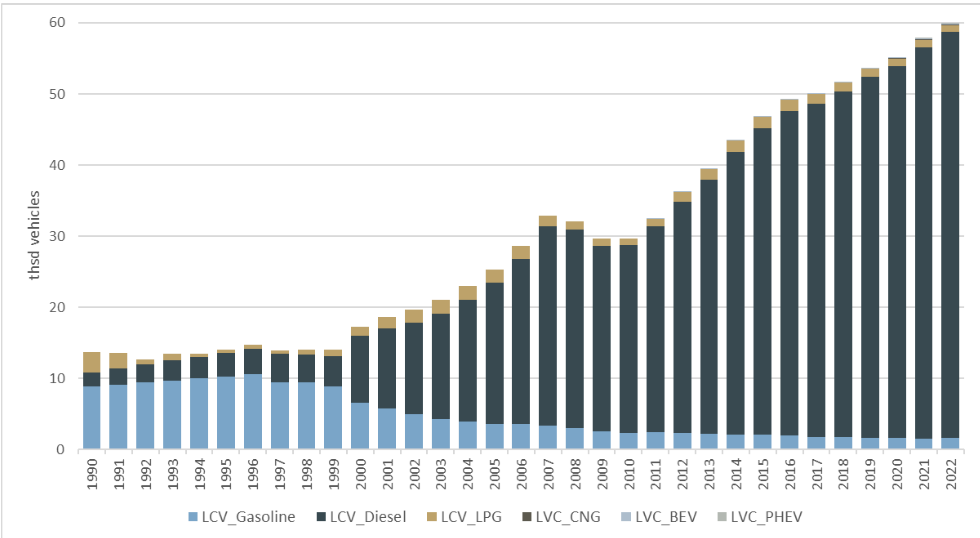

Figure 3.14 Distribution of light duty vehicles fleet by sub-classes

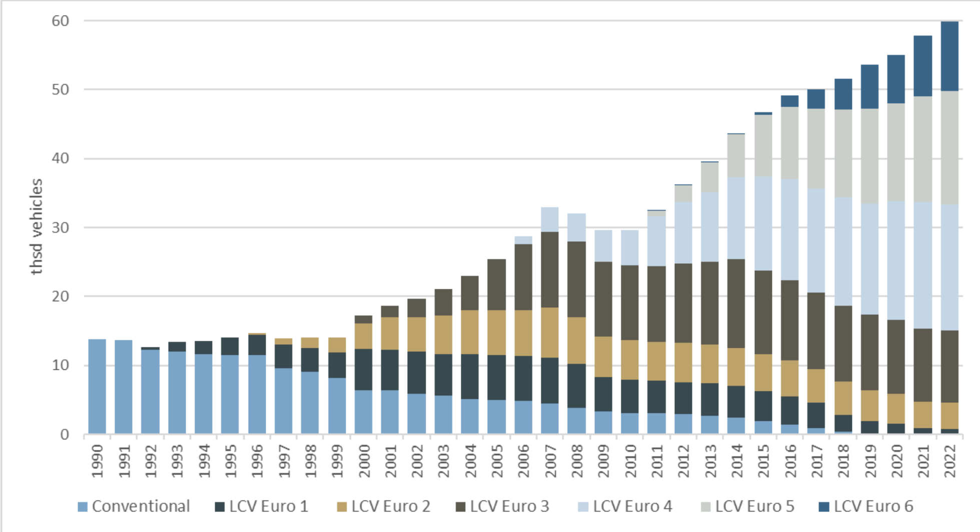

Figure 3.15 Distribution of light duty vehicles fleet by layers

Vehicle numbers per HDV sub-classes and layers are presented in the following figures.

Analysing the development of HDV fleet in the following time period, major features can be noted:

- Since 2000 the number of vehicles with a gasoline engines have rapidly decreased. The share of gasoline vehicles has decreased from 28% to 1.6% corresponding years 2000 and 2022;
- Since 2000 the number HDV with tonnage 14-50 t and a diesel engine starts to increase. In 2022 the share of this group constitutes around 49.4%;
- As of 2000, average age reduction of vehicles takes place gradually. In 2022, the share of EURO IV, EURO V and EURO VI vehicles constituted around 74.7%.

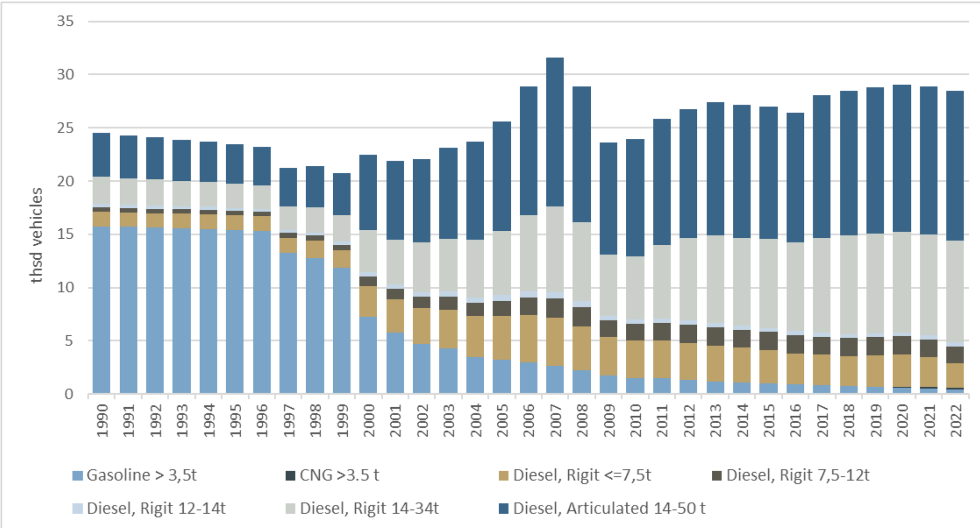

Figure 3.16 Distribution of heavy duty vehicles fleet by sub-classes

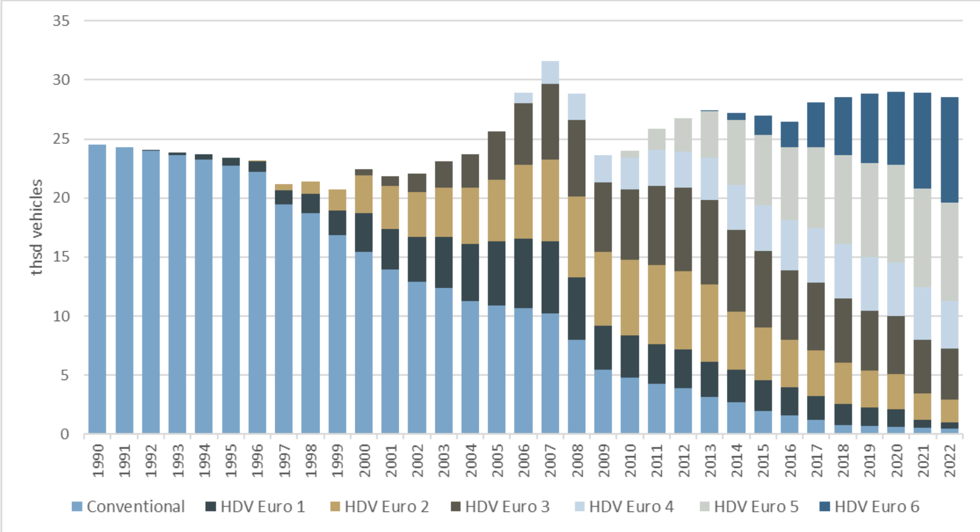

Figure 3.17 Distribution of heavy duty vehicles fleet by layers

Starting from 1990 emission for gasoline evaporation has been calculated according to the COPERT 5 model method. Calculation of PM emissions were performed considering emissions from road abrasion, tyres and brakes.

3.2.6.3.5 Uncertainties

Taking into account that CSB gives approximately 2% statistical sample error for statistical data, uncertainty in activity data of fuel consumption is ±2%. To ensure time series consistency any recalculation related with model version updating is realized for all time period. Linear interpolation was implemented only for cases when activity data fluctuation does not take place.

3.2.6.3.6 QA/QC and verification

Assessment of trends were performed. Estimated emissions verification:

- All estimations of the emissions done for a transport sector are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.
- Emissions are checked using time series consistency check for the IEF estimated in developed file for this procedure. All IEF changes in time series are double-checked and reasonable explanation for IEF changes has to be found under each subsector source category description.
- For road transport a checking is done on less aggregated level than emission reporting. IEF changes that are higher than 5% in time series are double-checked and reasonable explanation for IEF changes has to be found.

3.2.6.3.7 Recalculations

All emissions for 1990-2021 were recalculated. Recalculations have been done due to switch from COPERT 5.6.1 model version to COPERT 5.7.2 model version and due to the refinement of the number of cars for group LCV and buses. Compared to previously calculated and reported NO_x emissions, the change ranges from -2% to 4%. The recalculated NMVOC emissions are approximately 5% - 15% lower than previously reported.

3.2.6.3.8 Planned improvements

No improvements are planned for the next submission.

3.2.6.4 Railway (NFR 1A3c)

3.2.6.4.1 Overview

The source category 1A3c Railways includes emissions from all diesel-powered rail transport in Latvia. The source category 1A3c Railways includes emissions from all diesel-powered rail transport in Latvia. Freight transport plays a dominant role in diesel fuel consumption in the railways. Diesel fuel consumed in passenger transport accounts for a significantly smaller share. The railway transport accomplishes around 33.7% (2022) of the total freight transport in Latvia (measured in tonne-kilometres) and the transit transport traffic to ports is dominant. Since 2012, the transported freight along the railway (measured in tonne-kilometres) have decreased by around 66.1% due to dependence on transit transport of goods from Russian Federation and other neighbouring countries. Fuel consumption has decreased by approximately 70.8% in 2022 compared to 2012. The very sharp decline in fuel consumption came in exactly 2020 compared with 2019 (40.5%). The decline in fuel consumption continued in 2022 and was 5.6% lower than in 2021.

3.2.6.4.2 Trends in emissions

When analysing the development of emissions trends in railway (Table 3.15), following features could be noted:

- Due to the decrease of fuel consumption by around 86.0% in railway in time period 1990-2022 all emissions decreased by 84%-99%;
- From total emissions in transport sector (2022), railway contributes respectively 12.2% in NO_x, 10.3% in NMVOC, 13.5% in SO_2 and 5.6% in $PM_{2.5}$ emissions.

In 2005-2022 diesel fuel consumption decreased in railway by around 72.4%. It is a reason for PM and TSP emission decrease by around 69% and NOx emissions by around 70%. However, SO_2 emissions decreased by about 98.5% at the same time due to implementation of stronger fuel quality requirements.

Table 3.15 Trends and emissions in Railway in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	10.0771	4.5645	3.9056	4.9644	4.0229	4.0211	1.5698	1.4850	***-85.3***	***-70.1***
NMVOC		0.8048	0.3612	0.3089	0.3901	0.3174	0.3173	0.1254	0.1182	***-85.3***	***-69.7***
SO_2		0.6757	0.3039	0.2599	0.3279	0.1336	0.0142	0.0056	0.0053	***-99.3***	***-98.5***
NH_3		0.0017	0.0008	0.0006	0.0008	0.0007	0.0007	0.0003	0.0002	***-85.3***	***-69.6***
$PM_{2.5}$		0.2060	0.0975	0.0839	0.1046	0.0873	0.0879	0.0358	0.0332	***-83.9***	***-68.2***
PM_{10}		0.2229	0.1051	0.0904	0.1128	0.0940	0.0945	0.0384	0.0357	***-84.0***	***-68.3***
TSP		0.3308	0.1564	0.1344	0.1679	0.1399	0.1407	0.0570	0.0530	***-84.0***	***-68.4***
BC		0.1339	0.0634	0.0545	0.0680	0.0568	0.0571	0.0232	0.0216	***-83.9***	***-68.2***
CO		2.7555	1.2264	1.0473	1.3397	1.0739	1.0709	0.4119	0.3924	***-85.8***	***-70.7***
Cd	t	0.0017	0.0008	0.0006	0.0008	0.0007	0.0007	0.0003	0.0002	***-86.1***	***-71.3***
PAHs		0.0135	0.0061	0.0052	0.0066	0.0053	0.0053	0.0021	0.0020	***-86.1***	***-71.3***

While fuel consumption has fallen by around 5.6% in 2022 compared to 2021, most emissions other than SO_2 and Cd have remained at about the same level.

3.2.6.4.3 Methods

When calculating emissions from railway, Tier 2 method was applied. The Tier 2 approach is based on apportioning the total fuel used by railways to that used by different locomotive types as the measure of activity. Total diesel oil consumption (statistics) has been apportioned on the number of locomotives, categorised by type (line-haul, shunting and rail-cars) and their average usage. The sum of the average fuel consumption and hours of use for three types of locomotives have been calibrated to the total amount of fuel used (statistics). The fuel consumption factors of each locomotive type are derived from Table 3-5. (EMEP/EEA 2019). Total operation hours per year distributed among types of locomotives have been calculated based on available information about number of corresponding locomotive type and available information about total locomotive km per year. This information has been collected from the state railway JSC *"Latvijas Dzelzceļš"* annual reports.

3.2.6.4.4 Emission factors

Default Tier 2 approach emission factors for Railway are taken from EMEP/EEA 2019 (Table 3-2; Table 3-3; Table 3-4). Other emissions factors for Tier 1 approach (Table 3.16) are taken from EMEP/EEA 2019 as well. Emissions of SO_2 are based on country-specific calorific value and the actual sulphur content for diesel fuel (

Pollutant	Unit	Diesel oil
Cd		0.00024
Cr		0.00118
Cu		0.04001
Ni	t/PJ	0.00165
Se		0.00024
Zn		0.02353
benzo(a)pyrene		0.000706
benzo(b)fluoranthene		0.0011767

Table 3.17).

Table 3.16 Emission factors used for emissions calculation from Railway

Pollutant	Unit	Diesel oil
Cd		0.00024
Cr		0.00118
Cu		0.04001
Ni	t/PJ	0.00165
Se		0.00024
Zn		0.02353
benzo(a)pyrene		0.000706
benzo(b)fluoranthene		0.0011767

Table 3.17 SO_2 emission factors for Diesel oil used in the calculation of SO_2 emissions from Railway

	Sulphur content (%)	NCV (TJ/kt)	EF (kt/PJ)
1990-2002; 2005-2007	0.2	42.49	0.0941
2003-2004	0.05	42.49	0.0235
2008-2014	0.1	42.49	0.0471
2015-2022	0.001	42.49	0.005

3.2.6.4.5 Activity data

Information about fuel consumption from CSB was used as the basis for emission calculation. In 2009 and 2010 transported freight along the railway and therefore diesel consumption slightly decreased, compared to 2008 (Figure 3.18). Since 2012, the transported freight along the railway (measured in tonne-kilometres) have decreased by around 66.1%. Fuel consumption has decreased by approximately 70.8% in 2022 compared to 2012. Fuel consumption decreased by around 5.6% in 2022 compared to 2021.

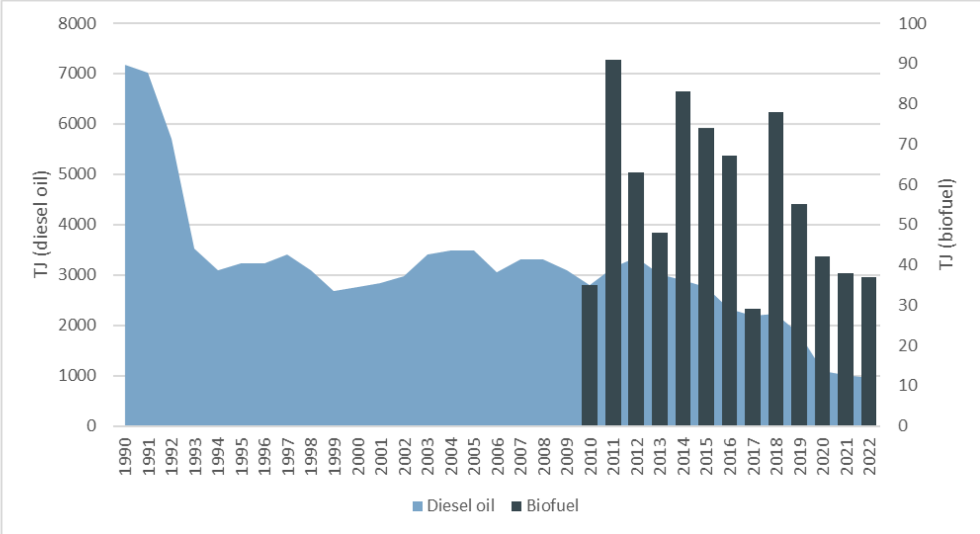

Figure 3.18 Fuel consumption in Railway transport, TJ

3.2.6.4.6 Uncertainties

Uncertainty in activity data of fuel consumption is ±2% in 2022. CSB gives approximately 2% statistical sample error for statistical data. The uncertainty of EF lies between 20-45%.

3.2.6.4.7 QA/QC and verification

Assessment of trends was performed. Estimated emissions verification:

- All estimations of the emissions done for a transport sector are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.
- Emissions are checked using time series consistency check for the IEF and all IEF changes in time series are double-checked and reasonable explanation for IEF changes has to be found under each source category description.

3.2.6.4.8 Recalculations

No recalculations were carried out.

3.2.6.4.9 Planned improvements

No improvements are planned for the next submission.

3.2.6.5 Navigation (NFR 1A3dii)

3.2.6.5.1 Overview

Although Latvia has several ports, domestic navigation that provides transport of freight or passengers among local ports is not developed. Major activities in ports deal with international freight transport. In domestic navigation the emissions are calculated for miscellaneous vessels (tugs, barges, towboats, icebreakers), recreational crafts and personal boats.

Fuel consumption for domestic navigation has variations. For example, in 2014 diesel oil consumption decreased approximately 2 times compared to 2013. Number of services for international freight in harbours mostly affects the changes in fuel consumption, however, dramatic fuel consumption decrease in 2014 was due to completion of the harbour deepening (a project that was carried out during 2013). Other additional factor which makes impact to fuel consumption in domestic navigation is weather conditions. This we can definitely see for 2010 and 2011 when air temperature was low and sea was covered by ice. An ice breaker operated many months to ensure operation of ports in 2010 and 2011. This has made an impact on fuel consumption in 2010 and 2011.

Diesel oil consumption decreased by approximately 30.8% in 2022 compared to 2021.

3.2.6.5.2 Trends in emissions

Table 3.18 Trends and emissions in domestic navigation in 1990-2022

	Unit	1990	2000	2005	2010	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	0.0213	0.0122	0.0107	0.3923	0.1747	0.1830	0.1269	***494.8***	***1091.3***
NMVOC	kt	0.0110	0.0144	0.0166	0.0264	0.0268	0.0436	0.0293	***165.1***	***76.4***
SO_x	kt	0.00028	0.00017	0.00015	0.00510	0.00228	0.00240	0.00166	***487.9***	***1029.6***
NH_3	kt	0.000002	0.000001	0.000001	0.000034	0.000015	0.000016	0.000011	***503.9***	***1180.3***
$PM_{2.5}$	kt	0.00091	0.00093	0.00102	0.00763	0.00418	0.00517	0.00354	***288.8***	***245.2***
PM_{10}	kt	0.00094	0.00095	0.00104	0.00813	0.00440	0.00540	0.00370	***294.9***	***256.5***
TSP	kt	0.00094	0.00095	0.00104	0.00813	0.00440	0.00540	0.00370	***294.9***	***256.5***
BC	kt	0.00014	0.00010	0.00010	0.00220	0.00101	0.00110	0.00076	***435.0***	***685.1***
CO	kt	0.0345	0.0452	0.0522	0.0761	0.0816	0.1346	0.0902	***161.3***	***72.6***
Cd	t	0.0000006	0.0000008	0.0000009	0.0000007	0.0000012	0.0000021	0.0000014	***142.4***	***54.2***
PAHs	t	0.0000305	0.0000205	0.0000194	0.0004944	0.0002259	0.0002424	0.0001678	***449.9***	***764.6***

Analysing the development of the emission trends in domestic navigation (Table 3.18), following features can be noted:

- Emissions from navigation account for a small part of total transport emissions in Latvia;
- Due to remarkable increase (more than 9 times) in fuel consumption in 1990-2022 all emissions increased several times;

In 2022 NO_x and SO_2 emissions decreased by around 30.6% compared to 2022 but $PM_{2.5}$ and PM_{10} emissions by around 31.6% due to decrease in diesel fuel consumption.

3.2.6.5.3 Methods

When calculating emissions from domestic navigation, Tier 1 method was applied.

3.2.6.5.4 Emission factors

Default EFs (Table 3.19 for domestic navigation is used (EMEP/EEA 2019) and "Emission factors used in the estimations of emissions from combustion (Last update: Jan. 18. 2017)":

Table 3.19 Emission factors used in the calculation of emissions from domestic navigation, kt/PJ

	NO_x	CO	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP
Diesel oil	1.84749	0.17416	0.06589	0.00016	0.03295	0.0353	0.0353
Gasoline (from 2003)	0.214	13.05505	4.12875	0.00016	0.21611	0.21611	0.21611
Gasoline (1990-2002)	0.2138	13.0549	4.12702	0.00016	0.21611	0.21611	0.21611

EFs for gasoline are different due to varying NCV. Emissions of SO_2 are based on country-specific thermal values and the actual sulphur content for diesel and gasoline fuel.

Table 3.20 Emission factors used in the calculation of emissions from domestic navigation, t/PJ

	Cd	Cr	Cu	Ni	Se	Zn	benzo(a)	benzo(b)	benzo (k)
Diesel oil	0.0000002	0.00118	0.02071	0.02353	0.00235	0.02824	0.00014	0.00066	0.00031

3.2.6.5.5 Activity data

The data about diesel oil and gasoline consumption in domestic navigation is derived from the CSB. CSB started to collect data about diesel oil and gasoline consumption in domestic navigation from 2006. For the time period 1990-2005 the data for fuel consumption was used from the study "Evaluation of fuel consumption for domestic aviation and navigation" (IPE, 2004). Development of the fuel consumption in domestic navigation is presented in Figure 3.19 below.

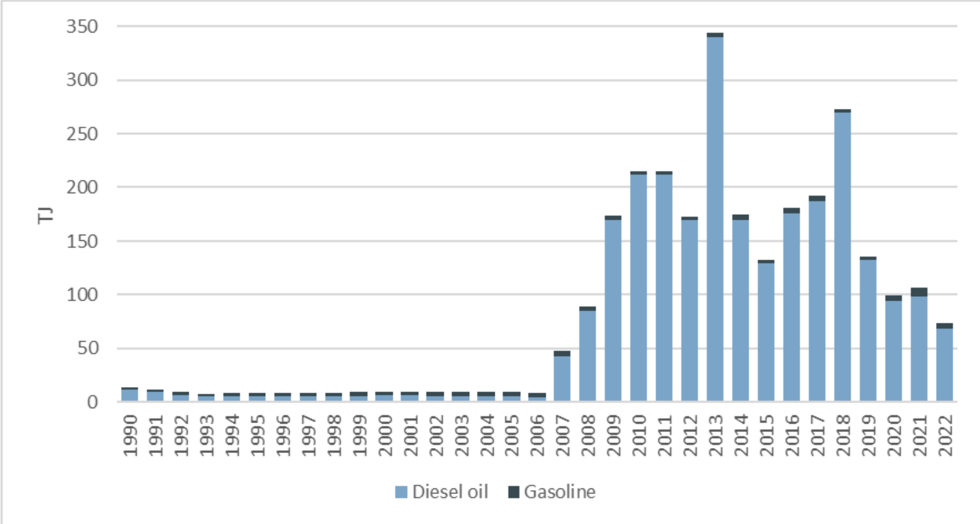

Figure 3.19 Development of gasoline and diesel oil fuel consumption in domestic Navigation

3.2.6.5.6 Uncertainties

Uncertainty in activity data of fuel consumption for time period 2006-2022 is ±2%. CSB gives approximately 2% statistical sample error for statistical data. For the rest of the time period uncertainty in activity data of fuel consumption is ±20%. The uncertainty of EF lies between 20-40%.

3.2.6.5.7 QA/QC and verification

Assessment of trends were performed. Estimated emissions verification:

- All estimations of the emissions done for a transport sector are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.
- Emissions are checked using time series consistency check for the IEF estimated and all IEF changes in time series are double-checked and reasonable explanation for IEF changes has to be found.

3.2.6.5.8 Recalculations

No recalculations were carried out.

3.2.6.5.9 Planned improvements

No improvements are planned for the next submission.

3.2.7 Other Sectors (NFR 1A4)

3.2.7.1 Overview

NFR 1A4 Other Sectors include emissions from the small combustion plants used in Commercial/Institutional, Residential sectors and Agriculture/Forestry/Fisheries. Emissions from autoproducers are included in relevant sectors of NFR 1A4 as it is stated that emissions have to be reported in sector they are produced. Also, emissions from mobile machinery used in Commercial (NFR 1A4aii), Residential (NFR 1A4bii) and Agriculture/Forestry (NFR 1A4cii) and Fishery (NFR 1A4ciii) sectors are reported as off-road is included in this sector.

3.2.7.2 Trends in emissions

Table 3.21 Trends in emissions from NFR 1A4 Other Sectors in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2019	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x		24.36	11.09	8.78	9.87	8.37	6.79	6.23	5.96	5.95	6.05	***-75.2***	***-38.7***
NMVOC		22.03	21.22	18.88	19.42	14.51	9.91	11.06	9.82	9.83	9.44	***-57.1***	***-51.4***
SO_x		35.12	9.95	3.93	3.66	2.27	1.79	1.66	1.47	1.49	1.48	***-95.8***	***-59.6***
NH_3		1.65	2.44	2.20	2.50	1.89	1.35	1.48	1.30	1.32	1.28	***-22.4***	***-48.7***
$PM_{2.5}$	kt	19.99	23.70	21.28	22.80	16.64	11.00	12.29	10.84	10.97	10.50	***-47.5***	***-53.9***
PM_{10}		20.72	24.38	21.86	23.41	17.09	11.29	12.61	11.12	11.25	10.74	***-48.1***	***-54.1***
BC		21.88	25.67	22.98	24.62	17.97	11.86	13.24	11.67	11.81	11.28	***-48.4***	***-54.2***
TSP		2.83	2.83	2.49	2.61	1.99	1.37	1.51	1.34	1.35	1.30	***-54.1***	***-50.2***
CO		170.20	141.72	126.24	142.91	112.79	77.61	84.63	74.88	75.59	72.63	***-57.3***	***-49.2***
Pb		10.10	2.24	1.71	1.72	1.36	1.06	0.99	0.86	0.84	0.83	***-91.8***	***-51.8***
Cd	t	0.40	0.52	0.45	0.52	0.40	0.32	0.34	0.30	0.30	0.29	***-27.4***	***-43.5***
Hg		0.200	0.065	0.037	0.039	0.034	0.022	0.019	0.016	0.016	0.015	***-92.3***	***-60.7***
PCDD/F	g I-Teq	22.91	25.72	22.80	24.88	18.12	11.96	13.18	11.58	11.75	11.22	***-51.0***	***-54.9***
PAHs	t	14.47	12.65	10.56	11.61	8.82	5.67	6.14	5.34	5.42	5.17	***-64.3***	***-55.5***
HCB	kg	0.15	0.20	0.17	0.20	0.15	0.12	0.13	0.11	0.12	0.11	***-25.8***	***-44.0***
PCBs		4.01	0.96	0.38	0.36	0.36	0.14	0.06	0.03	0.02	0.02	***-99.5***	***-94.9***

All emissions have decreased in 1990-2022 NFR 1A4 Other Sectors (Table 3.21). It can be explained with changes of structure of national economy as well as with significant decrease of fuel consumption in the sector. Increase of emissions in 2008–2009 is explained with development of national economy and well-being of population. But in years 2009-2010 a decrease in emissions can be seen, which can be explained with consequences caused by crisis. The emissions are also affected by weather conditions and recent increase of individual heating supply consumers in 1A4b Residential sector. The increase of gaseous fuels consumption, steady biomass fuel consumption and increase of peat consumption caused the increase of all emissions with the exception of SO_2 and PCBs emissions. Also, high cost of liquid fuels and increase of natural gas price in Latvia have caused the situation when previously used fuels have switched to biomass.

3.2.7.3 Methods

Tier 1 and Tier 2 methods were used to calculate emissions from the stationary fuel combustion. Calculation of all emissions from fuel combustion is done in MS Excel database. Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex IV: Summary Information on Condensable in PM. Tier 2 methodology was used to calculate emissions form natural gas, solid fuel and biomass in sector NFR 1A4ai for period 1990-2021, 2005-2021 and emissions from mobile combustion in sector NFR 1A4aii and NFR 1A4cii.

The general method for emission calculation:

$$Em = EF \times B_q$$

where:

Em – total emissions (kt)
EF – emission factor (t/TJ)
B_q – amount of fuel in thermal units (TJ)

Emissions from mobile combustion were calculated using methodology described in EMEP/EEA 2019 1.A.4.aii, 1.A.4.cii Non-road mobile sources and machinery Chapter 3.3 "Tier 2 technology-dependant approach".

For residential sector Tier 2 method was used to calculate emissions, taking into account also the combustion installations. The following method for estimation of emissions from EMEP/EEA 2019 was used:

$$E_i = \sum_{j,k} EF_{i,j,k} \times A_{j,k}$$

where:

E_i – annual emission of pollutant *i*,
$EF_{i,j,k}$ – default emission factor of pollutant I for source type *j* and fuel *k*
$A_{j,k}$ – annual consumption of fuel k in source type *j*

Calculations of all emissions are done in MS Excel database.

3.2.7.4 Emission factors

The main source for emission factors is EMEP/EEA 2019. Emission factors used for Energy sector are presented in Annex I, Table 3.

SO_2 emission factors are calculated using the same methodology as for NFR 1A1 and 1A2 sectors, using Tier 2 (see chapter 3.2.4.4), where sulphur content is country-specific for each fuel type.

The default emission factors used in estimation of emission were taken from EMEP/EEA 2019 (Annex I, Table 1). Emission factors for landfill gas were equalized to natural gas emission factors due to unavailability of particular emission factors for landfill gas. Emission factors for biodiesel were equalized to diesel emission factor.

3.2.7.5 Activity data

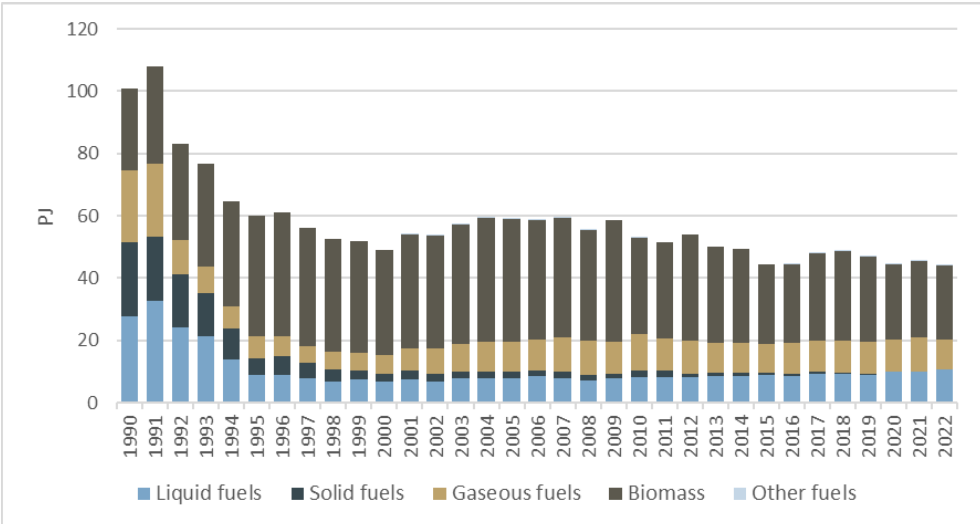

Figure 3.20 Fuel consumption in NFR 1A4 Other Sectors in 1990-2022, PJ

The major decrease in 1990-2022 was for solid fuel consumption – 99.6%, liquid fuels consumption – 62.3% (Figure 3.20) and gaseous fuels by 58.2%. It is explained with fuel switching processes when solid and liquid fuels were replaced with cheaper fuels. Also, stronger legislation contributed fuel switching to the type of fuels with a lower level of emissions.

Since 1990 biomass dominates as a fuel in NFR 1A4 sector. The biggest part of solid biomass consumption goes to Residential sector where biomass is the main fuel in small capacity burning installations. Consumption of biomass fuel has decreased by 10.0% in 1990–2022 in Other Sector and, compared to 2022, consumption have decreased by 2.7%. It can be seen that the amount of biomass has been fluctuating over the recent years which can be partly explained with changes of HDD.

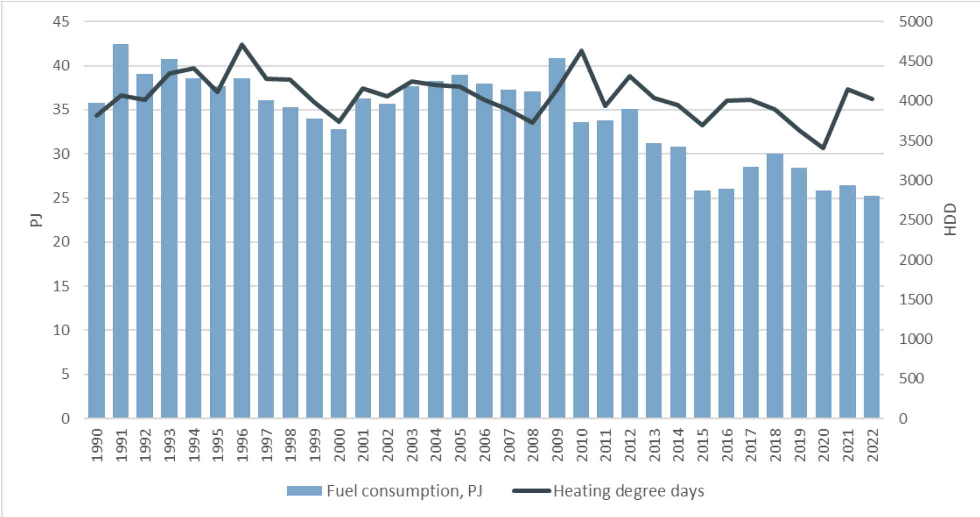

Figure 3.21 Fuel consumption in NFR 1A4b Residential sector and heating degree days in Latvia

As it can be seen in Figure 3.21, fuel consumption in 1A4b sector is related with changes in temperature – in years where HDD are more, the amounts of consumed fuel are also larger, especially it can be seen in 1994-2003. In 2009-2010 the correlation between HDDs and consumption is less visible because of impact of global crisis, which clearly affected the Residential sector. Difference in trend between fuel used and HDD could be explained with changes in heating devices that impact the amount of fuel used (more energy efficient). Higher efficiently boiler will use less fuel to produce the same amount of heat.

3.2.7.6 Uncertainties

Uncertainty for activity data of fuel combustion in NFR 1A4 sector is ±2% in 2022. CSB gives approximately 2% statistical sample error for statistical data. According to CSB, as data is obtained using information given by respondents, this number is a variation coefficient which characterizes selection of respondents. Total variation coefficient for energy balance is within 2-3%. In Latvia all fossil fuels (oil, natural gas and coal) are imported and import and export statistics are fairly accurate.

Uncertainty of activity data for solid biomass was assigned 1% as biomass activity data was collected by CSB with questionnaires sent to enterprises consuming biomass. Uncertainty for peat combustion activity data was assigned 2%. Uncertainty of landfill gas stationary combusted in enterprises covered by NFR 1A4 Other Sectors was assumed rather low – 2% because the combusted fuel amount is obtained directly from landfill plant that has precise measurement equipment for accounting of combusted fuel.

Emission factor uncertainty is assumed as 50%.

3.2.7.7 QA/QC and verification

Disaggregated data at the finest level possible are presented in the corresponding Annex II.

Activity data is checked with the data provider – CSB, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data is received, the sectoral expert responsible for the emission estimation and reporting compares all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

To verify the emissions, logical mistakes in time series of the activity data, emission factors and emissions consistency to display all significant and illogical changes in the activity data and emissions are checked. The emissions for substances reported also under UNFCCC as indirect GHGs are cross-checked with for verification purposes.

3.2.7.8 Recalculations

No recalculations were made for this sector.

3.2.7.9 Planned improvements

No improvement planned.

3.2.8 Other (NFR 1A5)

3.2.8.1 Overview

NFR 1A5 Other include emissions from mobile sources from liquid fuels – aviation gasoline, diesel oil and jet kerosene, used in aircrafts and ships. These emissions appear since 1995. Before that notation key NE is used.

3.2.8.2 Trends in emissions

Table 3.22 Trends in emissions from NFR 1A5 Other in 1995-2022

	Unit	1995	2000	2005	2010	2015	2019	2020	2021	2022	Changes in 1995-2022, %	Changes in 2005-2022, %
NO_x	kt	0.0080	0.0002	0.1449	0.1620	0.2079	0.4928	0.3452	0.5325	0.4291	***5263.7***	***196.0***
NMVOC		0.0380	0.0008	0.0168	0.0146	0.0153	0.0429	0.0180	0.0354	0.0605	***59.3***	***260.2***
SO_x		0.0040	0.0000	0.0084	0.0050	0.0061	0.0150	0.0093	0.0151	0.0154	***284.3***	***82.9***
NH_3		0.0420	0.0008	0.0252	0.0196	0.0214	0.0580	0.0273	0.0505	0.0759	***80.7***	***201.1***
$PM_{2.5}$		NO	NO	0.0025	0.0029	0.0037	0.0087	0.0061	0.0094	0.0075	***100***	***194.4***
PM_{10}		NO	NO	0.0027	0.0031	0.0039	0.0093	0.0066	0.0101	0.0080	***100***	***194.4***
TSP		NO	NO	0.0027	0.0031	0.0039	0.0093	0.0066	0.0101	0.0080	***100***	***194.4***
BC		NO	NO	0.0008	0.0009	0.0012	0.0029	0.0020	0.0031	0.0025	***100***	***194.4***
CO		2.4000	0.0528	0.7538	0.5761	0.5234	1.6586	0.3924	1.0910	2.9171	***21.5***	***287.0***
Pb	t	NO	NO	0.0002	0.0003	0.0003	0.0008	0.0006	0.0009	0.0007	***100***	***194.4***
Cd		NO	NO	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001	***100***	***194.4***
Hg		NO	NO	0.0001	0.0001	0.0001	0.0002	0.0001	0.0002	0.0002	***100***	***194.4***
PCDD/F	g I-Teq	NO	NO	0.0002	0.0003	0.0003	0.0008	0.0006	0.0009	0.0007	***100***	***194.4***
HCB	kg	NO	NO	0.0001	0.0002	0.0002	0.0005	0.0004	0.0005	0.0004	***100***	***194.4***
PCBs		NO	NO	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0002	***100***	***194.4***

Almost all emissions have increased in 1995-2022 NFR 1A5 Other (Table 3.22). Emissions from this sector are not influenced by the changes in national economy or in the economy of Latvia's trade partners. In the recent years there has been an increase of fuel consumption and increase in emissions.

3.2.8.3 Methods

Tier 1 method was used to calculate emissions from the stationary fuel combustion. Calculation of all emissions from fuel combustion is done in MS Excel database. Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex IV: Summary Information on Condensable in PM.

The general method for emission calculation:

$$Em = EF \times B_q$$

where:

Em – total emissions (kt)

EF – emission factor (t/TJ)

B_q – amount of fuel in thermal units (TJ)

3.2.8.4 Emission factors

The main source for emission factors is EMEP/EEA 2019. Emission factors used for the Energy sector are presented in Annex I, Table 3.

SO_2 emission factors are calculated using the same methodology as for NFR 1A1, NFR 1A2 and NFR 1A4 sectors, using Tier 2 (see chapter 3.2.4.4), where sulphur content is country-specific for each fuel type.

The default emission factors used in estimation of emission were taken from EMEP/EEA 2019 (Annex I, Table 1).

3.2.8.5 Activity data

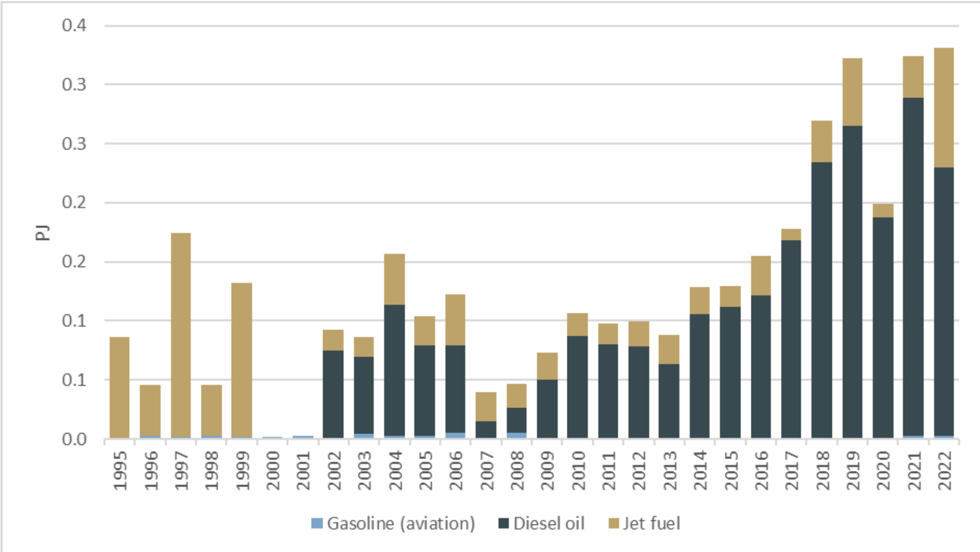

Figure 3.22 Fuel consumption in NFR 1A5 Other in 1990-2022, PJ

Fuel consumption in Other (NFR 1A5) have increased more than 3 times from 1995-2022 (Figure 3.22).

3.2.8.6 Uncertainties

Uncertainty for activity data of fuel combustion in sectors NFR 1A5b is 2±% because official statistical information from CSB is used.

Emission factor uncertainty is assumed as 50%.

3.2.8.7 QA/QC and verification

Disaggregated data at the finest level possible are presented in the corresponding Annex II.

Activity data is checked with the data provider – CSB, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data is received, the sectoral expert responsible for the emission estimation and reporting compares all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

To verify the emissions, logical mistakes of the activity data, emission factors and emission consistency to display all significant and illogical changes in the activity data and emissions are checked. The emissions for substances reported also under UNFCCC as indirect GHGs are cross-checked with for verification purposes.

3.2.8.8 Recalculations

No recalculations were made.

3.2.8.9 Planned improvements

No improvements planned.

3.3 Fugitive emissions (NFR 1B)

3.3.1 Overview of sector

Under fugitive emissions from fuels, Latvia reports following categories:

- NFR 1B1a Fugitive emissions from solid fuels: Coal mining and handling includes fugitive particulate matter emissions from coal transportation and storage;
- NFR 1B2a v Distribution of oil products includes NMVOC emissions from oil storage;
- NFR 1B2b Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) includes NMVOC emissions from natural gas transmission, storage and distribution systems in Latvia;
- NFR 1B2c Venting and flaring (oil, gas, combined oil and gas) includes NMVOC emissions from natural gas venting in Latvia.

There are no oil refineries in Latvia, therefore NMVOC emissions for 1990–2022 were calculated only from gasoline distribution.

Fugitive particulate matter emissions from the operations of solid fuels – coal and coke, transportation via railways and storage and handling in 1990-2022 are estimated.

3.3.2 Trends in emissions

Table 3.23 Fugitive emissions in 1990-2022, kt

	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NMVOC	4,31	3,28	2,55	2,35	2,40	2,44	0,81	0,79	0,57	*-86,8*	*-75,9*
$PM_{2.5}$	0,00028	0,00008	0,00003	0,00004	0,00005	0,00002	0,00001	0,00001	0,00001	*-97,8*	*-84,3*
PM_{10}	0,0028	0,0008	0,0003	0,0004	0,0005	0,0002	0,0001	0,0001	0,0001	*-97,8*	*-84,3*
TSP	0,0070	0,0020	0,0008	0,0010	0,0013	0,0006	0,0003	0,0002	0,0002	*-97,8*	*-84,3*

NMVOC emissions are decreasing due to decrease in use of gasoline (Table 3.23). Also, particulate matter emissions have decreased if compared to 1990.

3.3.3 Methods

LEGMC received data about CH_4 emissions from the natural gas holding company JSC "Latvijas Gāze" for the time period 1990–2016. Consequently JSC "Latvijas Gāze" calculated emissions itself, using data of natural gas density and other physical parameters and measures the content of methane and other chemical compounds in natural gas, therefore it is assumed as Tier 2 method, using country-specific data and calculations. In 2017 after liberalization of the Latvian gas market JSC "Conexus Baltic Grid" was handed over the natural gas infrastructure (main transmission system and underground gas storage) and JSC "Gaso" natural gas distribution. Therefore, information about fugitive emissions from natural gas is received from new companies since 2017. JSC "Conexus Baltic Grid" calculates emissions from main transmission system and underground gas storage for venting, transmission and storage and JSC "Gaso" from distribution system for venting, distribution and other.

EMEP/EEA 2023 Tier 1 methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in 1990–2022. It uses the general equation where emissions are obtained by multiplying the total amount of gasoline sold with the emission factor.

Particulate matter emissions are estimated by using Tier 2 methodology from EMEP/EEA 2023.

3.3.4 Emission factors

NMVOC emission factor – 2,2 kg/Mg gasoline handled – for emission from gasoline distribution was taken from EMEP/EEA 2023, Chapter 1.B.2.a.v Distribution of oil products 2023, Table 3-1.

Emission factors for particulate matter emission estimation are taken from EMEP/EEA 2023, Chapter 1.B.1.a Fugitive emissions from solid fuels: Coal mining and handling, Table 3-7 (Table 3.24). Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex IV: Summary Information on Condensable in PM.

Table 3.24 PM emission factors, g/t

	$PM_{2.5}$	PM_{10}	TSP
Coal	0.3	3	7.5

3.3.5 Activity data

In Figure 3.23 and Figure 3.24 and Table 3.25 activity data used for calculation can be seen.

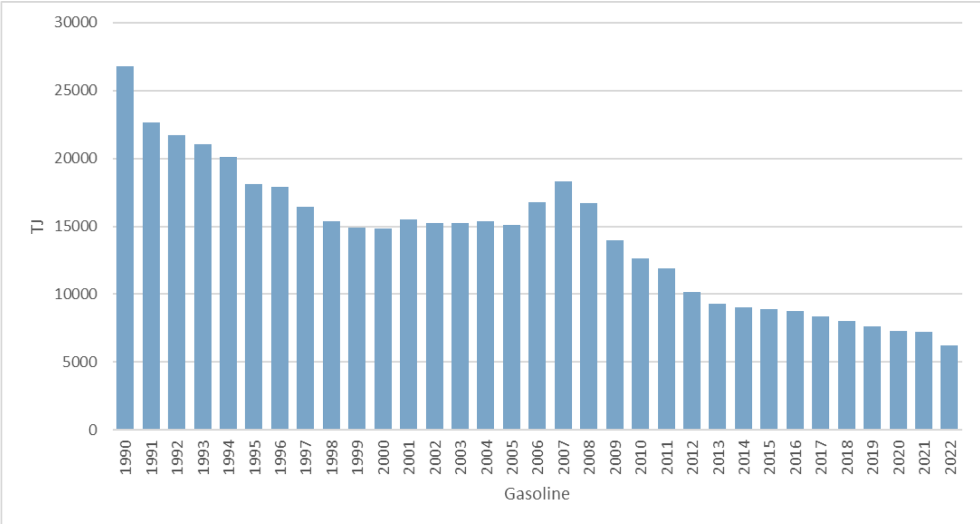

Figure 3.23 Gasoline consumption in Latvia in 1990-2022, TJ

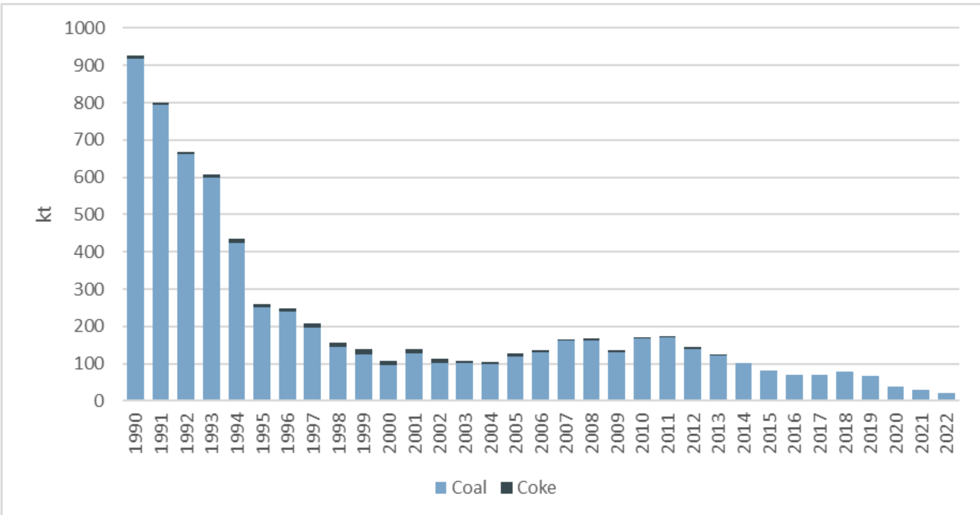

Figure 3.24 Activity data used for particulate matters emissions calculation in 1990–2022, kt

Table 3.25 Amounts of natural gas leaked in 1990-2022 (10^6 m^3)

Year	1B2c1ii Venting	1B2biii4 Transmission and storage	1B2biii5 Distribution	1B2biii6 Other	Total
1990	5.61	0.13	0.69	12.44	18.87
1991	5.38	0.13	0.69	11.98	18.17

Year	1B2c1ii Venting	1B2biii4 Transmission and storage	1B2biii5 Distribution	1B2biii6 Other	Total
1992	4.83	0.13	0.59	10.92	16.47
1993	4.58	0.13	0.69	10.44	15.85
1994	4.46	0.13	0.69	10.21	15.48
1995	4.32	0.13	0.69	9.94	15.08
1996	4.13	0.13	0.69	9.58	14.53
1997	3.80	0.13	0.69	8.94	13.56
1998	3.63	0.11	0.69	8.58	13.01
1999	3.42	0.11	0.69	8.18	12.40
2000	3.11	0.11	0.69	7.57	11.48
2001	0.30	0.10	0.69	10.03	11.14
2002	0.98	0.10	0.69	9.86	11.63
2003	1.09	0.10	0.69	7.20	9.07
2004	1.56	0.09	0.69	6.63	8.98
2005	3.25	0.09	0.69	6.12	10.15
2006	1.80	0.08	0.69	4.71	7.28
2007	1.76	0.07	0.69	4.95	7.47
2008	2.44	0.07	0.69	4.48	7.67
2009	1.78	0.06	0.69	4.71	7.25
2010	1.64	0.06	0.69	4.59	6.98
2011	1.77	0.05	0.69	1.70	4.21
2012	1.34	0.05	0.69	3.35	5.43
2013	1.09	0.04	0.69	4.06	5.89
2014	1.53	0.04	0.66	5.69	7.93
2015	0.95	0.04	0.71	4.35	6.06
2016	0.93	0.04	0.67	5.18	6.83
2017	0.83	0.01	0.73	7.82	9.39
2018	0.41	0.01	0.72	4.42	5.56
2019	0.84	0.01	0.73	4.40	5.98
2020	1.04	0.01	0.73	4.32	6.10
2021	1.00	0.01	0.75	4.26	6.02
2022	0.46	0.01	0.76	4.15	5.38

3.3.6 Uncertainties

Activity data for fugitive emissions from operations with gasoline and coal handling were taken from CSB and uncertainty was assumed as low - about 2% - as a statistical frame mistake. Uncertainty for emission factor is assumed as 50%.

The level of uncertainty was determined by natural gas distributing company JSC „Latvijas Gāze", JSC "Conexus Baltic Grid" and JSC "Gaso". The uncertainty both for activity data (gas amounts) and emissions from gas venting and natural gas leakages in gas distribution and transmission systems, as well as in gas storage facility is assigned as quite low – 10%, as these were estimated by the enterprise operated with natural gas by methodology developed for enterprise. However, for other leakage the uncertainty for the emissions is assumed as 35%.

Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no "not estimated" sectors.

3.3.7 QA/QC and verification

Activity data was checked at the data provider – CSB, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data was received, the sectoral expert responsible for the emission estimation and reporting were comparing all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

As all emission factors are taken from EMEP/EEA 2023, no additional verification procedures were performed.

To verify the NMVOC emissions, logical mistakes of the activity data, emission factors and emission consistency to display all significant and illogical changes in the activity data and emissions are checked. The emissions are also cross-checked with emissions reported within UNFCCC for verification purposes.

3.3.8 Recalculations

NMVOC emissions from gasoline distribution were recalculated from 1990 till 2021 according to implementation of new EMEP/EEA 2023 guidelines and updating of NMVOC EF for distribution of gasoline.

3.3.9 Planned improvements

No improvements are planned.

3.4 International bunkers

3.4.1 Overview

International bunkers cover International and Domestic Civil Aviation (only cruise mode) and International maritime navigation according to the IPCC GPG 2000. In accordance with the Reporting Guidelines, international bunker fuel emissions are not included in national totals.

3.4.2 Trends in emissions

International maritime navigation contributed around 89.1%, 63.4% and 91.1% in total memo items emissions correspondingly for NOx and SO_2 and $PM_{2.5}$ emissions in 2022. The remaining share of emissions comes from international aviation. The trend of emissions in international navigation has fluctuated during most of the period. A one of most important reason for these fluctuations has been the variation in bunker fuel prices.

3.4.3 Emission factors

Default emission factors for International Aviation and Navigation are taken from EMEP/EEA 2019 methodology and are presented in Table 3.26 and Table 3.27. The emission factors for PM for International Navigation are taken from CEPMEIP/TNO database (Table 3.28).

Table 3.26 Emission factors to calculate emissions from International Aviation, kt/PJ

	NO_X	CO	NMVOC	SO_2
Jet fuel	0.25	0.1	0.05	0.023

Table 3.27 Emission factors to calculate emissions from International Navigation

	NO_X	CO	NMVOC	NH_3	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
		kt/PJ							t/PJ				
Diesel oil	1	0.25	0.11	0.0038	0.0024	0.00024	0.0012	0.0012	0.0009	0.0012	0.0016	0.0047	0.0118
RFO	1.6	0.5	0.11	0.0062	0.0049	0.00074	0.0005	0.0123	0.0049	0.0123	0.7389	0.0099	0.0222

Table 3.28 Emission factors for Particulate Matters for International Navigation, kt/PJ

	PM_{10}	$PM_{2.5}$	TSP
Diesel oil	0.035	0.033	0.035
RFO	0.1527	0.1379	0.1527

The SO_2 emission factors are used consistent with sulphur content in diesel oil (Table 3.29,

	Fuel content, %	NCV, TJ/kt	EF, kt/PJ
1990-2007	0.2	42.49	0.094
2008-2022	0.1	42.49	0.0471

Table 3.30).

Table 3.29 SO_2 emission factors used for Diesel oil in the SO_2 emission calculation from International Bunkers

	Fuel content, %	NCV, TJ/kt	EF, kt/PJ
1990-2007	0.2	42.49	0.094
2008-2022	0.1	42.49	0.0471

Table 3.30 SO_2 emission factors used for RFO in the SO_2 emission calculation from International Bunkers

	Fuel content, %	NCV, TJ/kt	EF, kt/PJ
1990-2006	2.8	40.6	1.352
2007-2015	1.5	40.6	0.7241
2015 -2022	0.1	40.6	0.0471

3.4.4 Activity data

Fuel consumption for emission calculation is obtained from CSB (Figure 3.25). To provide the consistent allocation of fuel consumption between domestic and international mode in the navigation and aviation, CSB each month collects and summarises the information that is submitted by enterprises which perform fuel bunkering. For this purpose, the particular statistical report format is elaborated in which the enterprises have to fill in the data regarding amount of fuel sold respectively in domestic and international navigation and aviation.

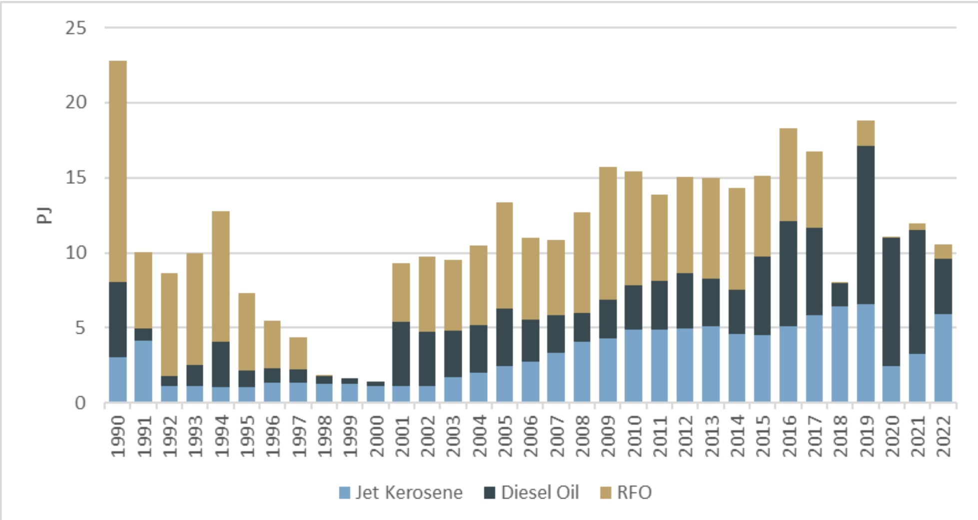

Figure 3.25 Fuel consumption in International Transport (PJ)

Considering the fact that ports in Latvia are focused on transit cargo transport, international navigation activities have big fluctuations and depend on neighbouring countries' economical and international trading activities and competitiveness of Latvian ports with other neighbouring ports in Baltic Sea. The other important reason for fuel consumption fluctuations has been the variation in bunker fuel prices. At the same time fuel consumption and emissions from aviation are more stable, and recent trend depicts a persistent increase from year 2003. In 2020, all emissions from international transport, compared to 2019 level, have decreased due to decreasing of arriving and departing flights affected by the Covid-19 pandemic. In 2020, the number of arriving and departing international flights have decreased by around 59%, compared to 2019 level. Since 2021 was slightly relieved by travel restrictions related to COVID-19, the number of aircraft flights increased. In 2022, the number of arriving and departing international flights have increased by around 43%, compared to 2021. Fuel consumption in international aviation increased by around 86% against 2021 in 2022.

After the sulphur regulation for marine fuels was entered into force on 1st of January 2015 in the North Sea and the Baltic Sea sulphur emission control area, SECA, a change in the fuel types used has occurred. The allowed sulphur content in marine fuels was decreased from 1 per cent to 0.1 per cent by mass. To fulfil requirements concerning sulphur content limit, from 2015 ships have used more diesel oil (Figure 3.25). Important reason for the fuel consumption fluctuations in international navigation has been the variation in bunker fuel prices. Vessels can refuel in one or other country depending on fuel prices. This was the main factor for a sharp decrease in fuel consumption in 2018 and 2022.

Table 3.31 Trends and emissions in International Transport in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	38.700	0.871	21.286	21.070	21.026	16.441	16.646	9.680	***-75.0***	***-54.5***
NMVOC		1.390	0.052	0.747	0.747	0.751	0.596	0.606	0.367	***-73.6***	***-50.8***
SO_2		20.451	0.054	9.959	5.734	0.591	0.457	0.476	0.342	***-98.3***	***-96.6***
NH_3		0.0034	0.0001	0.0019	0.0018	0.0018	0.0015	0.0015	0.0008	***-76.6***	***-57.6***
$PM_{2.5}$		2.210	0.016	1.110	1.163	0.940	0.309	0.345	0.282	***-87.2***	***-74.6***
PM_{10}		2.440	0.017	1.224	1.282	1.033	0.331	0.371	0.305	***-87.5***	***-75.1***
TSP		2.440	0.017	1.224	1.282	1.033	0.331	0.371	0.305	***-87.5***	***-75.1***
BC		0.301	0.006	0.161	0.165	0.152	0.094	0.098	0.065	***-78.3***	***-59.3***
CO		3.624	0.084	2.010	2.003	2.000	1.565	1.590	0.951	***-73.8***	***-52.7***
Cd	t	0.0084	0.0001	0.0044	0.0044	0.0039	0.0021	0.0022	0.0013	***-84.1***	***-69.3***
PAHs		0.0199	0.0008	0.0128	0.0111	0.0151	0.0198	0.0193	0.0089	***-55.3***	***-30.6***

4 Industrial processes and product use (NFR 2)

4.1 Overview of sector

4.1.1 Source category description

Sources of emissions from Industrial processes and product use (IPPU) are:

- Mineral products (NFR 2A);
- Metal production (NFR 2C);
- Other solvent and product use (NFR 2D-2L);
- Other industry production (NFR 2H).

There are no emissions reported from Wood processing (NFR 2I), POPs production (NFR 2J) as well as POPs and heavy metal consumption (NFR 2K) and other sectors (NFR 2L) in Latvia.

Table 4.1 Source categories and methods for Industrial processes and product use sector

NFR code	Description	Method	AD	EF
2A1	Cement production	Tier 1, Tier 2, Tier 3	PS	D, PS
2A2	Lime production	Tier 1, Tier 2	PS, NS	D
2A3	Glass production	Tier 1, Tier 3	PS, NS	D, PS
2A5a	Quarrying and mining of minerals other than coal	Tier 1	NS	D
2A5b	Construction and demolition	Tier 1	NS	D
2A5c	Storage, handling and transport of mineral products	Tier 1, Tier 3	NS	D
2A6	Other mineral products	NO	NO	NO
2B1	Ammonia production	NO	NO	NO
2B2	Nitric acid production	NO	NO	NO
2B3	Adipic acid production	NO	NO	NO
2B5	Carbide production	NO	NO	NO
2B6	Titanium dioxide production	NO	NO	NO
2B7	Soda ash production	NO	NO	NO
2B10a	Chemical industry: Other (please specify in the IIR)	NO	NO	NO
2B10b	Storage, handling and transport of chemical products (please specify in the IIR)	NO	NO	NO
2C1	Iron and steel production	Tier 2	NS, PS	D
2C2	Ferroalloys production	NO	NO	NO
2C3	Aluminium production	NO	NO	NO
2C4	Magnesium production	NO	NO	NO
2C5	Lead production	NO	NO	NO
2C6	Zinc production	NO	NO	NO
2C7a	Copper production	NO	NO	NO
2C7b	Nickel production	NO	NO	NO
2C7c	Other metal production (please specify in the IIR)	NO	NO	NO
2C7d	Storage, handling and transport of metal products (please specify in the IIR)	NO	NO	NO
2D3a	Domestic solvent use including fungicides	Tier 1, Tier 2	NS	Tier 2
2D3b	Road paving with asphalt	Tier1	NS	D
2D3c	Asphalt roofing	Tier1	NS	D
2D3d	Coating applications	Tier 1, Tier 2	NS	Tier 1
2D3e	Degreasing	CS	NS	Tier 1
2D3f	Dry cleaning	CS	NS	CS
2D3g	Chemical products	CS	NS	Tier 1, Tier 2
2D3h	Printing	CS	NS	Tier 1
2D3i	Other solvent use (please specify in the IIR)	Tier 1, Tier 2	NS	Tier 1, Tier 2
2G	Other product use (please specify in the IIR)	Tier 2	NS	Tier 2
2H1	Pulp and paper industry	Tier 1	NS	D
2H2	Food and beverages industry	Tier 2	NS	D
2H3	Other industrial processes (please specify in the IIR)	NO	NO	NO
2I	Wood processing	NE	NE	NE

NFR code	Description	Method	AD	EF
2J	Production of POPs	NO	NO	NO
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	NO	NO	NO
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	NO	NO	NO

Table 4.2 Reported emissions in Industrial processes and product use sector in 2022

NFR code	Emissions
2A1	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Hg
2A3	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO
2A5a	$PM_{2.5}$, PM_{10}, TSP
2A5b	$PM_{2.5}$, PM_{10}, TSP
2A5c	$PM_{2.5}$, PM_{10}, TSP
2D3a	NMVOC, Hg
2D3b	NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC
2D3c	NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC, CO
2D3d	NMVOC
2D3e	NMVOC
2D3f	NMVOC
2D3g	NMVOC
2D3h	NMVOC
2D3i	NMVOC
2G	NOx, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, total PAHs
2H2	NMVOC

4.1.2 Key sources

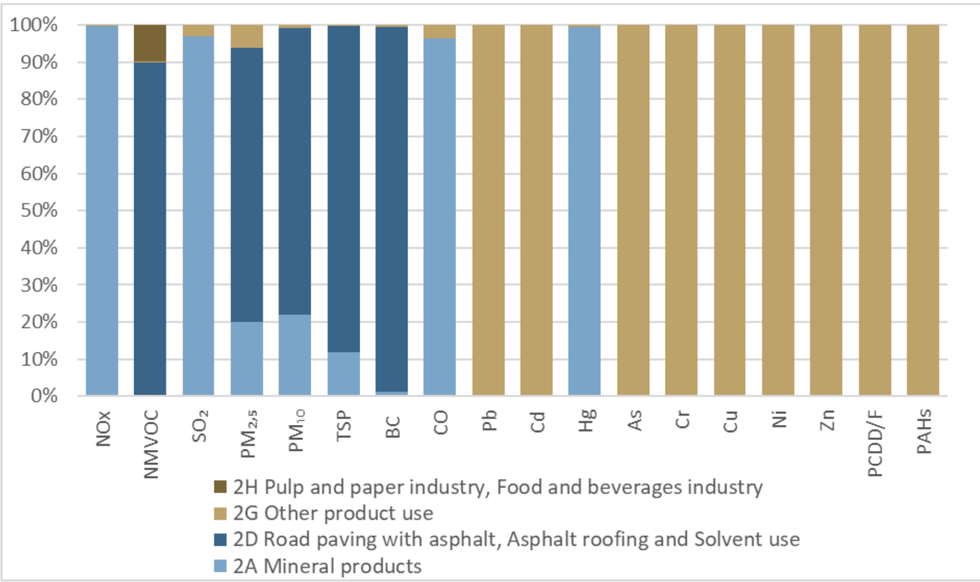

Figure 4.1 Emissions from Industrial processes and product use sector by subsectors in 2022

Main categories in IPPU sector are – mineral production (dominates in NO_x, SO_2, CO); other solvent and product use (dominates in NMVOC and particulate matter emissions) and other product use (dominates in heavy metal emissions). Coating application sector (NFR 2D3d) dominates in NMVOC, particulate matter and BC emissions (Figure 4.1). Division of emission most likely could be different because several emissions are not estimated due to lack of official methodology and default or country specific emission factors.

The main share of total NMVOC emissions was contributed by Coating (2D3d) – 14.7% or 4.49 kt and Other solvent use (2D3i) – 10.0% or 3.16 kt.

4.1.3 Trends in emissions

Table 4.3 Change in emissions from Industrial processes and product use sector in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	0.910	0.233	0.470	0.597	1.970	1.955	2.040	2.060	***126.3***	***338.1***
NMVOC		13.229	10.688	10.517	9.371	11.339	14.063	15.791	12.745	***-3.7***	***21.2***
SO_2		3.570	0.933	1.481	0.205	0.255	0.202	0.140	0.128	***-96.4***	***-91.3***
NH_3		0.010	0.009	0.007	0.007	0.007	0.010	0.010	0.008	***-20.5***	***9.8***
$PM_{2.5}$		0.684	0.574	0.959	0.852	0.952	0.718	0.934	0.813	***18.9***	***-15.2***
PM_{10}		1.698	1.981	4.800	4.146	7.204	5.080	6.685	5.793	***241.1***	***20.7***
TSP		3.399	6.644	18.032	15.137	28.999	20.691	27.649	23.639	***595.4***	***31.1***
BC		0.013	0.017	0.034	0.028	0.036	0.030	0.040	0.034	***159.6***	***1.3***
CO		0.14	0.13	0.12	0.96	1.79	2.73	3.42	3.22	***2141.6***	***2563.8***
Pb	t	163.02	149.12	164.85	160.36	0.14	0.10	0.06	0.99	***-99.4***	***-99.4***
Cd		0.454	0.411	0.453	0.438	0.012	0.013	0.013	0.012	***-97.3***	***-97.3***
Hg		0.000	0.000	0.000	0.012	0.008	0.000	0.007	0.014	***2868.2***	***3625.1***
As		16.301	14.895	16.459	16.025	0.0004	0.0002	0.0001	0.0017	***-100.0***	***-100.0***
Cr		1.260	1.147	1.272	1.231	0.003	0.002	0.001	0.020	***-98.4***	***-98.5***
Cu		0.180	0.254	0.321	0.232	0.070	0.069	0.047	0.568	***216.0***	***76.9***
Ni		5.464	4.983	5.515	5.352	0.017	0.010	0.009	0.043	***-99.2***	***-99.2***
Se		0.035	0.006	0.018	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	***-100.0***	***-100.0***
Zn		4.448	4.098	4.563	4.372	0.085	0.039	0.027	0.332	***-92.5***	***-92.7***
PCDD/ PCDF	g I-teq	0.057	0.045	0.055	0.039	0.038	0.0002	0.0002	0.0002	***-99.7***	***-99.7***
PAHs	kg	0.009	0.007	0.009	0.006	0.006	0.0006	0.0006	0.0005	***-95.0***	***-94.7***
PCBs		0.000	0.000	0.000	0.000	0.000	NO,NA	NO,NA	NO,NA	***-100.0***	***-100.0***

Emissions in the IPPU sector are linked with the economic situation in the country as well as availability of statistical data. The largest decrease in emissions occurred between 1990 and 1993, when industry was affected by a crisis (Table 4.3).

At the beginning of 1990s during the countrywide change of government system and national economy, statistics were not well kept, therefore there is a lack of statistical data regarding industry during this time period or it is vague.

From 2000 to 2008 the emissions from IPPU increased because of growing demand for industrial products in neighbouring countries. It led to rapid development of Latvian industry due to increased activity in construction and production of building materials.

Industrial production faced significant decrease at the end of 2008 and 2009, caused by financial crisis in economy of Latvia. It led to a reduction in purchase capacity which can be explained with decrease of population welfare. As a result, the activity in building and construction sectors decreased and companies were taxed with higher taxes.

In 2010, entire IPPU emissions increased with exception of SO_2 and NO_x which decreased by 88.9% and 5.9% accordingly compared to previous year. Decrease was related to switching from wet to dry cement production technology in the first half of 2010. The data of SO_2 and NO_x in 2010 may not be representative because the new dry process cement production technology began to work with full capacity only in July 2010. After switching from wet to dry process SO_2 and NO_x emissions are measured automatically by cement plant itself and are considered as plant-specific data and available from the national database "2-Air".

Heavy metal emissions from metal industry decreased remarkably comparing 1990 to 2022 due to technological changes in metal production plant that occurred in 2011 as well as due to cessation of the production of steel in 2016. Since 2011 crude steel was produced only in Electric arc furnace (EAF) whose EFs are lower than Open hearth furnace (OHF) technology which was used in 1990-2010. In relation to persistent organic pollutants (POPs) since IIR Submission 2016 PCDD/PCDF, PAHs and PCBs emissions from metal industry were calculated. PCBs emissions are applicable only for EAF technology. PCBs emissions were reported for 2011-2015 while PCDD/PCDF and PAHs were reported for 1990-2015. Since 2016 there are no emissions from 2.C.1 Iron and steel production due to interruption of steel production in the country.

From 2014-2016 the downward trend can be observed due to decrease in cement and glass production but from 2017 CO emissions are growing due to increased cement production. CO emissions are automatically measured at cement and glass fibre plants and available from the national database "2-Air".

In Solvent use the fluctuation of NMVOC emissions in the period 1990-2022 can be observed due to the welfare of the economic state of the country. A slight decrease in emissions occurred between years 1990 and 2006. From 2006 until 2008 the economy began to grow, when the world was affected by the economic crisis which also influenced the Solvent Use sector in Latvia. During the later period 2010 till 2022 NMVOC emissions were fluctuating.

4.2 Mineral products (NFR 2A)

4.2.1 Source category description

4.2.1.1 Overview

This chapter includes industrial production emissions from mineral production:

- NFR 2A1 Cement production – NO_x, NMVOC, SO_2, CO, particulate matter, BC and Hg emissions;
- NFR 2A2 Lime production - particulate matter, BC;
- NFR 2A3 Glass and glass fibre production – NO_x, NMVOC, SO_2, CO, particulate matter and BC emissions;
- NFR 2A5a Quarrying and mining of minerals other than coal - particulate matter emissions;
- NFR 2A5b Construction and demolition - particulate matter emissions;
- NFR 2A5c Storage, handling and transport of mineral products - particulate matter emissions.

Since 2016 there are no particulate matter and BC emissions from NFR 2A2 Lime production (NO) because the only lime producer ceased lime production in the country.

4.2.1.2 Trends in emissions

Table 4.4 Change in emissions from Mineral products in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	Change in 1990-2022, %	Change in 2005-2022, %
NO_x	kt	0.9025	0.2257	0.4635	0.5912	1.9658	1.9513	2.0358	2.0566	***127.9***	***343.7***
NMVOC		0.1550	0.0412	0.0724	0.0291	0.0170	0.0172	0.0170	0.0181	***-88.3***	***-75.0***
SO_2		3.4094	0.8526	1.3919	0.1186	0.2538	0.2016	0.1393	0.1244	***-96.3***	***-91.1***
$PM_{2.5}$		0.2807	0.0624	0.1541	0.1384	0.2720	0.1337	0.1653	0.1626	***-42.1***	***5.5***
PM_{10}		1.1025	0.3653	1.1228	1.1018	2.4345	1.1340	1.3570	1.2780	***15.9***	***13.8***
TSP		2.3422	0.6845	2.5712	2.5960	6.8188	2.5409	3.0641	2.8023	***19.6***	***9.0***
BC		0.0043	0.0009	0.0016	0.0005	0.0005	0.0004	0.0004	0.0004	***-90.3***	***-74.4***
CO		NA,NE	NA,NE	NA,NE	0.8525	1.6784	2.5961	3.2864	3.1070	***100.0***	***100.0***
Pb	t	0.0741	0.0125	0.0385	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***
Cd		0.0057	0.0010	0.0029	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***
Hg		0.0001	0.0000	0.0001	0.0120	0.0076	0.0000	0.0069	0.0141	***10687.7***	***20671.7***
As		0.0083	0.0014	0.0043	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***
Cr		0.0100	0.0017	0.0052	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***
Cu		0.0003	0.0001	0.0002	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***
Ni		0.0213	0.0036	0.0111	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***
Se		0.0349	0.0059	0.0181	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***
Zn		0.0161	0.0027	0.0084	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	***-100.0***	***-100.0***

During the time period 1990-2022 NO_x, CO, Hg and particulate matter emissions from Mineral products were increasing. At the same time NMVOC, BC, $PM_{2.5}$ and SO_2 emissions decreased. Compared to 2005,

NO_x, CO, Hg and particulate matter emissions have increased in 2022. Emission trend in 2A sector is linked with economic situation in the country which influences demand for mineral products (Table 4.4).

In 2022, NO_x emissions have increased by 127.9% compared to 1990 and by 343.7% compared to 2005 but CO emissions increased by 264.4% in 2022 compared to 2010 due to an increased amount of clinker produced. In cement plant NO_x, SO_2 and CO emissions, as well as particulate matter and Hg emissions are measured automatically by plant itself. Compared to 1990 emissions of PM_{10} and TSP increased by 19.6% and 15.9% accordingly. To reduce particulate matter emissions, all plants producing mineral products are equipped with filters.

NMVOC emissions decreased by 88.3% in 2022 compared to 1990 and by 75.0% compared to 2005. It is mainly due to closing of glass production plant in 2005 and change of cement production technology. Important condition which causes NMVOC emission fluctuations in glass production sector is market demand which determines necessity for different raw materials.

4.2.2 Cement production (NFR 2A1)

4.2.2.1 Overview

Under 2A1 sector NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC and Hg emissions from Cement production are reported.

4.2.2.2 Trends in emissions

Table 4.5 Change in emissions from Cement production in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	0.902	0.226	0.358	0.492	1.864	1.890	1.976	1.995	***121.1***	***456.9***
NMVOC	kt	0.154	0.038	0.061	0.008	0.009	0.011	0.011	0.011	***-93.1***	***-82.5***
SO_2	kt	3.409	0.853	1.354	0.075	0.191	0.185	0.124	0.108	***-96.8***	***-92.0***
$PM_{2.5}$	kt	0.120	0.030	0.048	0.019	0.019	0.018	0.029	0.035	***-71.2***	***-27.5***
PM_{10}	kt	0.341	0.085	0.135	0.029	0.029	0.028	0.044	0.052	***-84.6***	***-61.2***
TSP	kt	0.401	0.100	0.159	0.030	0.030	0.028	0.045	0.054	***-86.5***	***-66.0***
BC	kt	0.004	0.001	0.001	0.0002	0.0003	0.0003	0.0003	0.0003	***-91.7***	***-79.0***
CO	kt	NE	NE	NE	0.812	1.644	2.587	3.279	3.099	***100.0***	***100.0***
Hg	t	NE	NE	NE	0.012	0.008	0.000	0.007	0.014	***100.0***	***100.0***

There is only one cement producing company "SIA SCHWENK Latvija" in the country. During 1990-2010 cement was manufactured in wet process kiln and emissions were estimated by multiplying clinker production data with emission factors (Tier 1 and Tier 2 method). Starting from 2010 company switched from wet to fully dry cement production process and plant specific SO_2, NO_x, CO and particulate matter emission data become available from the national database "2-Air" (Tier 3 method).

Due to the change of cement production technology SO_2 and NO_x emissions in 2010 decreased by 95.7% and 10.4% accordingly compared to 2009. Rapid decrease of SO_2 emissions can be explained with the new technology (wet process) where raw materials and fuel have been chosen so to restrict the content of sulphur compounds. Fuels are mixed in a way that dust mass of clinker and filters can adsorb process SO_2 which causes emission decrease.

NO_x emission decrease in 2010 compared to 2009 and increase starting from 2011 is related to plant specification. The cement producer was asked to confirm correctness of NO_x data and they explained that NO_x emission increase since 2011 is related to technology which was changed when wet process was replaced with dry process. In dry process additional NO_x is caused also from drying of raw materials which was not done in wet technology. To reduce NO_x emissions from cement production SNCR (Selective Non-Catalytic Reduction System) method is used. Using SNCR system the NO_x emission reduction in flue gas of 40-60% is achievable, depending on the cement kiln type, fuel and NO_x content. Reducing agents such as urea and ammonia are injected into the hot flue gases. They react with nitrogen monoxide and form nitrogen and water. In addition, SNCR are used together with more than 50% ecofuel which functions as blaze extinguisher to reduce NO_x emissions. Cement producer confirmed that ammonia "helps" to keep temperature in kiln so that the NO_x limit is not exceeded.

SO_2 and NO_x emission data reported by cement producer was verified and acknowledged as correct as this is plant specific data. There is no way to create consistent time series for at least 2005-present in case of SO_2 and NO_x as Tier 3 method is applied since 2010 and plant specific data is not available prior to 2010.

In 2022, NMVOC, SO_2 and particulate matter emissions have decreased (Table 4.5) compared to 1990 and also to 2005 because all emissions are automatically measured by plant itself. TSP are weighted and returned in further production for different types of cement.

NO_x, NMVOC and particulate matter emissions have increased in 2022 compared to 2021 because the production capacity has slightly increased in the clinker furnace.

In 2011 and 2012 emissions from NFR 2A1 sector increased due to growing activity in cement production compared to previous year. In 2013 cement production decreased by 6.6% but again in 2014 increased by 3.6%. Then cement production decreased by 16.0% and 26.1%, accordingly in 2015 and 2016 due to decrease of amounts exported and reduced activity in building sector which caused lower demand for cement. In 2017, 2018 and in 2019 cement production increased each year. In 2020-2021 cement production decreased but in 2022 cement production increased by 1.1% compared to previous year. Cement products are mainly exported thereby cement production directly depends on demand in external and internal market.

Hg emission increase in 2016 compared to 2015 can be observed due to the use of solid recovered fuel (SRF). SRF usually is a composition of mixed plastics, paper, paperboard, wood, textiles etc. The composition and quality of SRF is changing all the time and it affects Hg fugitive emissions which are measured in main chimney. The amount of Hg emissions depends on the raw material which is used in the cement production as an additive material. In 2022, raw material supplier has been replaced and the amount of oxygen in the furnace is increased compared to 2021, therefore emissions increased by 104.3%.

Since 2010 all emissions from cement production are automatically measured at plant site and are plant specific – Tier 3 method (emission data are taken from the national database "2-Air"). It is not possible to separate emissions emitted from clinker production process and emissions emitted for fuel combustion purpose, because they are measured in main chimney. To ensure consistency and avoid double counting with category 1A2f Stationary Combustion in Manufacturing Industries and Construction: Non-Metallic Minerals Latvia reports fuel related emissions from cement industry under category 1A2f (only for time period 1990-2009). Since 2010 emissions from 2A1 sector include all emitted emissions from clinker production – technology and fuel combustion.

4.2.2.3 Methods

In 1990-2009 Tier 2 method was used to calculate NO_x, NMVOC, SO_2 (from EMEP/CORINAIR 2007) and particulate matter emissions (from EMEP/EEA 2009) from cement production considering the amount of produced clinker in wet process kiln and technology based EFs. An exception is BC emissions which are calculated using Tier 1 method from EMEP/EEA 2023.

In the middle of 2009 cement plant changed their technology from wet to dry process kiln, therefore, since 2010 emissions are automatically measured and reported by plant itself (Tier 3). NO_x data are taken from national database "2-Air" since 2010. The cement production company confirms correctness of NO_x data and explains that NO_x emission increase since 2010 is related to technology which was changed when wet process kiln was replaced with dry process kiln. In dry process kiln additional NO_x is caused from drying of raw materials which was not the case in wet technology. To keep NO_x emissions within set limit (500 mg/m^3) the ammonia is sprayed in the kiln. Cement producer says that ammonia is one of the reasons why they can keep temperature in kiln so that the NO_x limit is not exceeded. As regards to SO_2 emissions data are taken from "2-Air" since 2010.

According to Industrial emissions directive (IED) permit there are 36 dedusting filters installed in the cement plant with total efficiency approximately 99%[11]. These filters mainly are designed to collect large coarse particles. Therefore, total TSP emissions decreased by 99% due to installation of filters. The filter method is used in the enterprise, thus obtaining filterable PM. TSP emissions are measured automatically in plant and available from the national database "2-Air".

For 2010-2022 additionally Hg emissions are reported which also were taken from the database mentioned above.

4.2.2.4 Emission factors

As the EFs for NO_x, NMVOC and SO_2 are not available in EMEP/EEA 2023[12] (marked as NE) the EFs from EMEP/CORINAIR 2007[13] were used as these emissions are emitted in the production process according to cement production plant (Table 4.6). EFs were divided for wet process kiln used till the first half of 2009 and for dry process kiln used starting with second half of 2009 and afterwards.

Table 4.6 EFs for cement clinker production, kt/kt

	NO_x	NMVOC	SO_2	$PM_{2.5}$	PM_{10}	TSP	BC
Wet Process Kiln	0.00135	0.00023	0.0051	0.00018	0.00051	0.0006	0.0000054

Since 2010 the plant-specific emission data is reported by plant therefore EFs for new dry process technology are not applied.

4.2.2.5 Activity data

The produced clinker is estimated from final cement type by multiplying it with cement/clinker ratio. As the only cement producer in Latvia participates in European Union Emission Trading Scheme (EU ETS), the activity data are available annually from plant`s GHG report[14] under EU ETS (Figure 4.2).

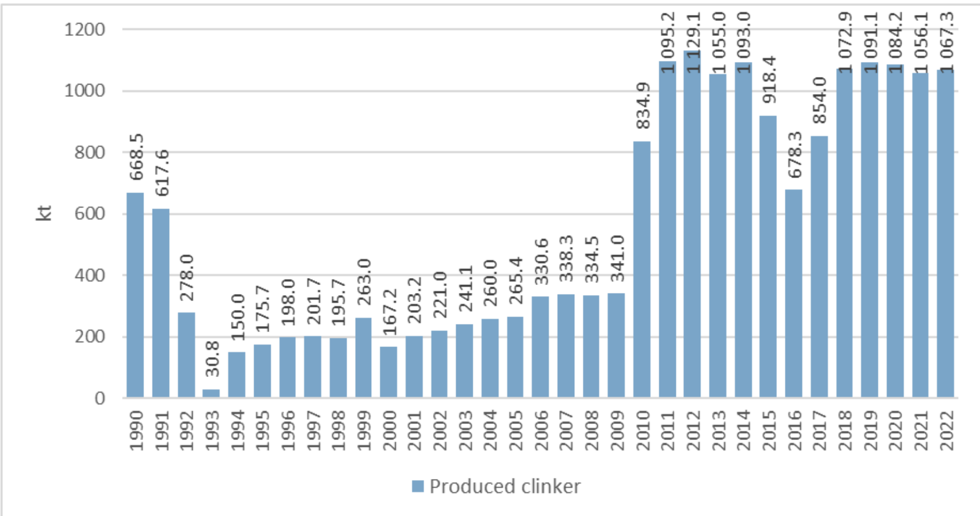

Figure 4.2 Cement production activity data in 1990-2022, kt

[11] https://registri.vvd.gov.lv/izsniegtas-atlaujas-un-licences/a-un-b-atlaujas/

[12] https://www.eea.europa.eu/publications/emep-eea-guidebook-2023/part-b-sectoral-guidance-chapters/2-industrial-processes-and-product-use/2-a-mineral-products/2-a-1-cement-production-2023/view

[13] http://www.eea.europa.eu/publications/EMEPCORINAIR5/B3311vs2.4.pdf/view (pages 12-13)

[14] https://registri.vvd.gov.lv/izsniegtas-atlaujas-un-licences/atlauju-un-licencu-mekletajs/?company_name=schwenk&company_code=&s=1

4.2.2.6 Uncertainties

Uncertainty of cement production data is taken from cement production plant`s GHG report under EU ETS (2.5% uncertainty for activity data of clinker production and 7.5% uncertainty for activity data of CKD).

The total uncertainty U_{total} is being calculated, using following formula of combined uncertainty:

$$U_{total} = \sqrt{(U_1^2 + U_2^2 + ... + U_n^2)}$$

where:
U_{total} - the percentage uncertainty in the product of the quantities
U_i - the percentage uncertainties associated with each of the quantities

Combined activity data uncertainty is calculated as 8%.

Emission factor for NFR 2A1 sector is used only for NMVOC emissions and for all other emissions in 1990 - 2009 and partially in 2010 so uncertainty of 10% is assumed. For CO, NO_x, SO_2, particulate matter and Hg emission factor is not applicable as these emissions are measured automatically at plant site starting from middle of 2010.

Up to 50% of uncertainty may be assigned to the emission estimates of most of the trace elements emitted from major point sources in Europe (Pacyna, 1994). Similar uncertainty can be assigned for emission estimates of these compounds from cement production.

4.2.2.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes comparing calculation data base with input data in NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based on final completed NFR data table.

4.2.2.8 Recalculations

No recalculations were carried out.

4.2.2.9 Planned improvements

No improvements are planned for the next submission.

4.2.3 Lime production (NFR 2A2)

4.2.3.1 Overview

Under NFR 2A2 sector $PM_{2.5}$, PM_{10}, TSP and BC emissions from lime production are reported based on total produced lime data.

4.2.3.2 Trends in emissions

Table 4.7 Emissions from Lime production in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
$PM_{2.5}$	kt	0.150	0.0134	0.0055	0.000095	0.000026	0.000026	NO	NO	NO	*-100*	*-100*
PM_{10}	kt	0.750	0.06723	0.02763	0.00063	0.00017	0.00017	NO	NO	NO	*-100*	*-100*
TSP	kt	1.928	0.17287	0.07105	0.00127	0.00034	0.00035	NO	NO	NO	*-100*	*-100*
BC	kt	0.001	6.2E-05	2.5E-05	4.4E-07	1.2E-07	1.2E-07	NO	NO	NO	*-100*	*-100*

In Latvia two companies produced lime during time period 1990-2015. Emissions from lime production were continuously decreasing since the beginning of 1990s due to recession of overall national economy. Economic crisis also affected lime production in 2008-2009. After 2009 emissions from lime production remained very small and fluctuated due to economic situation and changes in industrial activities in the country but in 2016 the lime production was fully stopped. In 2016 the only operating lime producer "SIA

Saulkalne S" ceased lime production therefore since 2016 there are no emissions from lime production (NO).

In 1990-2015 NO_x, NMVOC, SO_x and CO is "IE" because fuel-based emissions are included under source category 1.A.2 Manufacturing Industries and Construction (Combustion) and not included here to prevent double counting.

4.2.3.3 Methods

Tier 2 approach was used to estimate particulate matter and BC emissions from lime production. One lime producer used limestone in lime production 2007-2012. Second plant used dolomite in lime production from 1990-2015.

4.2.3.4 Emission factors

Both lime production plants had IED permits. Since 2005 the facilities must have the best available techniques (BAT) and the emissions from the production processes have to be controlled. Therefore, controlled EFs from EMEP/EEA 2023 for particulate matter and BC were used for 2005-2015. For 1990-2004 the uncontrolled EFs from EMEP/EEA 2023 were used to estimate particulate matter and BC emissions (Table 4.8).

Table 4.8 Emission factors for lime production in 1990-2015 (kt/kt)

	$PM_{2.5}$	PM_{10}	TSP	BC
Lime (total production) 1990-2004	0.0007	0.0035	0.009	0.0000032
Lime (total production) 2005-2015	0.00003	0.0002	0.0004	0.0000001

4.2.3.5 Activity data

The data of produced lime in lime production plants was not available due to confidentiality. This data was re-estimated backwards considering the approximate percentage of the lime that is produced by using raw materials (Table 4.9, Figure 4.3).

Table 4.9 Used raw materials in lime production, kt

	Used limestone	Used dolomite (dry)
1990	NO	383.25
1995	NO	33.67
2000	NO	13.84
2005	NO	5.97
2010	0.35	1.25
2011	0.35	NO
2012	0.32	0.69
2013	NO	0.89
2014	NO	1.49
2015	NO	1.63
2016	NO	NO
2017	NO	NO
2018	NO	NO
2019	NO	NO
2020	NO	NO
2021	NO	NO
2022	NO	NO

The information of technology used in lime production:

- in the first facility lime is produced only from limestone and there are 3 shaft-type kilns installed in facility;
- in the second facility lime is produced only from dolomite using shaft-type kilns.

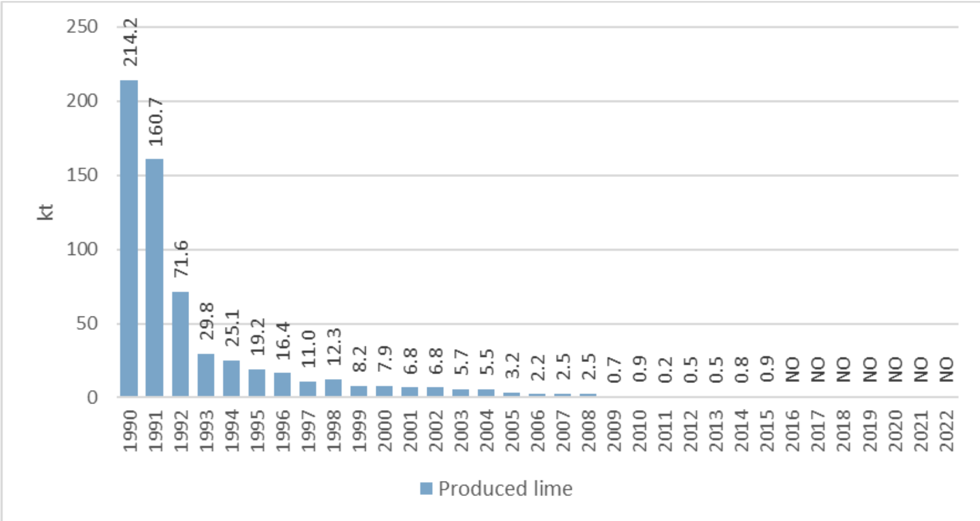

Figure 4.3 Lime production activity data in 1990-2022, kt

In 2011 production was stopped in one of the largest lime production plants due to exhausted limestone career and preparation of implementing the highest BAT. In latest years, there was an overall decrease in activity of lime production due to reduced industrial activity. In 2016 lime production was ceased and there are no emissions from NFR 2A2 sector anymore.

4.2.3.6 Uncertainties

Uncertainty of lime production activity data is taken from Lime production plant`s GHG report under EU ETS (8% uncertainty for activity data of lime production).

As default emission factors for lime production from 2006 IPCC Guidelines as well as Monitoring reporting Guidelines (MRG[15]) are used uncertainty is assumed 50% due to unavailable plant specific data of produced lime.

4.2.3.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes comparing calculation database with input data in NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based on final completed NFR data table.

4.2.3.8 Recalculations

No recalculations were carried out.

4.2.3.9 Planned improvements

No improvements are planned for the next submission.

4.2.4 Glass production (NFR 2A3)

4.2.4.1 Overview

In this sector NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, heavy metals and CO emissions from glass and glass fibre production are reported for 1990-2022.

In 1990-2004 particulate matter and heavy metal emissions were calculated by using known total produced glass amount from the CSB and applying EFs from EMEP/EEA 2023. In 1990-2004 CO, NO_x and SO_2 is "IE" because emissions are included in 1A2f Stationary Combustion in Manufacturing Industries and Construction: Non-Metallic Minerals to avoid double-counting. Since 2005 $PM_{2.5}$, PM_{10}, TSP, BC, CO, NO_x

[15] Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council

and SO_2 production-based emissions are available from the national database "2-Air". Heavy metal emissions were reported 1990-2006 when the total produced glass amount was available. Since 2007 only one glass production plant remained therefore activity data became confidential "C". Based on the information of the glass production plant, no heavy metals are formed in the production process, so for period 2007-2022 is used notation key "NA".

Based on the information of national database "2-Air", no NH_3 emissions are formed in the production process in the glass production plant. Natural gas is used for combustion in the glass production plant and EMEP/EEA 2023 Guidelines state that NH_3 emissions are not estimated (Table 3.3, Chapter - 1.A.2 Combustion in manufacturing industries and construction) from natural gas. So notation key "NE" is still used for NH_3 emissions.

4.2.4.2 Trends in emissions

Table 4.10 Emissions from Glass production in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	IE	IE	0.1052	0.0994	0.1021	0.0618	0.0601	0.0614	***100.0***	***-41.6***
NMVOC		0.0013	0.0027	0.0114	0.0207	0.0078	0.0064	0.0064	0.0074	***477.9***	***-35.0***
SO_2		IE	IE	0.0384	0.0441	0.0632	0.0164	0.0155	0.0164	***100.0***	***-57.3***
$PM_{2.5}$		0.0105	0.0018	0.0101	0.0157	0.0142	0.0059	0.0057	0.0059	***-43.7***	***-41.8***
PM_{10}		0.0118	0.0020	0.0256	0.0396	0.0360	0.0149	0.0144	0.0149	***26.3***	***-41.8***
TSP		0.0131	0.0022	0.0532	0.0825	0.0750	0.0310	0.0299	0.0310	***136.9***	***-41.8***
BC		0.0000	0.0000	0.0002	0.0003	0.0003	0.0001	0.0001	0.0001	***1714.8***	***-41.8***
CO		IE	IE	0.0119	0.0410	0.0339	0.0089	0.0073	0.0077	***100.0***	***-35.6***
Pb	t	0.0741	0.0125	0.0385	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
Cd		0.0057	0.0010	0.0029	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
Hg		0.0001	0.0000	0.0001	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
As		0.0083	0.0014	0.0043	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
Cr		0.0100	0.0017	0.0052	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
Cu		0.0003	0.0001	0.0002	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
Ni		0.0213	0.0036	0.0111	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
Se		0.0349	0.0059	0.0181	NA	NA	NA	NA	NA	***-100.0***	***-100.0***
Zn		0.0161	0.0027	0.0084	NA	NA	NA	NA	NA	***-100.0***	***-100.0***

In Latvia three glass producers were active 1990-2006. Since 2007 only one producer remained where emissions are only occurring from glass fibre production. Emissions from glass production fluctuate in all time series due to technological changes as well as changes in raw materials and adjuvants during time. Changes in raw materials strongly depend on market demand, for example, if the market requires product with specific quality or properties, producers need to adjust "recipe" of their product. These requirements lead to fluctuations in emissions.

In 2022, NMVOC, PM_{10}, TSP and BC emissions from glass production have increased if compared to 1990 due to increase in the volume of production especially since 2007 till 2011. But $PM_{2.5}$ emissions have decreased compared to 1990. However, in 2022 all emissions have decreased compared to 2005.

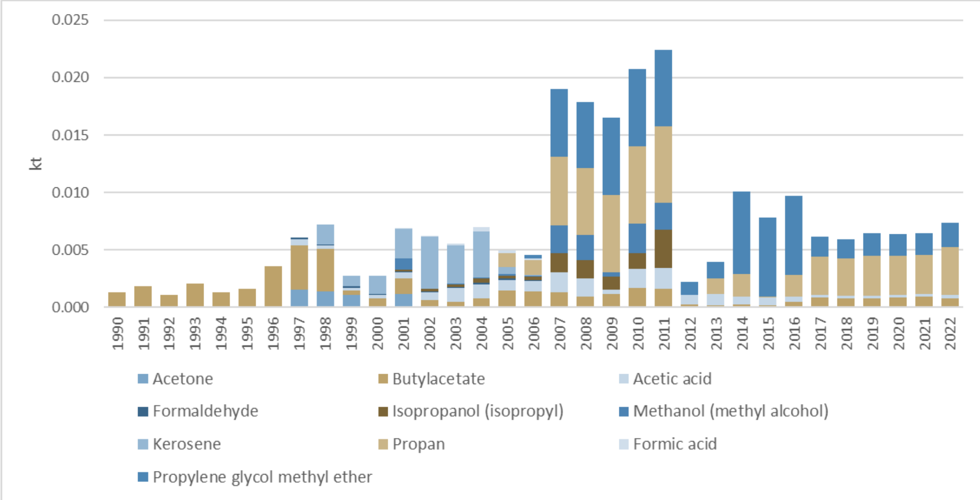

Figure 4.4 NMVOC emissions from glass fibre production in 1990-2022, kt

Several substances were used in glass/glass fibre production in Latvia causing NMVOC emissions. For 1990-1996 only data on butylacetate was available from glass fibre production company's application for GHG permit within EU ETS. Only for 2005 also glass production company reported its NMVOC emissions but since then glass is no longer produced in Latvia, thereby NMVOC emissions from glass production are reported only for 2005. NMVOCs from glass fibre production are still occurring and reported.

In 2022, butylacetate, acetic acid, propan (propyl alcohol) and propylene glycol methyl ether were used in glass fibre production in small amounts (Figure 4.4). NMVOC emissions are increased by 15.2% compared to 2021 due to increase in used propan and propylene glycol methyl ether. In 2022 NMVOC emissions decreased by 35.0% compared to 2005.

4.2.4.3 Methods

EFs of particulate matter (1990-2004) and heavy metals (1990-2006) were taken from EMEP/EEA 2023 for Tier 1 approach.

CO, NO_x, SO_2, NMVOC, particulate matter and BC emissions were taken from the national database "2-Air" where glass fibre production plant reported it`s emissions therefore no EF was used (Tier 3 method).

4.2.4.4 Emission factors

To estimate particulate matter emissions (1990-2004) and heavy metals (1990-2006), EF from EMEP/EEA 2023 are used (Table 4.11). Particulate matter emissions (2005-2022) are measured using ISO 9096:2003/Cor 1:2006 Stationary source emissions - Manual determination of mass concentration of particulate matter, therefore filterable emissions are gained.

Table 4.11 Emission factors for glass production 1990-2022, g/Mg

	$PM_{2.5}$	PM_{10}	TSP	BC	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
Glass production	240	270	300	0.062% of $PM_{2.5}$	1.7	0.13	0.003	0.19	0.23	0.007	0.49	0.8	0.37

4.2.4.5 Activity data

Activity data for particulate matter, BC and heavy metal emission calculation was total produced glass amount which was taken from CSB 1990-2006. Since 2005 emissions are available from the national database "2-Air" were particular glass producer reports their air emissions. Hence to ensure consistent time series since 2005 the particulate matter, BC, CO, NO_x and SO_2 emissions are taken from the data source mentioned above.

NMVOC emissions from 1997 to 2022 were also taken from the national database "2-Air" where glass/glass fibre production plant operator reported it`s emissions divided by NMVOC sub-type.

4.2.4.6 Uncertainties

Uncertainty of glass production activity data is taken from Glass production plant`s GHG report under EU ETS (2.5% uncertainty for activity data of glass production). The uncertainty is quite low as plant specific reported data is used. Accredited verifiers and Latvia's Regional Environmental Boards verify the activity data reported in production plant's annual GHG reports within EU ETS so the activity data is adequately verified.

EFs for this sector are taken from glass production plant so the uncertainty could be assumed as quite low. Still the estimation of the emission factors can't be adequately verified so the uncertainty is assumed as quite high – 60%, according to 2006 IPCC Guidelines.

4.2.4.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes by comparing calculation data base with input data in NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based on final completed NFR data table.

4.2.4.8 Recalculations

No recalculations were carried out.

4.2.4.9 Planned improvements

No improvements are planned for the next submission.

4.2.5 Quarrying and mining of minerals other than coal (NFR 2A5a)

4.2.5.1 Overview

Under 2A5a sector $PM_{2.5}$, PM_{10} and TSP emissions from quarrying and mining of minerals are reported since IIR Submission 2018.

4.2.5.2 Trends in emissions

In Latvia several non-metallic minerals are quarried:

- Marble, granite, sandstone, porphyry, basalt, other ornamental or building stone (excluding slate);
- Chalk and dolomite;
- Limestone and gypsum;
- Clays and kaolin;
- Sand and gravel;
- Other unclassified non-metallic minerals.

Biggest share of quarried minerals constitutes sand and gravel as well as chalk and dolomite.

Emissions from 2A5a sector are reflected in Table 4.12.

Table 4.12 Emissions from Quarrying and mining of minerals other than coal in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1995-2022, %*	*Change in 2005-2022, %*
$PM_{2.5}$	kt	NA	0.07	0.03	0.06	0.07	0.08	0.09	0.10	0.10	**40.3**	**55.0**
PM_{10}	kt	NA	0.72	0.25	0.65	0.73	0.77	0.88	1.02	1.00	**40.3**	**55.0**
TSP	kt	NA	1.46	0.51	1.32	1.50	1.56	1.80	2.08	2.05	**40.3**	**55.0**

Particulate matter emissions from quarrying of minerals are reported since 1995 when activity data was available from CSB. Emission fluctuations can be associated with development of construction and building sectors in Latvia which are the main sectors for realization of minerals. Sharp decrease of emissions in 2009 can be observed due to economic crisis in Latvia. After 2009 situation in quarrying of minerals is quite stable.

In 2022 emissions from 2A5a sector are decreased by 1.5% because of decreased amount of non-metallic minerals compared to 2021 and increased by 55.0% compared to 2005 (Figure 4.5).

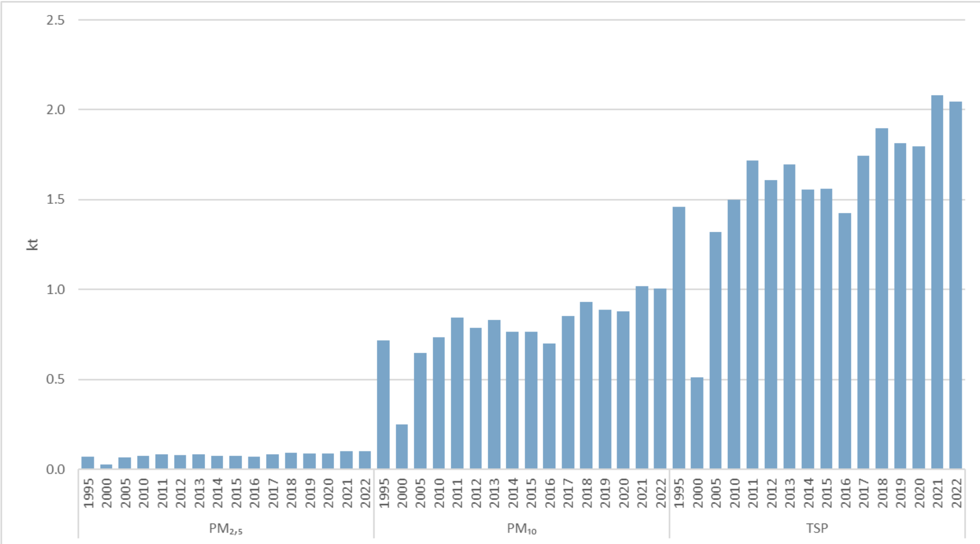

Figure 4.5 Particulate matter emissions from quarrying of minerals in 1995-2022, kt

4.2.5.3 Methods

Tier 1 approach from EMEP/EEA 2023 was used to estimate particulate matter emissions from quarrying of minerals in Latvia.

4.2.5.4 Emission factors

For 1995-2022 the EFs from EMEP/EEA 2023 were used to estimate particulate matter emissions (Table 4.13).

Table 4.13 Emission factors for quarrying of minerals in 1990-2022, g/Mg mineral

	$PM_{2.5}$	PM_{10}	TSP
Quarrying of minerals other than coal	5	50	102

4.2.5.5 Activity data

Activity data for 2A5a emission calculation was taken from the CSB database "Material flow accounts-domestic extraction (thsd tonnes)"[16].

4.2.5.6 Uncertainties

Activity data for particulate matter emissions from quarrying of minerals was taken from CSB and uncertainty was assumed as very low about, 2%, as a statistical frame mistake. Uncertainty for emission factor is assumed as 50%.

4.2.5.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes by comparing calculation data base with input data in NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based on final completed NFR data table.

4.2.5.8 Recalculations

No recalculations were carried out.

[16] https://stat.gov.lv/lv/statistikas-temas/vide/konti/tabulas/vim010-materialu-plusmas-konti-iekszemes-ieguve-tukst-tonnu

4.2.5.9 Planned improvements

No improvements are planned for the next submission.

4.2.6 Construction and demolition (NFR 2A5b)

4.2.6.1 Overview

$PM_{2.5}$, PM_{10} and TSP emissions from house and road construction were calculated for the first time in IIR Submission 2018.

Emissions are calculated according to CSB data on number of building permits granted and expected floor space in statistical regions and cities under state jurisdiction. Only construction emissions are calculated due to lack of data regarding demolition in Latvian statistics. According to CSB division there are following types of buildings:

- One-dwelling buildings;
- Summer houses and weekend houses;
- Two- and more dwelling buildings;
- Residences for communities;
- Hotels and similar buildings;
- Office buildings;
- Wholesale and retail trade buildings;
- Traffic and communication buildings;
- Industrial buildings and warehouses;
- Public entertainment, education, hospital or institutional care buildings;
- Other non-residential buildings.

Types mentioned above are classified according to Tier 1 default approach from EMEP/EEA 2023 – residential housing, single or two family, residential housing, apartments and non-residential housing. Particulate matter emissions from road construction are also calculated using statistics of newly constructed road length and width.

4.2.6.2 Trends in emissions

Emissions from 2A5b sector are reflected in Table 4.14.

Table 4.14 Emissions from building and road construction in 1990-2022, kt

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
$PM_{2.5}$	kt	NA	NA	NA	0.03	0.03	0.16	0.02	0.03	0.02	***100.0***	***-37.4***
PM_{10}		NA	NA	NA	0.31	0.30	1.57	0.20	0.27	0.20	***100.0***	***-37.4***
TSP		NA	NA	NA	1.04	0.98	5.24	0.67	0.89	0.65	***100.0***	***-37.4***

Particulate matter emissions from building construction are estimated in 2005-2022. Emission fluctuations can be associated with development of construction and building sectors in Latvia.

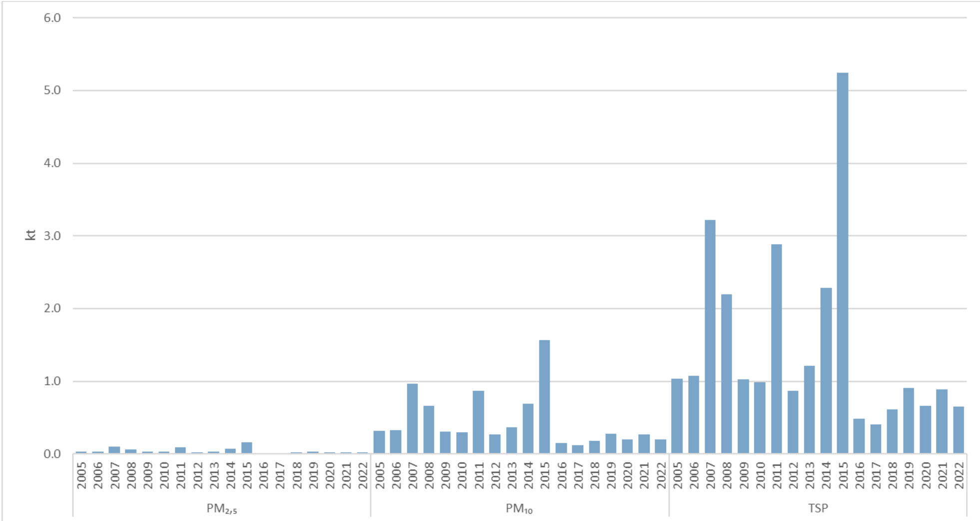

Figure 4.6 Particulate matter emissions from building and road construction in 2005-2022, kt

In 2022 the amount of emissions has decreased by 27.0% compared to 2021. The decrease in emissions is observed because the amount of building construction has decreased in Latvia in 2022. In 2022, emissions have decreased by 37.4% compared to 2005 (Figure 4.6).

4.2.6.3 Methods

Tier 1 approach from EMEP/EEA 2023 was used to estimate particulate matter emissions from building and road construction.

Estimation parameters (d, CE, PE and s):

Duration of construction (d) and Control efficiency of applied emission reduction measures (CE) is based on EMEP/EEA 2023 Guidelines.

Thornthwaite precipitation-evaporation index (PE) in Latvia was used for all above mentioned activities in 2A5b sector. Value of this index is 75.59, the input for calculation of this values is provided by LEGMC.

Soil silt content (s) %, is equal 20 and variable (s/9) has value 2.22 for all years.

4.2.6.4 Emission factors

For 2005-2022 the EFs from EMEP/EEA 2023 were used to estimate particulate matter emissions (Table 4.15).

Table 4.15 Emission factors for building and road construction in 1990-2022, kg/[m^2 year]

	$PM_{2.5}$	PM_{10}	TSP
Residential housing, single or two family	0.01	0.09	0.29
Residential housing, apartments	0.03	0.3	1
Non-residential housing	0.1	1	3.3
Road construction	0.23	2.3	7.7

4.2.6.5 Activity data

Activity data for 2A5b emission calculation was taken from the CSB database "Number of building permits granted and expected floor space in statistical regions and cities under state jurisdiction"[17]. Data on new constructed road length and width were received from the State Joint Stock Company "Latvian State Roads" as an answer to data request.

[17] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__NOZ__BU__BUE/BUE011/

4.2.6.6 Uncertainties

Activity data for particulate matter emission calculation from construction of buildings were taken from CSB and uncertainty was assumed as very low about 2%, as a statistical frame mistake. Data on newly constructed roads was provided directly by "Latvian State Roads" and uncertainty is also assumed 2%. Uncertainty for emission factor is assumed as 50%.

4.2.6.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes by comparing calculation data base with input data in NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based on final completed NFR data table.

4.2.6.8 Recalculations

Recalculations were done for all time series due to 2023 NECD review recommendation, in the calculation of emissions were added estimation parameters that are included in EMEP/EEA 2023 Tier 1.

4.2.6.9 Planned improvements

No improvements are planned for the next submission.

4.2.7 Storage, handling and transport of mineral products (NFR 2A5c)

4.2.7.1 Overview

Under 2A5c sector $PM_{2.5}$, PM_{10} and TSP emissions from storage, handling and transport of minerals are reported since IIR Submission 2018.

As the cement, lime and glass are being produced in Latvia, emissions from storage, handling and transport of minerals shall be assessed 1990-2022. Prior to 2011 emissions from particulate matter for categories 2A1, 2A2 and 2A3 are calculated using EMEP/EEA 2023 Tier 1 approach. It is assumed that these emissions are already included in the EFs applied in the sectorial source categories in the relevant mineral chapter therefore IE is reported (according to the EMEP/EEA 2023). Since 2011 data are available from the national database "2-Air" and figures are reported.

4.2.7.2 Trends in emissions

Emissions from 2A5c sector are reflected in Table 4.16.

Table 4.16 Emissions from storage, handling and transport of mineral products in 1990-2022

	Unit	1990	1995	2000	2005	2010	2011	2015	2020	2021	2022	Change in 2011-2022, %
$PM_{2.5}$	kt	IE	IE	IE	IE	IE	0.028	0.005	0.001	0.002	0.002	***-92.4***
PM_{10}		IE	IE	IE	IE	IE	0.039	0.035	0.009	0.011	0.011	***-72.6***
TSP		IE	IE	IE	IE	IE	0.068	0.044	0.019	0.021	0.020	***-70.1***

From 1990 till 2010 particulate matter emissions from 2A5c sector are included under 2A1, 2A2 and 2A3 sectors (IE). Since 2011 the data regarding storage, handling and transport of mineral products in case of cement production is available from the national database "2-Air". Particulate matter emissions cannot be accounted under 2A1 sector hence they are reported under 2A5c sector.

Emitted particulate matter amounts in 2A5c sector are very low (Figure 4.7). In 2015, there is a large decrease in emissions because in 2014 there were more plants and warehouses that caused emissions from storage, handling and transport, but from 2015 onwards, these sites have closed. In 2022, a large reduction in emissions is observed compared to 2011, because the total amount of storage and transportation has decreased. Compared to 2021, in 2022 $PM_{2.5}$ emissions are increased because of the increase of storage emissions.

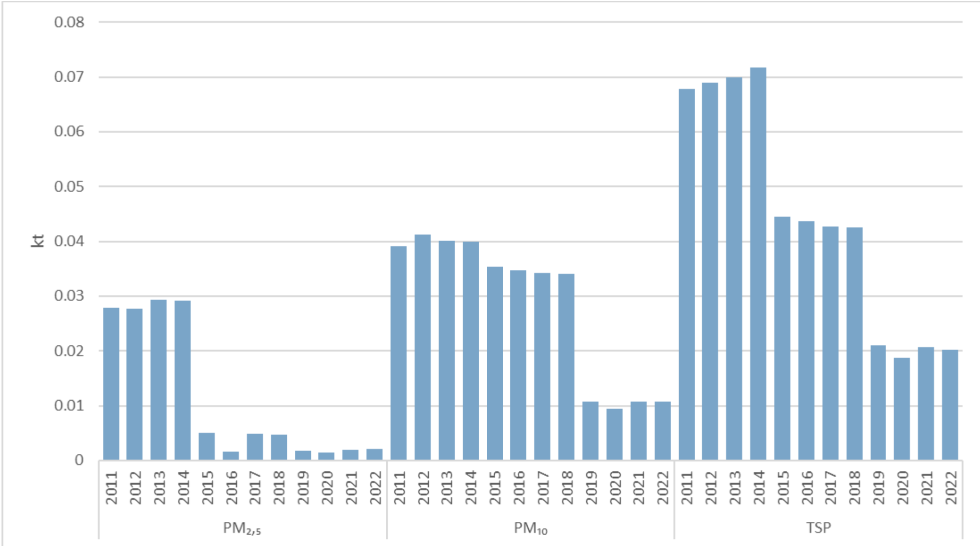

Figure 4.7 PM emissions from storage, handling and transport of mineral products 2011-2022, kt

4.2.7.3 Methods

In 1990-2010 Tier 1 approach from EMEP/EEA 2023 was used to estimate particulate matter emissions from storage, handling and transport of mineral products which assumes all emissions from this source to be included in the sectorial chapters (notation key 'IE'). Since 2011 mineral storage, handling and transport emission data is available from the national database "2-Air" so starting from 2011 Tier 3 approach has been used.

4.2.7.4 Emission factors

In the Tier 1 default approach according to EMEP/EEA 2023, the particulate matter emissions from storage, handling and transport of mineral products are included in the Tier 1 approaches in the respective mineral chapters and no emission factors are used. Since 2011 data is available from the national database "2-Air", so no emission factors are used.

4.2.7.5 Activity data

1990-2010 emissions are assumed as included under respective mineral chapters (cement, lime and glass production) and IE has been reported in NFR. Since 2011 data from the national database "2-Air" on storage, handling and transport of minerals are reported under 2A5c category.

4.2.7.6 Uncertainties

Uncertainty for activity data and emissions is assumed 50%.

4.2.7.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes by comparing calculation data base with input data in NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based on final completed NFR data table.

4.2.7.8 Recalculations

No recalculations were carried out.

4.2.7.9 Planned improvements

No improvements are planned for the next submission.

4.3 Chemical industry (NFR 2B)

Although there are strong traditions of the chemical industry in Latvia, no chemical industry production processes listed in 2006 IPCC Guidelines and EMEP/EEA 2023 Guidebook were identified.

The biggest part of chemical industry is medicine production and smaller part - paint and varnishes production. Also based on the available information, plastics recycling in Latvia primarily involves mechanical recovery processes that result in the formation of plastic granules and flakes.

All available data and emissions from chemical and pharmaceutical production are reported and described under sector 2D3g - Chemical products.

Therefore, in Latvia there are no emissions from Chemical industry.

4.4 Metal production (NFR 2C)

4.4.1 Overview

Under Metal production sector only air emissions from Iron and steel production (NFR 2C1) are estimated and reported. There are no emissions from the rest of Metal production sectors described in EMEP/EEA 2023.

In Latvia from 1990-2015 only one company produced steel. It used open-heart furnaces (OHF) from 1990 till 2010 and electric arc furnaces (EAF) from 1990 till 2015 in their steel production processes. In 2016 steel production in Latvia was stopped as the only metal producing plant ceased to produce steel.

4.4.2 Trends in emissions

Under 2C1 sector NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, total PAHs, PCBs emissions from Iron and steel production were reported from 1990 till 2015. Since 2016 emissions in this category are not occurring (NO) (Table 4.17).

Table 4.17 Emissions from Metal production in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	0.0037	0.0019	0.0030	0.0036	0.0029	0.0016	NO	NO	NO	***-100***	***-100***
NMVOC		0.0112	0.0057	0.0101	0.0112	0.0107	0.0006	NO	NO	NO	***-100***	***-100***
SO_2		0.0873	0.0443	0.0797	0.0881	0.0855	0.0007	NO	NO	NO	***-100***	***-100***
$PM_{2.5}$		0.3260	0.1655	0.2979	0.3292	0.3205	0.0003	NO	NO	NO	***-100***	***-100***
PM_{10}		0.4346	0.2207	0.3972	0.4389	0.4274	0.0003	NO	NO	NO	***-100***	***-100***
TSP		0.5433	0.2759	0.4965	0.5486	0.5342	0.0004	NO	NO	NO	***-100***	***-100***
BC		0.0078	0.0040	0.0071	0.0079	0.0077	0.000001	NO	NO	NO	***-100***	***-100***
CO		0.0123	0.0064	0.0071	0.0105	0.0025	0.0212	NO	NO	NO	***-100***	***-100***
Pb	t	162.940	82.733	148.940	164.557	160.253	0.0324	NO	NO	NO	***-100***	***-100***
Cd		0.436	0.221	0.398	0.440	0.428	0.0025	NO	NO	NO	***-100***	***-100***
Hg		0.00035	0.00018	0.00019	0.00029	0.00006	0.00062	NO	NO	NO	***-100***	***-100***
As		16.292	8.272	14.893	16.454	16.025	0.0002	NO	NO	NO	***-100***	***-100***
Cr		1.250	0.635	1.142	1.262	1.229	0.0012	NO	NO	NO	***-100***	***-100***
Cu		0.163	0.083	0.149	0.165	0.160	0.0002	NO	NO	NO	***-100***	***-100***
Ni		5.436	2.760	4.967	5.489	5.342	0.0087	NO	NO	NO	***-100***	***-100***
Zn		4.424	2.246	4.035	4.464	4.331	0.0449	NO	NO	NO	***-100***	***-100***
PCDD/F	g i-Teq	0.057	0.029	0.045	0.054	0.039	0.0374	NO	NO	NO	***-100***	***-100***
PAHs	t	0.009	0.004	0.007	0.008	0.006	0.0060	NO	NO	NO	***-100***	***-100***
PCBs	kg	0.000017	0.000009	0.000010	0.000015	0.000003	0.000031	NO	NO	NO	***-100***	***-100***

One of the biggest decreases in emissions occurred in 1990-1992 due to the crisis in Latvia's national economy. The crisis in late 1990s was caused by the economic crisis in Russian Federation and it reflected in decrease of demand for products from Metal Production sector. Also, final amount of steel products produced in the only metal plant decreased in latest years. From 1995 emissions were increasing due to increase in metal production.

Till 2009 the situation was quite stable when all producing sectors were affected by the economic crisis.

In 2011 compared to 2010 remarkable decrease (by 69%) of crude steel production emissions can be observed due to changes in technology used in Metal production plant when steel production process was stopped after a semester. The plant switched their technology from OHF to EAF. In 2011 Metal production plant went under reconstruction as a result all crude steel was produced in EAF since then.

In 2012 after plant reconstruction particulate matter emissions decreased by 94.6% and BC emissions decreased by 99.2% compared to 1990. At the same time NO_x, CO, NMVOC and POPs emissions increased significantly compared to the base year. Heavy metal emissions in 2012 compared to 1990 decreased by 81% on average.

In 2013 metal plant operated for 5-7 months, therefore there is noticeable decrease of produced steel amount and related emissions. Comparing emissions with the base year all emissions were decreased, except PCDD/PCDF, PAHs and PCBs which were additionally calculated since IIR Submission 2016. PCBs emissions are applicable only for EAF technology. PCDD/ PCDF and PAHs emissions have increased significantly because these emissions are calculated with quite higher EFs that are applicable for EAF technology.

In 2014 only 0.09 kt crude steel was produced from scrap metal because production was almost stopped. In 2015 the metal production company begun to produce steel again therefore emissions appeared again, however in 2016 steel production in Latvia was stopped as the only metal producing plant ceased to produce steel and there are no air emissions from 2C1 sector anymore.

4.4.3 Methods

Tier 2 method from EMEP/CORINAIR 2007 (1990-2010) and EMEP/EEA 2023 (since 2011) was used to calculate emissions from steel production.

4.4.4 Emission factors

Emission factors for NO_x, CO and SO_2 emissions are taken from EMEP/CORINAIR 2007 for 1990-2010 because EFs are not available in EMEP/EEA 2023 for OHF technology. Particulate matter and heavy metal EFs are taken from EMEP/EEA 2023. According to methodology for estimations of emissions from processes in OHF, where 95% of total steel production is produced, EFs for 1990-2010 taken from EMEP/EEA 2023 are applicable. After 2011 all crude steel was produced in EAF and EFs applicable to this production technology are taken from EMEP/EEA 2023. According to EMEP/EEA 2023, the TSP, PM_{10} and $PM_{2.5}$ emission factor represents only filterable PM emissions.

Table 4.18 Emission factors for Iron and Steel production

	Unit	1990-2010	1990-2015
NO_x	g/Mg	5.1	130
NMVOC		20	46
SO_2		160	60
$PM_{2.5}$		600	21
PM_{10}		800	24
TSP		1000	30
BC	% of $PM_{2.5}$	2.4	0.36
CO	g/Mg	1	1700
Pb	g/Mg	300	2.6
Cd		0.8	0.2
Hg		0.05	0.05
As		30	0.015
Cr		2.3	0.1
Cu		0.3	0.02

	Unit	1990-2010	1990-2015
Ni		10	0.7
Zn		0.81	3.6
PCDD/F	µg I-TEQ/Mg steel	0.067	3
Total 4 PAHs	g/Mg	0.01	0.48
PCB	mg/Mg	NA	2.5

4.4.5 Activity data

Activity data was taken from the CSB and metal plant`s GHG report under EU ETS[18] (Figure 4.8).

Activity data on production and output by manufacturing companies is freely available until 1999. CSB gives only restricted information on production and output of goods since 1999, the information is classified as confidential. LEGMC has signed an agreement with CSB to receive data about total production of products from sectors whose data is confidential. Still as industrial producers are participants in the EU ETS the GHG reports of these enterprises have to be freely available.

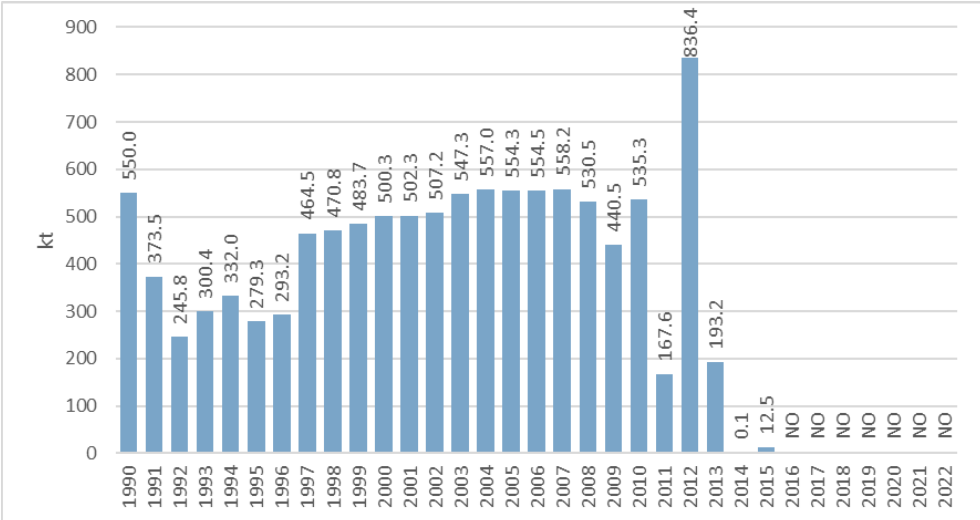

Figure 4.8 Steel production activity data in 1990-2022, kt

After going through a crisis in 2008-2009, there was an increase in all emissions from Metal production in 2010. Rapid decrease of emissions in 2011 can be observed due to change of technology in metal production. Since mid-2011 the OHF is not used anymore in this company. At the end of 2010 installation was dismantled and new one was set up. In 2011 plant was working for 4 months. All crude steel was produced from crude iron and scrap metal in EAF. In 2011-2013 all crude steel was produced in EAF and plant was not operating a full year but only for 4-7 month in these years. In 2012 a rapid increase of produced crude steel can be observed as new technology was implemented, but production plant operated for 7 months with full capacity. In 2014 steel production plant worked only one day for experimental reasons and produced only 0.093 kt steel. In 2015 the metal production company begun to produce steel again therefore emissions appeared and increased again. In 2016 steel production was ceased in the country and no metal production emissions are reported anymore.

4.4.6 Uncertainties

The uncertainty of activity data for this sector is assumed as 5%. The activity data reported in iron and steel production plant's annual GHG report within EU ETS is verified by accredited verifiers and Latvia's Regional Environmental Boards so the activity data is adequately verified.

[18] *https://registri.vvd.gov.lv/izsniegtas-atlaujas-un-licences/atlauju-un-licencu-mekletajs/?company_name=liep%C4%81jas+metalurgs&company_code=&s=1*

Uncertainty of emission factors taken from EMEP/EEA 2023 methodologies is assigned as 20% so it is appropriate for OHF and EAF in iron and steel industry in Latvia.

4.4.7 QA/QC and verification

Assessments of trends were performed. Data was checked on input mistakes by comparing calculation data base with input data from NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based on final completed NFR data table.

4.4.8 Recalculations

No recalculations were carried out.

4.4.9 Planned improvements

No improvements are planned for the next submission.

4.5 Other solvent and product use (NFR 2D-2L)

4.5.1 Source category description

4.5.1.1 Overview

Other solvent and product use sector includes indirect emissions from:

- 2D3a Domestic solvent use including fungicides;
- 2D3b Road paving with asphalt;
- 2D3c Asphalt roofing;
- 2D3d Coating applications;
- 2D3e Degreasing;
- 2D3f Dry cleaning;
- 2D3g Chemical products;
- 2D3h Printing;
- 2D3i Other solvent and product use;
- 2G Other product use (tobacco, fireworks);
- 2H1 Pulp and paper industry;
- 2H2 Food and beverages industry.
- 2I Wood processing

4.5.1.2 Trends in emissions

Table 4.19 Emissions from Other solvent and product use in 1990-2022

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NMVOC	kt	13.063	10.637	10.433	9.331	11.321	14.046	15.774	12.727	***-2.6***	***22.0***
SO_2		0.073	0.001	0.001	0.000	0.000	0.000	0.000	0.004	***-94.8***	***279.5***
$PM_{2.5}$		0.077	0.213	0.475	0.394	0.679	0.584	0.769	0.651	***740.3***	***36.9***
PM_{10}		0.161	1.218	3.239	2.617	4.769	3.946	5.328	4.515	***2703.2***	***39.4***
TSP		0.514	5.463	14.912	12.007	22.043	18.150	24.585	20.836	***3956.9***	***39.7***
BC		0.001	0.009	0.024	0.019	0.036	0.029	0.040	0.034	***3260.9***	***39.6***
CO		0.131	0.119	0.099	0.101	0.094	0.129	0.129	0.115	***-12.6***	***16.6***
Pb	t	0.006	0.165	0.260	0.110	0.106	0.100	0.061	0.985	***15890.5***	***279.5***
Cd		0.013	0.012	0.010	0.010	0.009	0.013	0.013	0.012	***-6.2***	***23.3***
Hg		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	***15885.4***	***278.9***
As		1.04E-05	2.79E-04	4.40E-04	1.87E-04	1.81E-04	1.69E-04	1.04E-04	1.67E-03	***15967.4***	***279.8***
Cr		0.000	0.003	0.005	0.002	0.002	0.002	0.001	0.020	***15834.8***	***279.8***
Cu		0.016	0.105	0.156	0.072	0.069	0.069	0.047	0.568	***3363.8***	***263.4***
Ni		0.007	0.012	0.015	0.009	0.009	0.010	0.009	0.043	***541.8***	***193.2***
Zn		0.008	0.060	0.091	0.041	0.040	0.039	0.027	0.332	***3819.7***	***266.0***

	Unit	1990	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
PCDD/F	g i-Teq	0.00024	0.00021	0.00017	0.00018	0.00017	0.00023	0.00023	0.00019	***-20.5***	***9.8***
PAHs	t	0.00011	0.00	0.00	0.00	0.00	0.00010	0.00010	0.00009	***-20.5***	***9.8***

Other solvent and product use sector in 2022 covered 36.1% (11.45kt) from the total Latvia's NMVOC emissions.

In Solvent use the fluctuation of NMVOC emissions in the period 1990-2022 has mostly occurred due to the welfare of the economic state of the country. A slight decrease in emissions occurred between years 1990 and 2006. From 2006 until 2008 the economy began to grow, when the world was struck by the economic crisis which also affected the Solvent Use sector in Latvia. During the later period of 2010 till 2022 NMVOC emissions were fluctuating.

The emissions from Asphalt roofing and Road paving with asphalt sectors are increasing since the beginning of 1990s. Slight emission decrease in 1999-2000 can be explained with used bitumen percentage division changes for road paving with asphalt and asphalt roofing.

Since Latvia is EU member state from 2004, financial resources from EU projects are available for national infrastructure projects which strongly influences the activities in road paving and building sector.

In 2004 a new highway "Via Baltica", which connects the capitals of all Baltic States, was constructed. This led to rapid emission increase in 2003-2004 that can be explained with availability of funding from EU which was the main reason why the road paving activity increased before and afterwards. In the next years road paving activities decreased, but not to the level before 2004.

4.5.2 Road paving with asphalt and Asphalt roofing (NFR 2D3b, 2D3c)

4.5.2.1 Overview

In this sector NMVOC, particulate matter, BC and CO emissions from construction materials production as well as road paving activities are reported.

According to CSB information, the biggest part of NMVOC and other emissions occurs during road paving with asphalt. Just a small part of all bitumen mixtures is used in asphalt roofing sector.

4.5.2.2 Trends in emissions

Table 4.20 Emissions from Asphalt roofing and Road paving in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NMVOC	kt	0.0015	0.0045	0.0116	0.0319	0.0257	0.0472	0.0388	0.0527	0.0446	***2849.6***	***39.8***
$PM_{2.5}$	kt	0.0393	0.0131	0.1559	0.4287	0.3449	0.6344	0.5217	0.7073	0.5994	***1425.0***	***39.8***
PM_{10}	kt	0.0967	0.2901	1.1608	3.1921	2.5679	4.7238	3.8841	5.2660	4.4633	***4514.6***	***39.8***
TSP	kt	0.4493	1.3477	5.4057	14.8656	11.9584	21.9982	18.0879	24.5234	20.7852	***4526.3***	***39.8***
BC	kt	0.0007	0.0021	0.0087	0.0239	0.0192	0.0354	0.0291	0.0394	0.0334	***4598.6***	***39.8***
CO	kt	0.0001	0.0002	0.0004	0.0011	0.0009	0.0016	0.0013	0.0018	0.0015	***1988.4***	***39.8***

The emissions from these two particular sectors are constantly increasing since the beginning of 1990s.

In 2004, compared to 2003, emissions were increased because Latvia joined to the EU in 2004 and EU funding became available and also the new highway "Via Baltica" was built. And in 2005 emissions were decreased because "Via Baltica" was finished.

The main factor, which influences the road paving activities, is availability of funding for road construction. In 2022, emissions from road paving and asphalt roofing decreased by 15.2% compared to 2021 due to decreased amount of used asphalt and increased by 39.8% compared to 2005.

4.5.2.3 Methods

EMEP/EEA 2023 Tier 1 approach was used to estimate NMVOC emissions from the 2D3c. Asphalt roofing and 2D3b Road Paving with Asphalt. According to CSB the biggest part of bitumen mixtures amount is used for road paving. Only a small part is used for roofing activities.

NMVOC emissions are estimated using simpler default methodology:

$$E_{NMVOC} = AD_{bitumen} \times EF_{NMVOC}$$

where:

E_{NMVOC} – NMVOC emissions (kt)
$AD_{bitumen}$ – bitumen and bitumen mixtures used in 2D3b and 2D3c activities (kt)
EF_{NMVOC} – NMVOC emission factor (kt/kt)

4.5.2.4 Emission factors

Default CO and NMVOC, as well as particulate matter and BC emission factors are taken from EMEP/EEA 2023. Due to lack of information about the technology Tier 1 EFs was implemented (Table 4.21). According to EMEP/EEA 2023 Tier 1, TSP, PM_{10} and $PM_{2.5}$ emission factor represents only filterable PM emissions.

Table 4.21 Emission factors for asphalt roofing and road paving

	CO	NMVOC	$PM_{2.5}$	PM_{10}	TSP	BC
	kt/kt	kt/kt	kt/kt	kt/kt	kt/kt	% of $PM_{2.5}$
Asphalt Roofing	0.0000095	0.00013	0.00008	0.0004	0.0016	0.013
Road Paving with Asphalt	NE	0.000016	0.0004	0.003	0.014	5.7

4.5.2.5 Activity data

The activity data to calculate NMVOC emissions from road paving and asphalt roofing is taken from the CSB (Table 4.22). The amount of bitumen mixtures was used as activity data. According to the CSB the bitumen mixtures include:

- Asphalt bitumen that usually consists of 60% or more of bitumen and solvent. Used for highway paving;
- Emulsion – or a solid asphalt, bitumen, pitch, tar suspensions in water that are used especially in highway paving;
- Asphalt mastic and other bitumen resins, and similar bituminous mixtures that include minerals such as sand or asbestos;
- Products that are sintered in blocks and that are repeatedly melted before use.

According to information provided by CSB the biggest part of bitumen mixtures is used for road paving. According to 2006 IPCC Guidelines typically 80-90% of bitumen is used for road paving materials[19]. Before the beginning of 1990s Latvia was part of former USSR and was going through the economic transition phase, so it was assumed that 80% was used for road paving and remaining was used for asphalt roofing till 2000. After 2000 it is assumed that 90% was used for road paving.

Table 4.22 Activity data for road paving with asphalt and asphalt roofing production

	Amount of bitumen mixtures used, kt	% of asphalt used for road paving	% of asphalt used for roofing	Road paving with asphalt, kt	Asphalt roofing, kt
1990	39.00	80%	20%	31.20	7.80
1991	12.60	80%	20%	10.08	2.52
1992	2.10	80%	20%	1.68	0.42
1993	58.93	80%	20%	47.14	11.79
1994	125.63	80%	20%	100.50	25.13
1995	116.99	80%	20%	93.59	23.40

[19] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_5_Ch5_Non_Energy_Products.pdf (page 5.14)

	Amount of bitumen mixtures used, kt	% of asphalt used for road paving	% of asphalt used for roofing	Road paving with asphalt, kt	Asphalt roofing, kt
1996	214.81	80%	20%	171.85	42.96
1997	225.00	80%	20%	180.00	45.00
1998	225.53	80%	20%	180.43	45.11
1999	334.81	80%	20%	267.85	66.96
2000	423.64	90%	10%	381.28	42.36
2001	495.70	90%	10%	446.13	49.57
2002	558.42	90%	10%	502.58	55.84
2003	625.67	90%	10%	563.11	62.57
2004	3651.96	90%	10%	3286.76	365.20
2005	1165.02	90%	10%	1048.51	116.50
2006	1116.70	90%	10%	1005.03	111.67
2007	1492.52	90%	10%	1343.27	149.25
2008	1536.66	90%	10%	1382.99	153.67
2009	838.45	90%	10%	754.60	83.84
2010	937.18	90%	10%	843.46	93.72
2011	1481.48	90%	10%	1333.33	148.15
2012	1584.97	90%	10%	1426.48	158.50
2013	1255.14	90%	10%	1129.62	125.51
2014	1289.97	90%	10%	1160.97	129.00
2015	1724.00	90%	10%	1551.60	172.40
2016	1681.00	90%	10%	1512.90	168.10
2017	1317.00	90%	10%	1185.30	131.70
2018	1263.00	90%	10%	1136.70	126.30
2019	1254.82	90%	10%	1129.34	125.48
2020	1417.54	90%	10%	1275.79	141.75
2021	1921.90	90%	10%	1729.71	192.19
2022	1628.93	90%	10%	1466.04	162.89

Amount of materials used and emissions produced in this sector are strictly dependant on funding and activity in road construction and building.

4.5.2.6 Uncertainties

Uncertainty of activity data for emission estimation from 2D3c Asphalt roofing sector and 2D3b Road Paving with Asphalt sector is assumed rather low as CSB data of used bitumen mixtures is used and the percentage of IPCC 2006 Guidelines is used to divide bitumen use for roofing and paving activities. As it is not clear how much of the total bitumen is used for asphalt paving and for asphalt roofing (bitumen use in construction sector) the uncertainty is assumed at least 20%.

The emission factors for 2D3c and 2D3b sectors are assumed 70% because default emission factors are used. The uncertainty EFs are taken from EMEP/EEA 2023 and Tier 1 EFs is assumed 50% because default EFs are used.

4.5.2.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes by comparing calculation data base with input data from NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made based of final completed NFR data table.

4.5.2.8 Recalculations

No recalculations were carried out.

4.5.2.9 Planned improvements

No improvements are planned for the next submission.

4.5.3 Solvent use (NFR 2D3a, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h, 2D3i)

4.5.3.1 Overview

Solvent Use sector in 2022 covered over 36.1% (11.40 kt kt) from the total Latvia's NMVOC emissions. From Solvent use sector the main share of total NMVOC emissions contributed Paint application – 39.43% or 4.49 kt and Other solvent use – 27.77 % or 3.16 kt (Figure 4.9).

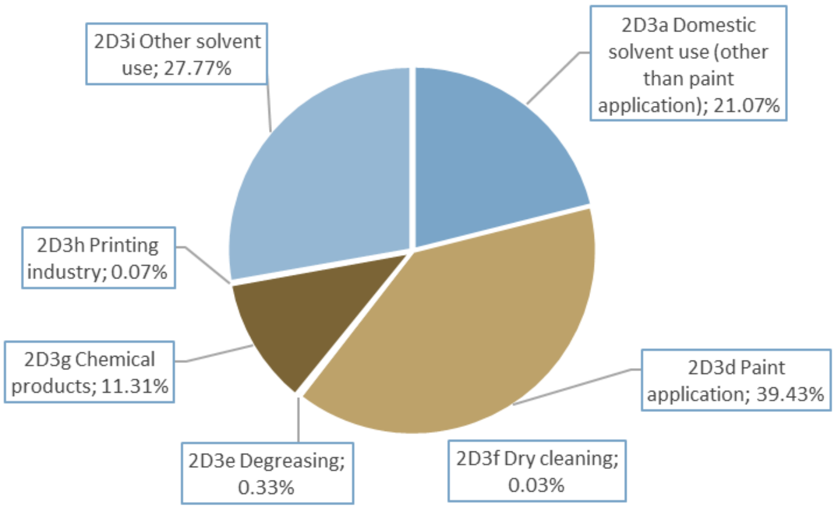

Figure 4.9 Distribution of NMVOC emissions in Solvent use sector in 2022, kt

Domestic solvent use including fungicides (NFR 2D3a) comprises NMVOC emissions from a number of product categories, for instance, cosmetics & toiletries, household products, construction and car care products. This subsector includes also Hg emissions from fluorescent tubes.

Coating applications (NFR 2D3d) includes paints and varnishes from *Decorative coating application* (paints for architectural application by construction enterprises and professional painters as well as by private consumers), *Industrial coating application* (paint application for manufacture automobiles, car repairing, coil coating, boat building, wood as well as other industrial paint applications) and *Other coating applications.*

Degreasing (NFR 2D3e) includes cleaning products from water-insoluble substances such as grease, fats, oils waxes and tars.

Dry Cleaning (NFR 2D3f) includes emissions from clothes and other textiles dry cleaning.

Chemical products (NFR 2D3g) sector covers NMVOC emissions from the use of chemical products considering many activities such as polyurethane and polystyrene foam processing, organic chemical industry, manufacture of paints, inks and glues, fat edible and non-edible oil extraction and industrial application of adhesives.

Printing (NFR 2D3h) involved the use of inks, cleaning solvents and organic dampeners.

Other solvent use (NFR 2D3i) includes emissions from application of underseal treatment and conservation of vehicles, glues and adhesives, preservation of wood, aircraft de-icing and other solvent use.

To divide the NMVOC containing products by NFR subsectors EMEP/EEA 2023 was used.

4.5.3.2 Trends in emissions

Solvent Use sector in 2022 covered 36.1% (11.40 kt) from the total Latvia's NMVOC emissions. Since 1990, NMVOC emissions have increased in the solvent sector by 19.55%. Categories where increase in NMVOC emissions has occurred in recent years include Domestic solvent use (other than paint application) (2D3a) and Other solvent use (2D3i). The fluctuation of NMVOC emissions in the period 1990-2022 has mostly occurred due to the welfare of the economic state of the country. The slightly decrease in emissions occurred between years 1990 and 2006. From 2006 the economy began to grow until 2008, when the world was struck by the economic crisis which also affected the Solvent Use sector in Latvia. As a result, by the year 2009, NMVOC emissions decrease by 35.05% in comparison with 2007. As shown, there is increase of NMVOC emissions during the later period of 2010 till 2022. In 2022 NMVOC emissions increased by 40.93% in comparison with 2005. In 2022 NMVOC emissions of Solvent sector have decreased by 10.39% in comparison with 2020 (Table 4.23). The sharp rise in NMVOC emissions observed in 2018 can be traced back to a single company's substantial importation of cleaning solvents. Conversely, the increase in emissions recorded in 2021 can be attributed to companies significantly escalating their imports, leading to the magnification of activity data augmentation.

Related to the PAHs emissions under 2D3g Chemical products (subsector Asphalt blowing) emissions are not estimated because in Latvia asphalt blowing is not occurring.

Table 4.23 NMVOC emissions from Solvent use in 1990-2022, kt

	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
Domestic solvent use including fungicides (NMVOC)	1.89	1.77	1.68	1.59	1.03	1.82	3.34	3.28	2.40	***0.27***	***0.51***
Domestic solvent use including fungicides (Hg)	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	***-0.30***	***-0.19***
Coating applications (NMVOC)	5.09	4.77	4.54	4.29	4.51	3.90	4.09	4.56	4.49	***-0.12***	***0.05***
Degreasing (NMVOC)	0.04	0.03	0.03	0.03	0.03	0.04	0.05	0.03	0.04	***0.06***	***0.26***
Dry cleaning (NMVOC)	0.02	0.02	0.02	0.02	0.01	0.01	0.004	0.004	0.003	***-0.87***	***-0.85***
Chemical products (NMVOC)	1.32	1.24	1.18	1.12	1.23	1.54	1.44	1.44	1.29	***-0.03***	***0.16***
Printing (NMVOC)	0.12	0.11	0.10	0.10	0.01	0.01	0.01	0.01	0.01	***-0.93***	***-0.92***
Other solvent use (NMVOC)	1.05	0.98	0.94	0.94	1.11	2.61	3.80	5.08	3.16	***2.01***	***2.38***

In Latvia Regulation of the Cabinet of Ministers of 3 April 2007 No.231 "Regulations Regarding the Limitation of Emissions of Volatile Organic Compounds From Certain Products" contains legal norms arising from Directive 2004/42/EC. According to this Regulation, I stage of the Directive came into force in 2007 and II stage – in 2010. Meanwhile Regulation of the Cabinet of Ministers of 2 April 2013 No. 186 "Procedure for Limiting Emissions of Volatile Organic Compounds From Equipment Using Organic Solvents" contains legal norms arising from Directive 2010/75/EU.

Although Latvia has adopted these Directives into its legislation, it is difficult to estimate effect on the decrease in NMVOC emissions due the economic growth after the entry into force of stage II of Directive 2004/42/EC in 2010.

4.5.3.3 Methods

NMVOC emissions from Domestic solvent use including fungicides (2D3a), Coating applications (2D3d) and Other solvent use (2D3i) were estimated according to EMEP/EEA 2023 methodology based on Tier 1 or Tier 2 approach (Table 4.24).

NMVOC emissions (kt) from these subcategories of Solvent Use sector were calculated for the time series 2006-2022 using the equation below:

$$E_{NMVOC} = EF_{NMVOC} \times AD$$

where:

E_{NMVOC} – non-methane volatile organic compounds emissions from solvents and other production use (kt);
EF_{NMVOC} – emission factor from *EMEP/EEA 2023*;

NMVOC emissions data from Degreasing (2D3e), Dry cleaning (2D3f), Chemical products (2D3g) and Printing (2D3h) subsectors was obtained directly from the national database "2-Air" for 2006-2022. From the 1990ties till 2001 statistics for NMVOC emissions data was not kept. The "2-Air" is a database where enterprises (that have any pollution activity and have category A, B, or C polluting activity) report their emissions data. There are 788 licences currently in force in Latvia (Category A – 40 licences, category B – 748 licences). From these enterprises data is used only from the enterprises that produced NMVOC emissions according to the EMEP/EEA 2023. The enterprises have been reporting their produced NMVOC emissions dividing in a particular NMVOC.

NMVOC emissions from Aircraft De-icing (2D3i) for time series consistency, surrogate statistical parameter data is used to calculate activity data for the period 2004-2014 and calculated according to the EMEP/EEA 2023.

$$Y_0 = Y_t \times (\frac{S_0}{S_t})$$

where:

y = the emission estimate in years 0 and t
s = the surrogate statistical parameter in years 0 and t

To calculate the surrogate statistical parameter for activity data. Data on the number of departing airplanes in months, from which the average number of departing airplanes per day is calculated is obtained from the CSB. In order to calculate the approximate number of days when aircraft de-icing could be used, data on the weather conditions in which aircraft de-icing is usually carried out in the winter months is obtained from the LEGMC weather database. The calculations of State Joint Stock Company "Riga International Airport" take into account that, on average, only 7% of departing planes are de-iced under certain weather conditions.

According to EMEP/EEA 2023 Hg emissions are not estimated under 2D3a Domestic solvent use including fungicides. In any case Hg emissions according to EMEP/EEA 2016 (Tier 1, EF is 5.6 mg/person) are negligible, in 2022 – 0.0105 t respectively.

4.5.3.4 Emission factors

The NMVOC emission factors (Table 4.24) for Domestic solvent use including fungicides (2D3a), Paint application (2D3d) and Other solvent use (2D3i) are taken from the EMEP/EEA 2023.

Table 4.24 Approaches and emission factors for Solvent Use sector

NFR	Tier	EF	Unit	Subsector
2D3a	2a	0.83	t/t solvent	Cosmetics and toiletries (all)
	2a	0.65	t/t solvent	Household products (all)
	2a	0.95	t/t solvent	Household products (soaps: liquid or paste, polishes and creams for floors, show polishes and creams)
	2a	0.95	t/t solvent	DIY/buildings (all), Adhesives, Paint/varnish removers and solvents
	2a	0.975	t/t solvent	DIY/buildings (sealants, filling agents)
	2a	0.94	t/t solvent	Car care products (all)
	2a	0.5	t/t solvent	Car care products (antifreeze agents in windscreen wiper systems)
	2a	0.865	t/t solvent	Pesticides

NFR	Tier	EF	Unit	Subsector
	2a	0.6	t/t product	Domestic use of pharmaceutical products
2D3d	2	0.23	t/t paint applied	Paint application: construction and buildings
	2	0.23	t/t paint applied	Paint application: domestic use
	1	0.4	t/t paint applied	Coating applications: manufacture of automobiles
	2	0.72	t/t paint applied	Paint application: car repairing
	2	0.48	t/t paint applied	Paint application: coil coating
	1	0.4	t/t paint applied	Coating applications: Boat building
	2	0.8	t/t paint applied	Paint application: wood
	1	0.4	t/t paint applied	Coating applications: Other industrial paint application
	2	0.74	t/t paint applied	Other non industrial paint application
2D3i	2	0.25	t/t solvent	Glass Wool Enduction
	1	0.002	t/t product used	Fat, edible and non-edible oil extraction
	2	0.562	t/t solvent	Application of glues and adhesives
	2	0.945	t/t preservative (organic solvent-borne preservative)	Preservation of wood (Organic solvent-borne preservative)
	2	0.005	t/t preservative (waterborne preservative)	Preservation of wood (Water-borne preservative)
	2	0.342	t/t product	Other solvent and product use
	2	0.053	t/t product	Aircraft De-icing

4.5.3.5 Activity data

From the 1990ties till 2005 statistics for Domestic solvent use including fungicides (2D3a), Coating From the 1990ties till 2005 statistics for Domestic solvent use including fungicides (2D3a), Coating applications (2D3d) and Other solvent use (2D3i) were not well kept due to the country-wide changes in the governmental system and the national economy. For 2006-2018 activity data for these subcategories was obtained from the Register of Chemical Substances and Chemical Mixtures (CR) at LEGMC. In the CR data of imported and produced amount of chemical products containing NMVOCs is collected together with the percentage of a particular NMVOC in imported or produced products. It is assumed that the NMVOC containing products imported in the country in a particular year are utilized in the same year as the data of the actual use is not available or is confidential. In the CR information on a particular year, amount of produced and imported chemicals (ton), product group (intended use), trade name, chemical name, CAS number and concentration (from … till … %) is provided.

In 2018 for the first time an estimation of exported NMVOC containing products from the country for the period 2006-2017 was carried out. Activity data on export of solvent products for the years 2006-2017 was provided by CSB. The results of estimation of exported NMVOC containing products are presented in Table 4.25. As shown NMVOC emissions have decreased for all time series between 14.6% in 2013 and 30.65% in 2005.

Share of export as percentage, calculated on NMVOC emissions for the year 2018-2022 were extrapolated taking into account GDP taken from CSB database.

Table 4.25 Share of export as percentage, calculated on NMVOC emissions

	Share of export as percentage, calculated from NMVOC emissions, %	Without export, kt	With export, kt
2006	23.86	10.95	8.05
2007	21.31	11.86	8.80
2008	28.44	10.04	6.93
2009	26.89	8.10	5.75
2010	19.17	10.09	7.93
2011	13.77	11.20	9.34
2012	14.65	10.79	8.89
2013	14.6	11.24	9.26
2014	15.19	11.74	9.58
2015	15.77	12.29	9.94

	Share of export as percentage, calculated from NMVOC emissions, %	Without export, kt	With export, kt
2016	18.03	11.86	9.34
2017	19.61	12.90	9.98
2018	21.08	20.11	14.47
2019	22.27	15.88	11.65
2020	21.45	16.19	12.73
2021	24.24	19.02	14.42
2022	28.25	15.88	11.41

To obtain a comparable data in time series for 1990-2005 where statistics were not well kept NMVOC emissions were extrapolated considering the number of inhabitants taken from database provided by CSB (Table 4.26).

Table 4.26 The number of population used as activity data under Other solvent and product use for years 1990-2005

	Number of inhabitants
1990	2668140
1991	2658161
1992	2643000
1993	2585675
1994	2540904
1995	2500580
1996	2469531
1997	2444912
1998	2420789
1999	2399248
2000	2377383
2001	2353384
2002	2320956
2003	2299390
2004	2276520
2005	2249724

Activity data from Degreasing (2D3e), Dry cleaning (2D3f), Chemical products (2D3g) and Printing (2D3h) subsectors is not available as that data is not required to be reported under national legislation and could be assumed as confidential.

EMEP/EEA 2023 Tier 2 method is used to estimate NMVOC emissions from the Aircraft de-icing. Activity data on the Aircraft de-icing from companies are available since 2015, and is obtained from National Chemicals Database at LEGMC, but for time series consistency, surrogate statistical parameter data is used. Activity data from the Aircraft de-icing prior to 2004 is not available.

4.5.3.6 Uncertainties

Latvia has developed a detailed inventory for the Solvent Use sector thereby the uncertainty of activity data is estimated to be the default value of 25% according to the 2006 IPCC Guidelines. Emission factor uncertainty is assumed to be ± 20% according to EMEP/EEA 2023, 2.D Other solvent and product use. Time series consistency was ensured by using one method for all time series.

4.5.3.7 QA/QC and verification

QA/QC check is performed with Tier1 method from EMEP/EEA 2023, 2.D Other solvent and product use.

All estimations of the emissions done in the LEGMC also are checked for logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Quality control check list is filled for each category considering criteria given in QA/QC plan approved in the national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived in centralized archiving system (common FTP folder).

4.5.3.8 Recalculations

In order to obtain more qualitative emission data each year activity data for latest submitted year (in this case year 2021) was reviewed and recalculated if it is necessary.

Table 4.27 Recalculated NMVOC emissions for the year 2021, kt

Sector	Emissions before recalculation, kt	Emissions after recalculation, kt	Relative difference, %
2D3a	3.73	3.28	- 11.89
2D3d	4.30	4.56	5.90
2D3e	0.03	0.03	0.33
2D3f	0.004	0.004	0.33
2D3g	1.44	1.44	0.33
2D3h	0.01	0.01	0.33
2D3i	4.92	5.08	3.25

The 2023 NECD review revealed, in accordance with the EMEP/EEA 2023 guidelines, that Latvia does not need to apply a correction factor in the calculation of NMVOC emissions for the 2.D.3.a. Domestic solvent use, including fungicides sub-category. Consequently, a recalculation has been executed for sector 2.D.3.a.

Table 4.28 Results of recalculations NMVOC emission in 2.D.3.a Domestic solvent use including fungicides 1990-2021

Year	Emissions on sub-category 2D3a with the correction factor	Emissions on sub-category 2D3a without the correction factor	Absolute difference kt	Relative difference, %
1990	*2.32*	*1.89*	*-0.44*	*- 18.84*
1995	*2.18*	*1.77*	*-0.41*	*- 18.84*
2000	*2.07*	*1.68*	*-0.39*	*- 18.84*
2005	*1.96*	*1.59*	*-0.37*	*- 18.84*
2006	*1.54*	*1.25*	*-0.29*	*- 18.84*
2007	*2.79*	*2.26*	*-0.53*	*- 18.84*
2008	*1.45*	*1.18*	*-0.27*	*- 18.84*
2009	*0.93*	*0.76*	*-0.18*	*- 18.84*
2010	*1.27*	*1.03*	*-0.24*	*- 18.84*
2011	*1.74*	*1.41*	*-0.33*	*- 18.84*
2012	*1.73*	*1.41*	*-0.33*	*- 18.84*
2013	*1.83*	*1.49*	*-0.35*	*- 18.84*
2014	*2.04*	*1.66*	*-0.38*	*- 18.84*
2015	*2.24*	*1.82*	*-0.42*	*- 18.84*
2016	*2.07*	*1.68*	*-0.39*	*- 18.84*
2017	*2.14*	*1.74*	*-0.40*	*- 18.84*
2018	*7.52*	*6.10*	*-1.42*	*- 18.84*
2019	*3.79*	*3.08*	*-0.71*	*- 18.84*
2020	*4.12*	*2.34*	*-0.78*	*- 18.84*
2021	*3.73*	*3.28*	*0.44*	*-11.89*

4.5.3.9 Planned improvements

No improvements are planned.

4.5.4 Other product use (NFR 2G)

4.5.4.1 Overview

Other Product Use sub-sector includes emissions from Use of fireworks and Tobacco combustion. This sub-sector contains SO_2, CO, NMVOC, NH_3, NO_x, TSP, BC, PM_{10}, $PM_{2.5}$, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, PCDD/PCDF, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, indeno (1,2,3-cd) pyrene emissions.

4.5.4.2 Trends in emissions

The emissions from Other product use subsector have constantly decreased since the beginning of 90ties although emissions from Use of fireworks have increased. Emissions of heavy metals mostly occur from Use of fireworks and their increase in the latest years is linked with the economic situation of the country (Table 4.29).

Table 4.29 Emissions from Other product use sector in 1990-2022

	Unit	1990	2000	2005	2010	2015	2019	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	0.0043	0.0039	0.0032	0.0033	0.0030	0.0073	0.0041	0.0037	***-12.9***	***17.1***
NMVOC		0.0115	0.0103	0.0083	0.0087	0.0081	0.0194	0.0111	0.0092	***-20.5***	***9.8***
SO_2		0.00002	0.0006	0.0010	0.0004	0.0004	0.0005	0.0002	0.0038	***15898.5***	***279.5***
NH_3		0.0099	0.0088	0.0072	0.0075	0.0069	0.0166	0.0095	0.0079	***-20.5***	***9.8***
$PM_{2.5}$		0.0643	0.0573	0.0466	0.0487	0.0450	0.1081	0.0619	0.0512	***-20.4***	***9.9***
PM_{10}		0.0643	0.0573	0.0466	0.0487	0.0450	0.1082	0.0619	0.0513	***-20.3***	***10.0***
TSP		0.0643	0.0573	0.0466	0.0487	0.0450	0.1082	0.0619	0.0513	***-20.3***	***10.0***
BC		0.0003	0.0003	0.0002	0.0002	0.0002	0.0005	0.0003	0.0002	***-20.4***	***9.9***
CO		0.1313	0.1185	0.0974	0.1003	0.0927	0.2219	0.1269	0.1134	***-13.7***	***16.4***
Pb	t	0.0062	0.1646	0.2595	0.1102	0.1065	0.1324	0.0614	0.9850	***15898.5***	***279.5***
Cd		0.0129	0.0118	0.0098	0.0099	0.0092	0.0219	0.0125	0.0121	***-6.1***	***23.3***
Hg		4.5E-07	1.2E-05	1.9E-05	8.0E-06	7.7E-06	0.0000	0.0000	0.0001	***15898.5***	***279.5***
As		0.0000	0.0003	0.0004	0.0002	0.0002	0.0002	0.0001	0.0017	***15898.5***	***279.5***
Cr		0.0001	0.0033	0.0052	0.0022	0.0021	0.0026	0.0012	0.0196	***15898.5***	***279.5***
Cu		0.0164	0.1047	0.1563	0.0722	0.0693	0.0966	0.0471	0.5681	***3373.8***	***263.4***
Ni		0.0067	0.0120	0.0146	0.0091	0.0086	0.0159	0.0085	0.0428	***541.9***	***193.4***
Zn		0.0085	0.0603	0.0907	0.0414	0.0398	0.0547	0.0265	0.3318	***3814.8***	***265.7***
PCDD/F	g I-Teq	0.0002	0.0002	0.0002	0.0002	0.0002	0.0004	0.0002	0.0002	***-20.5***	***9.8***
PAH	t	0.0006	0.0005	0.0004	0.0004	0.0004	0.0010	0.0006	0.0005	***-20.5***	***9.8***

4.5.4.3 Methods

Emissions from Use of fireworks and Tobacco combustion were calculated according to EMEP/EEA 2023 methodology and based on Tier 2 approach.

Emissions (kt) from Use of fireworks sector were calculated for the time series 1995-2022 and from Tobacco combustion for the time series 2003-2022 using the equation below:

$$E = EF \times AD$$

where:

E – emissions from Use of fireworks and Tobacco combustion (kt);
EF – emission factor from EMEP/EEA 2023;
AD – activity data from the CSB, (kt).

4.5.4.4 Emission factors

All emission factors for Use of fireworks and Tobacco combustion are taken from the EMEP/EEA 2023.

4.5.4.5 Activity data

From the 1990ties till 1994 statistics for Use of fireworks and from 1990 till 2002 statistics for Tobacco combustion were not well kept due to the country-wide changes in the governmental system and national economy. For 1995-2022 the quantity of used fireworks (CN code 3604) and for 1995-2022 tobacco combusted (CN code 2402) in Latvia is estimated by the import and export data available from database provided by the CSB. Data regarding production of fireworks and tobacco is not available.

To obtain a comparable data for Use of fireworks in time series for 1990-1994 and for Tobacco combustion in time series for 1990-2002 where statistics were not in sufficient quality, emissions were calculated using the same methodology as for the years 1995-2022 and 2003-2022, respectively. Assuming that base year for NMVOC emissions for Use of fireworks is 1995 and for Tobacco combustion - 2003, emissions for years where statistics were not well kept were calculated proportionally, taking into account the number of inhabitants provided by the CSB (Table 4.26).

4.5.4.6 Uncertainties

Emission factor uncertainty is assumed to be ± 20% according to EMEP/EEA 2023, 2.D Other solvent and product use. Time series consistency was ensured by using one method for all time series.

4.5.4.7 QA/QC and verification

All estimations of the emissions done in the LEGMC are checked for logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogical changes in the activity data and emissions.

Quality control check list is filled for each category taking into account criteria given in QA/QC plan approved in the national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived in centralized archiving system (common FTP folder).

4.5.4.8 Recalculations

No recalculations were carried out.

4.5.4.9 Planned improvements

No improvements are planned.

4.5.5 Pulp and paper industry and Food and beverages industry (NFR 2H1, 2H2)

4.5.5.1 Overview

Other Production sub-sector includes indirect emissions from:

- Pulp and Paper industry (2H1);
- Food and drink industry (2H2).

Under NFR 2H1 category SO_2 emissions are reported 1990-1996 and under NFR 2H2 NMVOC emissions are reported 1990-2022.

According to information from CSB currently there are no companies producing pulp or paper in processes described in the EMEP/EEA 2023 that should belong to category 2H1. No data in available in production statistics regarding pulp and paper produced in Latvia, therefore, since 1997 emissions from pulp and paper are not occurring (NO).

4.5.5.2 Trends in emissions

Table 4.30 Emissions from Pulp and paper industry (NFR 2H1) and Food and beverages industry (NFR 2H2) production sectors in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NMVOC	kt	3.38	1.89	2.00	2.19	1.37	1.33	1.27	1.29	1.27	***-62.5***	***-42.1***
SO_2		0.07	0.003	NO	NO	NO	NO	NO	NO	NO	***-100.0***	***-100.0***

Decrease of NMVOC emissions in 1999-2001 can be explained with economic crisis. In 2002-2004 NMVOC emissions were stable. NMVOC emissions decreased by 29.3% in 2006-2007, that could be explained with a decrease (by 35.5%) of produced spirits. Emissions in 2008-2009 decreased by 6.0%, which can be explained with the crisis in national economy that affected food and drink production industry because of decrease in purchasing capacity due to lower salaries, increased taxes etc. After the crisis, in 2010 it increased for about 5.1%. In 2022, NMVOC emissions constitute 1.27 kt which is 2.0% lower than in 2021 because of lower amount of bread and animal forage. In 2022, NMVOC emissions have decreased by 42.1% compared to 2005.

Emissions from margarine and solid cooking fats and animal rendering are included in the category - Meet, fish, poultry – based on the national statistical database.

Emission from handling of agricultural products is considered negligible based on EF from EMEP/EEA 2019 Guidelines (Table 3.10) and raw calculation therefore NE is used.

In Food and beverages industry of EMEP/EEA 2023 Guidelines it is recommended to use the product-based default emission factors and in Table 4.31 is seen which product-based activities have been calculated and which activities are included elsewhere.

Table 4.31 Product-based activities of EMEP/EEA 2023 Guidelines

Product–based activities	Calculated	Included elsewhere
Bread (typical)	X	
Sponge-dough		X (under Bread (typical))
White bread		X (under Bread (typical))
White bread (shortened process)		X (under Bread (typical))
Wholemeal bread		X (under Bread (typical))
Light Rye bread		X (under Bread (typical))
Cakes, biscuits and breakfast cereals	X	
Meat, fish and poultry	X	
Sugar	X	
Margarine and solid cooking fats		X (under Meat, fish and poultry)
Animal feed	X	
Coffee roasting	X	
Wine	X	
Red Wine		X (under Wine)
White wine		X (under Wine)
Beer	X	
Spirits	X	
Malt Whiskey		X (under Spirits)
Grain whiskey		X (under Spirits)
Brandy		X (under Spirits)
Other spirits		X (under Spirits)

SO_2 emissions are reported in 1990-1996 when there was a pulp and paper industry in the country. In 1996 pulp and paper facility was closed.

4.5.5.3 Methods

Tier 1 method from EMEP/EEA 2023 was used to calculate emissions from Pulp and paper industry and Tier 2 to calculate emissions from Food and beverages industry.

4.5.5.4 Emission factors

NMVOC emission factors (Table 4.32) are taken from the EMEP/EEA 2023. NMVOC emission factor for spirits production corresponds to "other spirits". CSB provided aggregated statistical data where it can be seen that 95.5% of all spirits produced in Latvia are produced from grains (sheer alcohol or spirits) and no brandy and whiskey is produced in Latvia. Hence EF for "other spirits" 0.4 kg/hl (alcohol) is used.

Table 4.32 Emission factors for food and beverages and pulp and paper industries

Production	Emission factors
Food and beverages industry (NMVOC)	
Wine	0.08 kg/hl
Beer	0.035 kg/hl
Spirits	0.4 kg/hl
Meet, fish, poultry	0.3 kg/t
Sugar	10 kg/t
Cakes, biscuits, breakfast cereals	1 kg/t
Bread	8 kg/t
Animal feed	1 kg/t
Coffee roasting	0.55 kg/t
Pulp and paper industry (SO_2)	
Pulp and paper	0.002 kt/kt

4.5.5.5 Activity data

Activity data for calculation of the NMVOC emissions from the Food and beverages industry is obtained from the CSB. Activity data of pulp and paper industry were also taken from CSB (Table 4.33). Since 2007 data for the category – wine production, was classified as confidential and not publicly available. That's why for this category 2006 year's data was used also for years 2007-2022. The same situation with spirits since 2012.

Table 4.33 Activity data for 2H sector

	Pulp and Paper	Wine	Beer	Spirits	Meat, fish, poultry	Sugar	Cakes, biscuits, breakfast cereals	Bread	Animal feed	Coffee roasting
	kt	1000 hl	1000 hl	1000 hl	kt	kt	kt	kt	kt	kt
1990	36.6	19.9	87.4	324.5	569.3	31	54.8	314	200	NO
1991	44.7	197.5	1295.3	330	490.4	35	39.2	293	200	NO
1992	30.8	179.8	858.9	259.3	281.6	39	22.1	240	200	NO
1993	4.7	87.7	545.9	217.4	154	26	15.8	177.4	245.4	NO
1994	0.2	134.2	637.9	314.8	95.6	15.8	22.7	161.5	174	NO
1995	1.5	159.2	652.8	341.5	82.8	29.3	24.4	145.4	214.4	NO
1996	1.5	154.7	644.9	379.6	100.5	31.2	13.1	137.1	206.2	NO
1997	NO	114.7	714.8	456.4	129.1	41.2	16.9	132.1	205	NO
1998	NO	99.6	721	417.4	110.9	64.9	18.1	124.8	203.3	NO
1999	NO	65.9	953.2	416	166.9	66.5	20.8	121.5	144.5	NO
2000	NO	68.9	945.1	269.5	197.3	62.8	24.3	121.1	173.8	NO
2001	NO	52.5	996.6	168.5	244.6	56	24.4	123.1	184.9	NO
2002	NO	56.8	1199.2	237.9	262.9	76.8	29	122.6	201.3	NO
2003	NO	45.9	1336.6	226.6	264.4	74.9	37.3	124	201.4	NO
2004	NO	59.7	1313.1	238.8	262.5	67	43.6	119.3	211.8	NO
2005	NO	73.4	1293.3	308.2	243.8	71.1	53.6	116.3	248.6	NO
2006	NO	77.1	1383	360.6	288.4	59.9	45	107.3	244.2	NO
2007	NO	C	1414.3	232.5	286	NO	46.5	102.3	336.8	NO
2008	NO	C	1333.8	220.7	297.7	NO	38.5	100.7	307.3	NO

	Pulp and Paper	Wine	Beer	Spirits	Meat, fish, poultry	Sugar	Cakes, biscuits, breakfast cereals	Bread	Animal feed	Coffee roasting
2009	NO	C	1292.4	180.1	253.5	NO	33.3	95.9	299.3	NO
2010	NO	C	1484.9	177.7	242.2	NO	37.5	89.9	405.8	NO
2011	NO	C	1626.6	166.5	261.5	NO	39.7	88.6	360.9	NO
2012	NO	C	1488.5	C	264.3	NO	44.5	91.4	348.2	NO
2013	NO	C	1513.7	C	286.2	NO	56.4	88.1	380.1	1.8
2014	NO	C	967.5	C	270.7	NO	50.4	84.9	379.5	2.1
2015	NO	C	887.8	C	260.4	NO	51.8	86.9	396.8	2.0
2016	NO	C	760.8	C	234.9	NO	58.4	82.9	389.7	2.2
2017	NO	C	845.9	C	235.7	NO	61.3	80.7	415.3	2.4
2018	NO	C	821.1	C	253.4	NO	75.1	78.6	424.1	2.2
2019	NO	C	779.1	C	249.3	NO	84.6	75.9	442.4	2.0
2020	NO	C	747.3	C	259.6	NO	91.9	72.7	420.4	1.6
2021	NO	C	770.6	C	260.6	NO	114.1	58.6	532.7	1.5
2022	NO	C	853.7	C	272.9	NO	256.1	50.3	423.8	1.5

4.5.5.6 Uncertainties

Uncertainty of activity data was assumed as ±2% for 1990-2006 because statistical data from the CSB was used. For 2007-2022 the uncertainty is assumed higher – 10%, as no precise information is available for wine production. NMVOC emission factors were assigned as 50% because default emission factors taken from EMEP/EEA 2023 were used.

4.5.5.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes to comparing calculation data base with input data in NFR tables in all time series. All figures and tables represented in IIR Submission 2024 are made on basis of final completed NFR data table.

4.5.5.8 Recalculations

No recalculations were carried out.

4.5.5.9 Planned improvements

No improvements are planned.

4.5.6 Wood processing (NFR 2I)

NOx, NMVOC, SOx, NH_3 and CO emissions from fuel combustion in 2I Wood processing are included under 1.A.2 Manufacturing Industries and Construction to prevent double counting therefore notation key "IE" is used.

TSP emissions of wood processing are negligible based on EF from EMEP/EEA 2023 Guidelines (Table 3.1) and the raw estimation therefore notation key "NE" is used. Also notation key "NE" will be used because of lack of robust data for all time series.

5 Agriculture (NFR 3)

5.1 Overview of sector

5.1.1 Source category description

In Agriculture sector emissions from following subsectors are calculated for:

• Manure management (NFR 3B), which includes cattle, sheep, goats, horses, swine, poultry and fur animals;
• Agricultural soils (NFR 3D), which includes inorganic N-fertilizers, animal manure, sewage sludge and other organic fertilizers application, urine and dung deposition by grazing animals, farm-level agricultural operations, crop cultivation and use of pesticides;
• Other (NFR 3I), which include emissions from last year's grass burning (Table 5.1).

Table 5.1 Source categories and methods for agriculture sector

NFR code	Longname	Method	EF	AD
3B1a	Manure management - Dairy cattle	Tier 1, 2	D[20], CS[21]	NS[22]
3B1b	Manure management - Non-dairy cattle	Tier 1, 2	D, CS	NS
3B2	Manure management - Sheep	Tier 1, 2	D, CS	NS
3B3	Manure management - Swine	Tier 1, 2	D, CS	NS
3B4a	Manure management - Buffalo		NO	
3B4d	Manure management - Goats	Tier 1, 2	D, CS	NS
3B4e	Manure management - Horses	Tier 1, 2	D, CS	NS
3B4f	Manure management - Mules and asses		NO	
3B4gi	Manure management - Laying hens	Tier 1, 2	D, CS	NS
3B4gii	Manure management - Broilers	Tier 1, 2	D, CS	NS
3B4giii	Manure management - Turkeys	Tier 1, 2	D, CS	NS
3B4giv	Manure management - Other poultry (Ducks, Geese and other)	Tier 1, 2	D, CS	NS
3B4h	Manure management - Other animals (Fur animals)	Tier 1, 2	D, CS	NS
3Da1	Inorganic N-fertilizers (includes also urea application)	Tier 2	D, CS	NS
3Da2a	Animal manure applied to soils	Tier 1, 2	D, CS	NS
3Da2b	Sewage sludge applied to soils	Tier 1	D	NS
3Da2c	Other organic fertilizers applied to soils (including compost, digestate and other)	Tier 1	D	NS
3Da3	Urine and dung deposited by grazing animals	Tier 1, 2	D, CS	NS
3Da4	Crop residues applied to soils		NA	
3Db	Indirect emissions from managed soils		NA	
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	Tier 1, 2	D	NS
3Dd	Off-farm storage, handling and transport of bulk agricultural products		NA	
3De	Cultivated crops	Tier 1	D	NS
3Df	Use of pesticides		Tier 1	
3F	Field burning of agricultural residues		NO	
3I	Agriculture other	Tier 1	D	NS

NO_x (nitrous oxides), NMVOC (volatile organic compounds), NH_3 (ammonia), PM (particulate matter), TSP (total suspended particulate matter), BC (black carbon), CO (carbon monoxide), DIOX (dioxins), PAH (polycyclic aromatic hydrocarbons) and HCB (hexachlorobenzene) emissions from agriculture sector are included in the IIR Submission 2024 (Table 5.2).

[20] Default value from EMEP/EEA 2019 or 2006 IPCC Guidelines
[21] Country specific value
[22] National statistics

Table 5.2 Reported emissions in agriculture sector in 2022

NFR code	Emissions
3B1a	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B1b	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B2	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B3	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B4d	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B4e	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B4gi	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B4gii	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B4giii	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B4giv	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3B4h	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP
3Da1	NO_x, NH_3
3Da2a	NO_X, NH_3
3Da2b	NOX, NH_3
3Da2c	NO_X, NH_3
3Da3	NO_x, NH_3
3Dc	$PM_{2.5}$, PM_{10}, TSP
3De	NMVOC
3Df	HCB
3I	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, PCDD/PCDF, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, total PAHs

5.1.2 Key sources

The Agriculture sector was responsible for the largest part of total NH_3 emissions (99.3%) in 2022. The remaining part originated from transport, combustion in power plants and from households, as well as from wastewater treatment. NO_x emission share of agriculture is 15.3%, but for NMVOC emissions – 19.6%.

NH_3 emissions in Agriculture sector are divided into emissions from crop production and agricultural soils, as well as emissions from manure management and other sources. In 2022, emissions from crop production and agricultural soils constituted 53.54% (6.81 kt), including emissions from inorganic N-fertilizers, animal manure and other organic fertilizers which were applied to soils, urine and dung from grazing animals. The share of NH_3 emissions from manure management in 2022 were 46.44% (5.90 kt). 96.31% (4.38 kt) of NOx emissions were reported from crop production and agricultural soils and 3.39% of emissions were linked to manure management.

In 2022, the largest part of NMVOC emissions were related to manure management – 71.55% (4.70kt). Crop production and agricultural soils accounted for 27.91% (1.83 kt) of NMVOC. 62.00% (0.17 kt) of $PM_{2.5}$, 89.48% (2.92 kt) of PM_{10} and 62.84% (2.03 kt) of TSP emissions originated from crop production and agricultural soils, while 32.51% (0.09 kt) of $PM_{2.5}$, 9.96% (0.33 kt) of PM_{10} and 36.30% (1.17 kt) of TSP were related to manure management (Figure 5.1).

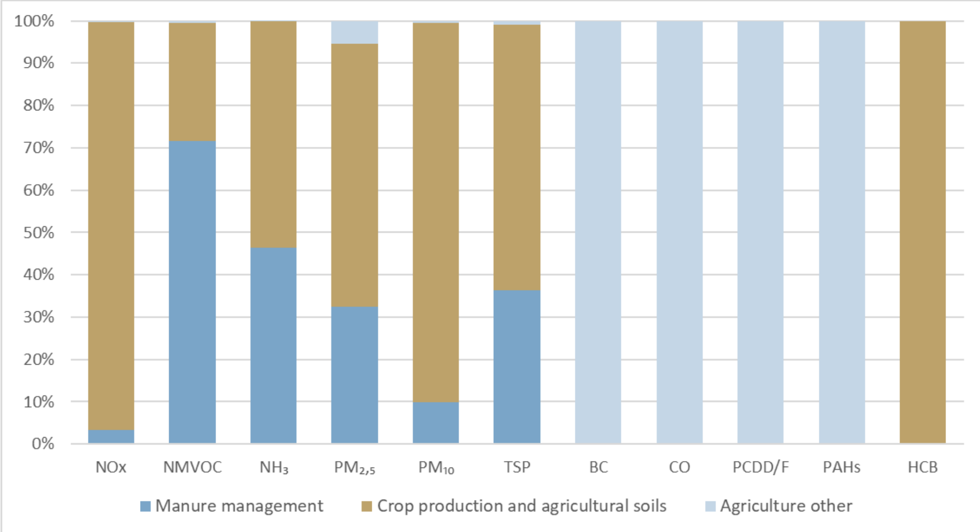

Figure 5.1 Distribution of emissions in Agriculture sector by subsectors in 2022, %

5.1.3 Trends in emissions

The NH_3 emissions from Agriculture have decreased by 59.5% over the period of 1990-2022 (Table 5.3). The general reason for this is transition to a market economy during 1991-1995, when the number of livestock in farms the use of nitrogen fertilizers significantly decreased. There is an increase of NH_3 emissions by 6.9% in 2022 compared to 2005. That is mostly due to increased consumption of mineral N fertilizers. Inorganic N fertilizer NH_3 emissions increased by 163.4% in 2022 compared to 2005. An increase of NH_3 emissions from non-dairy cattle, sheep, laying hens, broilers manure management and urine and dung deposited by grazing animals is associated with increase of livestock number in 2022 compared to 2005. NH_3 emissions from dairy cattle, swine, goats, horses, turkeys, other poultry, fur animals manure management and animal manure, sewage sludge decreased in 2022 compared to 2005. That is because of change in activity data and NH_3 abatement measures put in place (coverage of slurry storages, manure management practices during application to the soil). Decrease of NH_3 emissions in these positions does not offset increase. NH_3 emissions from Agriculture are approximately similarly distributed between the manure management and soil management sub-sectors, however, in recent years there has been a slight decrease of emissions from manure management and an increase from agricultural soils (Figure 5.2).

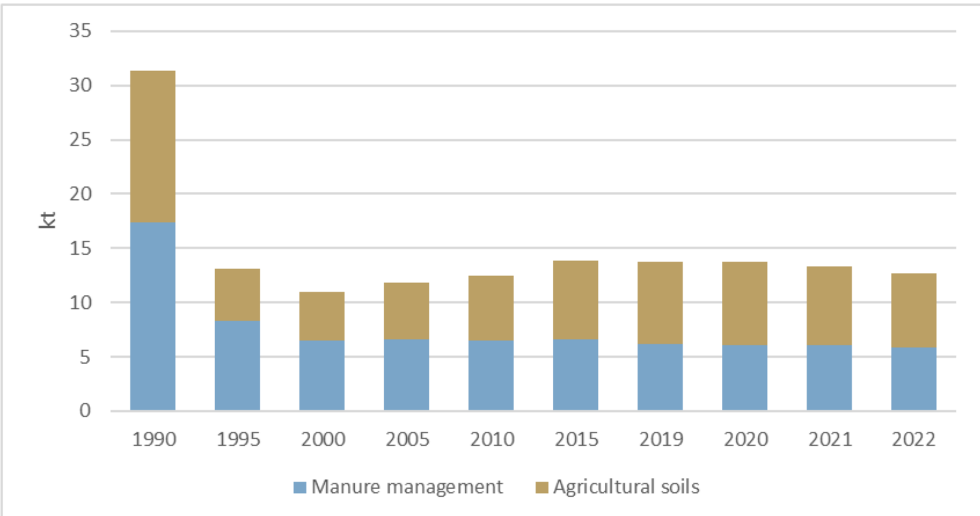

Figure 5.2 NH_3 emissions from agriculture sub-sectors 1990-2022, kt

Table 5.3 Emissions from Agriculture sector in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Changes in 1990-2022, %*	*Changes in 2005-2022, %*
NO_x	kt	9.27	2.28	2.28	3.01	3.73	4.51	4.70	4.71	4.55	***-51.0***	***51.2***
NMVOC		19.46	9.30	7.25	7.46	7.23	7.54	7.04	6.88	6.57	***-66.3***	***-12.0***
NH_3		31.40	13.15	10.99	11.89	12.48	13.85	13.72	13.36	12.71	***-59.5***	***6.9***
$PM_{2.5}$		0.46	0.24	0.22	0.23	0.25	0.29	0.27	0.31	0.27	***-41.1***	***17.4***
PM_{10}		3.54	2.00	1.91	2.11	2.47	2.92	3.23	3.35	3.26	***-7.8***	***54.4***
TSP		5.69	2.80	2.45	2.67	2.90	2.96	3.20	3.34	3.23	***-43.2***	***21.0***
BC		0.001	0.001	0.003	0.003	0.003	0.004	0.001	0.005	0.001	***90.9***	***-47.7***
CO		0.21	0.20	0.84	0.76	0.93	1.21	0.35	1.42	0.40	***90.9***	***-47.7***
PCDD/ PCDF	g i-Teq	0.004	0.004	0.018	0.016	0.019	0.025	0.007	0.030	0.008	***90.9***	***-47.7***
PAHs	t	0.01	0.01	0.06	0.05	0.06	0.08	0.02	0.10	0.03	***90.9***	***-47.7***
HCB	kg	5.46	0.00	0.00	0.01	0.06	0.16	0.20	0.20	0.20	***-96.3***	***3243.6***

The amount of PM, NMVOC and NO_x emissions depend on the number of produced animals and crops. In the time period 1990-2022, PM emissions have decreased by 7-43%, but increased by 17-54% in the time period 2005-2022. Similarly, emissions of NO_x and NMVOC have decreased by 51.0% and 66.3%, respectively (Table 5.3). NOx emissions increased in the time period 2005-2022 by 51.2% but NMVOC decreased by 12.0%.

Emissions from grassland burning were determined according to EMEP/EEA 2019 and 2006 IPCC Guidelines. In Latvia grassland burning takes place seasonally and emission amount depends on the burned area. Prohibition to burn grass and crop residues on fields has been defined as good agricultural and environmental condition under cross-compliance framework and has been respectively penalized in respect to beneficiaries of direct payment schemes and rural development area-related payments of the programming periods 2007-2013 and 2014-2020 and transitional period 2021-2022.

The area of grassland burning was taken from the State Fire and Rescue Service Republic of Latvia (SFRS). Under this system, SFRS sends reports on the recorded cases to the Rural Support Service who applies sanctions to the beneficiaries, such requirement under standards of good agricultural and environmental condition and respective sanctions will be continued onwards.

5.2 Manure management (NFR 3B)

5.2.1 Overview

In the NFR category 3B NO_x, NMVOC and NH_3 emissions from manure management are included. In 2022, the majority of NH_3 emissions from manure management in different livestock categories were related to production of the dairy cattle (57.56%), swine (14.81%), non–dairy cattle (9.89%), laying hens (5.88%) and broilers (5.30%) (Figure 5.3).

TSP, PM_{10} and $PM_{2.5}$ emissions include primary particles in the form of dust from housing. The main sources of PM emissions are livestock feeding and buildings of housing livestock. These emissions originate mainly from animal feed, bedding materials, feathers and manure. PM emissions arises from free-range animals, but EMEP/EEA 2023 methodology has focused on housed animals.

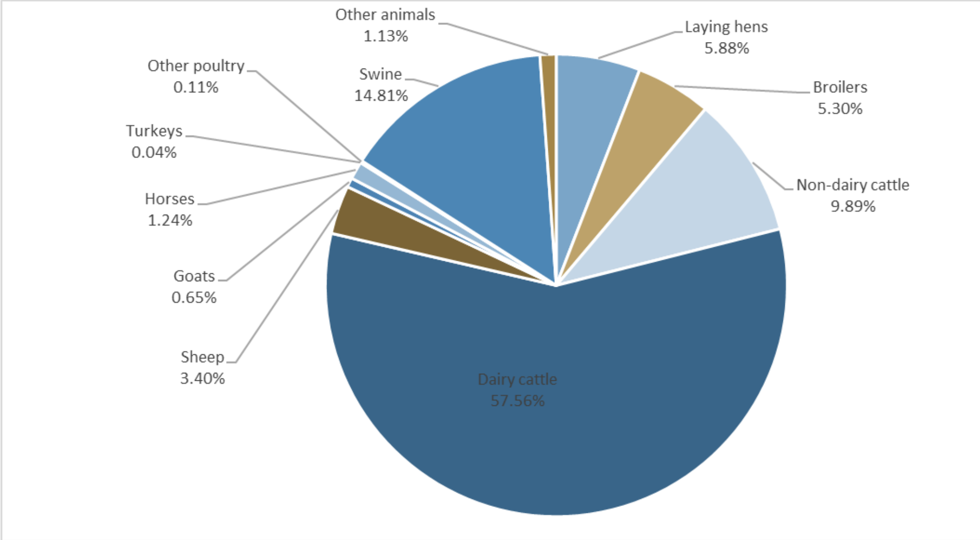

Figure 5.3 NH_3 emissions from manure management in 2022

5.2.2 Trends in emissions

Latvian livestock industry has been influenced by historical events and the changes in economic situation[23]. As seen in Table 5.4, emissions from manure management have noticeably decreased since the beginning of the 90`s after the collapse of the Soviet Union and the restoration of independence of the Republic of Latvia. Significant changes in the livestock industry began in 1992 when most of the big farms went into liquidation. However, after Latvia joined the EU in 2004 it was possible to observe a slight increase of livestock numbers and related emissions. The NH_3 emissions from manure management have decreased by 66.0%, NO_x – 79.8%, NMVOC – 68.3%, $PM_{2.5}$ – 71.2%, PM_{10} – 63.7%, TSP – 62.6% over the period of 1990-2022 (Table 5.4). In the time period 2005 – 2022 NH_3 emissions decreased from manure management by 11.0%, NO_x – 38.6%, NMVOC – 13.0%, $PM_{2.5}$ – 14.4%, but increased PM_{10} and TSP emissions by 3.5% and 10.8% respectively. Change in NH_3 emissions from manure management associated with change in activity data and implemented abatement measures (coverage of slurry storages).

Table 5.4 Trends in emissions from Manure management in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Changes in 1990-2022, %*	*Changes in 2005-2022, %*
NO_x	kt	0.76	0.36	0.27	0.25	0.23	0.20	0.17	0.16	0.15	***-79.8***	***-38.6***
NMVOC	kt	14.82	7.04	5.30	5.40	5.23	5.50	4.97	4.89	4.70	***-68.3***	***-13.0***
NH_3	kt	17.35	8.32	6.46	6.63	6.53	6.65	6.03	6.04	5.90	***-66.0***	***-11.0***
$PM_{2.5}$	kt	0.31	0.15	0.10	0.10	0.10	0.10	0.09	0.09	0.09	***-71.2***	***-14.4***
PM_{10}	kt	0.90	0.40	0.30	0.31	0.32	0.31	0.33	0.33	0.33	***-63.7***	***3.5***
TSP	kt	3.14	1.34	1.01	1.06	1.11	1.05	1.19	1.20	1.17	***-62.6***	***10.8***

Predominant part of PM emissions is related to cattle, swine and poultry. Since 1990 the PM emission trend depends on changes in the number of livestock due to significant changes in livestock industry (Figure 5.4).

[23] Aina Dobele, Irina Pilvere, Edgars Ozols, Lasma Dobele Land Resources for Agricultural Production In Latvia. http://www.westeastinstitute.com/journals/wp-content/uploads/2013/02/ZG12-261-Aina-and-Lasma-Full-Paper_formatted-Land-Resources-For-Agricultural-Production-In-Latvia.pdf

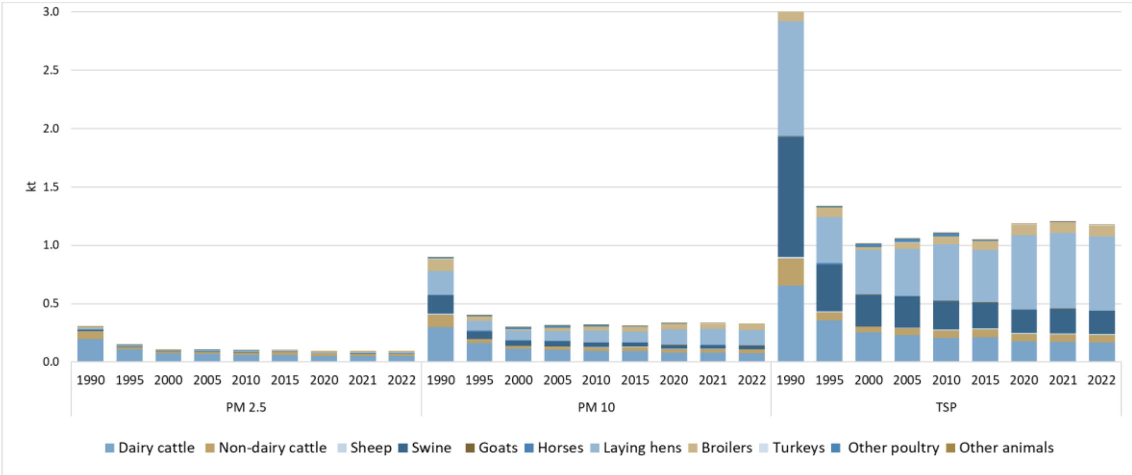

Figure 5.4 PM emissions from housing 1990-2022

In 2022, majority of PM emissions from manure management in different livestock categories were related to cattle, laying hens and broilers. The biggest contributors for $PM_{2.5}$ emissions were dairy cattle – 56.77% (0.05 kt), non-dairy cattle – 21.97% (0.02 kt) and laying hens 11.41% (0.01 kt). The biggest contributors for PM_{10} emissions were laying hens – 41.13% (0.13 kt), dairy cattle – 23.57% (0.08 kt) and broilers – 14.46% (0.05 kt). Laying hens – 54.13% (0.64 kt), swine – 16.83% (0.20 kt) and dairy cattle – 14.31% (0.17 kt) constituted the major fraction of TSP emissions.

All emissions related to manure management were strongly related to the livestock numbers. At the end of 2022, agricultural holdings were breeding 127.8 thousand dairy cows, which were by 3.4 thousand lesser than the year before, according to the information CSB[24]. The number of non-dairy cattle increased by 1.3 thousand. Overall swine number decreased over the year 2022: the numbers of fattening pigs decreased by 10.2 thousand or 7.0%, sows, boars' number did not change, but number of pigs in age below 4 months decreased by 6.9 thousand or 4.4%. In 2022, the poultry number stopped to grow and decreased by 113.4 thousand or 2.0%. The layer number decreased by 1.5%. The number of fur animals considerably decreased by 65.1 thousand or 52.3% compared to 2021.

Manure management of cattle emission trend shows that the share of slurry-based systems increases. Small farms use predominantly solid manure management systems, while large farms mostly use liquid/slurry management systems. The share of pasture tends to decrease for dairy cattle, however, for other all cattle categories the share of pasture shows small changes in the time series. Trends in manure management of swine show significant increase of the manure share for slurry-based system and manure use for biogas production in the time period 1990-2018. In the time period 2019-2022 there is a small variation in these parameters for swine.

5.2.3 Methods

Emissions calculations are based on EMEP/EEA 2023. Estimation is based on Tier 2 (mass flow approach) for NH_3 and NOx emissions. Calculations were done using MS Excel. Due to the N-flow calculation process, NH_3 emission estimates were obtained from manure management systems from housing and storage (reported in 3B Manure management), on field application and grazing (reported in 3D Agricultural soils). In the same process, NO_x emissions from manure storage were calculated. Emissions estimates are done separately for each animal category (NFR 3B1a,b; 3B2; 3B4d,e,f,h and 3Bgi,ii,iii,iv). Emissions from manure spreading are not calculated for fur animals (3B4h Other animals) and from grazing poultry (3Bgi,iii,iv) because there are no emission factors available. Calculated NO emissions were converted to NO_2 due to the reporting requirements.

[24] The collection of statistics "Agriculture in Latvia" (2022). Available at https://www.csb.gov.lv/en/statistika/db

Ammonia emissions from anaerobic digestion at biogas facilities from manure are estimated using Tier 2 approach described in EMEP/EEA 2023 5.B.2 chapter and are reported under 5B2 Biological treatment of waste - Anaerobic digestion at biogas facilities.

Total ammoniacal nitrogen (TAN) returned from biogas facilities to be used as fertilizers together with manure applied to soils is estimated using Tier 2 approach described in EMEP/EEA 2019 5.B.2 chapter and are reported under 3Da2a Animal manure applied to soils. TAN and total-N in digested manures are calculated using equations 4, 5, 6 and 7 page 9 EMEP/EEA 2019 5.B.2 chapter. Estimated TAN and total-Nin digestate used in equations 35 and 36 page 27 EMEP/EEA 2019 3B chapter. There is no national data available for relative share of organic N entering the digester that is mineralized to TAN in the digester (f_{min}), 0.32 kg kg^{-1} is used as suggested in EMEP/EEA 2019 5.B.2 chapter. TAN flow for digestion is calculated separately for the respective animal categories.

NMVOC emission estimations from geese and other animal livestock categories are based on Tier 1 methodology described in the EMEP/EEA 2023. PM and TSP emissions are estimated using Tier 1 methodology for all animal categories:

$$E_{pollutant_{animal}} = AAP_{animal} \times EF_{pollutant\_animal}$$

where:

EF $_{pollutant\_animal}$ - pollutant emissions for each livestock category;
AAP $_{animal}$ - number of animals of a particular category that are present on average within the year;
EF $_{pollutant\_animal}$ - EF of pollutant (kg a^{-1}).

For dairy and non-dairy cattle, sheep, swine, goats, horses, laying hens, broilers, turkeys and ducks NMVOC emissions estimations were done by using Tier 2 methodology described in the EMEP/EEA 2023.

The example of N flow calculations for dairy cattle in 2022 is described in Annex III.

Values about annual N excretion (Nex) per animal for dairy cattle and non-dairy cattle were calculated according to the 2006 IPCC Guidelines Tier 2 methodology (2006 IPCC Guidelines Equation 10.31, page 10.58):

$$Nex_{(T)} = N_{intake} * (1 - N_{rentention})$$

where:

$N_{ex(T)}$ - annual N excretion rates, kg N $animal^{-1}$ yr^{-1}
$N_{intake\ (T)}$) - the annual N intake per head of animal of species/category T, kg N $animal^{-1}$ yr^{-1}
$N_{retention\ (T)}$ - fraction of annual N intake that is retained by animal of species/category T, dimensionless

$$N_{intake\ (T)} = \frac{GE}{18.45} * \left(\frac{\frac{CP\%}{100}}{6.25}\right)$$

where:

N $_{intake\ (T)}$ - daily N consumed per animal of category T, kg N $animal^{-1}$ day^{-1}
GE - gross energy intake of the animal, MJ $animal^{-1}$ day^{-1}
18.45 - conversion factor for dietary GE per kg of dry matter, MJ kg^{-1}
CP% - percent crude protein in diet, input
6.25 - conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg N-1)

The daily N retention per animal head of species/category is estimated as (2006 IPCC Guidelines Equation 10.33, page 10.60):

$$N_{retention\ (T)} = \left[\frac{Milk * \frac{(MilkPR\%)}{100}}{6.38}\right] + \left[\frac{WG * \left[268 - \left(\frac{7.03NE_g}{WG}\right)\right]}{\frac{1000}{6.25}}\right]$$

where:

$N_{retention(T)}$ - daily N retained per animal of category T, kg N $animal^{-1}$ day^{-1}
Milk - milk production, kg $animal^{-1}$ day^{-1} (dairy cows only)
Milk PR% - percent of protein in milk, calculated as [1.9 + 0.4 * %Fat]
6.38 - conversion from milk protein to milk N, kg Protein $(kg\ N)^{-1}$
WG - weight gain, input for each livestock category, kg day-1
268 and 7.03 - constants
Neg - net energy for growth, MJ day-1
6.25 - conversion from kg dietary protein to kg dietary N, kg Protein $(kg\ N)^{-1}$

Crude protein (CP) values are adopted from national studies regarding to feeding requirements for cattle[25] based on milk yield and milk fat content data, CP=14% (1990-1995) and CP=15% is set for dairy cows. For other cattle CP values ranging from 9% to 14%.

Annual N excretion rate for swine is derived from the 2006 IPCC Guidelines (2006 IPCC Guidelines Equation 10.30, page 10.57) by using typical animal mass (TAM) data:

The daily N intake per head of each cattle category is calculated as (2006 IPCC Guidelines Equation 10.32, page 10.58):

$$Nex_{(T)} = N_{rate} * \frac{TAM}{1000} * 365$$

where:

$N_{ex(T)}$ - annual N excretion rates, kg N $animal^{-1}$ yr^{-1}
$N_{rate\ (T)}$ - default N excretion rate, kg N (1000 kg mass) $^{-1}$ day^{-1}(Market swine=0.52, Breeding swine=0.42 according to 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.19, page 10.59)
TAM - typical anima mass, kg $livestock^{-1}$

NH_3 emission abatement measures are incorporated in to estimations by modification of default emission factors based on reduction factor and proportion of the source to which the abatement technique is applied. Abatement techniques are defined as "mutually exclusive". Weighted average approach were used:

$$EF_{average} = \left(EF_{ref} \cdot \sum P_i \cdot (1 - AE_i)\right) + \left(EF_{ref}\left(1 - \sum P_i\right)\right)$$

where:
EF_{ref} – unabated reference emission factor;
P_i – penetration of measure or proportion of the source to which the abatement technique is applied;
AE_i – abatement efficiency of measure I or reduction factor I;

5.2.4 Emission factors

The emission factors used to estimate NH_3 emissions from manure management are default Tier 2 from EMEP/EEA 2023, 3B Manure management (Table 5.5). Country specific emission factors are used for Dairy cattle and pig's storage in the time period 2002-2020, in 2005-2020 for manure spreading (dairy cattle, non-dairy cattle, sheep, pigs, goats and horses) and in 2021 - 2022 for application of laying hen digestate to the soil. That is because of NH_3 emissions abatement practises implementation. More information available in this chapter about the assumptions used.

Table 5.5 Emission factors used for calculation of the NH_3-N emissions from manure management (proportion of TAN)

Animal type	Manure type	EF housing	EF storage	EF application	EF grazing/ outdoor
Dairy cattle	slurry	0.24	0.25	0.55	0.14
	solid	0.08	0.32	0.68	

[25] Latvietis J. (1994) Govju ēdināšanas normas. Jelgava: LLU, p.102

Animal type	Manure type	EF housing	EF storage	EF application	EF grazing/ outdoor
Non-dairy cattle	slurry	0.24	0.25	0.55	0.14
	solid	0.08	0.32	0.68	
Fattening pigs	slurry	0.27	0.11	0.40	-
	solid	0.23	0.29	0.45	
Sows	slurry	0.35	0.11	0.29	-
	solid	0.24	0.29	0.45	
Sheep	solid	0.22	0.32	0.90	0.09
Goats	solid	0.22	0.28	0.90	0.09
Horses	solid	0.22	0.35	0.90	0.35
Laying hens	solid	0.20	0.08	0.45	NA
	slurry	-	-	0.69	-
Broilers	solid	0.21	0.30	0.38	-
Turkeys	solid	0.35	0.24	0.54	NA
Ducks	solid	0.24	0.24	0.54	NA
Geese	solid	0.57	0.16	0.45	NA
Other poultry	solid	0.21	0.30	0.38	NA
Fur animals	solid	0.27	0.09	NA	-

Emission factors used to estimate NO_x emissions from manure management are the default values from EMEP/EEA 2023 (Table 5.6). Emission factors for pigs of age till 4 moths are estimated as weighted mean from EF of fattening pigs and sow based on share of piglets of 8 kg[26] due to improve accuracy of calculations as statistical data of animal numbers and national Nex, manure management system is available for such livestock group.

Table 5.6 Emission factors used for calculation of the NO-N emissions from manure management (proportion of TAN)

EF Storage	
Slurry	Solid
0.0001	0.01

Emission factors which are used to estimate NMVOC from manure management are represented in Table 5.7.

Table 5.7 Emission factors used for calculation of the NMVOC emissions from manure management

Tier 1 emission factors, kg AAP^{-1}a^{-1}			
Livestock	**EF, with silage feeding**	**EF, without silage feeding**	**Used EF**
Geese	-	0.489	0.489
Other poultry	-	0.108	0.108
Fur animals		1.941	1.941
Tier 2 emission factors, kg NMVOC kg/MJ feed intake			
Livestock	**$EF_{NMVOC, silage\_feeding}$**	**$EF_{NMVOC,building}$**	**$EF_{NMVOC,graz}$**
Dairy cattle	0.0002002	0.0000353	0.00000690
Non-dairy cattle	0.0002002	0.0000353	0.00000690
Finishing pigs (8-110 kg)	-	0.0000353	0.00000690
Sows (and piglets to 8kg, boars)	-	0.0017030	-
Sheep	0.010760	0.0070420	-
Goats	0.010760	0.0016140	0.00002349
Horses	0.010760	0.0016140	0.00002349
Laying hens	-	0.0016140	0.00002349
Broilers	-	0.0056840	-
Turkeys	-	0.0091470	-
Ducks	-	0.0056840	-

[26] Lauksaimniecības datu centrs Publiskā datu bāze http://pub.ldc.gov.lv/pub_stat.php?lang=lv

Group of other poultry defined further is calculated using the same emission factors as for broilers, because of similar characteristics of quail and small chicks. Calculated emissions reported together with ducks and geese in 3B4giv Manure management - Other poultry.

NH_3 emission calculations also include evaluation of the influence of emission reduction measures. Assumptions of emission reduction are based on expert judgment where group of experts based on:

- the Agricultural Data Centre Republic of Latvia Register of housing infrastructure and manure storage facilities that contains data relevant to 2020 (base for 2020 assumptions and for 2021 because data is relevant to the consequent years);
- data on slurry storage covers from survey of intensive pig farms conducted with assistance of Latvian Pig Breeders Association (base for all period of implemented abatement techniques);
- differ versions of legislative acts over period 2001-2020 that are relevant to ammonia abatement (base for assumption of implementation starting period).

Result of the expert judgement consists of activity data to estimate ammonia emissions abatement measures implemented in Latvia in agricultural sector. Proportion of the source to which the abatement technique is applied where determined for:

- K_AgriLivestock 3B1a Manure management - Dairy cattle;
- K_AgriLivestock 3B3 Manure management – Swine;
- L_AgriOther 3Da2a Animal manure applied to soils (dairy cattle, non-dairy cattle, pigs, sheep, goats, horses).

Reduction measures are estimated for slurry storage for the time period 2002-2021 and for manure application techniques 2005-2022 time period. In 2022 the same estimated reduction potential is used as in 2020 and 2021, because there is no new date at this point and estimations are still relevant.

For 2021 and 2022 reduction potential for application of laying hens digestate is calculated based on information provided by only holding to manage production of biogas from this specific manure. 60% of laying hens digestate is used to produce other organic fertilizer which is exported and nation used amount is included in statistical data for other organic fertilizer use. 50% remaining digestate is applicated to the field using injection technique.

For every abatement technique emission reduction factor were defined (Table 5.8) according to "Options for Ammonia Mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen"[27].

Table 5.8 NH_3 abatement techniques reduction factors, %

Abatement technique	Reduction factor
Slurry store with no cover or crust (reference technique)	0
Allowing formation of natural crust or floating covers (e.g., chopped straw, peat, bark, etc.) for slurry store	40
Plastic sheeting (floating cover) for slurry store	60
"Tight" lid, roof or tent structure for slurry store	80
Solid manure incorporation within 4 hours	60
Solid manure incorporation within 24 hours	30
Solid manure spread not followed by incorporation	0
Slurry band spreading with a trailing hose and incorporation within 4 hours	60
Slurry band spreading with trailing shoe and incorporation within 4 hours	65
Slurry band spreading with a trailing hose and incorporation after 4 hours	35
Slurry band spreading with trailing shoe and incorporation after 4 hours	50
Slurry band spreading slurry with a trailing hose and not followed by incorporation	30

[27] Bittman, S., Dedina, M., Howard C.M., Oenema, O., Sutton, M.A., (eds), 2014, Options for Ammonia Mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen, Centre for Ecology and Hydrology, Edinburgh, UK

Abatement technique	Reduction factor
Slurry band spreading slurry with a trailing shoe and not followed by incorporation	40
Slurry incorporation of surface applied slurry within 4 hours	45
Slurry incorporation of surface applied slurry within 12 hours	30
Slurry injecting slurry (open slot)	70
Slurry injecting slurry (closed slot)	80
Slurry spread not followed by incorporation	0

Table 5.9 summarizes estimated weighted average reduction factor for dairy cattle and swine storage of slurry and used emission factors for calculations of NH_3 emissions from slurry storage for dairy cows and swine.

Table 5.9 NH_3 reduction from storage of slurry, % and emission factors used for calculation of the dairy cows and swine NH_3-N emissions from manure storage (proportion of TAN)

Year	NH_3 reduction from storage of slurry, %		EF $_{NH3\_storage\_slurry}$, NH_3-N (kg TAN)$^{-1}$	
	Dairy cows	Swine	Dairy cows	Swine
2002	2.474	10.167	0.244	0.099
2003	4.547	20.334	0.239	0.088
2004	6.621	30.501	0.233	0.076
2005	8.694	40.668	0.228	0.065
2006	10.768	50.836	0.223	0.054
2007	12.842	51.291	0.218	0.054
2008	14.915	53.222	0.213	0.051
2009	16.988	55.588	0.208	0.049
2010	19.062	55.759	0.202	0.049
2011	21.136	55.198	0.197	0.049
2012	23.209	56.347	0.192	0.048
2013	25.283	57.637	0.187	0.047
2014	27.414	57.143	0.181	0.047
2015	29.545	56.748	0.176	0.048
2016	31.677	56.842	0.171	0.047
2017	33.808	58.463	0.165	0.046
2018	35.940	58.524	0.160	0.046
2019	38.071	61.389	0.155	0.042
2020	40.202	64.350	0.149	0.039
2021	40.202	64.350	0.149	0.039
2022	40.202	64.350	0.149	0.039

Table 5.10 summarizes estimated weighted average reduction factor for abatement techniques for solid manure application and used emission factors for calculations of NH_3 emissions from solid manure application to soil (cattle, swine, sheep, goats, horses).

Table 5.10 NH_3 reduction from solid manure application techniques, % and emission factors used for calculation NH_3-N emissions from solid manure application to soil (proportion of TAN)

Year	NH_3 reduction from solid manure applied to soil, %						EF $_{NH3\_applic\_solid}$, NH_3-N (kg TAN)$^{-1}$					
	Dairy cows	Non-dairy cattle	Swine	Sheep	Goats	Horses	Dairy cows	Non-dairy cattle	Swine	Sheep	Goats	Horses
2005	2.653	2.514	2.245	2.405	2.394	2.217	0.662	0.663	0.440	0.878	0.878	0.880
2006	5.305	5.029	4.490	4.811	4.787	4.435	0.644	0.646	0.430	0.857	0.857	0.860
2007	7.958	7.543	6.735	7.216	7.181	6.652	0.626	0.629	0.420	0.835	0.835	0.840
2008	10.611	10.058	8.980	9.621	9.575	8.870	0.608	0.612	0.410	0.813	0.814	0.820
2009	13.263	12.572	11.225	12.027	11.969	11.087	0.590	0.595	0.399	0.792	0.792	0.800
2010	15.916	15.086	13.470	14.432	14.362	13.304	0.572	0.577	0.389	0.770	0.771	0.780
2011	18.569	17.600	15.715	16.838	16.756	15.522	0.554	0.560	0.379	0.748	0.749	0.760
2012	21.221	20.115	17.960	19.243	19.150	17.739	0.536	0.543	0.369	0.727	0.728	0.740

Year	NH$_3$ reduction from solid manure applied to soil, %						EF $_{NH3\_applic\_solid}$, NH$_3$-N (kg TAN)$^{-1}$					
	Dairy cows	Non-dairy cattle	Swine	Sheep	Goats	Horses	Dairy cows	Non-dairy cattle	Swine	Sheep	Goats	Horses
2013	23.874	22.629	20.205	21.648	21.543	19.956	0.518	0.526	0.359	0.705	0.706	0.720
2014	26.527	25.144	22.450	24.053	23.937	22.174	0.500	0.509	0.349	0.684	0.685	0.700
2015	29.179	27.658	24.695	26.459	26.331	24.391	0.482	0.492	0.339	0.662	0.663	0.680
2016	31.832	30.172	26.940	28.864	28.724	26.609	0.464	0.475	0.329	0.640	0.641	0.661
2017	34.484	32.687	29.185	31.270	31.118	28.826	0.446	0.458	0.319	0.619	0.620	0.641
2018	37.137	35.201	31.430	33.675	33.512	31.043	0.427	0.441	0.309	0.597	0.598	0.621
2019	39.790	37.715	33.675	36.080	35.906	33.261	0.409	0.424	0.298	0.575	0.577	0.601
2020	42.442	40.230	35.920	38.486	38.299	35.478	0.391	0.406	0.288	0.554	0.555	0.581
2021	42.442	40.230	35.920	38.486	38.299	35.478	0.391	0.406	0.288	0.554	0.555	0.581
2022	42.442	40.230	35.920	38.486	38.299	35.478	0.391	0.406	0.288	0.554	0.555	0.581

Table 5.11 summarizes estimated weighted average reduction factor for abatement techniques for slurry manure application and used emission factors for calculations of NH$_3$ emissions from slurry manure application to soil (dairy cattle, swine and laying hen digestate).

Table 5.11 NH$_3$ reduction from slurry application techniques, % and emission factors used for calculation NH$_3$-N emissions from slurry application to soil (proportion of TAN)

Year	NH$_3$ reduction from slurry applied to soil, %			EF $_{NH3\_applic\_slurry}$, NH$_3$-N (kg TAN)$^{-1}$		
	Dairy cows	Swine	Laying hens	Dairy cows	Swine	Laying hens
2005	2.796	2.723	-	0.535	0.389	-
2006	5.592	5.447	-	0.519	0.378	-
2007	8.389	8.172	-	0.504	0.367	-
2008	11.184	10.896	-	0.488	0.356	-
2009	13.979	13.620	-	0.473	0.346	-
2010	16.776	16.344	NA	0.458	0.335	NA
2011	19.571	19.068	NA	0.442	0.324	NA
2012	22.367	21.792	NA	0.427	0.313	NA
2013	25.163	24.517	NA	0.412	0.302	NA
2014	27.960	27.241	NA	0.396	0.291	NA
2015	30.755	29.965	NA	0.381	0.280	NA
2016	33.551	32.688	NA	0.365	0.269	NA
2017	36.346	35.412	NA	0.350	0.258	NA
2018	39.143	38.136	NA	0.335	0.247	NA
2019	41.939	40.861	NA	0.319	0.237	NA
2020	44.734	43.620	NA	0.304	0.226	NA
2021	44.734	43.620	35.000	0.304	0.226	0.448
2022	44.734	43.620	35.000	0.304	0.226	0.448

Abatement measures implementation proportions according to expert judgment summarized in Annex III.

The calculation of PM and TSP emissions is based on EMEP/EEA 2023 methodology. Emission factors by type are shown in the Table 5.12.

Table 5.12 PM and TSP emission factors, kg AAP^{-1}a^{-1}

	EF TSP	EF PM$_{10}$	EF PM$_{2.5}$
Dairy cows	1.380	0.630	0.410
Other cattle	0.590	0.270	0.180
Calves	0.340	0.160	0.100
Fattening pigs	1.050	0.140	0.006
Sows	0.620	0.170	0.010
Weaners	0.270	0.050	0.002
Sheep	0.140	0.060	0.020
Goats	0.140	0.060	0.020
Horses	0.480	0.220	0.140

	EF TSP	EF PM_{10}	EF $PM_{2.5}$
Layers	0.190	0.040	0.003
Broilers	0.040	0.020	0.002
Turkeys	0.110	0.110	0.020
Ducks	0.140	0.140	0.020
Geese	0.240	0.240	0.030
Other poultry	0.040	0.020	0.002
Fur animals	0.018	0.008	0.004

5.2.5 Activity data

The number of cattle, sheep, swine, goats, horses, poultry and fur-bearing animal's population, as well as data on milk production and fat content in milk is obtained from the CSB Database[28] and statistical yearbooks[29]. The distribution of different manure management systems (MMS) is adopted from national studies. Calculations of the distribution are made based on research results and developed methodology provided by Latvia University of Life Sciences and Technologies[30]. MMS for all livestock categories 1990 – 2022 are summarized in Annex III.

Statistical information about the livestock number in Latvia is included in Table 5.13. The number of fur-bearing animals is not available for 1990-1992 and 1995 therefore interpolation and extrapolation are used to fill in the gaps of time series. The same activities have been done for turkeys, ducks and geese, because statistical data is not available for the period of 1990-1998. According to CSB not specified poultry or other poultry contains number of quail and small chicks from 1999 till 2014. Starting from 2014 other poultry group contains number of quails. Ostrich number is as well included in the group of other poultry from 2010 but the number is not significant.

Table 5.13 Number of livestock (thousand heads), 1990-2022

Year		1990	1995	2000	2005	2010	2015	2020	2021	2022
Dairy cows		535.1	291.9	204.5	185.2	164.1	162.4	136.0	131.2	127.8
Non-dairy cattle	**Growing cattle**	827.8	224.5	149.5	178.5	173.2	189.8	176.9	174.7	172.9
	Other mature cattle	76.4	20.7	12.7	21.5	42.2	66.9	86.0	87.6	90.7
Swine	**Fattening pigs**	759.2	287.7	191.7	175.7	156.3	155.4	135.4	145.6	135.4
	Sows, boars	146.5	75.8	35.3	37.7	36.0	25.0	23.7	23.7	23.7
	Pigs till 4 months	495.4	189.3	166.5	214.5	197.4	153.9	147.8	157.6	150.7
Sheep		164.6	72.2	28.6	41.6	76.8	102.3	91.9	90.3	87.3
Goats		5.4	8.9	10.4	14.9	13.5	12.7	11.5	11.4	11.7
Horses		30.9	27.2	19.9	13.9	12.0	9.6	8.3	8.4	8.7
Layers		5160.6	2071.2	1980.5	2121.8	2549.5	2335.3	3345.1	3395.2	3343.5
Broilers		5089.3	2055.8	570.2	1365.0	1638.3	2035.9	2356.6	2394.0	2351.4
Turkeys		10.1	10.1	12.5	15.1	1.0	3.1	3.0	3.8	4.3
Other poultry	**Ducks**	48.6	48.6	51.0	38.4	2.9	6.6	4.9	6.9	6.3
	Geese	12.6	12.6	14.4	16.2	1.6	3.3	6.9	2.9	2.4
	Other poultry	-	-	476.0	535.8	755.4	147.8	121.4	54.9	36.4
Fur animals		260.2	213.5	97.2	140.8	166.1	272.2	138.1	124.6	59.5

The data of N excretion during the year per each livestock category used for the inventory are mainly country specific and is obtained from national studies. The research of country specific N excretion values is done according to outcomes of pre-defined project "Development of the National System for Greenhouse

[28] Agriculture, Forestry and Fishery. http://data.csb.gov.lv/pxweb/en/lauks/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8
[29] The collection of statistics "Agriculture in Latvia" (2022). Available at https://www.csb.gov.lv/en/statistika/db
[30] Priekulis J., Āboltiņš A. (2015) Calculation Methodology for Cattle Manure Management Systems Based on the 2006 IPCC Guidelines. Proceedings of the 25th NJF Congress Nordic View to Sustainable Rural Development. Riga, pp.274-280

Gas Inventory and Reporting on Policies, Measures and Projections" under 2009-2014 EEA Grants Programme National Climate Policy related to sub-project "Agricultural sector GHG emissions calculation methods and data analysis with the modelling tool development, integrating climate change". All N excretion values used in the inventory are represented in Table 5.14 and Table 5.15. Detailed description of country specific N_{ex} is available at Latvia`s National Inventory Report 2022 and in previous submissions[31].

Table 5.14 Average N excretions (N, kg year^{-1}) per head of animal

Livestock category	N, kg year^{-1}	Source
Fattening pigs	14	National studies
Sows, boars	27.6	National studies
Pigs till 4 months	5.1	National studies
Sheep	15.3	National studies
Goats	15.8	National studies
Horses	44.0	National studies
Layers	0.55	National studies
Broilers	0.35	National studies
Turkeys	1.64	EMEP/EEA 2019
Ducks	0.58	National studies
Geese	1.12	National studies
Other poultry	0.35	National studies
Fur animals	4.60	EMEP/EEA 2019

Average N excretion data during the year for dairy cattle vary in all emissions reporting period depending on productivity indicators and age structure for non-dairy cattle (Table 5.15).

Table 5.15 Average N excretions for cattle (N, kg year^{-1}) per head of cattle

Year	1990	1995	2000	2005	2010	2015	2020	2021	2022
Dairy cows	85.77	84.74	99.62	104.00	106.56	108.80	118.19	119.86	120.38
Growing cattle	20.10	20.00	19.50	19.40	19.80	20.00	19.80	19.93	19.88
Other mature cattle	58.60	58.50	55.00	58.90	60.10	61.90	63.10	63.28	63.28

Calculations of MMS are done according to pre-defined project "Development of the National System for Greenhouse Gas Inventory and Reporting on Policies, Measures and Projections" (2009-2014 EEA Grants Programme National Climate Policy) the most important outcomes in relation to sub-project "Agricultural sector GHG emissions calculation methods and data analysis with the modelling tool development, integrating climate change". Main differences caused by implementation of the new methodology to determine MMS should be tended to liquid manure system, which was found as not typical for non-dairy cattle in Latvia. Significantly, the share of pasture, range and paddock variated according livestock groups. Most of the large livestock farms refuse from grazing to keep high productivity of animals and arrange resources in economically feasible way. Table 5.16 represents the share of each manure management system in 2022.

The increase of grazing days for sheep is associated with the increase in biological practice where grazing is obligatory. The proportion of horses used in sport and recreation rise compared to use in farm work and transportation. That boosts average grazing days for horses because of all-year grazing practice. An increase in grazing days for poultry is associated with the share of small holding that operates free range practice.

Table 5.16 Share of each manure management system per animal type (%), 2022

	Pasture	Solid storage	Slurry	Anaerobic digester
Dairy cows	4.8	34.8	42.9	17.5
Growing cattle	29.8	60.7	0.0	9.5
Other mature cattle	78.7	21.3	0.0	0.0
Fattening pigs	0.0	3.7	49.6	46.7

[31] Latvia Inventory Report submissions https://videscentrs.lvgmc.lv/lapas/gaisa-piesarnojums

Sows, boars	0.0	4.0	49.5	46.5
Pigs till 4 months	0.0	4.0	49.5	46.5
Sheep	38.4	61.6	0.0	0.0
Goats	9.7	90.3	0.0	0.0
Horses	35.1	64.9	0.0	0.0
Layers	4.2	45.1	0.0	50.7
Broilers	0.0	100.0	0.0	0.0
Turkeys	29.6	70.4	0.0	0.0
Ducks	31.5	68.5	0.0	0.0
Geese	29.3	70.7	0.0	0.0
Fur animals	0.0	100.0	0.0	0.0

The straw use is adjusted based on default values summarized EMEP/EEA 2023 Table 3.7. Used straw amount summarized in Table 5.17. N added in straw is estimated accordingly the use of the straw 4 g kg^{-1}.

Table 5.17 Annual use of straw, kg AAP-1 a-1

	1990	1995	2000	2005	2010	2015	2020	2021	2022
Dairy cattle	2692	2700	2717	2750	2783	2842	2875	2883	2892
Non-dairy cattle - growing cattle	611	693	752	743	772	719	716	720	713
Non-dairy cattle - mature cattle	217	217	217	217	217	217	217	217	217
Fattening pigs	200	200	200	200	200	200	200	200	200
Sows	600	600	600	600	600	600	600	600	600
Sheep	192	192	192	192	192	186	150	150	150
Goat	217	217	217	217	217	218	220	220	220
Horses	900	900	900	900	900	869	658	658	658

NMVOC emissions calculation for dairy, non-dairy cattle, sheep, swine, goats, horses, laying hens, broilers, turkeys and ducks is based on Tier 2 approach of EMEP/EEA 2023. Feed intake values in MJ and excreted volatile solids (VS) used for NMVOC emissions calculation are calculated using methodology from 2006 IPCC Guidelines (Table 5.18).

Table 5.18 Feed intake values in MJ per year and excreted VS in kg

	1990	1995	2000	2005	2010	2015	2020	2021	2022
Feed intake values in MJ per year									
Dairy cattle	88168	86267	96435	102604	107976	113407	127006	129468	130307
Young cattle	29330	28699	27745	27789	28277	29050	28667	28957	28874
Adult cattle	55803	55825	53880	61061	63445	67679	70966	71154	70995
Excreted VS in kg									
Sheep	146								
Swine	110								
Goats	110								
Horses	777								
Laying hens	7								
Broilers	4								
Turkeys	7								
Ducks	26								

5.2.6 Uncertainties

The uncertainty associated with activity data was received from CSB of Latvia. Generally, the uncertainty of activity data provided by CSB of Latvia is set as 2%. Uncertainty of emission factors for NH_3 ranges is from ±14% to ±136%, for NO_x is from -50% to +100% according to EMEP/EEA 2019.

5.2.7 QA/QC and verification

Assessment of trends were performed by a sectorial expert. Statistical data were verified by CSB of Latvia.

5.2.8 Recalculations

NMVOC emissions for sheep, swine, goats, horses, laying hens, broilers, turkeys and ducks were recalculated because of transition to Tier 2 methodological approach. Cattle, sheep, goats and horses NMVOC emissions from gracing reported under 3Da3 Urine and dung deposited by grazing animals. Cattle, sheep, swine, goats, horses, laying hens, broilers, turkeys and ducks NMVOC emissions from manure application reported under 3Da2a Animal manure applied to soil.

5.2.9 Planned improvements

It is planned:

- to continue to work on quantification and preparation of detailed documentations of abatement strategies for poultry ammonia emissions because information on digestate application in 2021 and 2022 is only included in this submission;
- to review the Agricultural Data Centre Republic of Latvia Register of housing infrastructure and manure storage facilities database information.

5.3 Agricultural soils (NFR 3D)

5.3.1 Overview

Under the category NFR 3D Latvia reports: ammonia (NH_3) and nitrous oxides (NO_x) emissions from inorganic N-fertilizers application, NH_3 and NO_x emissions from animal manure, sewage sludge and other organic fertilizers applied to soils, NH_3 and NO_x emissions from urine and dung deposited by grazing animals as well as volatile organic compounds (NMVOC) and particulate matter ($PM_{2.5}$, PM_{10}, TSP) emissions from crop production. Under 3.D.f Latvia reports HCB emissions from the use of pesticides.

5.3.2 Trends in emissions

Emissions from agricultural soils have noticeably decreased since the beginning of 90`s when agricultural production levels were significantly reduced (Table 5.19).

Table 5.19 Emissions from fertilizers, urine and dung deposited by grazing animals and crop production, 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2019	2020	2021	2022	*Changes in 1990-2022, %*	*Changes in 2005-2022, %*
NO_x	kt	8.50	1.92	1.99	2.73	3.48	4.26	4.38	4.52	4.50	4.38	-48.5	60.4
NMVOC	kt	4.62	2.24	1.87	2.00	1.91	1.93	2.05	2.04	1.86	1.83	-60.4	-8.2
NH_3	kt	14.05	4.83	4.52	5.26	5.95	7.18	7.68	7.70	7.30	6.81	-51.6	29.5
$PM_{2.5}$	kt	0.15	0.09	0.09	0.10	0.12	0.15	0.16	0.16	0.17	0.17	14.9	68.8
PM_{10}	kt	2.63	1.59	1.58	1.77	2.10	2.56	2.82	2.89	2.96	2.92	10.9	65.4
TSP	kt	2.54	1.45	1.37	1.56	1.72	1.82	1.97	1.99	2.03	2.03	-20.0	30.3
HCB	kg	5.46	0.00	0.00	0.01	0.06	0.16	0.20	0.20	0.20	0.20	-96.3	3243.6

NH_3 emissions

In 2022, agricultural soils contributed 6.81 kt of NH_3. The main source of NH_3 emissions was application of inorganic N-fertilizers, contributing 45.7% or 3.11 kt of NH_3 emissions from agricultural soils. NH_3 emissions from animal manure applied to soils contributed 2.96 kt or 43.5%. NH_3 emissions from pastures had a share of 10.4% (0.71 kt). Application of sludge and other organic fertilizers emitted 0.02 kt of NH_3 or 0.4% of total NH_3 emissions from agricultural soils (Figure 5.5). In 2022, the total emission of NH_3 from agricultural soils decreased by 7.2%, compared to 2021 and by 29.5% - compared to 2005. NH_3 from agricultural soils decreased by 51.6%, compared to 1990.

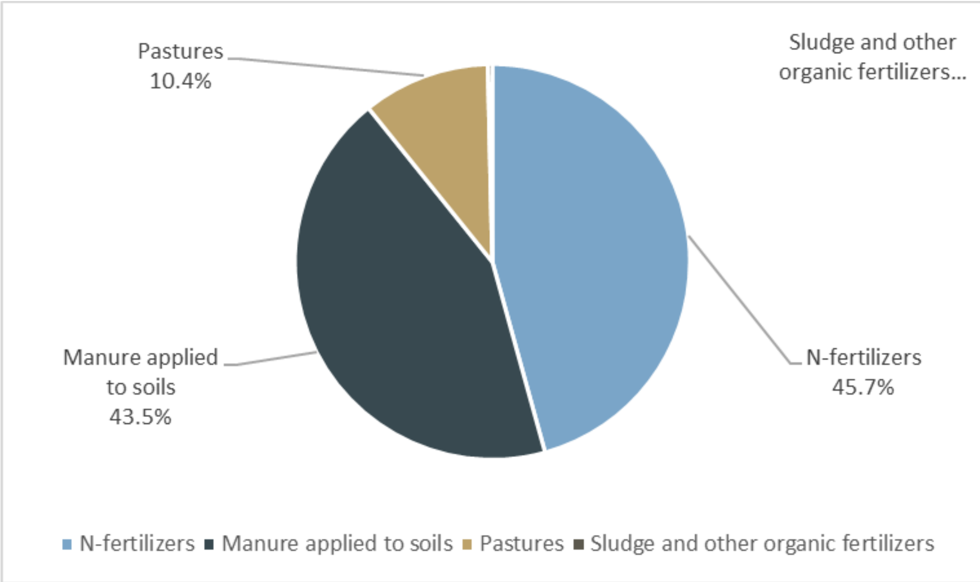

Figure 5.5 NH_3 emissions from agricultural soils by source in 2022

NO_x emissions

NO_x emissions from agricultural soils reached 4.38 kt in 2022. The main sources of NO_x emissions similarly to NH_3 emissions were application of inorganic N-fertilizers, manure, sludge and other organic fertilizers as well as pastures. 75.2% of NO_x emissions formed from the use of inorganic N-fertilizers, 18.2% from manure application, 6.5% from pastures, 0.2% from sludge and other organic fertilizers application. NO_x emissions decreased by 2.7% compared to previous submission year. NO_x emissions increased by 60.4%, compared to 2005, but decreased by 48.5%, compared to 1990. The most important source of emissions increases after 2005 was application of inorganic N-fertilizers and other organic fertilizers.

NMVOC and PM emissions

In 2022, agricultural soils contributed 1.83 kt of NMVOC (by 1.6% less as in 20210) emissions in Latvia. The sources for NMVOC was emissions from cultivated crops (3De), as well as manure application and pastures. Agricultural soils also contributed 0.17 kt and 2.92 kt of the total agricultural $PM_{2.5}$ and PM_{10} emissions, respectively. These emissions were reported in category 3Dc (Farm-level agricultural operations including storage, handling and transport of agricultural products). Emissions of NMVOC decreased by 8.2% compared to 2005, and decreased by 60.4% compared to 1990. Emissions of particulate matter show increase over all inventory period. $PM_{2.5}$ and PM_{10} emissions decreased by 1.0% and 1.4% comparing to previous submission, respectively. $PM_{2.5}$ and PM_{10} emissions increased by 68.8% and 65.4%, compared to 2005. The same emissions increased by 14.9% and 10.9%, compared to 1990.

HCB emissions

In 2022, agriculture contributed 0.20 kg of HCB emissions in Latvia. These emissions were reported in category 3Df (Use of pesticides). Emissions notably decrease by 96.3%, since 1990.

Trends of agricultural production

At the end of 2022 in Latvia were 61.8 thousand agricultural holdings, which is 15.3% fewer than in 2020., and the average size of a holding constituted 44.7 ha, which is 13.5% more than in 2020. Agricultural area on average per holding has increased from 26.9 ha in 2020 to 31.1 ha in 2022 or by 15.6%. Compared to 2021, in 2022 the total utilized agricultural area in the country grew by only 0.3 thousand ha and found 1970.4 thousand ha. Over the year arable land has decreased by 5.5 thousand ha or 0.4% while areas of pastures and meadows increased by 4.8 thousand ha or 0.8%.

In 2022, 780.1 thousand ha of land were covered with cereals, which is 3.7 thousand ha or 0.5% more than a year before, and this is the largest area registered in the agriculture of Latvia. In 2022, 3.2 million t of grain were harvested, which is 249.1 thousand t or 8.3% more than in 2021. In 2022 cereals took 59.9% of the total sown area (59.0% in 2020). The share of winter wheat in the cereal area increased significantly – from 50.7% in 2020 to 57.5% in 2022. Harvested production of winter cereals reached 2.5 million tons in 2022, which is 168.8 thousand t or 7.3% more than a year ago. The share of winter cereals in the harvested production of grain has dropped from 77.6% in 2021 to 76.8% in 2022. Winter wheat took 69.0% of all harvested grain (70.1% in 2021). Due to the wider areas of winter cereals (up by 22.5 thousand ha or 5.3%), the harvested production reached 2.2 million t, which is 141.7 thousand t or 6.8% more than a year ago.

In 2022 sown area of rape reached 160.3 thousand ha, which is 13.4 thousand ha or 9.2% more than in 2021 and the widest area of rape recorded in the history of Latvia. Due to unfavorable weather conditions only 354.9 thousand t of rape seeds were harvested, which is 16.5% less than a year ago. In 2022, a total of 246.7 thousand t of potatoes were harvested, which is 2.3 thousand t or 0.9% less than a year ago. The average yield of potatoes from one hectare grew by 8.8%. Potato plantations have diminished more than twice over the past 12 years – from 30.1 thousand ha in 2010 to 14.9 thousand ha in 2022.

The year 2022, just like the year before, was unfavorable for open field vegetables. A total of 115.5 thousand t of vegetables were produced (including in greenhouses), which is 11.6 thousand t or 9.2% less than in 2021. Due to the significantly higher mineral fertilizer prices, the volume of mineral fertilizers used on agricultural crops decreased by 9.4% over the year, however the sown area remained unchanged. The volume of mineral fertilizers used per one hectare has reduced from 117 kg in 2021 to 106 kg in 2022 or by 9.4%. The volume of mineral fertilizers used per hectare decreased for all principal agricultural crops; the biggest decrease was recorded for open-field vegetables (of 28.6%) and potatoes (21.6%). Straight nitrogen fertilizers were used more commonly – their share in the total utilization of mineral fertilizers (in physical weight) has risen from 38.2% in 2021 to 44.5% in 2022. In 2022, compared to 2021, utilization of organic fertilizers decreased. The volume of organic fertilizers applied on average per one hectare of sown area dropped from 3.5 t in 2021 to 3.4 t in 2022. All statistical information is adopted from the collection of statistics "Agriculture in Latvia" (2023)[32] developed by the Agricultural Statistics Section, Agricultural and Environment Statistics Department of CSB of Latvia.

Emissions from animal manure applied to soils and urine and dung deposited by grazing animals are related to the total number of livestock in the country described in the Chapter 3B.

5.3.3 Methods

NH_3 emissions calculation from inorganic N-fertilizer is based on the consumption data of different fertilizer types and related emission factors. Emission calculation of NO_x is based on the total consumption of N in inorganic N-fertilizer, manure or excreta, other organic fertilizers and related emission factor. NMVOC and PM, including TSP emissions were calculated using the data of the total sown area and respective emission factors. NH_3 and NMVOC emissions from animal manure applied to soils and urine and dung deposited by grazing animals were calculated under the category 3B.

NH_3, NO_x, NMVOC, PM and TSP emissions are calculated by methodology explained in EMEP/EEA 2019. NO_x emissions from crop production and agricultural soils are calculated using the following equation:

$$E_{pollutant} = AR_{nitrogen\ applied} \times EF_{pollutant}$$

[32]Agriculture of Latvia. Collection of Statistics. Rīga (2023) https://stat.gov.lv/en/statistics-themes/business-sectors/fishery-and-aquaculture/publications-and-infographics/15214?themeCode=ZI

where:

$E_{pollutant}$ = amount of pollutant emitted (kg a^{-1}),
$AR_{nitrogen\ applied}$ = amount of N applied in fertilizer or organic waste (kg a^{-1}),
$EF_{pollutant}$ = EF of pollutant (kg kg^{-1}).

For calculation of NH_3 emissions from inorganic N-fertilizers in the country, the number of fertilizer consumption (expressed as mass of fertilizer-N used per year) is multiplied by the appropriate emission factor. NH_3 emissions from the application of inorganic fertilizers are calculated using the Tier 2 approach according to EMEP/EEA 2019 Crop production and agricultural soils 3D[33], distinguishing between various fertilizer types.

PM emissions from crop production and agricultural soils are calculated by using the following equation:

$$E_{pollutant} = AR_{area} \times EF_{pollutant}$$

where:

$E_{pollutant}$ = amount of pollutant emitted (kg a^{-1}),
AR_{area} = area covered by crop (ha),
$EF_{pollutant}$ = EF of pollutant (kg $ha^{-1}a^{-1}$).

NMVOC emissions from crop production and agricultural soils are calculated by using Tier 1 approach outlined in the 2019 EMEP/EEA Emission Inventory Guidebook Table 3.3. Estimations were done by different emission factors for wheat (EF=0.32), rye (EF=1.03), rape (EF =1.34) and grass (EF=0.41). For other crops EF=0.86 of MNVOC ha^{-1} of sown area was used.

The emissions of HCB were calculated keeping methodology proposed in the EMEP/EEA 2019 (3Df/3I, chapter 3, Tier 1 approach)[34]. To estimate the emission of HCB which is present as an impurity, an impurity factor (IF) has to be considered in the calculation:

$$E_{pest} = \sum(mpest\_i \times IF_i)$$

where:

E_{pest} = total HCB emission of active substance (in mg a^{-1}, unit conversion reported in kg a^{-1}),
Mpest_i = mass of individual active substance applied (kg a^{-1}),
IF_i = impurity factor of the active substance (mg kg^{-1})

5.3.4 Emission factors

The default (Tier 1) emission factors for TSP and NO_X were used for calculations as given in EMEP/EEA 2019 and the same emission factors are used for all years 1990-2022:

- 1.56 kg ha^{-1} for TSP;
- 0.04 kg kg^{-1} fertilizer, manure or other waste applied for NO_2.

NH_3 emissions from inorganic N-fertilizer are calculated on the basis of inorganic fertilizer types application data and suggested EF`s according to EMEP/EEA 2019 Tier 2 methodology (EMEP/EEA 2019, 3.D Crop production and agricultural soils, Table 3.2 EFs for NH_3 emissions from fertilizers (in g NH_3 (kg N applied)$^{-1}$)[35]. Emission factors refer to cool climate and normal pH of soils. NH_3 emissions from sewage sludge applied to soils was estimated using default emission factor of sewage sludge taken from EMEP/EEA 2019,

[33] EMEP/EEA air pollutant emission inventory guidebook 2019. Available at https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/4-agriculture/3-d-crop-production-and/view

[34] EMEP/EEA air pollutant emission inventory guidebook 2019. Available at: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/4-agriculture/3-d-f-3-i/view

[35] EMEP/EEA air pollutant emission inventory guidebook 2019. Table 3.2. Available at: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/4-agriculture/3-d-crop-production-and/view

Table 3.1 Tier 1 EFs for source category 3.D as 0.13 kg NH_3 kg^{-1} fertilizer N applied. NO_x emissions are calculated using Tier 1 methodology according to the EMEP/EEA 2019. For all fertilizer types the default emission factor 4% (i.e. 0.04 kg NO_2 per kg applied fertilizer-N) is used. For 1990-2021, PM emissions are estimated based on suggested Tier 2 EF`s for agricultural crop operations in wet climate conditions. The implemented emission factors for PM emissions are represented in Table 5.20.

Table 5.20 PM emission factors for agricultural crop operations

Crop	EF, kg ha^{-1} for PM_{10}				EF, kg ha^{-1} $PM_{2.5}$			
	Soil cultivation	Harvesting	Cleaning	Drying	Soil cultivation	Harvesting	Cleaning	Drying
Wheat	0.25	2.7	0.19	0.56	0.015	0.02	0.009	0.168
Ray	0.25	2.0	0.16	0.37	0.015	0.015	0.008	0.111
Barley	0.25	2.3	0.16	0.43	0.015	0.016	0.008	0.129
Oat	0.25	3.4	0.25	0.66	0.015	0.025	0.0125	0.198
Other arable	0.25	NC	NC	NC	0.015	NC	NC	NC
Grass	0.25	0.25	0	0	0.015	0.01	0	0

NH_3 emissions from pasture grazed by livestock and animal manure applied to soils are derived by Tier 2 methodology that is implemented for NH_3 emissions calculation from manure management.

Proposed maximum HCB concentration (impurity factor) in active substances is used according to EMEP/EEA 2019 suggestions[36].

5.3.5 Activity data

Information regarding inorganic N-fertilizer use and the area covered by crops is provided by CSB for the period of 1990-2022. The data about the use of nitrogen with inorganic fertilizers are included in Figure 5.6.

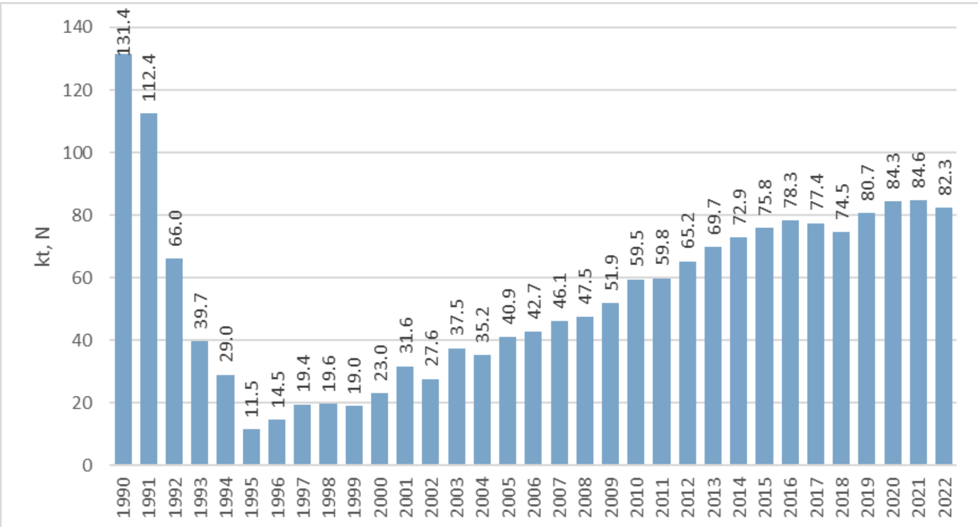

Figure 5.6 Used N with inorganic N-fertilizer 1990-2022, kt

The area covered by crops for period 1990-2022 is represented in Figure 5.7. Activity data source is CSB. Total sown area in 2022 was 1302.4 thousand hectares. Due to climatic conditions and agriculture practice, it is assumed that the number of operations for soil cultivation take place once per year.

[36] EMEP/EEA air pollutant emission inventory guidebook 2019. Table 4. Available at: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/4-agriculture/3-d-f-3-i/view

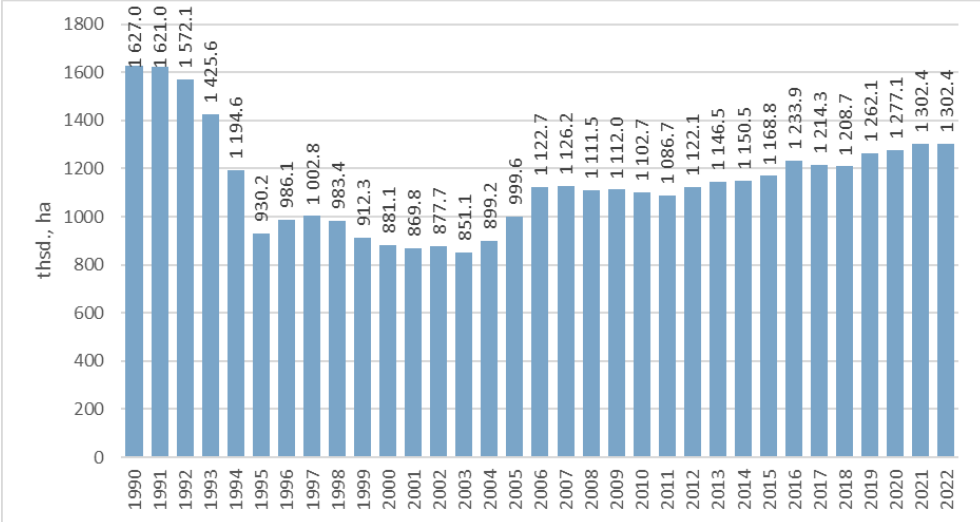

Figure 5.7 Area covered by crops 1990-2022, thsd. ha

Data on the amount of sewage sludge applied to agricultural soils are provided LEGMC, other data of organic N fertilizer applied to soils are obtained from CSB. The amount of nitrogen in sewage sludge and other organic fertilizers is calculated based on available research projects outcomes[37;38]. Available data are represented in Figure 5.8.

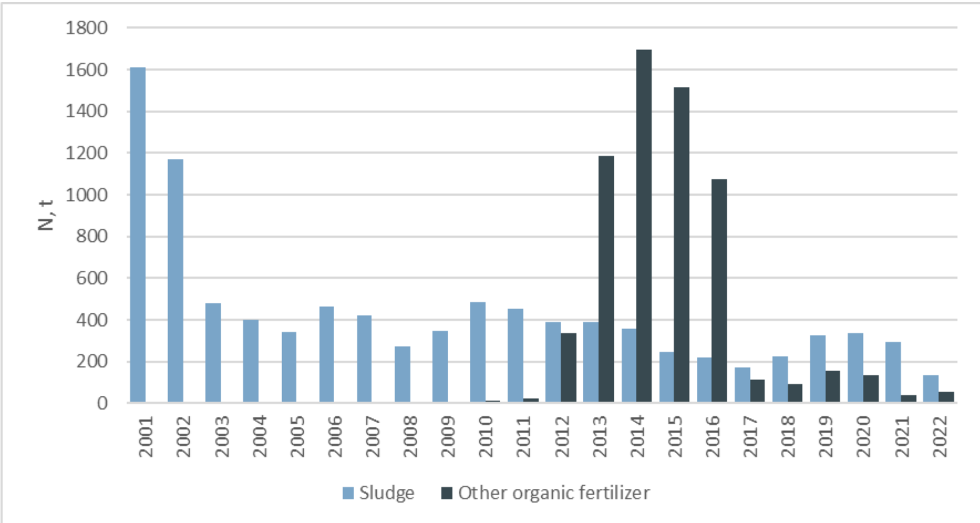

Figure 5.8 N in sewage sludge and other organic fertilizers applied to soils 2001-2022, t

The used amount of organic fertilizers is different each year and depends on weather conditions and synthetic fertilizers' market situation. Latvian statistics report the amount of fertilizers applied. Detailed statistics of the used amount of different fertilizer types in 2022 is available in Table 5.21.

Table 5.21 Activity data for the estimation of NH_3 emissions from application of inorganic fertilizers, t

Fertilizer type	2022
Ammonium nitrate (AN)	101852
Ammonium sulphate (AS)	38560
Calcium ammonium nitrate (CAN)	11656
Urea	7522

[37] Gemste I., Vucāns A. (2010) Notekūdeņu dūņas. Jelgava, LLU, 276 lpp.
[38] Litiņa I. (2013) Digestāta kā mēslošanas līdzekļa efektivitātes novērtējums kukurūzas sējumā. Zinātniski praktiskā konference LAUKSAIMNIECĪBAS ZINĀTNE VEIKSMĪGAI SAIMNIEKOŠANAI. Jelgava, LLU, 206-209 lpp.

Fertilizer type	2022
N solutions (UAN)	14261
Calcium nitrate	1267
Other N compounds	23448
NPK Mixtures	109477

The calculation results of NH_3 and NOx emissions from application of sewage sludge is described in subcategory Da2b – Sewage sludge applied to soils. Nitrogen quantities from application of sewage sludge were calculated from LEGMC data. NH_3 and NOx emissions are calculated by multiplying the amounts of nitrogen in sewage sludge applied with the respective Tier 1 emission factors. To calculate nitrogen in sewage sludge, it is assumed that sewage sludge has a nitrogen content of 5.2% in the dry matter.

The subcategory 3Da2c – other organic fertilizers applied to soils describes Latvia's NH_3 and NOx emissions from application of digestate and composts. Nitrogen quantities from application of digestate and composts were calculated from data of CSB. It is assumed that digestate has nitrogen content of 5.85% in the dry matter and composts have around 2% of nitrogen in the dry matter.

Annual statistics on the quantities of plant protection products sold domestically and consumption are collected in limited amounts in Latvia. CSB provides information on the total amounts of fungicides and bactericides, herbicides, insecticides and plant growth regulators use for cereals in 2014 and 2017, as well as for the use for vegetables and fruits in 2014 (on 1 ha of sown area as active substances, kg). Distributed quantities of active substances that case HCB emissions during 2004-2021 are collected by State Plant Protection Service. Based on the available information from State Plant Protection Service data of pesticide use are estimated by expert for 1990-2003. Data of State Plant Protection Service have restricted access. For reporting C (confidential) is used for sources of pollutants.

5.3.6 Uncertainties

The uncertainty associated with activity data is received from CSB. Generally, the uncertainty of activity data provided by CSB is set as 2%. Uncertainty of emission factors is no less than 50% for NH_3 emissions.

5.3.7 QA/QC and verification

A sectorial expert performed assessment of trends. Statistical data are verified by CSB.

5.3.8 Recalculations

Recalculations are done for NMVOC emissions. NMVOC emissions form soils are recalculated with Tier 2 methodology and NMVOC emissions form crop production are recalculated with different EFs for wheat, rye, rape and grass.

5.3.9 Planned improvements

Implementation of EMEP/EEA air pollutant emission inventory guidebook 2023 methodology.

5.4 Other (NFR 3I)

5.4.1 Overview

Under the category 3I Other NOx, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, BC, TSP, CO, PCDD/PCDF and PAHs emissions from grassland burning are included. Activities like this happen seasonally in Latvia.

5.4.2 Trends in emissions

Table 5.22 Emissions from grassland burning in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022	*Change in 2005-2022, %*
NOx	kt	0.007	0.007	0.029	0.026	0.032	0.042	0.009	0.016	0.026	0.035	0.012	0.013	0.014	***-47.7***
NMVOC		0.019	0.018	0.077	0.069	0.085	0.111	0.023	0.042	0.069	0.091	0.032	0.034	0.036	***-47.7***

	Unit	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022	*Change in 2005-2022, %*
SO_2		0.002	0.002	0.007	0.006	0.007	0.010	0.002	0.004	0.006	0.008	0.003	0.003	0.003	***-47.7***
NH_3		0.002	0.002	0.007	0.006	0.007	0.010	0.002	0.004	0.006	0.008	0.003	0.003	0.003	***-47.7***
$PM_{2.5}$		0.008	0.007	0.032	0.028	0.035	0.046	0.010	0.017	0.028	0.038	0.013	0.014	0.015	***-47.7***
PM_{10}		0.009	0.009	0.039	0.035	0.043	0.056	0.012	0.021	0.035	0.046	0.016	0.017	0.018	***-47.7***
BC		0.001	0.001	0.003	0.003	0.003	0.004	0.001	0.002	0.003	0.003	0.001	0.001	0.001	***-47.7***
TSP		0.015	0.014	0.060	0.054	0.066	0.086	0.018	0.033	0.053	0.071	0.025	0.027	0.028	***-47.7***
CO		0.207	0.196	0.844	0.756	0.931	1.215	0.253	0.461	0.753	1.002	0.349	0.376	0.395	***-47.7***
PCDD/F	g i-Teq	0.004	0.004	0.018	0.016	0.019	0.025	0.005	0.010	0.016	0.021	0.007	0.008	0.008	***-47.7***
PAHs	t	0.014	0.014	0.058	0.052	0.064	0.084	0.017	0.032	0.052	0.069	0.024	0.026	0.027	***-47.7***

Emissions from grassland burning decreased by 47.7% in 2022 in comparison to 2005. Emission amount is directly dependent on the burned area of grassland (Table 5.22, Figure 5.9). The number of grassland fires and burned area of grassland is directly dependent on anthropogenic activities and meteorological conditions, especially during weekends in the spring. Wildfires in grasslands are more common in south eastern part of the country and around urban centers. Decrease of the number of grassland fires and burned area of grassland is related to the rising awareness in society about dangers and negative ecological aspects of deliberate grassland burning. Moreover, grassland burning occurs unorganized and a fine may be applied in accordance with the legislation in Latvia. Over the past 20 years, most (in numbers and area burned) grassland fires occurred in 2006.

5.4.3 Methods

Emissions from grassland burning were determined according to the EMEP/EEA 2023 and 2006 IPCC Guidelines. Emissions from wildfires in grassland were calculated using equation 2.27 of the 2006 IPCC Guidelines. Mass of available fuel in grassland's fires – 2.1 t DM ha^{-1} (Table 2.4 of 2006 IPCC Guidelines), fraction of the biomass combusted 0.74 (Table 2.6 of 2006 IPCC Guidelines).

5.4.4 Emission factors

Emission factors for NO_x, CO, NMVOC, SO_2, NH_3, TSP, PM_{10}, $PM_{2.5}$ and BC emission calculation regarding burning of grassland are shown in the Table 5.23 ((EMEP/EEA 2023, 11.B Forest fires, Table 3-8). Information of condensable component inclusion in emission factors of PM is not provided by the EMEP/EEA 2023.

Table 5.23 Emission factors for grassland burning according to EMEP/EEA 2023

Pollutant	Value	Unit
NO_x	13	kg/ha area burned
CO	373	kg/ha area burned
NMVOC	34	kg/ha area burned
SO_2	3	kg/ha area burned
NH_3	3	kg/ha area burned
TSP	17	g/kg wood burned
PM_{10}	11	g/kg wood burned
$PM_{2.5}$	9	g/kg wood burned
BC	9	% of $PM_{2.5}$

PAH emissions are calculated according to EMEP/CORINAIR, but DIOX emissions are calculated according to UNEP, Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases. Emission factor is chosen as for Grassland and moor fires – 5 µg TEQ/t.

Currently used emission factors are the best available information. National researches on emission factors for grassland burning are not conducted.

5.4.5 Activity data

Area of grassland burning was taken from the SFRS and data is available starting from 1993 (Figure 5.9). For 1990-1992 no statistical information exists. However, an expert's assumption for years 1990-1992 was made, using extrapolation from burned areas of the following 5 years' period.

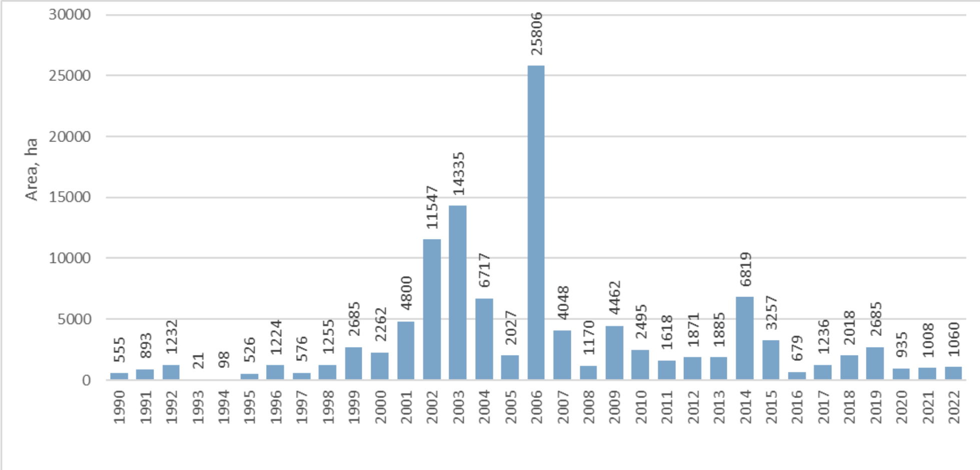

Figure 5.9 Area of last years grass burned (ha)

5.4.6 Uncertainties

Uncertainty of activity data (area) for biomass burning is estimated at ±10 % based on expert judgement. Uncertainties in emission factors are based on the EMEP/EEA 2023 (11.B Forest fires, Table 3-8) default values.

5.4.7 QA/QC and verification

Quality control procedures according to 2006 IPCC Guidelines were done. Assessment of trends were performed. Land areas of wildfires burning were reviewed with latest statistics.

5.4.8 Recalculations

Recalculations are introduced for 2021 due to improvement of activity data (area of burned grassland corrected to 1008 ha in 2021).

5.4.9 Planned improvements

No improvements are planned.

6 Waste (NFR 5)

6.1 Overview of sector

6.1.1 Source category description

Waste management has acquired prior significance in the environmental protection policy as one of the instruments for sustainable use of natural resources. The main directions in the waste management are the development of the construction of polygons and collecting system for non–hazardous municipal waste and the development of system for the collection and treatment of hazardous waste. Currently 10 non-hazardous waste polygons and 1 hazardous waste polygon have got an "A" category pollution permit according to IED directive 2010/75/EC. Biogas collection and use for energy production from biodegradable waste and sludge is set as one of the main priorities in Latvia.

Main activity data sources for emission calculations in waste sector is the "3-Waste" data base, which is developed by LEGMC. According to the information from LEGMC the total generated volume of waste every year is shown in Table 6.1.

Table 6.1 Generated waste in Latvia, kt

	Municipal (all non-hazardous) waste	Hazardous waste	Total
2006	1420.46	54.37	1474.83
2007	1386.57	41.61	1428.18
2008	1368.79	46.40	1415.19
2009	1033.91	55.56	1089.47
2010	1131.40	55.09	1186.49
2011	1535.06	58.48	1593.53
2012	1799.44	85.12	1884.56
2013	1902.01	109.23	2011.24
2014	2013.70	80.98	2094.67
2015	2087.51	86.60	2174.11
2016	1980.28	63.66	2043.94
2017	2141.21	68.76	2209.97
2018	1587.74	118.14	1705.88
2019	1698.71	115.46	1814.17
2020	1605.95	150.03	1755.98
2021	2011.35	111.18	2122.53
2022	2099.51	79.17	2178.68

Data of water abstraction and use, wastewater treatment and discharge has been collected since 1991 in the frame of the state statistical survey "2-Water". Data in the national database "2-Water" must be reported by all enterprises which have issued permits on water resources use or IED permit.

Table 6.2 shows the methods and source for activity data and emission factors used for emission calculation in Waste sector. Table 6.3 shows list of pollutants which are produced in Waste sector.

Table 6.2 Source categories and methods for Waste sector

NFR code	Long name	Method	AD	EF
5A	Solid waste disposal on land	Tier 1	PS	D
5B1	Biological treatment of waste - Composting	Tier 1	PS	D
5B2	Biological treatment of waste – Anaerobic digestion	Tier 2	CS	D
5C1bii	Hazardous waste incineration	Tier 1	PS	D
5C1biii	Clinical waste incineration	Tier 1	PS	D
5C1bv	Cremation	Tier 1	PS	D
5D	Waste-water handling	Tier 2	PS, CS	D
5E	Other (fires)	Tier2	CS	D

Table 6.3 Reported emissions in Waste sector in 2022

NFR code	Emissions
5A	NMVOC, $PM_{2.5}$,PM_{10} ,TSP
5B1	NH_3
5B2	NH_3
5C1bii	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Ni, PCDD/F, total PAHs, HCB
5C1biii	NO_x, NMVOC, SO_2, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, PCDD/F, total PAHs, HCB
5C1bv	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, total PAHs, HCB, PCBs
5D1	NMVOC, NH_3
5D2	NMVOC
5D3	NMVOC
5E	$PM_{2.5}$, PM_{10}, TSP, Pb Cd, Hg, As, Cr, Cu, PCDD/F

6.1.2 Key sources

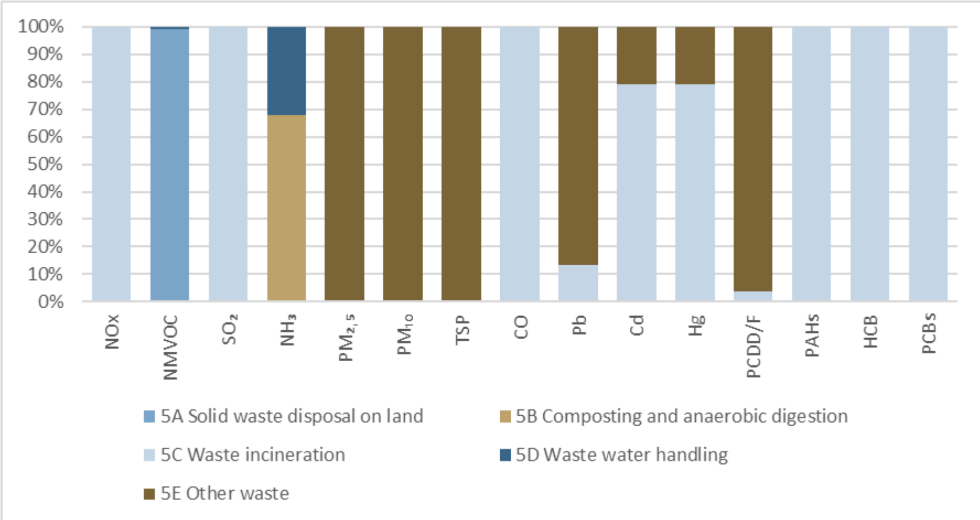

Figure 6.1 Distribution of emissions in Waste sector by subsectors in 2022, %

Almost all NMVOC emissions in Waste sector occur from solid waste disposal (NFR 5A), and largest part of NH_3 emissions are generated in anaerobic digestion process at biogas facilities as well as from composting (NFR 5B). All emissions of NO_x, SO_2, BC, CO, PAHs, HCB and PCB in Waste sector are caused by waste incineration (NFR 5C), and this subsector generates also the largest part of Pb and Hg emissions. Other waste subsector (fires; NFR 5E) produce almost all particulate matter emissions, as well as Cd and largest part of PCDD/F emissions. Wastewater handling (NFR 5D) produces a small part of NMVOC emissions and about one third of NH_3 emissions generated in Waste sector.

6.1.3 Trends in emissions

NO_x and SO_2 emissions have increased since 1990 due to cremation since 1994. NMVOC emissions fluctuate through time series due to the changes of disposed waste amounts. The main source for solid particles emission are fires (5E). As number of fires is estimated back till year 1990 there are no significant changes in emissions.

Table 6.4 Change in emissions from Waste sector between 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x		0,00045	0,00100	0,00166	0,00168	0,00194	0,00202	0,00350	0,00373	0,00338	***643,7***	***101,0***
NMVOC	kt	0,220	0,257	0,299	0,261	0,287	0,249	0,237	0,227	0,246	***11,6***	***-5,8***
SO_2		0,00006	0,00013	0,00019	0,00024	0,00025	0,00028	0,00048	0,00051	0,00046	***684,7***	***94,6***

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	Change in 1990-2022, %	Change in 2005-2022, %
NH_3		0,227	0,214	0,208	0,218	0,244	0,252	0,299	0,304	0.284	***25,2***	***30,3***
$PM_{2.5}$		0,40654	0,40956	0,40959	0,40960	0,40962	0,38576	0,29311	0,28949	0,27740	***-32,3***	***-32,3***
PM_{10}		0,40963	0,40966	0,40970	0,40971	0,40973	0,35856	0,29321	0,28958	0,27748	***-32,3***	***-32,3***
TSP		0,41114	0,41143	0,41081	0,41161	0,41011	0,38630	0,29348	0,28972	0,27760	***-32,5***	***-32,6***
BC		3,24E-05	3,77E-05	2,22E-05	3,99E-05	5,05E-06	7,23E-06	3,16E-06	2,80E-09	NO	***-100,0***	***-100,0***
CO		0,00023	0,00035	0,00065	0,00038	0,00044	0,00034	0,00060	0,00064	0,00057	***151,1***	***49,5***
Pb	t	0,0067	0,0076	0,0056	0,0078	0,0023	0,0023	0,0015	0,0010	0,0010	***-85,1***	***-87,2***
Cd		0,0031	0,0032	0,0029	0,0033	0,0025	0,0024	0,0018	0,0017	0,0077	***149,5***	***137,7***
Hg		0,0060	0,0074	0,0066	0,0091	0,0061	0,0066	0,0083	0,0084	0,0077	***29,2***	***-14,9***
PCDD/F	g I-Teq	3,719	4,285	2,801	4,464	0,887	0,855	1,447	0,003	0,003	***-99,9***	***-99,9***
PAHs	t	9,39E-09	3,00E-08	5,42E-08	6,01E-08	7,56E-08	8,17E-08	5,26E-07	1,39E-07	1,39E-07	***1377,6***	***130.7***
HCB	kg	0,0089	0,0104	0,0072	0,0109	0,0020	0,0022	0,0014	0,0006	0,0007	***-92,4***	***-93,8***
PCB		NA	0,00023	0,00046	0,00063	0,00086	0,00098	0,00172	0,00185	0,00168	***100,0***	***168.1***

Emissions from the waste sector include:

- NMVOC, $PM_{2.5}$, PM_{10}, TSP emissions from solid waste disposal and fires (5E);
- NH_3 emissions from composting and anaerobic digestion;
- NMVOC, NH_3 emissions from waste water handling;
- Many pollutant emissions from incineration of hazardous and clinical waste and cremation. Emissions from waste incineration with energy recovery are counted under the Energy sector.

Data on hazardous waste in Latvia has been collected and compiled by LEGMC since 1997, but data on municipal waste since 2001. Since 2002 databases about hazardous and municipal waste are combined in one database - "3-Waste". Data in this database is taken from State Statistical survey about waste, which takes place every year. Statistical survey about waste must be filled by all enterprises, that have permits on pollutant activities (A and B category) and all enterprises, that have permits on waste management operations.

Data of wastewater treatment and discharge has been collected since 1991 in the frame of the state statistical survey "2-Water". State statistical survey "2-Water" must be reported by all enterprises which have issued permits on water resources use or IED permit. CSB data is also used as activity data for emission calculation.

6.2 Solid waste disposal (NFR 5A)

6.2.1 Overview

Solid waste disposal is the main waste treatment operation in Latvia. Significant amount of landfill gas is emitted annually from waste disposal sites. NMVOC are part of landfill gas. NMVOC emissions relate to methane emissions from solid waste disposal.

6.2.2 Trends in emissions

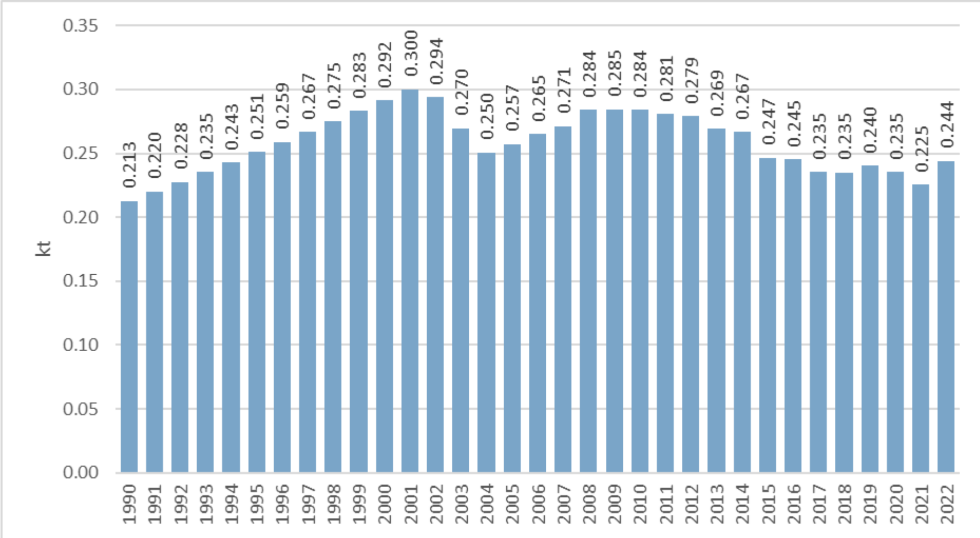

Figure 6.2 NMVOC emissions from Solid waste disposal, kt

Emissions of NMVOC from solid waste disposal (Figure 6.2) correlate with CH_4 emissions, which are calculated according under UNFCCC. These emissions mostly relate to disposed waste amount in landfills. In last year's emissions decrease due to smaller amount of disposed waste in landfills.

6.2.3 Methods

NMVOC, $PM_{2.5}$, PM_{10}, TSP emissions from solid waste disposal are calculated. Methodology from EMEP/EEA 2019 is used for emission calculations. To estimate NMVOC, $PM_{2.5}$, PM_{10}, TSP emissions from solid waste disposal, disposed amount is multiplied by emission factors from "Table 3-1 Tier 1 emission factors for source category 5.A Biological treatment of waste - Solid waste disposal on land".

6.2.4 Emission factors

Table 6.5 Emission factors for disposed waste (EMEP/EEA 2019)

Pollutant	EF (unit/disposed waste)
NMVOC	5.65 g /1 m^3 landfill gas
$PM_{2.5}$	0.033 g/t
PM_{10}	0.219 g/t
TSP	0.463 g/t

6.2.5 Activity data

To calculate $PM_{2.5}$, PM_{10}, TSP emissions - amount of disposed waste must be known.

Data about disposed amount is taken from the waste statistical survey "3-Waste" (Figure 6.3).

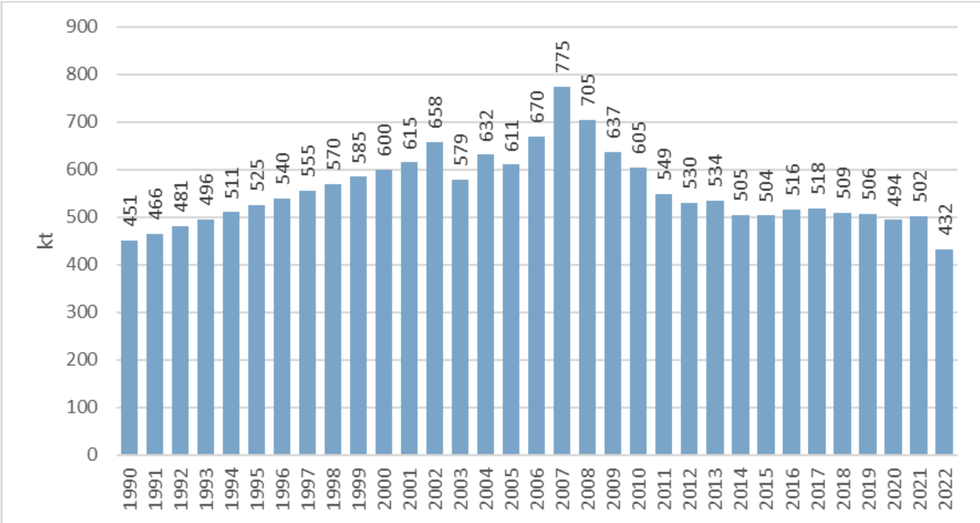

Figure 6.3 Disposed waste amount in Latvia, kt

Disposed amount for 1990-2001 is estimated according to equal growth between 1975 and 2002. The base year for disposed amount is 1975. According to research about Latvia landfills (LEGMC, 2016) disposed amount in 1975 was 249 860 tonnes. Data about waste disposal on land for 2002-2021 is taken from the database "3-Waste". Fluctuations in disposed waste amount is due to economic growth in years 2007 and 2008. The disposed amount last year decreased due to waste recovery development.

To calculate NMVOC emissions - CH_4 emission from annual GHG inventory must be known. CH_4 emissions are calculated with 2006 IPCC Guidelines waste model spreadsheet. Calculation are divided in two parts - for managed and unmanaged waste disposal sites.

6.2.6 Uncertainties

Uncertainty for activity data is estimated as 5.57%. The same uncertainty is used also for emission calculations in GHG inventory under UNFCCC.

6.2.7 QA/QC and verification

Disposed waste amount is taken from waste database. Data in this database is checked and approved by Regional Environmental Boards. Checks for emission calculations were done. Assessment of trends was performed.

6.2.8 Recalculations

NMVOC emissions are recalculated for entire time series due to new estimation of CH_4 emissions from solid waste disposal.

6.2.9 Planned improvements

No planned improvements.

6.3 Composting and anaerobic digestion (NFR 5B)

6.3.1 Overview

NH_3 emissions from waste composting and manure anaerobic digestion are calculated under this category.

Composting is set as one of the priorities in waste treatment in Latvia. Composting biological degradable waste is useful. In Latvia that is mostly "park - garden" and "food production" waste.

Data about industrial composting became available 2003, when waste treatment companies started waste composting and got IPPC permits for this activity.

Composting in private households has been very popular for many years. Composted waste amount in households is estimated according household statistics from CSB. To estimate composted amount research done by Waste Management Association of Latvia in 2015 about composting was taken into account.

6.3.2 Trends in emissions

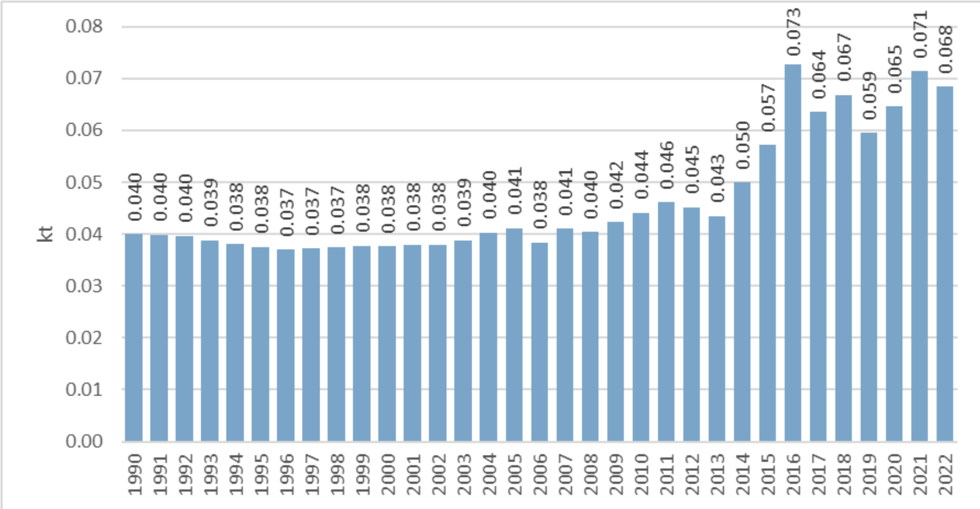

Figure 6.4 NH_3 emissions from composting, kt

Composting NH_3 emissions increase in 2016 was due to increase of industrial composting amounts.

Manure anaerobic digestion in biogas facilities starts in 2009. Data is obtained from agriculture sector. Emissions associated with manure anaerobic digestion are increasing every year because of increase of used manure feedstock.

Table 6.6 Manure anaerobic digestion at biogas facilities

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AR feedstock, kt	0.60	0.77	1.64	2.24	2.56	2.29	2.40	2.95	3.69	3.69	4.19	4.14	3.71
NH_3 emission, kt	0.02	0.03	0.05	0.07	0.09	0.08	0.08	0.10	0.12	0.12	0.14	0.14	0.12

6.3.3 Methods

Composted waste amount is multiplied by emission factor.

Ammonia emissions from anaerobic digestion at biogas facilities from manure are estimated using Tier 2 approach described in EMEP/EEA 2023 5.B.2 chapter:

$$E_{NH_3} = AR_{feedstock} \cdot \sum_{stages} EF_{NH3-N\,i} \cdot 17/14$$

Where:

$AR_{feedstock}$ - the total annual amount of N in feedstock estimated by EMEP/EEA 2023 3.B-chapter Tier 2 approach section 3.4 in Step 8, kg N;

$EF_{NH3-N\,i}$ - NH_3-N EF per stage: pre-storage – 0.0009 kg NH_3-N per kg N feedstock (Table 3.2), digester (considered negligible as described in section 2.3 EMEP/EEA 2023 5.B.2 chapter), storage of digestate – 0.0266 kg NH_3-N per kg N feedstock (Table 3.3.).

Emissions associated with digestate application to the soil are described in chapter 5 AGRICULTURE (NFR3).

6.3.4 Emission factors

NH_3 emission factor (0.24 kg/t) for composting is taken from EMEP/EEA 2023.

For manure digestion in biogas facilities Tier 2 emission factors are used for different stages. Emission factor for pre-storage of feedstock is 0.0009 kg NH_3-N per kg N feedstock (EMEP/EEA 2023 5.B.2 chapter Table

3.2). Emission from digester is considered negligible. Emission factor for storage of digestate (open storage) is 0.0266 kg NH_3-N per kg N feedstock (EMEP/EEA 2023 5.B.2 chapter Table 3.3).

6.3.5 Activity data

Composted waste amount is taken from the "3-Waste" database, R3 - Recycling/reclamation of organic substances that are not used as solvents (including composting and other biological transformation processes), recovery operation for determination of composted amount was used. Not all amount, which is classified under recovery as R3, is composted. To determine composted amount, each enterprise, which reports recovery operations R3, working profile must be considered. Starting from 2013 separate R3A code for composting was implemented in legislation and reporting requirements of Latvia.

Table 6.7 Composted waste amount, kt

	Industrial waste composted	Household waste composted	Total waste composted
1990	NO	166.89	166.89
1991	NO	166.26	166.26
1992	NO	165.31	165.31
1993	NO	161.73	161.73
1994	NO	158.93	158.93
1995	NO	156.41	156.41
1996	NO	154.46	154.46
1997	NO	155.34	155.34
1998	NO	155.98	155.98
1999	NO	157.37	157.37
2000	NO	157.14	157.14
2001	NO	158.18	158.18
2002	NO	158.18	158.18
2003	2.22	159.49	161.72
2004	7.91	160.05	167.96
2005	6.56	164.91	171.47
2006	11.70	148.18	159.88
2007	9.42	161.88	171.29
2008	9.28	159.23	168.51
2009	15.11	161.14	176.25
2010	18.55	165.19	183.74
2011	23.70	168.72	192.42
2012	17.62	170.79	188.41
2013	14.37	166.70	181.07
2014	40.04	168.25	208.29
2015	67.58	170.53	238.11
2016	135.22	167.82	303.04
2017	98.90	166.10	265.00
2018	112.25	166.17	278.42
2019	81.94	165.87	247.81
2020	95.48	173.83	269.31
2021	126.6	171.129	297.729
2022	116.33	168.64	284.97

Activity data for estimation of manure feedstock for anaerobic digestion is described in 5.2 Manure management chapter.

6.3.6 Uncertainties

Uncertainty for activity data is estimated as 28.13%. The same uncertainty is used also for calculations in GHG inventory under UNFCCC.

Activity data uncertainty for anaerobic digestion of manure is 25%.

6.3.7 QA/QC and verification

Industrial composted waste amount is taken from "3-Waste" data base. Data in this data base is checked and approved by State Environmental Service Regional Environmental Boards. Assessment of trends have been performed.

6.3.8 Recalculations

No recalculations.

6.3.9 Planned improvements

No planned improvements.

6.4 Waste incineration (NFR 5C)

6.4.1 Overview

Currently there are no large amounts of waste being incinerated in Latvia without energy recovery. The main source of emissions is attributed to the hazardous and clinical waste incineration. The amount of incinerated clinical waste are registered in the hazardous waste database (from 2002 in the "3-Waste" data base) as "Health service for humans and animals as well as related research waste" (European Waste catalogue class – 180103). The rest of the incinerated waste from hazardous waste database is considered as hazardous (industrial) waste.

Incinerated amount for years 1990-1998 is extrapolated according to the average value of incinerated amount for years 2002-2013 what is attributed to disposed waste value.

Open burning of waste is reported as NE (Not estimated). Open burning is not allowed in Latvia according to the Waste Management Law.

In cremation sector 5C1bv emissions from human bodies and animal waste (carcasses) incineration are calculated.

6.4.2 Trends in emissions

PM_{10}, $PM_{2.5}$, NO_x and SO_2 emissions have increased since 1990 due to cremation since 1994 and animal waste burning since 2011. NMVOC emissions decrease till 2016 due to decrease of incineration of hazardous waste. In years 2015 and 2016 hazardous waste was not incinerated in Latvia.

For clinical waste all 18 European Waste catalogue (EWC) group codes are counted. For clinical waste increase is in 2006 and 2007, when clinical waste was incinerated in hazardous waste incineration facility. From year 2008 facility was closed.

$PM_{2.5}$, PM_{10}, TSP emissions are calculated from animal (carcasses) waste burning. Data in the "3-Waste" data base is available from 2011. Bird factory and cattle remains were burned in installation without energy recovery.

Table 6.8 Emissions in Waste incineration in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NO_x	kt	0,00045	0,00100	0,00166	0,00168	0,00194	0,00202	0,00350	0,00373	0,00338	*643,7*	*101,0*
NMVOC		0,00231	0,00270	0,00516	0,00168	0,00152	0,00004	0,00020	0,00021	0,00005	*-97,7*	*-96,9*
SO_2		0,00006	0,00013	0,00019	0,00024	0,00025	0,00028	0,00048	0,00051	0,00046	*684,7*	*94,6*
$PM_{2.5}$		0,00000	0,00002	0,00004	0,00005	0,00007	0,00008	0,00015	0,00016	0,00015	*11852,2*	*170,2*
PM_{10}		0,00000	0,00002	0,00004	0,00005	0,00007	0,00008	0,00015	0,00016	0,00014	*6566,7*	*160,0*
TSP		0,00141	0,00166	0,00101	0,00180	0,00030	0,00041	0,00030	0,00017	0,00016	*-88,8*	*-91,2*
BC		0,00003	0,00004	0,00002	0,00004	0,00001	0,00001	3,2E-06	2,8E-09	NO	*-100,0*	*-100,0*
CO	t	0,00023	0,00035	0,00065	0,00038	0,00044	0,00034	0,00060	0,00064	0,00057	*151,1*	*49,5*

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
Pb		0,00553	0,00646	0,00443	0,00666	0,00112	0,00122	0,00065	0,00016	0,00012	*-97,8*	*-98,2*
Cd		0,00069	0,00081	0,00053	0,00085	0,00013	0,00016	0,00009	0,00002	0,00611	*782,4*	*621,9*
Hg		0,00357	0,00501	0,00414	0,00668	0,00370	0,00436	0,00661	0,00671	0,00611	*70,9*	*-8,6*
PCDD/F	g I-Teq	3,41614	3,98127	2,49803	4,16042	0,58378	0,73998	0,33027	0,00712	0,00011	*-100,0*	*-100,0*
PAHs	t	9,4E-09	3,0E-08	5,4E-08	6,0E-08	7,6E-08	8,2E-08	5,3E-07	5,5E-07	1,4E-07	*1377,6*	*130,7*
HCB	kg	0,00888	0,01044	0,00719	0,01087	0,00200	0,00221	0,00144	0,00068	0,00062	*-93,1*	*-94,3*
PCB		NA	0,00023	0,00046	0,00063	0,00086	0,00098	0,00172	0,00185	0,00168	*100,0*	*168,1*

6.4.3 Methods

For emission calculation EMEP/EEA 2023 methodology was used. The amount of incinerated waste was multiplied by emission factors.

6.4.4 Emission factors

Table 6.9 Emission factors for waste incineration

	Units EF	Industrial EF	Clinical EF	Animal EF
NO_x	kg/t	0.87	2.3	-
NMVOC	kg/t	7.4	0.7	-
SO_2	kg/t	0.047	0.54	-
CO	kg/t	0.07	0.19	-
$PM_{2.5}$	kg/t	0.004	NE	0.538
PM_{10}	kg/t	0.007	NE	0.628
TSP	kg/t	0.01	17	0.897
Pb	g/t	1.3	62	-
Cd	g/t	0.1	8	-
Hg	g/t	0.056	43	-
As	g/t	0.016	0.2	-
Cr	g/t	NE	2	-
Cu	g/t	NE	98	-
Ni	g/t	0.14	2	-
Se	g/t	NE	NE	-
Zn	g/t	NE	NE	-
PCDD/PCDF	µg i-Teq/t	350	40	-
PAHs	g/t	0.02	0.04	-
HCB	g/t	0.002	0.1	-
PCBs	g/t	NE	NA	-

Emissions from cremation are calculated according to EMEP/EEA 2023.

Table 6.10 Emission factors from cremation

	EF	Units EF
NO_x	0.825	kg/body
NMVOC	0.013	kg/body
SO_2	0.113	kg/body
CO	0.14	kg/body
$PM_{2.5}$	34.70	g/body
PM_{10}	34.70	g/body
TSP	38.56	g/body
CO	0.14	kg/body
Pb	30.03	mg/body
Cd	5.03	mg/body
Hg	1.49	g/body
As	13.61	mg/body

	EF	Units EF
Cr	13.56	mg/body
Cu	12.43	mg/body
Ni	17.33	mg/body
Se	19.78	mg/body
Zn	160.12	mg/body
PCDD/ PCDF	0.027	µg/body
benzo(a) pyrene	13.2	µg/body
HCB	0.15	mg/body
PCBs	0.41	mg/body

6.4.5 Activity data

Table 6.11 Incinerated waste in Latvia, kt

	Hazardous waste	Clinical waste	Animal waste	Total
1990	0.429082	0.116729	NO	0.810708
1991	0.404964	0.110168	NO	0.765137
1992	0.380845	0.103606	NO	0.719567
1993	0.356726	0.097045	NO	0.673997
1994	0.332607	0.090484	NO	0.628427
1995	0.308488	0.083922	NO	0.582857
1996	0.321434	0.087444	NO	0.607317
1997	0.341924	0.093018	NO	0.646031
1998	0.362414	0.098592	NO	0.684744
1999	0.347210	0.201420	NO	0.750146
2000	0.690280	0.056410	NO	1.188603
2001	1.319270	0.213310	NO	2.364508
2002	0.165643	0.032247	NO	0.301688
2003	0.201813	0.040607	NO	0.368726
2004	0.210125	0.112325	NO	0.445552
2005	0.215127	0.102127	NO	0.444831
2006	0.786160	0.261890	NO	1.527627
2007	0.540500	0.350861	NO	1.200583
2008	0.299750	0.012361	NO	0.505465
2009	0.200000	0.011663	NO	0.340263
2010	0.200000	0.012843	NO	0.341302
2011	0.006300	0.012738	0.366092	0.343765
2012	NO	0.018049	0.348861	0.322881
2013	NO	0.005887	0.479833	0.427434
2014	0.166927	0.010341	0.316603	0.493301
2015	NO	0.018498	0.185480	0.203978
2016	NO	0.010198	0.186535	0.196733
2017	0.135432	0.02906	0.042067	0.206559
2018	0.2396	0.00138	NO	0.24098
2019	0.01412	0.01	NO	0.02412
2020	0.008086	0.0192	NO	0.027286
2021	0.02	NO	NO	0.02
2022	NO	NO	NO	NO

Emissions from cremation are calculated according to EMEP/EEA 2023.

Data about burned bodies provided by operators of crematorium.

Table 6.12 Burned bodies in Riga and Valmiera crematoriums

	Burned bodies
1994	54
1995	564
1996	819
1997	817

	Burned bodies
1998	869
1999	982
2000	1127
2001	1297
2002	1293
2003	1389
2004	1391
2005	1529
2006	1630
2007	1959
2008	2227
2009	1977
2010	2102
2011	2158
2012	1970
2013	2150
2014	2222
2015	2395
2016	2396
2017	3343
2018	3708
2019	4029
2020	4200
2021	4500
2022	4100

6.4.6 Uncertainties

Uncertainty for cremation of bodies is not estimated, because it is correct figure from crematorium. Uncertainty of incinerated amount from the "3-Waste" database is 51.79 %. The same uncertainty is also used for calculations in GHG inventory under UNFCCC.

6.4.7 QA/QC and verification

Incinerated waste amount is taken from waste database. Data in this database is checked and approved by Regional Environmental Boards. Assessment of trends was performed.

QA/QC and verification includes:

- Quality check of activity data in the period of reporting;
- Quality check in calculation of emissions in GHG inventory under UNFCCC.

6.4.8 Recalculations

No recalculations.

6.4.9 Planned improvements

No planned improvements.

6.5 Waste water handling (NFR 5D)

6.5.1 Overview

Data of LEGMC shows there were 173 million m^3 of waste water discharged in Latvia, including 114 million m^3 of treated wastewater (2022). Most of national population (81%, 2022) is served by centralized urban waste water collecting and treatment.

6.5.2 Trends in emissions

Table 6.13 NMVOC and ammonia emissions from Waste water handling, kt

	1990	2000	2005	2010	2015	2019	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
NMVOC	0,0053	0,0023	0,0020	0,0020	0,0018	0,0019	0,0017	0,0017	0,0017	*-67,8*	*-13,7*
NH_3	0,1867	0,1707	0,1767	0,1799	0,1183	0,0885	0,0943	0,0945	0,0917	*-50,9*	*-48,1*

NH_3 emissions are slightly decreasing over entire period (Table 6.13) due to factors as slow decrease of national population, increase of collection and treatment of waste water. Emissions of NMOVC are stable around 0.0017 kt/a in the last years although they too tend to decrease if viewed in a longer time period.

Domestic waste water handling is main source of NMVOC emissions in waste water handling sector, contributing on average 79% of sector emissions (87% in 2022). Industrial and other waste water handling subsectors have less significance, contributing on average 11% and 12% of emissions, correspondingly (or 3% and 10% correspondingly in 2022).

6.5.3 Methods

For emission calculation methodology from EMEP/EEA air pollution emission inventory guidebook 2023 was used (Table 6.14). According to the methodology, activity data is multiplied by relevant emission factors to calculate emissions, and for both substances Tier 2 method is applied.

Amount of treated waste water (i.e. activity data to estimate NMVOC emissions) were divided into three flows: domestic (municipal waste water collection and treatment), industrial (manufacturing industry) and other (agriculture, fisheries, services etc.), and NMVOC emissions were calculated separately for each flow, and reported correspondingly as NFR 5D1 (domestic), NFR 5D2 (industrial) and NFR 5D3 (other).

Emissions of NH_3, originating only from latrines, are reported under sector NFR 5D1 (domestic waste water).

6.5.4 Emission factors

Table 6.14 Activity data and emission factors for calculation of NH_3 and NMVOC emission from NFR 5D

	Activity data	Emission factor value	Emission factor unit
NH_3	Population using latrines	1.6	kg/person/year
NMVOC	Amount of waste water produced	15	mg/m^3 waste water

Default EMEP/EEA emission factors for both NH_3 and NMVOC were used.

6.5.5 Activity data

Activity data was taken from water use, treatment and discharge national statistics (data base of the state statistical survey "2-Water").

Table 6.15 Activity data type and value example

	Source of activity data	Activity data value (2022)
NH_3	Population using latrines	57 (thousands of people)
NMVOC	Amount of waste water treated and discharged	114 (millions of m^3)

Population using latrines was estimated through rate of urbanization (data of World Bank and CSB) and degree of treatment and discharge pathway or method for national population not connected to waste water collecting system (2006 IPCC Guidelines). Part of national population, not connected to centralized waste water collecting and treatment system, are served with septic tanks, which, according to EMEP/EEA 2023, is not a source of NH_3 emissions.

Statistical data on number of national population served or not served by waste water collecting and treatment services is available since 2000. Extrapolation was used to obtain part of population not served for period 1990-1999. Extrapolation and change in reporting procedure implemented in 2008 and again in 2011 can lead to some inconsistency of statistical data results.

Extrapolation was also used to divide amount of treated waste water between flows of domestic, industrial and other waste water for period 1990-1999, when exact statistical data were not available.

Table 6.16 Activity data and result of emission (NH_3, NMVOC) calculations from NFR 5D 1990-2022

	Population using latrines	Emission of NH_3, kt	Amount of domestic waste water treated and discharged, mio m^3	Amount of industrial waste water treated and discharged, mio m^3	Amount of other waste water treated and discharged, mio m^3	Emission of NMVOC, kt
1990	116 677	0.187	246	63.6	45.6	0.00533
1991	116 116	0.186	237	58.8	43.4	0.00508
1992	115 787	0.185	221	52.6	40.0	0.00470
1993	114 275	0.183	182	41.9	32.5	0.00384
1994	111 525	0.178	173	38.2	30.5	0.00362
1995	110 136	0.176	155	32.8	27.1	0.00323
1996	108 987	0.174	146	29.5	25.2	0.00301
1997	108 060	0.173	145	28.1	24.8	0.00297
1998	107 052	0.171	144	26.5	24.3	0.00292
1999	106 560	0.170	129	22.6	21.5	0.00259
2000	106 703	0.171	118	19.5	15.7	0.00230
2001	123 286	0.197	116	18.2	16.0	0.00225
2002	115 131	0.184	117	18.1	15.6	0.00226
2003	126 418	0.202	105	15.8	14.6	0.00204
2004	112 579	0.180	107	11.4	14.5	0.00199
2005	110 467	0.177	105	12.2	14.6	0.00199
2006	106 308	0.170	101	11.1	14.5	0.00189
2007	104 218	0.167	113	9.7	13.8	0.00205
2008	122 758	0.196	104	8.3	12.2	0.00187
2009	112 415	0.180	95	8.8	8.4	0.00168
2010	112 410	0.180	106	6.3	19.7	0.00198
2011	80 662	0.129	107	8.7	12.2	0.00192
2012	82 816	0.133	103	8.7	9.7	0.00182
2013	79 592	0.127	105	9.7	12.2	0.00191
2014	79 617	0.127	100	9.4	15.0	0.00186
2015	73 952	0.118	100	9.7	12.2	0.00183
2016	72 753	0.116	102	4.7	7.5	0.00171
2017	57 601	0.092	107	4.5	30.1	0.00214
2018	62 998	0.101	94	4.2	24.9	0.00185
2019	55 317	0.089	103	4.1	19.1	0.00189
2020	58 945	0.094	97	5.1	10.0	0.00169
2021	59 036	0.094	98	3.7	12.0	0.00170
2022	57 299	0.092	100	3.1	11.3	0.00172

Considerable increase of amount of treated other waste water in the period 2017-2019 are due to emerging of rather large amount of treated waste water from fisheries and quarrying facilities.

6.5.6 Uncertainties

The following uncertainties have been calculated for Wastewater Handling sector for activity data and emission factors. Uncertainties were estimated, using similar methodology as in the GHG inventory under UNFCCC.

Table 6.17 Uncertainties for Waste Water handling sector

Emission	Activity data	Emission factor
NH_3	11%	200%
NMVOC, combined	8%	150%
NMVOC, 5D1 (domestic waste water handling)	8%	150%
NMVOC, 5D2 (industrial waste water handling)	29%	150%

Emission	Activity data	Emission factor
NMVOC, 5D3 (other waste water handling)	24%	150%

6.5.7 QA/QC and verification

QA/QC and verification included:

- Quality check of activity data in the period of annual reporting, when water using enterprises are submitting their annual water data (including both number of national population served by waste water collection and/or certain type and level of treatment, and amount of total waste water discharged); data is submitted electronically in the water statistics data base "2-Water", and only after a quality check, performed by an inspector of Regional Environment Board of State Environment Service, the particular report is included in national statistics.
- Quality check in calculation of emissions for GHG inventory under UNFCCC;
- Trend analysis;
- Additional data checks were performed to increase the quality of waste water statistics itself.

6.5.8 Recalculations

Recalculations were performed for period 2000 – 2021 for NMVOC in all subsectors due to update of activity data. As result of recalculation, emissions of NMVOC from Domestic waste water subsector increased in average by 0.7%, from Industrial subsector – decreased in average by 0.06%, and from other waste water sector – decreased by 5.1%.

Emissions of NH_3 were recalculated for 2021 due to update of activity data. As result, emission increased by 0.7% in 2021.

However, these recalculations did not inflict significant changes in emissions of both NH_3 and NMVOC in scope of entire Waste water sector.

6.5.9 Planned improvements

No improvements are planned.

6.6 Other waste (NFR 5E)

6.6.1 Overview

Emissions from various types of fires are estimated since 1990.

To estimate emissions from fires, data from Fire and Rescue service was used. Data from Fire and Rescue service is available since 2011. Every year Fire and Rescue service publishes a report on number of fires in the country. According to EMEP/EEA 2023 guidelines number of industrial, undetached and detached house and car fires are used for emissions calculations. For years 1990-2010 average number of fires from years 2011 to 2016 are used as activity data. Detached houses are estimated as 65.2% from all living houses[39].

6.6.2 Trends in emissions

Table 6.18 Emissions in Other waste in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
$PM_{2.5}$	kt	0,4095	0,4095	0,4095	0,4095	0,4095	0,3857	0,2930	0,2893	0,2772	*-32,3*	*-32,3*
PM_{10}		0,4095	0,4095	0,4095	0,4095	0,4095	0,3857	0,2930	0,2893	0,2772	*-32,3*	*-32,3*
TSP		0,4095	0,4095	0,4095	0,4095	0,4095	0,3857	0,2930	0,2893	0,2772	*-32,3*	*-32,3*
Pb	t	0,0012	0,0012	0,0012	0,0012	0,0012	0,0011	0,0009	0,0008	0,0008	*-32,5*	*-32,5*
Cd		0,0024	0,0024	0,0024	0,0024	0,0024	0,0023	0,0017	0,0017	0,0016	*-32,6*	*-32,6*

[39] Eurostat - https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-1a.html?lang=ne

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 1990-2022, %*	*Change in 2005-2022, %*
Hg		0,0024	0,0024	0,0024	0,0024	0,0024	0,0023	0,0017	0,0017	0,0016	*-32,6*	*-32,6*
As		0,0038	0,0038	0,0038	0,0038	0,0038	0,0036	0,0027	0,0027	0,0026	*-32,4*	*-32,4*
Cr		0,0037	0,0037	0,0037	0,0037	0,0037	0,0034	0,0026	0,0026	0,0025	*-32,5*	*-32,5*
Cu		0,0085	0,0085	0,0085	0,0085	0,0085	0,0041	0,0061	0,0060	0,0057	*-32,5*	*-32,5*
PCDD/F	g I-Teq	0,3033	0,3033	0,3033	0,3033	0,3033	0,1146	1,1170	0,0029	0,0028	*-99,1*	*-99,1*

$PM_{2.5}$ emissions in 2022 decrease by 32,3% comparing to 2005.

6.6.3 Methods

Number of fires multiplied by emissions factors from EMEP/EEA 2023.

6.6.4 Emission factors

Table 6.19 Emission factors from fires

	Unit	Industrial	Undetached	Detached	Car
$PM_{2.5}$	kg/fire	27.23	61.62	143.82	2.3
PM_{10}	kg/fire	27.23	61.62	143.82	2.3
TSP	kg/fire	27.23	61.62	143.82	2.3
Pb	g/fire	0.08	0.18	0.42	-
Cd	g/fire	0.16	0.36	0.85	-
Hg	g/fire	0.16	0.36	0.85	-
As	g/fire	0.25	0.58	1.35	-
Cr	g/fire	0.24	0.55	1.29	-
Cu	g/fire	0.57	1.28	2.99	-
PCDD/F	mg/fire	0.27	0.62	1.44	0.048

6.6.5 Activity data

Table 6.20 Number of fires

	Industrial	Undetached	Detached	Car
2011	282	1380	2298	449
2012	252	1456	2314	468
2013	263	1410	2237	566
2014	271	1475	2329	633
2015	300	1302	2057	621
2016	269	1231	1950	610
2017	208	2111	1616	624
2018	258	1999	1360	670
2019	175	1842	1258	669
2020	163	1682	1276	589
2021	179	1623	1272	650
2022	200	1671	1163	681

Statistics show that there are 200-300 events of industrial fires and 2800-3800 fires of undetached and detached houses per annum with a fluctuating trend between years.

6.6.6 Uncertainties

Not estimated.

6.6.7 QA/QC and verification

Activity data taken from Fire and Rescue service annual report. This data is verified by the responsible persons for data publications.

6.6.8 Recalculations

Recalculations done due to implementation of detached house fires in calculations. Emissions increases for all years.

6.6.9 Planned improvements

No planned improvements.

7 Other and Natural emissions (NFR 6A, 11B)

7.1 Biomass burning on - site in the forest (NFR 6A)

7.1.1 Overview of sector

This category (NFR 6A) comprises NO_x, CO, $PM_{2.5}$, PM_{10}, TSP, PCDD/PCDF and PAHs emissions arising from burning on site in forest (Table 7.1).

Table 7.1 Emissions from on-site burning in the forest in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 2005-2022, %*
NO_x	kt	0.163	0.225	0.350	0.072	0.048	0.049	0.052	0.054	0.058	*-20.1*
$PM_{2.5}$		1.336	1.840	2.864	0.590	0.395	0.403	0.427	0.443	0.471	
PM_{10}		1.633	2.248	3.500	0.721	0.482	0.493	0.522	0.541	0.576	
TSP		2.523	3.475	5.409	1.115	0.745	0.761	0.806	0.836	0.890	
BC		0.120	0.166	0.258	0.053	0.036	0.036	0.038	0.040	0.042	
CO		11.577	15.943	24.820	5.114	3.419	3.493	3.700	3.838	4.085	
PCDD/F	g i-Teq	0.742	1.022	1.591	0.328	0.219	0.224	0.237	0.246	0.262	
PAHs	t	2.458	3.385	5.269	1.086	0.726	0.742	0.786	0.815	0.867	

Emissions from on-site burning in the forest land have reduced by 20.1% in 2022 in comparison to 2005. Variation of the emissions depends from the annual felling stock and the approach used to utilize harvesting residues. Since 2005 it is becoming more common to use harvesting residues from final felling in forest biofuel production, therefore, incineration and other types of utilization of residues are not used widely anymore in final felling. In thinning harvesting residues are used to improve soils bearing capacity during forwarding. The study on the actual utilization practice was implemented by Latvian State Forest Research Institute "Silava" (LSFRI Silava) in 2012 and 2014. The results demonstrated that no harvesting residues are incinerated in state forests and in 15 % of the clear-felling sites (by area) harvesting residues are incinerated in private forests[40]. Due to lack of information about transition between previous practice and correct figures of incineration of harvesting residues, it is assumed that incineration of harvesting residues is reduced in 2011, but earlier studies[41] are used for previous years.

7.1.2 Methodological issues

2006 IPCC Guidelines, EMEP/EEA 2023 and EMEP/CORINAIR simpler methodologies were used. Emissions were estimated as follows: emission factor multiplied by activity data provided by National forest inventory, State forest service and Fire and Rescue Service.

7.1.3 Emission factors and other parameters

For CO and NO_x emission calculation from burning on - site in the forest default emission factors according to 2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.5 were used. For $PM_{2.5}$, PM_{10}, TSP and BC emission calculation from burning on - site in the forest default emission factors according to EMEP/EEA 2023, 11.B Forest fires, Table 3-1 (Table 7.2) were used. Information of condensable component inclusion in emission factors of PM is not provided by the EMEP/EEA 2023.

Table 7.2 Emission factors for open burning of forests

	Value	Unit
CO	78 ± 31	g kg^{-1} dry matter burnt

[40] Lazdiņš, A., Zariņš, J., 2013. Meža ugunsgrēku un mežizstrādes atlieku dedzināšanas radītās siltumnīcefekta gāzu emisijas Latvijā (Greenhouse gas emissions due to forest fires and incineration of harvesting residues in Latvia), in: Referātu tēzes. Presented at the Latvijas Universitātes 71. zinātniskā konference "Ģeogrāfija, ģeoloģija, vides zinātne", Latvijas Universitāte, Rīga, pp. 133–137.

[41] Līpiņš, L., 2004. Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resersu un to izmantošanas efektivitātes novērtējums).

	Value	Unit
NO_x	1.1 ± 0.6	g kg^{-1} dry matter burnt
TSP	17	g kg^{-1} wood burned
PM_{10}	11	g kg^{-1} wood burned
$PM_{2.5}$	9	g kg^{-1} wood burned
BC	9	% of $PM_{2.5}$

Emission factors for PAHs were estimated by multiplying the benz[a]pyrene emission factor by the appropriate ratios (Table 7.3).

Table 7.3 PAHs emission factors for open burning of forests

PAH	Default emission factor (best estimate), g t^{-1}	Ratio	Emission factor, g t^{-1}
Benzo [b] fluoranthene	7.2	0.6	4.32
Benzo [k] fluoranthene	7.2	0.3	2.16
Benz [a] pyrene	7.2	1.0	7.20
Indeno [123cd] pyrene	7.2	0.4	2.88

Dioxins (PCDD/ PCDF) are calculated according to the UNEP methodology (97. pp.), emission factor – 5 micrograms TEQ/t incinerated material.

The following assumptions were made for burnt harvesting residues calculation (Source: State Forest Service, private forest owners questionnaires):

- 1990 to 2000 – 50 % of harvesting residues left for incineration and 67 % incinerated, the rest left to decay;
- 2001 to 2004 – 30 % of harvesting residues left for incineration and 67 % incinerated and 70 % left to decay;
- 2005 to 2009 – 7 % of harvesting residues left for incineration and 100 % burned on-site, the rest left for decay or extracted for bioenergy production.
- starting from 2010 – 4 % of harvesting residues left for incineration and 100 % burned on-site, the rest left for decay or extracted for bioenergy production.

7.1.4 Activity data

Emissions from controlled fires were calculated considering average stock of harvesting residues (BEFs for conversion of stem biomass to above-ground biomass). Emissions increased due to increase of estimates of harvesting stock (Figure 7.1).

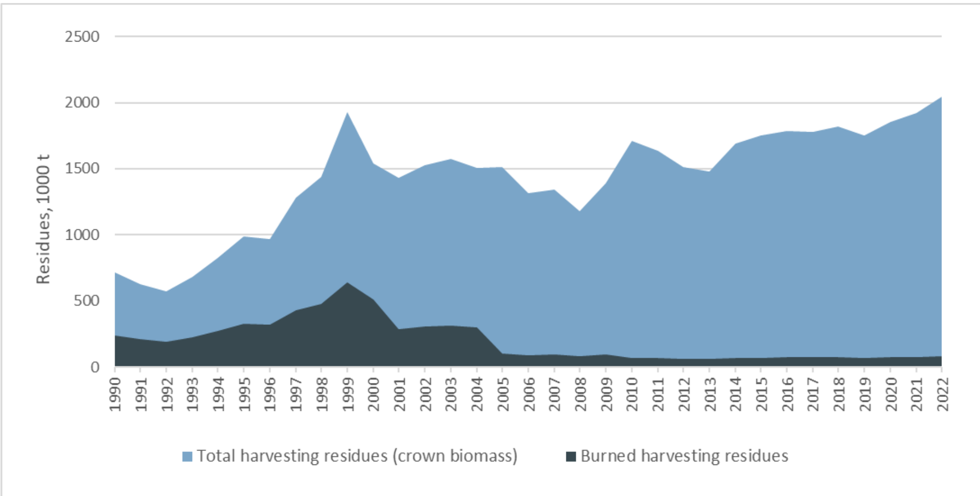

Figure 7.1 Harvesting residues, 1000 tons

7.1.5 Uncertainties

Combined activity data uncertainty is ± 92.6%. Uncertainties of emission factors are based on the 2006 IPCC Guidelines' and EMEP/EEA 2023 default values.

7.1.6 Recalculations

No recalculations were introduced.

7.1.7 Planned improvements

No improvements are planned.

7.2 Forest wildfires (NFR 11B)

7.2.1 Overview of sector

This source category (NFR 11B) includes NO_x, NMVOC, SO_x, NH_3, CO, $PM_{2.5}$, PM_{10}, TSP, BC, PCDD/PCDF and PAHs emission from wildfires in forest land (Table 7.4).

Table 7.4 Emissions from forest wildfires in 1990-2022

	Unit	1990	1995	2000	2005	2010	2015	2020	2021	2022	*Change in 2005-2022, %*
NO_x	kt	0.049	0.102	0.250	0.023	0.060	0.083	0.059	0.096	0.044	***91.2***
NMVOC		0.129	0.268	0.658	0.060	0.159	0.218	0.155	0.253	0.115	***91.2***
SO_2		0.010	0.020	0.050	0.005	0.012	0.017	0.012	0.019	0.009	***91.2***
NH_3		0.011	0.023	0.057	0.005	0.014	0.019	0.013	0.022	0.010	***91.2***
$PM_{2.5}$		0.136	0.317	0.857	0.084	0.230	0.322	0.228	0.373	0.169	***101.3***
PM_{10}		0.166	0.387	1.047	0.103	0.281	0.394	0.278	0.456	0.207	***101.3***
TSP		0.257	0.598	1.619	0.159	0.434	0.609	0.430	0.705	0.320	***101.3***
BC		0.012	0.029	0.077	0.008	0.021	0.029	0.020	0.034	0.015	***101.3***
CO		1.393	2.889	7.106	0.648	1.712	2.360	1.669	2.727	1.239	***91.2***
PCDD/F	g i-Teq	0.076	0.176	0.476	0.047	0.128	0.179	0.127	0.207	0.094	***101.3***
PAHs	t	0.250	0.583	1.577	0.155	0.423	0.593	0.419	0.686	0.311	***101.3***

NO_x, NMVOC, SO_x, NH_3 and CO emissions from forest wildfires increased by 91.2% in 2022 in comparison to 2005, but $PM_{2.5}$, PM_{10}, TSP, BC, PCDD/PCDF and PAHs emissions from wildfires in forest land increased by 101.3% in 2022 in comparison to 2005. Emission amount from forest wildfires in 1990-2022 has fluctuated directly depending on the burned area of forests and burned biomass due to wildfires (Table 7.4, Figure 7.2).

7.2.2 Methodological issues

EMEP/EEA 2023, 2006 IPCC Guidelines and EMEP/CORINAIR simpler methodologies were used. Emissions were estimated as follows: emission factor multiplied by activity data provided by National forest inventory, State forest service and Fire and Rescue Service. Dioxins (PCDD/ PCDF) were calculated according to the UNEP methodology (97. pp), emission factor – 5 micrograms TEQ/t incinerated material.

Amount of burned biomass was considered according to the average growing stock of living biomass, dead wood and litter in the particular year. Combustion efficiency or fraction of biomass combusted (dimensionless) was considered 0.45 according to Table 2.6 of 2006 IPCC Guidelines[42].

7.2.3 Emission factors and other parameters

For NO_x, NMVOC, SO_x, NH_3, CO, $PM_{2.5}$, PM_{10}, BC and TSP emission calculations from forest wildfires default emission factors were used according to EMEP/EEA 2023, 11.B Forest fires, Table 3-5 (Table 7.5).

[42] *Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types.*

Information of condensable component inclusion in emission factors of PM is not provided by the EMEP/EEA 2023.

Table 7.5 Emission factors for forest wildfires

	Value	Unit
NO_x	190	kg ha^{-1} area burned
CO	5400	kg ha^{-1} area burned
NMVOC	500	kg ha^{-1} area burned
SO_x	38	kg ha^{-1} area burned
NH_3	43	kg ha^{-1} area burned
TSP	17	g kg^{-1} wood burned
PM_{10}	11	g kg^{-1} wood burned
$PM_{2.5}$	9	g kg^{-1} wood burned
BC	9	% of $PM_{2.5}$

Emission factors for PAHs were estimated by multiplying the benz[a]pyrene emission factor by the appropriate ratios (Table 7.3).

7.2.4 Activity data

The statistics on forest wildfire areas are compiled by the State forest service and they are based on information given by the local units. Area of forest fires and biomass in burned area is shown in Figure 7.2.

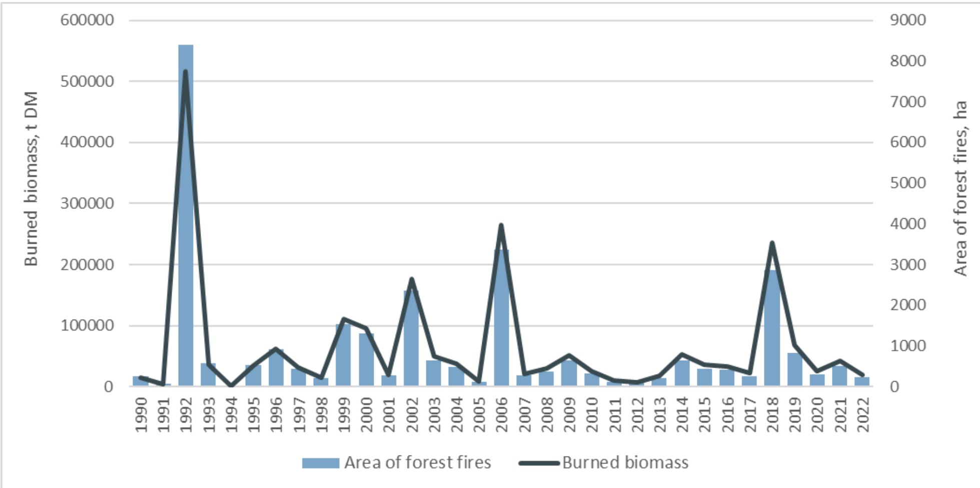

Figure 7.2 Area of forest fires and biomass in burned area

7.2.5 Uncertainties

Combined activity data uncertainty is ± 37.4%. Uncertainties of emission factors are based on the EMEP/EEA 2023 default values.

7.2.6 Recalculations

Recalculations are introduced for 2021 due to improvement of activity data (area of forest wildfires corrected to 505 ha in 2021).

7.2.7 Planned improvements

No improvements are planned.

8 Recalculations, improvements and recommendations from the TERT

8.1 Recalculations

Recalculations made in IIR Submission 2024 can be seen in Figure 8.1.

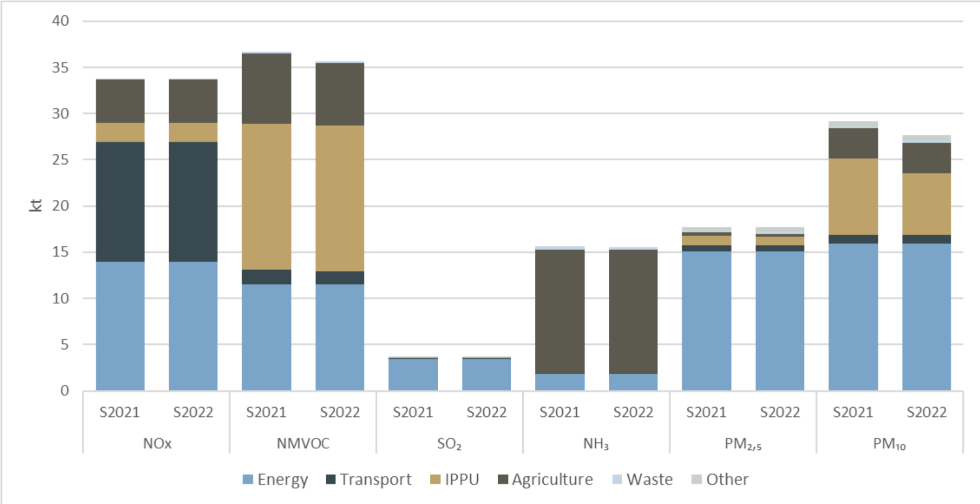

Figure 8.1 Emission comparison for 2021 between IIR Submission 2023 and IIR Submission 2024

Comparing reported emissions of 2021 in the IIR Submission 2023 and IIR Submission 2024, NO_x emissions have decreased by 0.2%. NMVOC emissions have decreased by 2.8% mainly due to the recalculation in Agriculture sector. NH_3 emissions have decreased by 0.1%. Total $PM_{2.5}$ emissions have decreased by 0.5%. Total PM_{10} emissions have decreased by 5.2%.

Detailed information about recalculations done in each sector is described in appropriate chapter.

8.2 Planned improvements

Planned improvements:

Energy sector

- Continue work on developing Tier 2 calculation methodology for sector NFR 1A1a biomass combustion.
- Work on implementing EMEP/EEA 2023 guidelines.

IPPU sector

- No improvements planned.

Agriculture sector

- 3B - continue to work on quantification and preparation of detailed documentations of abatement strategies for poultry ammonia emissions because information on digestate application in 2021 and 2022 is only included in this submission; to review the Agricultural Data Centre Republic of Latvia Register of housing infrastructure and manure storage facilities database information;
- 3D - implementation of EMEP/EEA air pollutant emission inventory guidebook 2023 methodology.

Waste sector

- No improvements planned.

8.3 Recommendations from the TERT

Table 1. All findings for NOX, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10}, including those made during the 2023 NECD inventory review and those not implemented from previous reviews

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
LV-1A1-2022-0001	Yes	1A1 Energy industries, SO2, NOX, NH3, CO, 1990-2021	For 1A1a Public electricity and heat production, pollutants SO2, NOX, NH3 and CO and all years, the TERT notes that it is a key category and that biomass combustion emissions are based on a Tier 1 methodology. The issue was raised in the 2022 NECD review. In response to questions raised during the 2023 review Latvia explained that a Tier 2 methodology for solid biomass is a planned improvement ahead of the next submission. The TERT noted that the issue is below the threshold of significance for a technical correction. In the 2019 EMEP/EEA Guidebook, Tier 2 emission factors are only provided for wood and wood waste (Table 3-13) and these are the same as for the Tier 1 methodology (Table 3-7) and therefore a Tier 3 would be preferential. **The TERT recommends that Latvia explore the possibility of using a method to estimate emissions from combustion of solid biomass in this sector that is higher than Tier 1, and includes the results and the documentation of the method in their next submission.**	Work ongoing on developing Tier 2 calculation methodology for sector NFR 1A1a biomass combustion.	3.2.4.9
LV-1A2a-2023-0001	No	1A2a Stationary combustion in manufacturing industries and construction: Iron and steel, NH3, 1990-2017, and 2020-2021	For 1A2a Stationary combustion in manufacturing industries and construction: Iron and steel, for NH3 in 1990-2017, 2020 and 2021, the TERT notes that there is a lack of transparency regarding the use of the notation key 'NE'. This does not relate to an over- or under-estimate of emissions. In accordance with the 2023 Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution, paragraph 12(d), the notation key 'NA' should be used, for activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant. In response to a question raised during the review, Latvia agreed with the proposal. **The TERT recommends that Latvia use the notation key 'NA' for this sector and pollutant where applicable in their next submission.**	Notation key corrected from NE to NA.	
LV-1A2b-2023-0001	No	1A2b Stationary combustion in manufacturing industries	For 1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals, pollutant NH3 and years 1997-2021, the TERT notes that there is a lack of transparency regarding the use of the notation key 'NE'. This	Notation key corrected from NE to NA.	

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
		and construction: Non-ferrous metals, NH3, 1997-2021	does not relate to an over- or under-estimate of emissions. In accordance with the 2023 Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution, paragraph 12(d), the notation key 'NA' should be used, for activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant. In response to a question raised during the review, Latvia explained that they agreed with the proposal. **The TERT recommends that Latvia use the notation key 'NA' for this sector and pollutant where applicable in their next submission.**		
LV-1A2f-2023-0001	No	1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals, SO2, 2020-2021	For 1A2f Stationary combustion in manufacturing industries and construction: Non-metallic minerals, pollutant SO2 and years 2020-2021, the TERT notes that there is a lack of transparency regarding why emissions decline substantially between these years. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Latvia explained that the largest contributor is the consumption of coal and that in 2021, all coal reported in this sector was consumed in the cement plant "SCHWENK Latvija". Since 2010, emissions arising from this cement plant have been reported in the IPPU sector (2A1) as it has not been possible to split out the emissions into those arising from combustion and those from the process. The latter information (on emissions being reported in 2A1) is outlined in Chapter 3.2.5.3 of the 2023 IIR. **The TERT recommends, that Latvia also include information on the reasons for the decline in emissions between 2020 and 2021 in the IIR of their next submission.**	Emission trends from cement production are described in Chapter 4.2.2.2 Trends in emissions	4.2.2.2
LV-2A5b-2023-0001	Yes	2A5b Construction and demolition, PM2.5, PM10, 2005-2021	For category 2A5b Construction and demolition and pollutants PM2.5 and PM10 (and TSP) and years 2005-2021, the TERT noted that a Tier 1 method is applied for a key category. In response to a question raised during the review, Latvia explained that limited country-specific assumptions were applied in the 2023 submission but illustrated ongoing work to develop country-specific parameters for use in the 2019 EMEP/EEA Guidebook Tier 1 methodology. The TERT notes that (a) there is no Tier 2 methodology in the 2019 EMEP/EEA Guidebook for category 2A5b; (b) it is not possible for Latvia to implement the Tier 3 method from the 2019 EMEP/EEA Guidebook at a national scale; (c) the Tier 1 method	Estimation parameters are included in the calculation of emissions for 2A5b Construction and demolition	4.2.6 Construction and demolition

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
			from the 2019 EMEP/EEA Guidebook includes a range of potential country-specific information for its implementation. This includes factors such as the duration of construction (d), the efficiency of emission control measures (CE), Thornthwaite precipitation-evaporation index (PE), and soil silt content (s). Given these requirements, the methodology appears to align more closely with a Tier 2 rather than a traditional Tier 1 approach; therefore, the TERT concludes that under the current version of the 2019 EMEP/EEA Guidebook, there is no basis for the TERT to recommend that Latvia use a more advanced Tier method. **However, the TERT recommends that Latvia develops information that allows development of country-specific parameters that are used in the calculations of their next submission.**		
LV-2B10a-2023-0001	No	2B10a Chemical industry: Other, NMVOC, PM2.5, CO, 2021	For 2B10a Chemical industry: Other, NMVOC, PM2.5 and CO, 2021, the TERT notes that there is a lack of transparency as emissions are reported (IIR Section 4.3) but no chemical processes listed in the 2019 EMEP/EEA Guidebook are identified in the IIR. In response to a question raised during the review, Latvia clarified that the processes used for plastics recycling are largely mechanical and that NMVOC emissions from processes using recycled plastics are considered within 2D3g Chemical products. **The TERT recommends that Latvia include the information provided in the 2024 IIR submission.**	The information about plastics recycling is included in the IIR 2024	4.3 Chemical industry
LV-2I-2023-0001	No	2I Wood processing, PM2.5, PM10, TSP, 2000-2021	For category 2I Wood processing and pollutants TSP, PM2.5 and PM10 the TERT notes that emissions are not estimated in the NFR but forestry and wood products are reported as a major industry in Latvia's national statistics and provide a significant contribution to Latvia's export trade. The TERT notes that the 2019 EMEP/EEA Guidebook does not provide a methodology for PM10 and PM2.5 for category 2I. In response to a question raised during the review, Latvia supplemented the information provided in the IIR and provided data to show that emissions of TSP would be a small contribution to the national total. The TERT notes that the issue is below the threshold of significance for a technical correction and related to a non-mandatory pollutant. **The TERT recommends that Latvia includes emission estimates in their next submission for completeness and that Latvia review whether other activity data,**	Latvia is still using notation keys “NE” and “IE” as these emissions are considered as negligible in the IIR 2024	4.5.6. Wood processing

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
			which reflects the wider wood processing industry, may be more appropriate and whether PM10 and PM2.5 emission estimates can be developed, and report their results in the IIR of their next submission.		
LV-2D3a-2022-0002	Yes	2D3a Domestic solvent use including fungicides, NMVOC, 2005-2021	For 2D3a Domestic solvent use including fungicides, for pollutant NMVOC and years 2005-2021, the TERT notes that Latvia used correction factors recommended by the 2019 EMEP/EEA Guidebook in case of the use of ESIG data. However, Latvia does not use ESIG data. During the 2022 NECD review, a reverse recommendation was made probably due to misunderstanding. In response to a question raised during the review, Latvia confirmed that ESIG data are not used and, on contrary, a specific in-country method is used. Latvia provided a revised estimate excluding the correction factors applicable from 2005 to 2021 and stated that it will be included in the 2024 submission. The TERT agreed with the revised estimate provided by Latvia. **The TERT recommends that Latvia include the revised estimate in their next submission.**	Latvia has taken TERT's recommendation into account	4.5.3 Solvent use (NFR 2D3a, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h, 2D3i), Table 4.28
LV-3Da3-2023-0001	No	3Da3 Urine and dung deposited by grazing animals, NMVOC, 1990-2021	For category 3Da3, pollutant NMVOC and for all years the TERT noted that Latvia reports the notation key 'IE' (included elsewhere) and that there is a lack of transparency regarding the use of this notation key as no explanation is provided in the IIR. The TERT also noted that Latvia adopts the Tier 1 method to estimate emissions of NMVOC from category 3B for all livestock excluding cattle and that no Tier 1 emission factor is presented for category 3Da3 in the 2019 EMEP/EEA Guidebook. Furthermore the TERT notes that Latvia utilises the Tier 2 methodology to estimate emissions of NH3 from livestock in category 3B and should thus be able to estimate emissions of NMVOC from category 3Da3 using the Tier 2 approach described in the Chapter 3B of the 2019 EMEP/EEA Guidebook. It is also encouraged on page 18 of the 2019 EMEP/EEA Guidebook that countries calculate emissions of NMVOC using the Tier 2 approach if possible. In response to a question raised during the review, Latvia provided a revised estimate for categories 3B2 to 3B4h, 3Da2a and 3Da3. The TERT agreed with the revised estimate provided by Latvia, however it noted that the values presented are a first approximation using IPCC default volatile solid values and more refined values will be needed in future estimates.	Sheep, swine, goats, horses, laying hens, broilers, turkeys, ducks NMVOC emissions calculated using Tier 2 methodology. Emissions 3Da2a and 3Da3 are reported form this livestock groups.	5.2.8 Recalculations

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
			The TERT recommends that Latvia continue to examine the applicability of IPCC default values and recognises that the revised estimate is a first step, which needs further refinement for inclusion in their next submission.		
LV-3Da2c-2023-0001	No	3Da2c Other organic fertilisers applied to soils (including compost), NH3, 2020-2021	For category 3Da2c Other organic fertilisers applied to soils (including compost), pollutant NH3 and years 2020-2021, the TERT notes that there is an annual change equal to a factor of 2.44 for the years 2020-2021 in the 2023 submission. In response to a question raised during the review Latvia explained that the use of organic fertilizers dropped to 10.1 kt in 2021, compared to 32.5 kt in 2020 and that the amount used is different each year and depends on weather conditions and synthetic fertilizers' market situation. **The TERT recommends that where significant dips and jumps exist in the activity data for category 3Da2c Other organic fertilisers applied to soils (including compost), Latvia explain these in the IIR.**	Explanation added.	5.3.5 Activity data
LV-3De-2023-0001	Yes	3De Cultivated crops, NMVOC, 1990-2021	The TERT notes with reference to category 3De Cultivated crops, pollutant NMVOC, for all years, and page 131 of the IIR that a Tier 1 method is used for a key category. The TERT notes that using a Tier 1 method is not best practice, and could result in an over-estimate of emissions. This over-estimate may have an impact on total emissions that is above the threshold of significance. In response to a question raised during the review Latvia provided a revised estimate for all years 1990-2021. The TERT agreed with the revised estimate provided by Latvia. **The TERT recommends that Latvia include the revised estimate in their next submission.**	NMVOC emissions calculated using Tier 2 methodology.	5.3.8 Recalculations
LV-5C2-2022-0001	No	5C2 Open burning of waste, SO2, NOX, NH3, NMVOC, PM2.5, CO, 1990-2020	For 5C2 Open burning of waste, for pollutants SO2, NOX, NH3, NMVOC, PM2.5 and CO and years 1990-2020, the TERT notes that there is a lack of transparency regarding the regulation banning open burning of wastes regarding the explanation of the issue referencing the NFR and the IIR, as appropriate. This does not relate to an over- or under-estimate of emissions. In the 2022 review the TERT proposed an PTC to correct missing emissions. In response to the PTC after the review, Latvia did not agree with the PTC with the argument that there is a law and a regulation that forbid open burning of wastes in Latvia, and also provided references to these. In the 2023 review the TERT checked the specific parts of the law and regulations and found that derogation is possible. In response to a	Open burning of waste is reported as NE (Not estimated). Open burning is not allowed in Latvia according to the Waste Management Law.	6.4 Waste incineration

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
			question on this Latvia explained that it is not common practice to burn pruning woods on site and that waste management laws give reflection to municipal legal acts, but no official information exits to indicate that municipalities allow burning of pruning woods on site. **The TERT recommends that Latvia include a clear explanation on banning of open waste burning including reference to applicable laws and regulations and the derogation possibilities of regional and local authorities in the IIR of their next submission.**		
LV-5E-2022-0001	No	5E Other waste, SO2, NOX, NMVOC, PM2.5, PM10, 1990-2021	For category 5E Other waste, pollutants SO2, NOX, NMVOC, PM10 and PM2.5 and years 1990-2021, the TERT notes that Latvia calculates emissions from house fires with 100% undetached houses. The TERT notes that the issue is below the threshold of significance for a technical correction. This was raised during the 2022 NECD inventory review. The TERT notes that the Eurostat statistic https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-1a.html?lang=en provides a split in relevant housing types. In response on a question Latvia stated that a study will be made on the figures in this statistic and that they will include the result in their next submission. **The TERT recommends that Latvia use the Eurostat statistic on housing to improve the activity data and include the resulting emissions in their next submission.**	In calculations Eurostat proposed distribution between undetached and detached houses are implemented.	6.6 Other waste

9 References

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Annex I: Detailed methodological descriptions

Table 1 Emission factors for Energy Industries (NFR 1A1)

		NOx	CO	NMVOC	NH_3	TSP	PM_{10}	$PM_{2.5}$	BC	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCBs	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	Reference
Unit		***g/GJ***							***% of $PM_{2.5}$***	***mg/GJ***									***µg/GJ***	***ng/GJ***	***mg/GJ***				***µg/GJ***	
Shale Oil		65	16.2	0.8	NE	6.5	3.2	0.8	33.5	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	NE	0.5	NE	NE	NE	6.92	NE	EMEP/EEA 2019 - 1A1 - Table 3-6
LPG		89	39	2.6	NE	0.89	0.89	0.89	2.5	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015	NE	0.5	0.56	0.84	0.84	0.84	NE	EMEP/EEA 2019 - 1A1 - Table 3-4
Jet Kerosene		65	16.2	0.8	NE	6.5	3.2	0.8	33.5	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	NE	0.5	NE	NE	NE	6.92	NE	EMEP/EEA 2019 - 1A1 - Table 3-6
Diesel Oil		65	16.2	0.8	NE	6.5	3.2	0.8	33.5	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	NE	0.5	NE	NE	NE	6.92	NE	EMEP/EEA 2019 - 1A1 - Table 3-6
RFO		142	15.1	2.3	NE	35.4	25.2	19.3	5.6	4.56	1.2	0.341	3.98	2.55	5.31	255	2.06	87.8	NE	2.5	NE	4.5	4.5	6.92	NE	EMEP/EEA 2019 - 1A1 - Table 3-5
Other Oil Products		65	16.2	0.8	NE	6.5	3.2	0.8	33.5	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	NE	0.5	NE	NE	NE	6.92	NE	EMEP/EEA 2019 - 1A1 - Table 3-6
Coal		209	8.7	1	NE	11.4	7.7	3.4	2.2	7.3	0.9	1.4	7.1	4.5	7.8	4.9	23	19	3.3	10	0.7	37	29	1.1	6.7	EMEP/EEA 2019 - 1A1 - Table 3-2
Peat		247	8.7	1.4	NE	11.7	7.9	3.2	1	15	1.8	2.9	14.3	9.1	1	9.7	45	8.8	3.3	10	1.3	37	29	2.1	6.7	EMEP/EEA 2019 - 1A1 - table 3-3
Natural Gas	Tier 1	89	39	2.6	NE	0.89	0.89	0.89	2.5	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015	NE	0.5	0.56	0.84	0.84	0.84	NE	EMEP/EEA 2019 - 1A1 - Table 3-4
	Dry bottom boilers	89	39	2.6	NE	0.89	0.89	0.89	2.5	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015	NE	0.5	0.56	0.84	0.84	0.84	NE	EMEP/EEA 2019 - 1A1 - Table 3-12
	Gas turbine	48	4.8	1.6	NE	0.2	0.2	0.2	2.5	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015	NE	NE	0.56	1.58	1.11	8.36	NE	EMEP/EEA 2019 - 1A1 - Table 3-17
Wood		81	90	7.31	NE	172	155	133	3.3	20.6	1.76	1.51	9.46	9.03	21.1	14.2	1.2	181	3.5	50	1.12	0.043	0.0155	0.0374	5	EMEP/EEA 2019 - 1A1 - Table 3-7
Straws		81	90	7.31	NE	172	155	133	3.3	20.6	1.76	1.51	9.46	9.03	21.1	14.2	1.2	181	3.5	50	1.12	0.043	0.0155	0.0374	5	EMEP/EEA 2019 - 1A1 - Table 3-7
Biofuel		65	16.2	0.8	NE	6.5	3.2	0.8	33.5	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	NE	0.5	NE	NE	NE	6.92	NE	EMEP/EEA 2019 - 1A1 - Table 3-6
Biogas		89	39	2.6	NE	0.89	0.89	0.89	2.5	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015	NE	0.5	0.56	0.84	0.84	0.84	NE	EMEP/EEA 2019 - 1A1 - Table 3-4
Waste Oil		65	16.2	0.8	NE	6.5	3.2	0.8	33.5	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	NE	0.5	NE	NE	NE	6.92	NE	EMEP/EEA 2019 - 1A1 - Table 3-6

Table 2 Emission factors for Manufacturing Industries and Construction (NFR 1A2)

		NOx	CO	NMVOC	NH_3	TSP	PM_{10}	$PM_{2.5}$	BC	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCBs	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	Reference
Unit		*g/GJ*							*% of $PM_{2.5}$*	*mg/GJ*									*µg/GJ*	*ng/GJ*	*mg/GJ*				*µg/GJ*	
Shale Oil		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
LPG		74	29	23	NE	0.78	0.78	0.78	4	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	NE	0.52	0.72	2.9	1.1	1.08	NE	EMEP/EEA 2019 - 1A2 - Table 3-3
Jet Kerosene		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
Other Kerosene		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
Diesel Oil		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
RFO		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
Petroleum Coke		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
Other Oil Products		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
Anthracite		173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A2 - Table 3-2
Coal	Tier 1	173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A2 - Table 3-2
	> 50 kWth to ≤ 1 MWth	160	2000	200	NE	200	190	170	6.4	200	3	7	5	1578	30	20	2	300	170	400	100	130	50	40	0.62	EMEP/EEA 2019 – 1A4ai -Table 3-20
	> 1 MWth to ≤ 50 MWth	180	200	90	NE	80	76	72	6.4	100	1	9	4	15	10	10	2	150	170	100	13	17	9	6	0.62	EMEP/EEA 2019 – 1A4ai -Table 3-21
Coke		173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A2 - Table 3-2
Oil Shale		173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A2 - Table 3-2
Peat		173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A2 - Table 3-2

		NOx	CO	NMVOC	NH_3	TSP	PM_{10}	$PM_{2.5}$	BC	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCBs	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	Reference
Unit		*g/GJ*							*% of $PM_{2.5}$*	*mg/GJ*									*µg/GJ*	*ng/GJ*	*mg/GJ*				*µg/GJ*	
Natural Gas	Tier 1	74	29	23	NE	0.78	0.78	0.78	4	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	NE	0.52	0.72	2.9	1.1	1.08	NE	EMEP/EEA 2019 - 1A2 - Table 3-3
	> 50 kWth to ≤ 1 MWth	73	24	0.36	NE	0.45	0.45	0.45	5.4	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.011	0.0015	NA	0.5	0.56	0.84	0.84	0.84	NA	EMEP/EEA 2019 - 1A4ai - Table 3-26
	> 1 MWth to ≤ 50 MWth	40	30	2	NE	0.45	0.45	0.45	5.4	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.011	0.0015	NA	0.5	0.56	0.84	0.84	0.84	NA	EMEP/EEA 2019 - 1A4ai - Table 3-27
Wood		91	570	300	37	150	143	140	28	27	13	0.56	0.19	23	6	2	0.5	512	0.06	100	10	16	5	4	5	EMEP/EEA 2019 - 1A2 - Table 3-5
Straws		91	570	300	37	150	143	140	28	27	13	0.56	0.19	23	6	2	0.5	512	0.06	100	10	16	5	4	5	EMEP/EEA 2019 - 1A2 - Table 3-5
Biofuel		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4
Biogas		74	29	23	NE	0.78	0.78	0.78	4	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	NE	0.52	0.72	2.9	1.1	1.08	NE	EMEP/EEA 2019 - 1A2 - Table 3-3
Waste Oil		513	66	25	NE	20	20	20	56	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	NE	1.4	1.9	15	1.7	1.5	NE	EMEP/EEA 2019 - 1A2 - Table 3-4

Table 3 Emission factors for Small combustion (NFR 1A4ai, 1A4ci)

	NOx	CO	NMVOC	NH_3	TSP	PM_{10}	$PM_{2.5}$	BC	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCBs	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	Reference
Unit	*g/GJ*							*% of $PM_{2.5}$*	*mg/GJ*									*µg WHO-TEG/GJ*	*ng I-TEQ/GJ*	*mg/GJ*				*µg/GJ*	
Shale Oil	306	93	20	NE	21	21	18	56	8	0.15	0.1	0.5	10	3	125	0.1	18	0.13	6	1.9	15	1.7	1.5	0.22	EMEP/EEA 2019 - 1A4 - Table 3-9
LPG	74	29	23	NE	0.78	0.78	0.78	4	0.011	0.0009	0.1	0.1	0.013	0.0026	0.013	0.058	0.73	NA	0.52	0.72	2.9	1.1	1.08	NA	EMEP/EEA 2019 - 1A4 - Table 3-8
Other Kerosene	306	93	20	NE	21	21	18	56	8	0.15	0.1	0.5	10	3	125	0.1	18	0.13	6	1.9	15	1.7	1.5	0.22	EMEP/EEA 2019 - 1A4 - Table 3-9
Diesel Oil	306	93	20	NE	21	21	18	56	8	0.15	0.1	0.5	10	3	125	0.1	18	0.13	6	1.9	15	1.7	1.5	0.22	EMEP/EEA 2019 - 1A4 - Table 3-9
RFO	306	93	20	NE	21	21	18	56	8	0.15	0.1	0.5	10	3	125	0.1	18	0.13	6	1.9	15	1.7	1.5	0.22	EMEP/EEA 2019 - 1A4 - Table 3-9
Other Oil Products	306	93	20	NE	21	21	18	56	8	0.15	0.1	0.5	10	3	125	0.1	18	0.13	6	1.9	15	1.7	1.5	0.22	EMEP/EEA 2019 - 1A4 - Table 3-9

		NOx	CO	NMVOC	NH_3	TSP	PM_{10}	$PM_{2.5}$	BC	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCBs	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	Reference
Unit		*g/GJ*							*% of $PM_{2.5}$*	*mg/GJ*									*µg WHO-TEG/GJ*	*ng I-TEQ/GJ*	*mg/GJ*				*µg/GJ*	
Anthracite		173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A4 - Table 3-7
Coal	Tier 1	173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A4 - Table 3-7
	> 50 kWth to ≤ 1 MWth	160	2000	200	NE	200	190	170	6.4	200	3	7	5	1578	30	20	2	300	170	400	100	130	50	40	0.62	EMEP/EEA 2019 – 1A4ai -Table 3-20
	> 1 MWth to ≤ 50 MWth	180	200	90	NE	80	76	72	6.4	100	1	9	4	15	10	10	2	150	170	100	13	17	9	6	0.62	EMEP/EEA 2019 – 1A4ai -Table 3-21
Peat		173	931	88.8	NE	124	117	108	6.4	134	1.8	7.9	4	13.5	17.5	13	1.8	200	170	203	45.5	58.9	23.7	18.5	0.62	EMEP/EEA 2019 - 1A4 - Table 3-7
Natural Gas	Tier 1	74	29	23	NE	0.78	0.78	0.78	4	0.011	0.0009	0.1	0.1	0.013	0.0026	0.013	0.058	0.73	NA	0.52	0.72	2.9	1.1	1.08	NA	EMEP/EEA 2019 - 1A4 - Table 3-8
	> 50 kWth to ≤ 1 MWth	73	24	0.36	NE	0.45	0.45	0.45	5.4	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.011	0.0015	NA	0.5	0.56	0.84	0.84	0.84	NA	EMEP/EEA 2019 - 1A4ai - Table 3-26
	> 1 MWth to ≤ 50 MWth	40	30	2	NE	0.45	0.45	0.45	5.4	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.011	0.0015	NA	0.5	0.56	0.84	0.84	0.84	NA	EMEP/EEA 2019 - 1A4ai - Table 3-27
Wood		91	570	300	37	170	163	160	28	27	13	0.56	0.19	23	6	2	0.5	512	0.06	100	10	16	5	4	5	EMEP/EEA 2019 - 1A4 - Table 3-10
Straws		91	570	300	37	170	163	160	28	27	13	0.56	0.19	23	6	2	0.5	512	0.06	100	10	16	5	4	5	EMEP/EEA 2019 - 1A4 - Table 3-10
Biofuel		306	93	20	NE	21	21	18	56	8	0.15	0.1	0.5	10	3	125	0.1	18	0.13	6	1.9	15	1.7	1.5	0.22	EMEP/EEA 2019 - 1A4 - Table 3-9
Biogas		74	29	23	NE	0.78	0.78	0.78	4	0.011	0.0009	0.1	0.1	0.013	0.0026	0.013	0.058	0.73	NA	0.52	0.72	2.9	1.1	1.08	NA	EMEP/EEA 2019 - 1A4 - Table 3-8
Waste Oil		306	93	20	NE	21	21	18	56	8	0.15	0.1	0.5	10	3	125	0.1	18	0.13	6	1.9	15	1.7	1.5	0.22	EMEP/EEA 2019 - 1A4 - Table 3-9

Table 4 Emission factors for Off-road transport

		NOx	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)P	HCB	PCB	Reference
		IEF for 2018, g/tonnes fuel								*mg/kg*									*ng/kg*	*µg/kg*						
1.A.2.gvii	Gasoline: 2-stroke	2495	113157	4	4299	4299	4299	215	695237	1990-1998 - 0.00015 1999-2015 - 5.05391	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.2.gvii Non-road mobile sources and machinery Table 3-1, Table 3-2
	Gasoline: 4-stroke	6676	16126	4	159	159	159	8	804157		0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.2.gvii Non-road mobile sources and machinery Table 3-1, Table 3-2
	Diesel	13871	1270	8	697	697	697	524	6931	NE	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	30	50	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.2.gvii Non-road mobile sources and machinery Table 3-1, Table 3-2
1.A.4.a.ii	Gasoline: 2-stroke	2495	113157	4	4299	4299	4299	215	695237	1990-1998 - 0.00015 1999-2015 - 5.05391	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.a.ii Non-road mobile sources and machinery Table 3-1, Table 3-2
	Gasoline: 4-stroke	6676	16126	4	159	159	159	8	80157		0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.a.ii Non-road mobile sources and machinery Table 3-1, Table 3-2
	Diesel	13871	1270	8	697	697	697	524	6931	NE	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	30	50	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.a.ii Non-road mobile sources and machinery Table 3-1, Table 3-2
1.A.4.b.ii	Gasoline: 2-stroke	2765	227289	3	3762	3762	3762	188	620793	1990-1998 - 0.00015 1999-2015 - 5.05391	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.b.ii Non-road mobile sources and machinery Table 3-1
	Gasoline: 4-stroke	7117	18893	4	157	157	157	8	770368		0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.b.ii Non-road mobile sources and machinery Table 3-1
	Diesel	32629	3377	8	2104	2014	2014	1306	10774	NE	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	30	50	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.b.ii Non-road mobile sources and machinery Table 3-1
1.A.4.c.ii	Gasoline: 2-stroke	2495	113157	4	4299	4299	4299	215	695237	1990-1998 - 0.00015 1999-2015 - 5.05391	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.c.ii Non-road mobile sources and machinery Table 3-1, Table 3-2

		NOx	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)P	HCB	PCB	Reference
		IEF for 2018, g/tonnes fuel								*mg/kg*									*ng/kg*	*µg/kg*						
	Gasoline: 4-stroke	6676	16126	4	159	159	159	8	804157		0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.c.ii Non-road mobile sources and machinery Table 3-1, Table 3-2
	Diesel Agriculture	15421	1432	8	612	612	612	388	6892	NE	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	30	50	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.c.ii Non-road mobile sources and machinery Table 3-1, Table 3-2
	Diesel Forestry	10533	1103	8	387	387	387	240	6940	NE	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	30	50	NE	NE	NE	NE	EMEP/EEA 2019 - 1.A.4.c.ii Non-road mobile sources and machinery Table 3-1, Table 3-2
1.A.4.c.iii	RFO	79300	7400	NE	5600	6200	6200	NE	7400	0.18	0.02	0.02	0.68	0.72	1.25	32	0.21	1.2	0.47	NE	NE	NE	NE	0.14	0.57	EMEP/EEA 2019 - 1.A.4.c.iii National fishing Table 3-1
	Diesel	78500	2800	NE	1400	1500	1500	NE	7400	NE	0.01	0.03	0.04	0.05	0.88	1	0.1	1.2	0.13	NE	NE	NE	NE	0.08	0.038	EMEP/EEA 2019 - 1.A.4.c.iii National fishing Table 3-2
1.A.5.b	Aviation gasoline	4000	19000	NE	0	0	0	NE	1200	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NE	EMEP/EEA 2019 - 1.A.5.b Aviation Table 3.3
	Jet Kerosene	4000	19000	NE	0	0	0	NE	1200	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NE	EMEP/EEA 2019 - 1.A.5.b Aviation Table 3.3
	Diesel oil	78500	2800	NE	1400	1500	1500	NE	7400	0.13	0.01	0.03	0.04	0.05	0.88	1	0.1	1.2	0.13	NE	NE	NE	NE	0.08	0.038	EMEP/EEA 2019 - 1.A.4.c.iii National fishing Table 3-2

Table 5 Emission factors in Residential wood burning appliances

		Fireplaces	Conventional stoves	High-efficiency stoves	Advanced/ecolabelled stoves	Conventional boiler <50kW	Pellet stoves
NOx	**g/GJ**	50	50	80	95	80	80
CO		4000	4000	4000	2000	4000	300
NMVOC		600	600	350	250	350	10
NH_3		74	70	37	37	74	12
TSP		880	800	400	100	500	62
PM_{10}		840	760	380	95	480	60
$PM_{2.5}$		820	740	370	93	470	60
BC		57.4	74	59.2	26.04	75.2	9
Pb	**mg/GJ**	27	27	27	27	27	27
Cd		13	13	13	13	13	13
Hg		0.56	0.56	0.56	0.56	0.56	0.56

		Fireplaces	Conventional stoves	High-efficiency stoves	Advanced/ecolabelled stoves	Conventional boiler <50kW	Pellet stoves
As		0.19	0.19	0.19	0.19	0.19	0.19
Cr		23	23	23	23	23	23
Cu		6	6	6	6	6	6
Ni		2	2	2	2	2	2
Se		0.5	0.5	0.5	0.5	0.5	0.5
Zn		512	512	512	512	512	512
PCBs	**µg/GJ**	0.06	0.06	0.03	0.007	0.06	0.01
PCDD/F	**ng I-TEQ/GJ**	800	800	250	100	550	100
benzo(a)pyrene	**mg/GJ**	121	121	121	10	121	10
benzo(b)fluoranthene		111	111	111	16	111	16
benzo(k(fluoranthene		42	42	42	5	42	5
indeno(1,2,3-cd)pyrene		71	71	71	4	71	4
HCB	**µg/GJ**	5	5	5	5	5	5
Reference		*EMEP/EEA 2019 - 1A4bi - Table 3.39*	*EMEP/EEA 2019 - 1A4bi - Table 3.40*	*EMEP/EEA 2019 - 1A4bi - Table 3.41*	*EMEP/EEA 2019 - 1A4bi - Table 3.42*	*EMEP/EEA 2019 - 1A4bi - Table 3.43*	*EMEP/EEA 2019 - 1A4bi - Table 3.44*

Table 6 Sulphur content and SO_2 emission factors used in Energy sector

Fuel	NCV	Sulphur content (%)											
		1990-95	**2000**	**2005**	**2010**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Diesel	*42.49*	*0.20*	*0.20*	*0.20*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
RFO	*40.60*	*2.00*	*2.08*	*1.23*	*0.91*	*0.79*	*0.66*	*0.60*	*0.51*	*0.64*	*0.87*	*0.95*	*0.74*
Gasoline	*43.97*	*0.015*	*0.020*	*0.020*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Jet fuel	*43.21*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
Other liquid fuel	*41.86*	*0.65*	*0.56*	*0.50*	*0.44*	*0.40*	*0.42*	*0.45*	*0.41*	*0.64*	*0.34*	*0.32*	*0.34*
LPG	*45.54*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*	*0.0003*
Shale oil	*39.35*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*
Coal	*23.91*	*1.80*	*0.90*	*0.72*	*0.39*	*0.57*	*0.49*	*0.53*	*0.55*	*0.48*	*0.48*	*0.48*	*0.48*
Coke	*26.79*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*	*0.60*
Oil shale	*9.20*	*1.60*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*10.05*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*
RFO (marine)	*40.60*	*2.00*	*1.50*	*1.50*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Wood	*6.70*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Natural gas	*Changes annually*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*
		EF (kt/PJ)											
Diesel		*0.094*	*0.094*	*0.094*	*0.047*	*0.047*	*0.047*	*0.047*	*0.047*	*0.047*	*0.047*	*0.047*	*0.047*
RFO		*0.966*	*1.003*	*0.596*	*0.442*	*0.384*	*0.318*	*0.288*	*0.247*	*0.308*	*0.420*	*0.456*	*0.355*
Gasoline		*0.0068*	*0.0068*	*0.0068*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*
Jet fuel		*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*
Other liquid fuel		*0.311*	*0.267*	*0.237*	*0.208*	*0.190*	*0.202*	*0.216*	*0.196*	*0.305*	*0.163*	*0.157*	*0.164*
LPG		*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Shale oil		*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*
Coal		*1.138*	*0.567*	*0.498*	*0.266*	*0.431*	*0.370*	*0.398*	*0.406*	*0.352*	*0.352*	*0.352*	*0.398*
Coke		*0.410*	*0.410*	*0.403*	*0.403*	*0.403*	*0.403*	*0.403*	*0.403*	*0.403*	*0.403*	*0.403*	*0.403*
Oil shale		*3.130*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat		*0.508*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*
RFO (marine)		*0.966*	*0.724*	*0.724*	*0.483*	*0.483*	*0.483*	*0.483*	*0.483*	*0.483*	*0.483*	*0.483*	*0.483*
Wood		*0.045*	*0.045*	*0.045*	*0.045*	*0.045*	*0.045*	*0.045*	*0.045*	*0.045*	*0.045*	*0.045*	*0.045*
Natural gas		*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*

Notes:
Gasoline, diesel oil – EU legislation
RFO – EU legislation, average value from database Nr.2-Air
Other liquids – average value from database Nr.2-Air
Coal – average value from database Nr.2-Air
Shale oil – Luik, H. "Coal, oil shale, natural bitumen, heavy oil and peat" Vol. II *Chemicals and Other products from Shale Oil*
Oil shale – Gavrilova, O., Randla, T., Vallner, L., Strandberg, M., Vilu, R. 2005. "Life Cycle Analysis of the Estonian Oil Shale Industry"
Peat, peat briquettes – Latvian Peat Producers Association
Wood – Zandersons, J, Žūriņš, A., Rižikovs, J., Dobele, G., Latvian Institute of Wood chemistry "Feasibility of processing and utilisation of used up railway sleepers"
Natural gas – allowed content of mercaptan (3 mg/m^3)

Table 7 Distribution of road transport fleet by subsectors and layers, year 2022

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
Passenger Cars	*Petrol*	*Small*	*Euro 2*	*1 892*	*5 416*
Passenger Cars	*Petrol*	*Small*	*Euro 3*	*8 045*	*6 722*
Passenger Cars	*Petrol*	*Small*	*Euro 4*	*11 970*	*7 159*
Passenger Cars	*Petrol*	*Small*	*Euro 5*	*9 214*	*13 373*
Passenger Cars	*Petrol*	*Small*	*Euro 6*	*17 168*	*10 782*
Passenger Cars	*Petrol*	*Medium*	*Euro 1*	*9 989*	*5 201*
Passenger Cars	*Petrol*	*Medium*	*Euro 2*	*29 310*	*7 166*
Passenger Cars	*Petrol*	*Medium*	*Euro 3*	*19 915*	*9 198*
Passenger Cars	*Petrol*	*Medium*	*Euro 4*	*26 043*	*12 251*
Passenger Cars	*Petrol*	*Medium*	*Euro 5*	*14 969*	*13 341*
Passenger Cars	*Petrol*	*Medium*	*Euro 6*	*18 898*	*12 525*
Passenger Cars	*Petrol*	*Large*	*Euro 2*	*3 873*	*7 830*
Passenger Cars	*Petrol*	*Large*	*Euro 3*	*7 147*	*12 551*
Passenger Cars	*Petrol*	*Large*	*Euro 4*	*8 347*	*11 538*
Passenger Cars	*Petrol*	*Large*	*Euro 5*	*3 876*	*14 471*
Passenger Cars	*Petrol*	*Large*	*Euro 6*	*4 105*	*14 231*
Passenger Cars	*Diesel*	*Small*	*Euro 2*	*16*	*6 091*
Passenger Cars	*Diesel*	*Small*	*Euro 3*	*1 851*	*6 091*
Passenger Cars	*Diesel*	*Small*	*Euro 4*	*2 289*	*9 103*
Passenger Cars	*Diesel*	*Small*	*Euro 5*	*2 654*	*8 219*
Passenger Cars	*Diesel*	*Small*	*Euro 6*	*2152*	*12 513*
Passenger Cars	*Diesel*	*Medium*	*Euro 1*	*11 292*	*7 035*
Passenger Cars	*Diesel*	*Medium*	*Euro 2*	*24 595*	*7 774*
Passenger Cars	*Diesel*	*Medium*	*Euro 3*	*83 496*	*8 646*
Passenger Cars	*Diesel*	*Medium*	*Euro 4*	*82 798*	*13 341*
Passenger Cars	*Diesel*	*Medium*	*Euro 5*	*56 937*	*11 717*
Passenger Cars	*Diesel*	*Medium*	*Euro 6*	*30 367*	*17 594*
Passenger Cars	*Diesel*	*Large*	*Euro 1*	*7 809*	*10 774*
Passenger Cars	*Diesel*	*Large*	*Euro 2*	*14 371*	*11 569*
Passenger Cars	*Diesel*	*Large*	*Euro 3*	*75 043*	*9 954*
Passenger Cars	*Diesel*	*Large*	*Euro 4*	*37 177*	*15 011*
Passenger Cars	*Diesel*	*Large*	*Euro 5*	*32 289*	*13 747*
Passenger Cars	*Diesel*	*Large*	*Euro 6*	*6 133*	*19 434*
Passenger Cars	*LPG Biofuel*	*Small*	*Euro 1*	*2 426*	*10 343*
Passenger Cars	*LPG Biofuel*	*Small*	*Euro 2*	*6 618*	*12 412*
Passenger Cars	*LPG Biofuel*	*Small*	*Euro 3*	*9 500*	*15 060*
Passenger Cars	*LPG Biofuel*	*Small*	*Euro 4*	*10 435*	*17 211*
Passenger Cars	*LPG Biofuel*	*Small*	*Euro 5*	*3 711*	*17 583*
Passenger Cars	*LPG Biofuel*	*Small*	*Euro 6*	*653*	*17 583*
Passenger Cars	*CNG Biofuel*	*Small*	*Euro 4*	*14*	*13 497*
Passenger Cars	*CNG Biofuel*	*Small*	*Euro 5*	*117*	*13 497*
Passenger Cars	*CNG Biofuel*	*Small*	*Euro 6*	*144*	*13 497*
Passenger Cars	*BEV*	*Medium*	*Euro 6*	*3772*	*9 208*
Passenger Cars	*Petrol PHEV*	*Medium*	*Euro 6*	*787*	*10 148*
Passenger Cars	*Diesel PHEV*	*Medium*	*Euro 6*	*130*	*10 887*
Light Commercial Vehicles	*Petrol*	*N1-II*	*Euro 1*	*19*	*15 303*
Light Commercial Vehicles	*Petrol*	*N1-II*	*Euro 2*	*127*	*17 827*
Light Commercial Vehicles	*Petrol*	*N1-II*	*Euro 3*	*301*	*18 765*
Light Commercial Vehicles	*Petrol*	*N1-II*	*Euro 4*	*459*	*18 853*
Light Commercial Vehicles	*Petrol*	*N1-II*	*Euro 5*	*425*	*20 866*
Light Commercial Vehicles	*Petrol*	*N1-II*	*Euro 6*	*267*	*22 834*
Light Commercial Vehicles	*Diesel*	*N1-II*	*Euro 1*	*694*	*20 557*
Light Commercial Vehicles	*Diesel*	*N1-II*	*Euro 2*	*3 479*	*24 257*
Light Commercial Vehicles	*Diesel*	*N1-II*	*Euro 3*	*9 990*	*25 542*
Light Commercial Vehicles	*Diesel*	*N1-II*	*Euro 4*	*17 584*	*29 370*

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
Light Commercial Vehicles	*Diesel*	*N1-II*	*Euro 5*	*15 710*	*29 370*
Light Commercial Vehicles	*Diesel*	*N1-II*	*Euro 6*	*9 668*	*30 571*
Light Commercial Vehicles	*LPG Biofuel*	*Large*	*Euro 1*	*26*	*20 854*
Light Commercial Vehicles	*LPG Biofuel*	*Large*	*Euro 2*	*212*	*26 134*
Light Commercial Vehicles	*LPG Biofuel*	*Large*	*Euro 3*	*200*	*29 138*
Light Commercial Vehicles	*LPG Biofuel*	*Large*	*Euro 4*	*270*	*31 391*
Light Commercial Vehicles	*LPG Biofuel*	*Large*	*Euro 5*	*192*	*33 493*
Light Commercial Vehicles	*LPG Biofuel*	*Large*	*Euro 6*	*56*	*33 944*
Light Commercial Vehicles	*CNG Biofuel*	*Medium*	*Euro 4*	*13*	*20 285*
Light Commercial Vehicles	*CNG Biofuel*	*Medium*	*Euro 5*	*39*	*20 285*
Light Commercial Vehicles	*CNG Biofuel*	*Medium*	*Euro 6*	*62*	*20 285*
Light Commercial Vehicles	*BEV*	*Medium*	*Euro 6*	*109*	*15 609*
Light Commercial Vehicles	*Petrol PHEV*	*Medium*	*Euro 6*	*1*	*18 929*
Heavy Duty Trucks	*Petrol*	*>3,5 t*	*Conventional*	*548*	*30 730*
Heavy Duty Trucks	*Diesel*	*Rigid <=7,5 t*	*Euro I*	*12*	*19 657*
Heavy Duty Trucks	*Diesel*	*Rigid <=7,5 t*	*Euro II*	*270*	*26 672*
Heavy Duty Trucks	*Diesel*	*Rigid <=7,5 t*	*Euro III*	*365*	*28 635*
Heavy Duty Trucks	*Diesel*	*Rigid <=7,5 t*	*Euro IV*	*402*	*29 339*
Heavy Duty Trucks	*Diesel*	*Rigid <=7,5 t*	*Euro V*	*695*	*32 333*
Heavy Duty Trucks	*Diesel*	*Rigid <=7,5 t*	*Euro VI*	*560*	*36 980*
Heavy Duty Trucks	*Diesel*	*Rigid 7,5 - 12 t*	*Euro II*	*54*	*31 437*
Heavy Duty Trucks	*Diesel*	*Rigid 7,5 - 12 t*	*Euro III*	*335*	*33 672*
Heavy Duty Trucks	*Diesel*	*Rigid 7,5 - 12 t*	*Euro IV*	*528*	*34 648*
Heavy Duty Trucks	*Diesel*	*Rigid 7,5 - 12 t*	*Euro V*	*321*	*36 158*
Heavy Duty Trucks	*Diesel*	*Rigid 7,5 - 12 t*	*Euro VI*	*298*	*39 657*
Heavy Duty Trucks	*Diesel*	*Rigid 12 - 14 t*	*Euro II*	*45*	*31 437*
Heavy Duty Trucks	*Diesel*	*Rigid 12 - 14 t*	*Euro III*	*49*	*33 672*
Heavy Duty Trucks	*Diesel*	*Rigid 12 - 14 t*	*Euro IV*	*112*	*34 648*
Heavy Duty Trucks	*Diesel*	*Rigid 12 - 14 t*	*Euro V*	*139*	*36 158*
Heavy Duty Trucks	*Diesel*	*Rigid 12 - 14 t*	*Euro VI*	*99*	*39 657*
Heavy Duty Trucks	*Diesel*	*Rigid 14 - 20 t*	*Euro I*	*288*	*30 395*
Heavy Duty Trucks	*Diesel*	*Rigid 14 - 20 t*	*Euro II*	*500*	*37 758*
Heavy Duty Trucks	*Diesel*	*Rigid 14 - 20 t*	*Euro III*	*695*	*38 650*
Heavy Duty Trucks	*Diesel*	*Rigid 14 - 20 t*	*Euro IV*	*172*	*40 196*
Heavy Duty Trucks	*Diesel*	*Rigid 14 - 20 t*	*Euro V*	*747*	*41 267*
Heavy Duty Trucks	*Diesel*	*Rigid 14 - 20 t*	*Euro VI*	*1345*	*44 581*
Heavy Duty Trucks	*Diesel*	*Rigid 20 - 26 t*	*Euro I*	*158*	*36 215*
Heavy Duty Trucks	*Diesel*	*Rigid 20 - 26 t*	*Euro II*	*491*	*44 498*
Heavy Duty Trucks	*Diesel*	*Rigid 20 - 26 t*	*Euro III*	*618*	*46 352*
Heavy Duty Trucks	*Diesel*	*Rigid 20 - 26 t*	*Euro IV*	*618*	*46 816*
Heavy Duty Trucks	*Diesel*	*Rigid 20 - 26 t*	*Euro V*	*809*	*47 001*
Heavy Duty Trucks	*Diesel*	*Rigid 20 - 26 t*	*Euro VI*	*667*	*53 420*
Heavy Duty Trucks	*Diesel*	*Rigid 26 - 28 t*	*Euro I*	*47*	*33 594*
Heavy Duty Trucks	*Diesel*	*Rigid 26 - 28 t*	*Euro II*	*77*	*39 077*
Heavy Duty Trucks	*Diesel*	*Rigid 26 - 28 t*	*Euro III*	*180*	*44 395*
Heavy Duty Trucks	*Diesel*	*Rigid 26 - 28 t*	*Euro IV*	*76*	*46 816*
Heavy Duty Trucks	*Diesel*	*Rigid 26 - 28 t*	*Euro V*	*172*	*47 001*
Heavy Duty Trucks	*Diesel*	*Rigid 26 - 28 t*	*Euro VI*	*176*	*52 829*
Heavy Duty Trucks	*Diesel*	*Rigid 28 - 32 t*	*Euro I*	*1*	*28 350*
Heavy Duty Trucks	*Diesel*	*Rigid 28 - 32 t*	*Euro II*	*117*	*39 077*
Heavy Duty Trucks	*Diesel*	*Rigid 28 - 32 t*	*Euro III*	*220*	*44 395*
Heavy Duty Trucks	*Diesel*	*Rigid 28 - 32 t*	*Euro IV*	*143*	*46 816*
Heavy Duty Trucks	*Diesel*	*Rigid 28 - 32 t*	*Euro V*	*263*	*47 001*
Heavy Duty Trucks	*Diesel*	*Rigid 28 - 32 t*	*Euro VI*	*288*	*52 829*
Heavy Duty Trucks	*Diesel*	*Rigid >32 t*	*Euro II*	*65*	*39 077*
Heavy Duty Trucks	*Diesel*	*Rigid >32 t*	*Euro III*	*216*	*44 395*
Heavy Duty Trucks	*Diesel*	*Rigid >32 t*	*Euro IV*	*190*	*46 816*

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
Heavy Duty Trucks	*Diesel*	*Rigid >32 t*	*Euro V*	*113*	*47 001*
Heavy Duty Trucks	*Diesel*	*Rigid >32 t*	*Euro VI*	*96*	*52 829*
Heavy Duty Trucks	*Diesel*	*Articulated 14 - 20 t*	*Euro II*	*179*	*38 127*
Heavy Duty Trucks	*Diesel*	*Articulated 14 - 20 t*	*Euro III*	*1 296*	*49 889*
Heavy Duty Trucks	*Diesel*	*Articulated 14 - 20 t*	*Euro IV*	*1 549*	*51 061*
Heavy Duty Trucks	*Diesel*	*Articulated 14 - 20 t*	*Euro V*	*4 167*	*63 388*
Heavy Duty Trucks	*Diesel*	*Articulated 14 - 20 t*	*Euro VI*	*3 971*	*64 014*
Heavy Duty Trucks	*Diesel*	*Articulated 20 - 28 t*	*Euro II*	*54*	*39 712*
Heavy Duty Trucks	*Diesel*	*Articulated 20 - 28 t*	*Euro III*	*260*	*51 314*
Heavy Duty Trucks	*Diesel*	*Articulated 20 - 28 t*	*Euro IV*	*270*	*53 260*
Heavy Duty Trucks	*Diesel*	*Articulated 20 - 28 t*	*Euro V*	*803*	*61 262*
Heavy Duty Trucks	*Diesel*	*Articulated 20 - 28 t*	*Euro VI*	*1 299*	*66 850*
Heavy Duty Trucks	*Diesel*	*Articulated 28 - 34 t*	*Euro II*	*2*	*39 712*
Heavy Duty Trucks	*Diesel*	*Articulated 28 - 34 t*	*Euro III*	*22*	*51 314*
Heavy Duty Trucks	*Diesel*	*Articulated 28 - 34 t*	*Euro IV*	*12*	*53 260*
Heavy Duty Trucks	*Diesel*	*Articulated 28 - 34 t*	*Euro V*	*18*	*61 262*
Heavy Duty Trucks	*Diesel*	*Articulated 28 - 34 t*	*Euro VI*	*36*	*66 850*
Heavy Duty Trucks	*Diesel*	*Articulated 40 - 50 t*	*Conventional*	*7*	*39 712*
Heavy Duty Trucks	*Diesel*	*Articulated 40 - 50 t*	*Euro I*	*32*	*51 314*
Heavy Duty Trucks	*Diesel*	*Articulated 40 - 50 t*	*Euro II*	*57*	*53 260*
Heavy Duty Trucks	*Diesel*	*Articulated 40 - 50 t*	*Euro III*	*37*	*61 262*
Heavy Duty Trucks	*CNG Biofuel*	*Large*	*Euro 4*	*8*	*33 809*
Heavy Duty Trucks	*CNG Biofuel*	*Large*	*Euro 5*	*46*	*33 809*
Heavy Duty Trucks	*CNG Biofuel*	*Large*	*Euro 6*	*86*	*33 809*
Buses	*Diesel*	*Buses <=3.5 t*	*Euro II*	*12*	*13 898*
Buses	*Diesel*	*Buses <=3.5 t*	*Euro III*	*2*	*17 271*
Buses	*Diesel*	*Buses <=3.5 t*	*Euro IV*	*54*	*25 674*
Buses	*Diesel*	*Buses <=3.5 t*	*Euro V*	*9*	*25 690*
Buses	*Diesel*	*Urban Buses Midi <=15 t*	*Euro I*	*7*	*38 627*
Buses	*Diesel*	*Urban Buses Midi <=15 t*	*Euro II*	*4*	*41 910*
Buses	*Diesel*	*Urban Buses Midi <=15 t*	*Euro III*	*29*	*45 361*
Buses	*Diesel*	*Urban Buses Midi <=15 t*	*Euro IV*	*29*	*47 333*
Buses	*Diesel*	*Urban Buses Midi <=15 t*	*Euro V*	*76*	*48 122*
Buses	*Diesel*	*Urban Buses Midi <=15 t*	*Euro VI*	*212*	*51 031*
Buses	*Diesel*	*Urban Buses Standard 15 - 18 t*	*Euro I*	*4*	*38 261*
Buses	*Diesel*	*Urban Buses Standard 15 - 18 t*	*Euro II*	*2*	*41 910*
Buses	*Diesel*	*Urban Buses Standard 15 - 18 t*	*Euro III*	*15*	*45 361*
Buses	*Diesel*	*Urban Buses Standard 15 - 18 t*	*Euro IV*	*15*	*47 333*
Buses	*Diesel*	*Urban Buses Standard 15 - 18 t*	*Euro V*	*39*	*48 319*
Buses	*Diesel*	*Urban Buses Standard 15 - 18 t*	*Euro VI*	*118*	*50 883*
Buses	*Diesel*	*Urban Buses Articulated >18 t*	*Euro I*	*7*	*36 578*
Buses	*Diesel*	*Urban Buses Articulated >18 t*	*Euro II*	*3*	*41 910*
Buses	*Diesel*	*Urban Buses Articulated >18 t*	*Euro III*	*27*	*45 361*
Buses	*Diesel*	*Urban Buses Articulated >18 t*	*Euro IV*	*27*	*47 333*
Buses	*Diesel*	*Urban Buses Articulated >18 t*	*Euro V*	*67*	*48 122*
Buses	*Diesel*	*Urban Buses Articulated >18 t*	*Euro VI*	*203*	*51 031*
Buses	*Diesel*	*Coaches Standard <=18 t*	*Euro I*	*39*	*30 031*
Buses	*Diesel*	*Coaches Standard <=18 t*	*Euro II*	*107*	*30 689*
Buses	*Diesel*	*Coaches Standard <=18 t*	*Euro III*	*331*	*36 677*
Buses	*Diesel*	*Coaches Standard <=18 t*	*Euro IV*	*127*	*37 613*
Buses	*Diesel*	*Coaches Standard <=18 t*	*Euro V*	*81*	*39 297*
Buses	*Diesel*	*Coaches Standard <=18 t*	*Euro VI*	*289*	*41 168*
Buses	*Diesel*	*Coaches Articulated >18 t*	*Euro I*	*93*	*25 638*
Buses	*Diesel*	*Coaches Articulated >18 t*	*Euro II*	*134*	*29 566*
Buses	*Diesel*	*Coaches Articulated >18 t*	*Euro III*	*264*	*36 303*
Buses	*Diesel*	*Coaches Articulated >18 t*	*Euro IV*	*192*	*37 463*
Buses	*Diesel*	*Coaches Articulated >18 t*	*Euro V*	*309*	*38 922*

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
Buses	*Diesel*	*Coaches Articulated >18 t*	*Euro VI*	*528*	*41 168*
Buses	*LPG*	*Urban LNG Buses*	*Euro III*	*1*	*28 647*
Buses	*Petrol*	*Medium*	*Euro II*	*1*	*18 165*
Buses	*CNG*	*Urban CNG Buses*	*Euro IV*	*38*	*52 514*
Buses	*BEV*	*Medium*	*Euro VI*	*63*	*24 667*
L-Category	*Petrol*	*Mopeds 2-stroke <50 cm³*	*Conventional*	*426*	*807*
L-Category	*Petrol*	*Motorcycles 2-stroke >50 cm³*	*Euro 1*	*619*	*888*
L-Category	*Petrol*	*Motorcycles 2-stroke >50 cm³*	*Euro 2*	*1 438*	*982*
L-Category	*Petrol*	*Motorcycles 2-stroke >50 cm³*	*Euro 3*	*2031*	*1 053*
L-Category	*Petrol*	*Motorcycles 2-stroke >50 cm³*	*Euro 4*	*1 932*	*1 182*
L-Category	*Petrol*	*Motorcycles 2-stroke >50 cm³*	*Euro 5*	*366*	*1 200*
L-Category	*Petrol*	*Motorcycles 4-stroke 250 - 750 cm³*	*Conventional*	*356*	*1 125*
L-Category	*Petrol*	*Motorcycles 4-stroke 250 - 750 cm³*	*Euro 1*	*1 111*	*1 277*
L-Category	*Petrol*	*Motorcycles 4-stroke 250 - 750 cm³*	*Euro 2*	*2328*	*1 465*
L-Category	*Petrol*	*Motorcycles 4-stroke 250 - 750 cm³*	*Euro 3*	*4 650*	*1 783*
L-Category	*Petrol*	*Motorcycles 4-stroke 250 - 750 cm³*	*Euro 4*	*3642*	*2 372*
L-Category	*Petrol*	*Motorcycles 4-stroke 250 - 750 cm³*	*Euro 5*	*704*	*2 526*
L-Category	*Petrol*	*Motorcycles 4-stroke >750 cm³*	*Conventional*	*356*	*1 125*
L-Category	*Petrol*	*Motorcycles 4-stroke >750 cm³*	*Euro 1*	*1 003*	*1 277*
L-Category	*Petrol*	*Motorcycles 4-stroke >750 cm³*	*Euro 2*	*2023*	*1 465*
L-Category	*Petrol*	*Motorcycles 4-stroke >750 cm³*	*Euro 3*	*3 549*	*1 783*
L-Category	*Petrol*	*Motorcycles 4-stroke >750 cm³*	*Euro 4*	*2824*	*2 372*
L-Category	*Petrol*	*Motorcycles 4-stroke >750 cm³*	*Euro 5*	*568*	*2526*
L-Category	*Petrol*	*Quad & ATVs*	*Euro 4*	*1746*	*250*

Annex II: National energy balance

Table 1 National Energy Balance in 2022, TJ

	Oil products - total	Shale oil	LPG	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Petroleum coke	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Oil shale	Natural gas	Firewood	Wood wastes	Wood chips	Wood briquettes	Pelleted wood	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Production of primary energy resources	1054	-	-	-	-	-	-	-	-	-	1054	-	-	-	-	-	-	64	59	-	-	-	24603	5191	39475	1127	34723	-	-	3267	288	63	1972	116
Recycled products	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38
Imports	91099	-	9217	8045	-	8968	11	58457	118	57	1664	3979	461	-	122	0	1070	-	-	-	-	28975	398	1112	1381	232	6541	109	505	2780	-	-	-	119
Imported for bunkering	4613	-	-	-	-	-	-	3614	999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exports	25484	-	5935	1412	-	216	11	14634	-	3	1832	1339	1	-	96	5	161	4	12	-	-	-	4901	1336	9761	438	29237	179	-	5681	-	-	-	-
Bunkering	4613	-	-	-	-	-	-	3614	999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interproduct transfers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stock changes	-2103	-	16	-312	-	-2645	0	911	-5	0	-40	-36	7	-	1	0	-439	25	-40	-	-	65	1048	3435	-613	-379	-8629	-66	-82	6	-	-	-	8
Statistical differences	1646	-	-	-88	-	-	-	1734	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross energy consumption	66217	-	3298	6233	-	6107	0	46468	113	54	846	2604	467	-	27	0	470	85	7	-	-	29040	21148	8402	30482	542	3398	-136	423	372	288	63	1972	281
Consumed in transformation sector	-911	-	-48	-	-	-	-	-788	-75	-	-	-	-	-	-	-	-30	-53	0	-	-	-15774	-829	-428	-22782	-1	-288	-	-	-	-162	-63	-1794	-11
Produced in transformation sector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204	-	-	-	-	-	-
Transformation	-911	-	-48	-	-	-	-	-788	-75	-	-	-	-	-	-	-	-30	-53	0	-	-	-15774	-829	-428	-22782	-1	-288	204	-	-	-162	-63	-1794	-11
Electricity plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public CHP	-747	-	-4	-	-	-	-	-743	-	-	-	-	-	-	-	-	-	-2	-	-	-	-13269	-	-379	-13027	-	-19	-	-	-	-17	-63	-1246	-7
Utoproducer CHP	-6	-	-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-121	-	-	-222	-	-	-	-	-	-145	-	-548	-
Public heat plants	-109	-	-18	-	-	-	-	-16	-75	-	-	-	-	-	-	-	-30	-2	-	-	-	-1890	-91	-14	-8570	-1	-165	-	-	-	-	-	-	-

	Oil products - total	Shale oil	LPG	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Petroleum coke	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Oil shale	Natural gas	Firewood	Wood wastes	Wood chips	Wood briquettes	Pelleted wood	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Autoproducer heat plants	-49	-	-20	-	-	-	-	-29	-	-	-	-	-	-	-	-	-	-	0	-	-	-494	-221	-35	-963	0	-104	-	-	-	-	-	-	-4
Utilised heat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Production of peat briquettes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-517	-	-	-	-	204	-	-	-	-	-	-
Energy sector	286	-	-	-	-	-	-	286	-	-	-	-	-	-	-	-	-	-	-	-	-	375	-	-	-	-	1	-	-	-	-	-	-	-
Losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	402	-	-	-	-	-	-	-	-	-	-	-	-
Final consumption	65020	-	3250	6233	-	6107	0	45394	38	54	846	2604	467	-	27	0	440	32	7	-	-	12489	20319	7974	7700	541	3109	68	423	372	126	-	178	270
Transport	48774	-	1508	5959	-	6107	-	34386	-	-	814	-	-	-	-	-	-	-	-	-	-	86	-	-	-	-	-	-	423	248	-	-	-	-
International air transport	5961	-	-	0	-	5961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Domestic air transport	161	-	-	15	-	146	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Road transport	41605	-	1508	5959	-	-	-	33355	-	-	814	-	-	-	-	-	-	-	-	-	-	86	-	-	-	-	-	-	423	211	-	-	-	-
Rail transport	973	-	-	-	-	-	-	963	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Inland shipping	74	-	-	6	-	-	-	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pipeline transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Industry and construction	5513	-	519	19	-	-	0	1813	38	53	-	2604	467	-	-	0	355	23	1	-	-	3204	3407	7296	7378	30	272	-	-	2	-	-	0	193
Manufacture of metals	0	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	4	-	-	-	-	4	2	-	-	-	0	-	-	-	-	-	-	-
Manufacture of chemicals and chemical products	238	-	171	0	-	-	-	14	-	53	-	-	-	-	-	-	2	-	-	-	-	234	1	0	122	-	1	-	-	-	-	-	-	-

	Oil products - total	Shale oil	LPG	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Petroleum coke	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Oil shale	Natural gas	Firewood	Wood wastes	Wood chips	Wood briquettes	Pelleted wood	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Manufacture of other fabricated metal products	1	-	0	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-
Manufacture of other non-metallic mineral products	346	-	32	0	-	-	0	314	-	-	-	-	-	-	-	-	334	-	-	-	-	1071	10	-	25	0	2	-	-	2	-	-	-	157
Manufacture of motor vehicles	27	-	13	0	-	-	0	14	-	-	-	-	-	-	-	-	0	-	-	-	-	16	-	-	-	-	3	-	-	-	-	-	-	-
Machinery	34	-	20	0	-	-	-	14	-	-	-	-	-	-	-	-	1	-	-	-	-	181	12	12	21	8	37	-	-	-	-	-	-	-
Mining and quarrying	319	-	4	0	-	-	-	255	-	-	-	60	-	-	-	-	-	-	-	-	-	17	6	-	-	-	1	-	-	-	-	-	-	-
Manufacture of food products	317	-	116	1	-	-	-	162	38	-	-	-	-	-	-	0	9	-	0	-	-	979	67	0	143	12	26	-	-	-	-	-	0	32
Manufacture of paper and paper products	6	-	6	0	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	66	2	0	16	0	2	-	-	-	-	-	-	-
Manufacture of wood and wood products	600	-	39	4	-	-	-	389	-	-	-	-	168	-	-	-	-	23	1	-	-	224	3103	7140	6986	9	166	-	-	-	-	-	-	4
Construction	3289	-	102	14	-	-	-	629	-	-	-	2544	-	-	-	-	5	-	-	-	-	217	27	-	1	0	20	-	-	-	-	-	-	-
Manufacture of textiles	11	-	10	0	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	153	2	-	-	-	6	-	-	-	-	-	-	-
Other manufacturing	325	-	6	0	-	-	-	20	-	-	-	-	299	-	-	-	0	-	-	-	-	33	175	144	64	1	8	-	-	-	-	-	-	-
Other sectors	10733	-	1223	255	-	-	0	9195	0	1	32	-	-	-	27	0	85	9	6	-	-	9199	16912	678	322	511	2837	68	-	122	126	-	178	77
Other consumers - commercial and public sector	2058	-	398	32	-	-	0	1600	0	1	-	-	-	-	27	0	33	9	6	-	-	4692	1000	41	238	44	889	-	-	-	126	-	-	3
Households	2265	-	733	198	-	-	-	1334	-	-	-	-	-	-	-	-	52	-	-	-	-	4392	15822	319	-	467	1896	68	-	-	-	-	-	-

	Oil products - total	Shale oil	LPG	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Petroleum coke	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Oil shale	Natural gas	Firewood	Wood wastes	Wood chips	Wood briquettes	Pelleted wood	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Crop and animal production	6180	-	89	24	-	-	-	6036	-	-	31	-	-	-	-	-	-	-	0	-	-	112	86	318	83	-	49	-	-	122	-	-	178	74
Fishing	230	-	3	1	-	-	-	225	0	-	1	-	-	-	-	-	-	-	-	-	-	3	4	-	1	-	3	-	-	-	-	-	-	-

Table 2 Fuel consumption in Energy sector (stationary combustion), TJ

1.A.1 Energy Industries

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1.A.1. Energy Industries																				
Total	***95424***	***89290***	***74201***	***58345***	***53160***	***50516***	***51326***	***52637***	***54187***	***48325***	***42657***	***44355***	***43268***	***43796***	***40977***	***40412***	***41926***	***39412***	***38942***	***37912***
Liquid Fuels	*40437*	*33253*	*28441*	*27170*	*30859*	*20519*	*27333*	*17437*	*20662*	*17491*	*7900*	*5235*	*5033*	*3576*	*3055*	*2365*	*1511*	*1389*	*905*	*1194*
Solid Fuels	*2305*	*1736*	*1935*	*2106*	*1366*	*1395*	*740*	*541*	*455*	*398*	*371*	*398*	*285*	*209*	*210*	*183*	*105*	*341*	*446*	*472*
Peat	*2089*	*2343*	*2814*	*3007*	*2841*	*3432*	*2974*	*3083*	*2157*	*1275*	*2351*	*1230*	*1005*	*663*	*70*	*60*	*30*	*29*	*20*	*10*
Gaseous Fuels	*50115*	*51368*	*40338*	*25200*	*16770*	*24107*	*18644*	*28165*	*26802*	*25464*	*28803*	*33510*	*32497*	*34074*	*32371*	*33306*	*35181*	*32613*	*32650*	*31236*
Biomass	*436*	*590*	*673*	*862*	*1324*	*1063*	*1634*	*3412*	*4111*	*3697*	*3232*	*3940*	*4406*	*5245*	*5183*	*4469*	*5099*	*5040*	*4921*	*4971*
Other Fossil Fuels	*42*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*42*	*29*	*88*	*29*	*NO*	*NO*	*NO*	*29*
1.A.1.a. Public Electricity and Heat Production																				
Total	***92473***	***86689***	***71901***	***55946***	***51496***	***48590***	***48499***	***51233***	***50453***	***44329***	***39919***	***42931***	***41998***	***42183***	***39325***	***39066***	***40493***	***38390***	***37652***	***36795***
Liquid Fuels	*40098*	*33002*	*28190*	*26919*	*30426*	*20266*	*26110*	*17107*	*18116*	*14486*	*6350*	*5065*	*4821*	*3406*	*2843*	*2153*	*1299*	*1219*	*693*	*1031*
Solid Fuels	*2305*	*1736*	*1935*	*2106*	*1366*	*1395*	*740*	*541*	*427*	*370*	*371*	*398*	*285*	*209*	*210*	*183*	*105*	*341*	*446*	*472*
Peat	*1378*	*1703*	*1945*	*2437*	*2246*	*2703*	*2403*	*2600*	*1764*	*1046*	*1970*	*1125*	*995*	*653*	*60*	*40*	*20*	*20*	*20*	*10*
Gaseous Fuels	*48214*	*49658*	*39158*	*23622*	*16134*	*23163*	*17612*	*27599*	*26069*	*24831*	*27996*	*32633*	*31691*	*33199*	*31499*	*32434*	*34242*	*32043*	*31845*	*30739*
Biomass	*436*	*590*	*673*	*862*	*1324*	*1063*	*1634*	*3386*	*4077*	*3596*	*3232*	*3668*	*4164*	*4687*	*4625*	*4227*	*4827*	*4767*	*4648*	*4514*
Other Fossil Fuels	*42*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*42*	*29*	*88*	*29*	*NO*	*NO*	*NO*	*29*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*39*	*NO*	*NO*	*NO*	*394*	*944*	*472*	*354*	*157*	*NO*	*NO*	*39*	*39*	*NO*	*NO*
LPG	*46*	*46*	*46*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*5524*	*5226*	*3824*	*935*	*382*	*85*	*42*	*297*	*85*	*85*	*127*	*42*	*42*	*42*	*42*	*42*	*42*	*43*	*43*	*16*
RFO	*32561*	*26147*	*23183*	*24563*	*30044*	*20016*	*25984*	*16768*	*17905*	*14007*	*5279*	*4425*	*4425*	*3207*	*2801*	*2111*	*1218*	*1137*	*650*	*1015*
Other liquid	*1967*	*1583*	*1137*	*1421*	*NO*	*126*	*84*	*42*	*126*	*NO*	*NO*	*126*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*2305*	*1736*	*1935*	*2106*	*1366*	*1395*	*740*	*541*	*427*	*370*	*371*	*398*	*285*	*209*	*210*	*183*	*105*	*341*	*446*	*472*
Peat	*1347*	*1688*	*1930*	*2422*	*2231*	*2626*	*2341*	*2523*	*1749*	*1046*	*1970*	*1125*	*995*	*653*	*60*	*40*	*20*	*20*	*20*	*10*
Peat briquettes	*31*	*15*	*15*	*15*	*15*	*77*	*62*	*77*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*48214*	*49658*	*39158*	*23622*	*16134*	*23163*	*17612*	*27599*	*26069*	*24831*	*27996*	*32633*	*31691*	*33199*	*31499*	*32434*	*34242*	*32043*	*31845*	*30739*
Wood	*436*	*590*	*673*	*831*	*1300*	*1045*	*1595*	*3363*	*4060*	*3558*	*3191*	*3617*	*4097*	*4644*	*4570*	*4132*	*4740*	*4675*	*4556*	*4390*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Biofuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Landfill gas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*9*
Sludge gas	*NO*	*NO*	*NO*	*31*	*24*	*18*	*39*	*23*	*17*	*38*	*41*	*51*	*67*	*43*	*55*	*95*	*87*	*92*	*92*	*115*
Other biogas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*42*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*42*	*29*	*88*	*29*	*NO*	*NO*	*NO*	*29*
1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries																				
Total	***2951***	***2601***	***2300***	***2399***	***1664***	***1926***	***2826***	***1405***	***3734***	***3996***	***2738***	***1424***	***1270***	***1613***	***1652***	***1346***	***1433***	***1022***	***1290***	***1117***

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Liquid Fuels	*339*	*251*	*251*	*251*	*433*	*253*	*1223*	*330*	*2546*	*3005*	*1550*	*170*	*212*	*170*	*212*	*212*	*212*	*170*	*212*	*163*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*28*	*28*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*711*	*640*	*869*	*570*	*595*	*729*	*571*	*483*	*393*	*229*	*381*	*105*	*10*	*10*	*10*	*20*	*10*	*9*	*NO*	*NO*
Gaseous Fuels	*1901*	*1710*	*1180*	*1578*	*636*	*944*	*1032*	*566*	*733*	*633*	*807*	*877*	*806*	*875*	*872*	*872*	*939*	*570*	*805*	*497*
Biomass	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*26*	*34*	*101*	*NO*	*272*	*242*	*558*	*558*	*242*	*272*	*273*	*273*	*457*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*46*	*NO*	*NO*	*NO*	*182*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*216*	*346*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*212*	*170*	*170*	*170*	*170*	*212*	*127*	*127*	*127*	*212*	*127*	*170*	*212*	*170*	*212*	*212*	*212*	*170*	*212*	*163*
RFO	*81.2*	*81.2*	*81.2*	*81.2*	*81.2*	*40.6*	*1096*	*202.6*	*487*	*731*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1716*	*1716*	*1423*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*28*	*28*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*710.9*	*640.1*	*868.95*	*569.65*	*594.65*	*729*	*571.4*	*483.1*	*392.75*	*229.35*	*380.65*	*105.25*	*10*	*10*	*10*	*20*	*10*	*9*	*NO*	*NO*
Natural gas	*1901*	*1710*	*1180*	*1578*	*636*	*944*	*1032*	*566*	*733*	*633*	*807*	*877*	*806*	*875*	*872*	*872*	*939*	*570*	*805*	*497*
Wood	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*26*	*34*	*101*	*NO*	*272*	*242*	*558*	*558*	*242*	*272*	*273*	*273*	*457*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.A.1. Energy Industries													
Total	***45623***	***42405***	***40447***	***46121***	***43893***	***46754***	***51075***	***48143***	***55231***	***54242***	***45365***	***49188***	***40666***
Liquid Fuels	*918*	*848*	*662*	*466*	*319*	*283*	*295*	*281*	*360*	*416*	*305*	*379*	*1142*
Solid Fuels	*419*	*419*	*513*	*424*	*175*	*105*	*152*	*107*	*112*	*104*	*35*	*72*	*30*
Peat	*11*	*9*	*NO*	*40*	*NO*	*NO*	*NO*	*29*	*102*	*35*	*23*	*23*	*53*
Gaseous Fuels	*38687*	*35607*	*31872*	*33926*	*29870*	*31395*	*32108*	*26556*	*33211*	*31283*	*23442*	*24387*	*15534*
Biomass	*5559*	*5519*	*7400*	*11265*	*13529*	*14971*	*18520*	*21170*	*21446*	*22404*	*21560*	*24327*	*23907*
Other Fossil Fuels	*29*	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.1.a. Public Electricity and Heat Production													
Total	***44302***	***40877***	***39071***	***44641***	***42383***	***45442***	***49929***	***46874***	***54053***	***52876***	***44272***	***47937***	***39642***
Liquid Fuels	*705*	*593*	*492*	*211*	*33*	*28*	*30*	*37*	*80*	*39*	*54*	*94*	*856*
Solid Fuels	*419*	*419*	*513*	*424*	*175*	*105*	*152*	*107*	*112*	*104*	*35*	*72*	*30*
Peat	*11*	*9*	*NO*	*40*	*NO*	*NO*	*NO*	*NO*	*85*	*NO*	*1*	*1*	*4*
Gaseous Fuels	*37812*	*34664*	*30895*	*32997*	*29040*	*30712*	*31595*	*26116*	*32691*	*30713*	*22949*	*23860*	*15159*
Biomass	*5326*	*5189*	*7171*	*10969*	*13135*	*14597*	*18152*	*20614*	*21085*	*22020*	*21233*	*23910*	*23593*
Other Fossil Fuels	*29*	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*2*	*NO*
LPG	*NO*	*NO*	*NO*	*4*	*1*	*1*	*1*	*1*	*1*	*2*	*6*	*2*	*22*
Diesel oil	*15*	*25*	*127*	*94*	*22*	*14*	*11*	*14*	*49*	*9*	*4*	*3*	*759*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RFO	*690*	*568*	*365*	*113*	*10*	*13*	*18*	*22*	*30*	*28*	*44*	*87*	*75*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*419*	*419*	*513*	*424*	*175*	*105*	*152*	*107*	*112*	*104*	*35*	*72*	*30*
Peat	*10*	*9*	*NO*	*40*	*NO*	*NO*	*NO*	*NO*	*85*	*NO*	*1*	*1*	*4*
Peat briquettes	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*37812*	*34664*	*30895*	*32997*	*29040*	*30712*	*31595*	*26116*	*32691*	*30713*	*22949*	*23860*	*15159*
Wood	*5120*	*4635*	*5793*	*9198*	*11184*	*12286*	*15662*	*18003*	*18751*	*19948*	*19120*	*22322*	*22266*
Straws	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*18*	*66*	*NO*	*37*	*26*	*7*
Biofuel	*8*	*52*	*39*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*
Landfill gas	*18*	*22*	*22*	*14*	*16*	*13*	*13*	*14*	*14*	*14*	*13*	*12*	*11*
Sludge gas	*137*	*102*	*102*	*102*	*93*	*85*	*107*	*101*	*83*	*90*	*76*	*81*	*63*
Other biogas	*42*	*378*	*1215*	*1655*	*1842*	*2213*	*2370*	*2478*	*2170*	*1968*	*1987*	*1469*	*1246*
Waste oils	*29*	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries													
Total	***1321***	***1528***	***1376***	***1480***	***1510***	***1312***	***1146***	***1269***	***1178***	***1366***	***1093***	***1251***	***1024***
Liquid Fuels	*213*	*255*	*170*	*255*	*286*	*255*	*265*	*244*	*280*	*377*	*251*	*285*	*286*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*29*	*17*	*35*	*22*	*22*	*49*
Gaseous Fuels	*875*	*943*	*977*	*929*	*830*	*683*	*513*	*440*	*520*	*570*	*493*	*527*	*375*
Biomass	*233*	*330*	*229*	*296*	*394*	*374*	*368*	*556*	*361*	*384*	*327*	*417*	*314*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*213*	*255*	*170*	*255*	*286*	*255*	*265*	*244*	*280*	*377*	*251*	*285*	*286*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*29*	*17*	*35*	*22*	*22*	*49*
Natural gas	*875*	*943*	*977*	*929*	*830*	*683*	*513*	*440*	*520*	*570*	*493*	*527*	*375*
Wood	*233*	*330*	*229*	*296*	*394*	*374*	*368*	*556*	*361*	*384*	*327*	*417*	*314*

1.A.2 Manufacturing Industries and Construction

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1.A.2 Manufacturing Industries and Construction																				
Total	***58640***	***45567***	***38083***	***32982***	***29888***	***29837***	***29430***	***28709***	***26228***	***24129***	***20526***	***20910***	***21411***	***21329***	***22992***	***24018***	***25618***	***24376***	***23172***	***22367***
Liquid Fuels	*29747*	*20311*	*17430*	*17082*	*16545*	*16745*	*16344*	*16010*	*12910*	*11400*	*7575*	*4681*	*3966*	*4417*	*4277*	*2866*	*4075*	*3843*	*3076*	*2936*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solid Fuels	*1545*	*882*	*968*	*1639*	*1444*	*650*	*592*	*450*	*393*	*421*	*252*	*252*	*253*	*262*	*236*	*971*	*1394*	*1967*	*1993*	*1363*
Peat	*NO*	*20*	*10*	*NO*	*15*	*15*	*15*	*25*	*25*	*15*	*NO*	*NO*	*NO*	*NO*	*10*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*25894*	*23752*	*19059*	*12482*	*9783*	*10014*	*9815*	*9484*	*9712*	*9080*	*9873*	*11583*	*12838*	*12729*	*13157*	*13680*	*13395*	*12881*	*11836*	*9261*
Biomass	*617*	*603*	*616*	*1779*	*2101*	*2414*	*2664*	*2740*	*3188*	*3186*	*2733*	*3926*	*3487*	*3391*	*4795*	*5588*	*6464*	*5415*	*5895*	*8675*
Other Fossil Fuels	*837*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*26*	*94*	*469*	*866*	*530*	*517*	*914*	*290*	*270*	*372*	*132*
1.A.2.a. Iron and Steel																				
Total	***6304***	***4622***	***4130***	***3651***	***3992***	***3065***	***3282***	***5079***	***5083***	***4991***	***5049***	***5142***	***4861***	***4932***	***5016***	***4777***	***5059***	***5081***	***4738***	***4187***
Liquid Fuels	*1192*	*989*	*705*	*731*	*885*	*705*	*785*	*1162*	*1088*	*1130*	*1145*	*1042*	*963*	*963*	*963*	*99*	*963*	*963*	*917*	*792*
Solid Fuels	*NO*	*NO*	*NO*	*28*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*27*	*27*	*5*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*4275*	*3633*	*3425*	*2892*	*3107*	*2360*	*2497*	*3917*	*3995*	*3861*	*3904*	*4058*	*3898*	*3969*	*4026*	*4125*	*4091*	*4118*	*3821*	*3395*
Biomass	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other Fossil Fuels	*837*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*NO*	*NO*	*NO*	*526*	*NO*	*NO*	*NO*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*79*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*15*	*15*	*15*	*NO*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*15*	*NO*	*NO*	*NO*	*NO*	*15*	*NO*	*NO*	*NO*	*NO*
RFO	*1177*	*974*	*690*	*284*	*284*	*203*	*325.2*	*325*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*122*	*81*
Other liquid	*NO*	*NO*	*NO*	*447*	*586*	*502*	*460*	*837*	*1088*	*1130*	*1130*	*963*	*963*	*963*	*963*	*84*	*963*	*963*	*795*	*711*
Anthracite	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*NO*	*NO*	*28*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coke	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*27*	*27*	*5*	*NO*	*NO*	*NO*
Natural gas	*4275*	*3633*	*3425*	*2892*	*3107*	*2360*	*2497*	*3917*	*3995*	*3861*	*3904*	*4058*	*3898*	*3969*	*4026*	*4125*	*4091*	*4118*	*3821*	*3395*
Wood	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*837*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*NO*	*NO*	*NO*	*526*	*NO*	*NO*	*NO*	*NO*
1.A.2.b. Non-Ferrous Metals																				
Total	***NO***	***NO***	***NO***	***NO***	***NO***	***NO***	***NO***	***NO***	***53***	***100***	***168***	***190***	***269***	***302***	***269***	***203***	***204***	***201***	***134***	***101***
Liquid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*53*	*100*	*168*	*190*	*269*	*302*	*269*	*203*	*204*	*201*	*134*	*101*
Biomass	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Natural gas	NO	NO	NO	NO	NO	NO	NO	NO	53	100	168	190	269	302	269	203	204	201	134	101
Biofuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals																				
Total	**3943**	**2515**	**2013**	**3638**	**3935**	**5645**	**4160**	**3529**	**643**	**538**	**486**	**479**	**469**	**449**	**452**	**472**	**540**	**455**	**811**	**679**
Liquid Fuels	3516	1932	1599	2963	3207	4547	3451	3207	325	122	122	164	162	122	NO	NO	NO	NO	81	31
Solid Fuels	NO	NO	NO	28	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	427	584	414	643	693	1090	696	302	298	362	317	269	278	308	405	442	480	381	513	518
Biomass	NO	NO	NO	4	7	7	13	20	20	54	47	46	29	19	47	30	60	74	188	130
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other kerosene	389	389	259	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
RFO	3127	1543	1340	2963	3207	4547	3451	3207	325	122	122	122	162	122	NO	NO	NO	NO	81	31
Other liquid	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO
Coal	NO	NO	NO	28	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	427	584	414	643	693	1090	696	302	298	362	317	269	278	308	405	442	480	381	513	518
Wood	NO	NO	NO	4	7	7	13	20	20	54	47	46	29	19	47	30	57	72	187	127
Biofuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	2	1	3
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO
1.A.2.d. Pulp, Paper and Print																				
Total	**2956**	**2827**	**2562**	**953**	**330**	**326**	**194**	**181**	**142**	**168**	**124**	**176**	**182**	**214**	**213**	**255**	**281**	**217**	**208**	**264**
Liquid Fuels	203	162	122	122	41	81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid Fuels	28	28	28	113	56	56	56	57	28	28	NO	28	28	26	26	26	26	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	2724	2637	2412	653	45	101	118	104	94	100	101	135	134	168	167	202	235	201	201	101
Biomass	NO	NO	NO	65	188	87	20	20	20	40	23	13	20	20	20	27	20	16	7	163
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
RFO	203	162	122	122	41	81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coal	*28*	*28*	*28*	*113*	*56*	*56*	*56*	*57*	*28*	*28*	*NO*	*28*	*28*	*26*	*26*	*26*	*26*	*NO*	*NO*	*NO*
Natural gas	*2724*	*2637*	*2412*	*653*	*45*	*101*	*118*	*104*	*94*	*100*	*101*	*135*	*134*	*168*	*167*	*202*	*235*	*201*	*201*	*101*
Wood	*NO*	*NO*	*NO*	*65*	*188*	*87*	*20*	*20*	*20*	*40*	*23*	*13*	*20*	*20*	*20*	*27*	*20*	*16*	*7*	*163*
1.A.2.e. Food Processing, Beverages and Tobacco																				
Total	***11791***	***8021***	***7340***	***7910***	***7380***	***7842***	***8807***	***8002***	***7721***	***6747***	***5615***	***4899***	***5112***	***4423***	***4879***	***5019***	***4876***	***4037***	***3139***	***2874***
Liquid Fuels	*7318*	*4471*	*3944*	*3578*	*3654*	*4141*	*4919*	*4398*	*4516*	*3581*	*2418*	*1184*	*1102*	*694*	*533*	*615*	*661*	*456*	*208*	*374*
Solid Fuels	*1069*	*598*	*655*	*594*	*565*	*309*	*309*	*252*	*168*	*224*	*140*	*140*	*141*	*158*	*105*	*132*	*106*	*79*	*79*	*52*
Peat	*NO*	*NO*	*NO*	*NO*	*15*	*NO*	*NO*	*15*	*15*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*3177*	*2722*	*2511*	*3500*	*2829*	*3065*	*3250*	*3013*	*2694*	*2578*	*2607*	*2775*	*2985*	*2764*	*3238*	*3149*	*3249*	*2684*	*2370*	*1930*
Biomass	*228*	*231*	*230*	*238*	*316*	*327*	*330*	*325*	*328*	*349*	*450*	*800*	*842*	*719*	*916*	*1035*	*772*	*701*	*394*	*488*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*88*	*88*	*88*	*88*	*117*	*88*	*30*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*39.35*	*NO*	*NO*	*NO*	*NO*	*629.5*	*79*	*79*	*39*	*39*	*79*	*39*	*40*	*40*	*39*
LPG	*46*	*46*	*46*	*46*	*NO*	*NO*	*NO*	*46*	*46*	*46*	*NO*	*46*	*46*	*46*	*46*	*46*	*91*	*91*	*46*	*91*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*43*	*86*	*43*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*43*	*43*	*43*	*43*	*43*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
RFO	*7105*	*4425*	*3898*	*3532*	*3654*	*4060*	*4791*	*4223*	*4384*	*3492*	*1745*	*975*	*893*	*609*	*406*	*406*	*447*	*325*	*122*	*244*
Other liquid	*167*	*NO*	*NO*	*NO*	*NO*	*42*	*42*	*NO*	*NO*	*NO*	*NO*	*84*	*84*	*NO*	*42*	*84*	*84*	*NO*	*NO*	*NO*
Coal	*911*	*598*	*655*	*541*	*512*	*256*	*256*	*199*	*142*	*171*	*114*	*114*	*114*	*131*	*105*	*105*	*79*	*79*	*79*	*52*
Coke	*158*	*NO*	*NO*	*53*	*53*	*53*	*53*	*53*	*26*	*53*	*26*	*26*	*27*	*27*	*NO*	*27*	*27*	*NO*	*NO*	*NO*
Peat briquettes	*NO*	*NO*	*NO*	*NO*	*15*	*NO*	*NO*	*15*	*15*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*3177*	*2722*	*2511*	*3500*	*2829*	*3065*	*3250*	*3013*	*2694*	*2578*	*2607*	*2775*	*2985*	*2764*	*3238*	*3149*	*3249*	*2684*	*2370*	*1930*
Wood	*228*	*231*	*230*	*238*	*316*	*327*	*330*	*325*	*328*	*349*	*450*	*800*	*842*	*719*	*915.8*	*1035*	*772*	*701*	*394*	*483*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Biofuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*5*
Other biogas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*88*	*88*	*88*	*88*	*117*	*88*	*30*
1.A.2.f. Non-metallic minerals																				
Total	***9369***	***5784***	***5542***	***2920***	***3829***	***3968***	***3899***	***3103***	***2960***	***2986***	***2470***	***2755***	***3631***	***3861***	***3606***	***4016***	***4085***	***4357***	***4180***	***2566***
Liquid Fuels	*3458*	*1180*	*1259*	*1218*	*2888*	*2478*	*2477*	*2354*	*1827*	*2189*	*1479*	*440*	*316*	*1325*	*1167*	*509*	*708*	*252*	*80*	*165*
Solid Fuels	*170*	*85*	*114*	*199*	*171*	*114*	*57*	*85*	*28*	*28*	*28*	*28*	*28*	*26*	*26*	*682*	*1127*	*1809*	*1888*	*1285*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*10*	*10*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*5734*	*4513*	*4163*	*1476*	*750*	*1282*	*1345*	*634*	*1066*	*698*	*808*	*1821*	*2352*	*1884*	*1845*	*2381*	*1878*	*1979*	*1782*	*942*
Biomass	*7*	*6*	*6*	*27*	*20*	*94*	*20*	*20*	*29*	*44*	*61*	*82*	*111*	*184*	*139*	*144*	*170*	*165*	*175*	*101*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	94	385	824	442	429	300	202	153	255	73
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	118	748	236	118	118	79	39	39	39	39	NO
LPG	NO	NO	NO	NO	46	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other kerosene	43	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
RFO	3289	1137	1259	1218	2842	2436	2477	2354	1827	2071	731	162	NO	NO	NO	41	NO	81	41	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	198	956	1088	429	627	132	NO	165
Other liquid	126	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	42	NO	251	NO	NO	42	NO	NO	NO
Coal	142	85	114	199	171	114	57	85	28	28	28	28	28	26	26	682	1127	1809	1888	1285
Oil shale	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	10	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	5734	4513	4163	1476	750	1282	1345	634	1066	698	808	1821	2352	1884	1845	2381	1878	1979	1782	942
Wood	7	6	6	27	20	94	20	20	29	34	24	12	17	102	50	95	136	139	77	67
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biofuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Municipal wastes (biomass fraction)	NO	NO	NO	NO	NO	NO	NO	NO	NO	10	37	70	94	82	89	49	34	26	98	34
Municipal wastes (fossil fraction)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	80	29
Industrial wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	94	176	238	208	224	125	85	65	58	15
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	209	586	234	205	175	117	88	117	29
1.A.2.g. Other																				
Total	**24278**	**21798**	**16497**	**13910**	**10424**	**8992**	**9088**	**8814**	**9626**	**8599**	**6615**	**7269**	**6886**	**7148**	**8557**	**9276**	**10573**	**10028**	**9962**	**11697**
Liquid Fuels	14061	11578	9802	8470	5871	4793	4712	4888	5154	4378	2411	1851	1423	1313	1615	1643	1743	2172	1790	1574
Solid Fuels	278	171	171	677	623	170	169	56	169	141	84	56	56	52	52	104	130	79	26	26
Peat	NO	20	10	NO	NO	15	15	NO	NO	NO	NO	NO	NO	NO	10	NO	NO	NO	NO	NO
Gaseous Fuels	9557	9664	6134	3318	2360	2115	1910	1515	1512	1380	1968	2335	2922	3334	3208	3177	3258	3318	3014	2275
Biomass	382	366	380	1445	1570	1899	2281	2355	2791	2699	2152	2985	2485	2449	3673	4352	5442	4459	5132	7793
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	29

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*39*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*NO*	*NO*	*NO*	*NO*	*91*	*137*	*91*	*NO*	*46*	*46*	*NO*	*NO*	*NO*	*46*	*46*	*46*	*46*	*45*	*NO*
Gasoline	*880*	*220*	*220*	*220*	*132*	*44*	*132*	*88*	*88*	*44*	*44*	*44*	*69*	*44*	*88*	*88*	*88*	*88*	*88*	*44*
Other kerosene	*NO*	*NO*	*NO*	*86*	*43*	*86*	*43*	*86*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*5549*	*5591*	*4019*	*3779*	*1597*	*1485*	*1315*	*1740*	*1655*	*1527*	*1469*	*1357*	*1231*	*1187*	*1357*	*1385*	*1527*	*1997*	*1657*	*1530*
RFO	*7632*	*5766*	*5563*	*4385*	*4099*	*3086*	*3085*	*2883*	*3411*	*2761*	*813*	*366*	*123*	*82*	*82*	*82*	*82*	*41*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*84*	*NO*	*NO*	*42*	*42*	*NO*	*NO*	*NO*	*NO*
Coal	*199*	*171*	*171*	*625*	*597*	*170*	*169*	*56*	*169*	*141*	*84*	*56*	*56*	*52*	*52*	*104*	*130*	*79*	*26*	*26*
Coke	*79*	*NO*	*NO*	*52*	*26*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*20*	*10*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*10*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*NO*	*NO*	*NO*	*NO*	*NO*	*15*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*9557*	*9664*	*6134*	*3318*	*2360*	*2115*	*1910*	*1515*	*1512*	*1380*	*1968*	*2335*	*2922*	*3334*	*3208*	*3177*	*3258*	*3318*	*3014*	*2275*
Wood	*382*	*366*	*380*	*1445*	*1570*	*1899*	*2281*	*2355*	*2791*	*2699*	*2152*	*2985*	*2485*	*2449*	*3673*	*4352*	*5442*	*4459*	*5132*	*7793*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Biofuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*29*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.A.2 Manufacturing Industries and Construction													
Total	***26693***	***25237***	***27823***	***26084***	***26820***	***26271***	***23655***	***24234***	***27505***	***26188***	***26707***	***27669***	***28462***
Liquid Fuels	*3500*	*2298*	*2649*	*2576*	*2254*	*2014*	*2193*	*2282*	*2326*	*2079*	*2128*	*2001*	*2394*
Solid Fuels	*1861*	*2229*	*2149*	*1406*	*1336*	*1014*	*727*	*974*	*1341*	*1213*	*808*	*530*	*355*
Peat	*14*	*2*	*2*	*24*	*24*	*11*	*34*	*NO*	*1*	*14*	*8*	*25*	*24*
Gaseous Fuels	*10537*	*7578*	*7952*	*6259*	*5258*	*5262*	*4755*	*4689*	*4936*	*4264*	*4227*	*4779*	*3322*
Biomass	*10319*	*12381*	*14194*	*14703*	*16670*	*16722*	*15034*	*15124*	*17319*	*17211*	*17914*	*18706*	*20627*
Other Fossil Fuels	*462*	*749*	*877*	*1115*	*1279*	*1248*	*913*	*1166*	*1582*	*1407*	*1621*	*1629*	*1740*
1.A.2.a. Iron and Steel													
Total	***4869***	***1207***	***1633***	***583***	***13***	***406***	***46***	***6***	***5***	***10***	***7***	***8***	***10***
Liquid Fuels	*1005*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0*	*0*	*NO*	*NO*	*NO*	*NO*
Solid Fuels	*26*	*27*	*184*	*32*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*4*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*3838*	*1180*	*1449*	*551*	*13*	*406*	*46*	*6*	*4*	*6*	*7*	*8*	*4*
Biomass	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*4*	*NO*	*NO*	*2*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Diesel oil	*0*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0*	*0*	*NO*	*NO*	*NO*	*NO*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*1005*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anthracite	*NO*	*NO*	*82*	*27*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*26*	*27*	*102*	*5*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*4*
Coke	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*3838*	*1180*	*1449*	*551*	*13*	*406*	*46*	*6*	*4*	*6*	*7*	*8*	*4*
Wood	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*4*	*NO*	*NO*	*2*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.2.b. Non-Ferrous Metals													
Total	***135***	***170***	***170***	***138***	***72***	***61***	***37***	***26***	***26***	***24***	***14***	***21***	***9***
Liquid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Solid Fuels	*NO*	*2*	*1*	*NO*	*NO*	*1*	*1*	*NO*	*1*	*1*	*NO*	*1*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*135*	*168*	*168*	*138*	*72*	*60*	*36*	*26*	*25*	*23*	*14*	*20*	*9*
Biomass	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*2*	*1*	*NO*	*NO*	*1*	*1*	*NO*	*1*	*1*	*NO*	*1*	*NO*
Natural gas	*135*	*168*	*168*	*138*	*72*	*60*	*36*	*26*	*25*	*23*	*14*	*20*	*9*
Biofuel	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.2.c. Chemicals													
Total	***803***	***621***	***737***	***756***	***780***	***720***	***718***	***810***	***816***	***618***	***609***	***659***	***531***
Liquid Fuels	*9*	*46*	*137*	*137*	*144*	*139*	*127*	*142*	*182*	*163*	*166*	*176*	*171*
Solid Fuels	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*2*	*NO*	*1*	*8*	*2*
Peat	*NO*	*NO*	*NO*	*20*	*11*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*606*	*404*	*371*	*385*	*316*	*330*	*390*	*452*	*480*	*297*	*241*	*330*	*234*
Biomass	*188*	*170*	*229*	*214*	*309*	*251*	*201*	*216*	*151*	*158*	*201*	*145*	*124*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*46*	*137*	*137*	*144*	*139*	*127*	*142*	*182*	*163*	*166*	*176*	*171*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
RFO	*9*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*2*	*NO*	*1*	*8*	*2*
Peat	*NO*	*NO*	*NO*	*20*	*10*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*606*	*404*	*371*	*385*	*316*	*330*	*390*	*452*	*480*	*297*	*241*	*330*	*234*
Wood	*187*	*169*	*210*	*208*	*278*	*221*	*179*	*188*	*151*	*158*	*200*	*145*	*124*
Biofuel	*1*	*1*	*NO*	*NO*	*1*	*1*	*NO*	*6*	*NO*	*NO*	*1*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Other biogas	*NO*	*NO*	*19*	*6*	*30*	*29*	*22*	*22*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.2.d. Pulp, Paper and Print													
Total	***257***	***209***	***170***	***200***	***104***	***104***	***102***	***118***	***118***	***116***	***103***	***125***	***92***
Liquid Fuels	*NO*	*NO*	*NO*	*NO*	*4*	*4*	*4*	*4*	*3*	*4*	*4*	*5*	*6*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*101*	*101*	*68*	*103*	*97*	*95*	*86*	*105*	*107*	*95*	*79*	*98*	*66*
Biomass	*156*	*108*	*102*	*97*	*3*	*5*	*11*	*9*	*8*	*17*	*20*	*22*	*20*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*NO*	*NO*	*NO*	*4*	*4*	*4*	*4*	*3*	*4*	*4*	*5*	*6*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*101*	*101*	*68*	*103*	*97*	*95*	*86*	*105*	*107*	*95*	*79*	*98*	*66*
Wood	*156*	*108*	*102*	*97*	*3*	*5*	*11*	*9*	*8*	*17*	*20*	*22*	*20*
1.A.2.e. Food Processing, Beverages and Tobacco													
Total	***2738***	***2609***	***2790***	***2616***	***2477***	***2097***	***2144***	***1984***	***2086***	***2042***	***2143***	***2000***	***1515***
Liquid Fuels	*396*	*291*	*379*	*305*	*226*	*156*	*197*	*200*	*170*	*195*	*138*	*97*	*154*
Solid Fuels	*52*	*16*	*27*	*25*	*24*	*24*	*46*	*40*	*17*	*14*	*17*	*11*	*9*
Peat	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*1919*	*1886*	*1819*	*1808*	*1729*	*1627*	*1476*	*1303*	*1378*	*1336*	*1391*	*1550*	*1031*
Biomass	*339*	*360*	*536*	*449*	*469*	*261*	*404*	*417*	*492*	*495*	*597*	*342*	*321*
Other Fossil Fuels	*29*	*56*	*29*	*29*	*29*	*29*	*21*	*24*	*29*	*2*	*NO*	*NO*	*NO*
Shale oil	*39*	*79*	*39*	*NO*	*NO*	*NO*	*NO*	*NO*	*8*	*9*	*1*	*NO*	*NO*
LPG	*72*	*91*	*137*	*182*	*160*	*148*	*190*	*191*	*153*	*141*	*109*	*85*	*116*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
RFO	*285*	*121*	*203*	*81*	*31*	*8*	*7*	*9*	*9*	*45*	*28*	*12*	*38*
Other liquid	*NO*	*NO*	*NO*	*42*	*35*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*52*	*16*	*27*	*25*	*24*	*24*	*46*	*40*	*17*	*14*	*17*	*11*	*9*
Coke	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*1919*	*1886*	*1819*	*1808*	*1729*	*1627*	*1476*	*1303*	*1378*	*1336*	*1391*	*1550*	*1031*
Wood	*333*	*360*	*535*	*449*	*467*	*230*	*361*	*371*	*442*	*445*	*553*	*293*	*289*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*29*	*41*	*45*	*49*	*48*	*43*	*49*	*32*
Biofuel	*6*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other biogas	*NO*	*NO*	*NO*	*NO*	*2*	*2*	*2*	*1*	*1*	*2*	*1*	*NO*	*NO*
Waste oils	*29*	*56*	*29*	*29*	*29*	*29*	*21*	*24*	*29*	*2*	*NO*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.A.2.f. Non-metallic minerals													
Total	***4318***	***4973***	***5282***	***4765***	***5125***	***4521***	***3686***	***4347***	***5570***	***5466***	***5515***	***5488***	***5146***
Liquid Fuels	*627*	*NO*	*NO*	*NO*	*NO*	*1*	*124*	*45*	*21*	*6*	*61*	*1*	*32*
Solid Fuels	*1757*	*2136*	*1910*	*1299*	*1254*	*957*	*650*	*899*	*1292*	*1183*	*783*	*502*	*334*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*1010*	*977*	*1280*	*1344*	*1353*	*1208*	*1186*	*1286*	*1239*	*1251*	*1284*	*1341*	*1072*
Biomass	*520*	*1196*	*1273*	*1035*	*1269*	*1136*	*835*	*976*	*1465*	*1621*	*1765*	*2016*	*1968*
Other Fossil Fuels	*404*	*664*	*819*	*1086*	*1250*	*1219*	*892*	*1142*	*1553*	*1405*	*1621*	*1629*	*1740*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*1*	*16*	*6*	*1*	*1*	*32*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Petroleum coke	*627*	*NO*	*NO*	*NO*	*NO*	*NO*	*124*	*44*	*5*	*NO*	*60*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*1757*	*2136*	*1910*	*1299*	*1254*	*957*	*650*	*899*	*1292*	*1183*	*783*	*502*	*334*
Oil shale	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*1010*	*977*	*1280*	*1344*	*1353*	*1208*	*1186*	*1286*	*1239*	*1251*	*1284*	*1341*	*1072*
Wood	*10*	*3*	*23*	*NO*	*NO*	*3*	*25*	*6*	*5*	*34*	*30*	*36*	*37*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*211*	*261*	*224*	*245*	*157*
Biofuel	*NO*	*NO*	*NO*	*NO*	*3*	*2*	*2*	*2*	*2*	*2*	*5*	*3*	*2*
Municipal wastes (biomass fraction)	*510*	*1193*	*1250*	*1035*	*1266*	*1131*	*808*	*968*	*1247*	*1324*	*1506*	*1732*	*1772*
Municipal wastes (fossil fraction)	*320*	*332*	*577*	*707*	*892*	*934*	*736*	*962*	*1215*	*1086*	*1270*	*1256*	*1373*
Industrial wastes	*84*	*331*	*242*	*379*	*358*	*284*	*155*	*180*	*338*	*320*	*351*	*372*	*367*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.2.g. Other													
Total	***13573***	***15448***	***17041***	***17026***	***18249***	***18362***	***16922***	***16943***	***18884***	***17912***	***18316***	***19368***	***21159***
Liquid Fuels	*1463*	*1961*	*2133*	*2134*	*1880*	*1714*	*1741*	*1891*	*1950*	*1711*	*1759*	*1722*	*2031*
Solid Fuels	*26*	*47*	*27*	*50*	*58*	*32*	*29*	*35*	*29*	*15*	*7*	*8*	*6*
Peat	*11*	*2*	*2*	*4*	*13*	*11*	*34*	*NO*	*NO*	*14*	*8*	*25*	*24*
Gaseous Fuels	*2928*	*2862*	*2797*	*1930*	*1678*	*1536*	*1535*	*1511*	*1703*	*1256*	*1211*	*1432*	*906*
Biomass	*9116*	*10547*	*12053*	*12908*	*14620*	*15069*	*13583*	*13506*	*15202*	*14916*	*15331*	*16181*	*18192*
Other Fossil Fuels	*29*	*29*	*29*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*19*	*91*	*92*	*94*	*115*	*114*	*137*	*194*	*189*	*148*	*159*	*164*	*199*
Gasoline	*44*	*44*	*44*	*44*	*43*	*48*	*41*	*36*	*37*	*43*	*13*	*16*	*19*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*1359*	*1785*	*1997*	*1996*	*1722*	*1547*	*1560*	*1657*	*1722*	*1520*	*1587*	*1542*	*1813*
RFO	*41*	*41*	*NO*	*NO*	*NO*	*5*	*3*	*3*	*2*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*26*	*47*	*27*	*50*	*58*	*32*	*29*	*32*	*28*	*14*	*7*	*8*	*6*
Coke	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*3*	*1*	*1*	*NO*	*NO*	*NO*
Peat	*10*	*2*	*2*	*NO*	*10*	*10*	*34*	*NO*	*NO*	*NO*	*6*	*25*	*23*
Peat briquettes	*1*	*NO*	*NO*	*4*	*3*	*1*	*NO*	*NO*	*NO*	*14*	*2*	*NO*	*1*
Natural gas	*2928*	*2862*	*2797*	*1930*	*1678*	*1536*	*1535*	*1511*	*1703*	*1256*	*1211*	*1432*	*906*
Wood	*9115*	*10547*	*12051*	*12906*	*14620*	*15069*	*13583*	*13506*	*15202*	*14916*	*15321*	*16176*	*18188*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*10*	*5*	*4*
Biofuel	*1*	*NO*	*2*	*2*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*29*	*29*	*29*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

1.A.4 Other Sectors

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1.A.4 Other Sectors																				
Total	***101006***	***107881***	***83180***	***76877***	***64625***	***60095***	***61217***	***56087***	***52424***	***51957***	***49115***	***54027***	***53754***	***57204***	***59271***	***58976***	***58737***	***59294***	***55356***	***58765***
Liquid Fuels	*27829*	*32499*	*24223*	*21319*	*14008*	*8731*	*8715*	*7674*	*6901*	*7307*	*6886*	*7360*	*6844*	*7817*	*7779*	*7728*	*8334*	*7849*	*7067*	*7720*
Solid Fuels	*22398*	*19894*	*15853*	*13347*	*9363*	*5180*	*5521*	*4639*	*3330*	*2817*	*2162*	*2988*	*2390*	*2203*	*2150*	*2045*	*1940*	*1940*	*1783*	*1574*
Peat	*1128*	*880*	*1030*	*617*	*515*	*390*	*506*	*357*	*266*	*66*	*41*	*15*	*NO*	*10*	*NO*	*20*	*40*	*61*	*31*	*16*
Gaseous Fuels	*23203*	*23548*	*11201*	*8384*	*7002*	*7150*	*6732*	*5434*	*5670*	*5865*	*6218*	*7061*	*8098*	*8795*	*9651*	*9632*	*9983*	*11027*	*10959*	*10241*
Biomass	*26448*	*31060*	*30873*	*33210*	*33737*	*38643*	*39743*	*37983*	*36257*	*35902*	*33808*	*36561*	*36295*	*38321*	*39574*	*39523*	*38382*	*38388*	*35487*	*39215*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*126*	*58*	*117*	*29*	*58*	*29*	*29*	*NO*
1.A.4.a. Commercial/Institutional																				
Total	***39260***	***39062***	***33600***	***26832***	***17464***	***16430***	***16535***	***14620***	***12251***	***12993***	***11354***	***12363***	***13105***	***13786***	***14985***	***14213***	***14844***	***15946***	***13201***	***12520***
Liquid Fuels	*13453*	*16642*	*11910*	*10556*	*5308*	*2804*	*2712*	*2285*	*1971*	*2214*	*1713*	*1926*	*1743*	*2138*	*2010*	*1781*	*2167*	*1863*	*1549*	*1528*
Solid Fuels	*14913*	*11413*	*10872*	*7854*	*4297*	*2903*	*3272*	*2732*	*2419*	*2049*	*1565*	*1536*	*1423*	*1338*	*1285*	*1049*	*1075*	*1075*	*918*	*735*
Peat	*672*	*517*	*620*	*288*	*326*	*113*	*250*	*163*	*71*	*15*	*31*	*15*	*NO*	*10*	*NO*	*20*	*40*	*61*	*31*	*16*
Gaseous Fuels	*5004*	*5328*	*4916*	*2625*	*1903*	*2328*	*2271*	*1805*	*2175*	*2536*	*3054*	*3347*	*4103*	*4278*	*4680*	*4598*	*4851*	*5676*	*5679*	*5415*
Biomass	*5218*	*5162*	*5282*	*5508*	*5630*	*8282*	*8029*	*7636*	*5615*	*6179*	*4991*	*5497*	*5709*	*5965*	*6894*	*6737*	*6652*	*7242*	*4995*	*4826*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*126*	*58*	*117*	*29*	*58*	*29*	*29*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*79*	*NO*	*NO*	*NO*	*NO*	*39*	*NO*	*NO*	*NO*	*NO*
LPG	*46*	*NO*	*NO*	*182*	*137*	*91*	*137*	*182*	*410*	*91*	*NO*	*91*	*46*	*182*	*137*	*137*	*137*	*137*	*91*	*91*
Gasoline	*44*	*44*	*44*	*44*	*220*	*NO*	*85*	*87*	*41*	*86*	*86*	*75*	*46*	*39*	*41*	*42*	*38*	*43*	*39*	*43*
Other kerosene	*43*	*130*	*86*	*173*	*173*	*346*	*43*	*43*	*43*	*86*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Diesel oil	*8116*	*11515*	*7436*	*7478*	*1529*	*1189*	*1147*	*552*	*340*	*935*	*1020*	*1190*	*1242*	*1465*	*1546*	*1198*	*1627*	*1643*	*1339*	*1344*
RFO	*4953*	*4953*	*4344*	*2679*	*3248*	*1177*	*1300*	*1421*	*1137*	*974*	*528*	*528*	*325*	*284*	*244*	*365*	*365*	*40*	*80*	*50*
Other liquid	*251*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*NO*	*42*	*84*	*167*	*42*	*NO*	*NO*	*NO*	*NO*	*NO*
Anthracite	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*14913*	*11413*	*10872*	*7854*	*4297*	*2903*	*3272*	*2732*	*2419*	*2049*	*1565*	*1536*	*1423*	*1338*	*1285*	*1049*	*1075*	*1075*	*918*	*735*
Peat	*161*	*161*	*171*	*40*	*171*	*51*	*110*	*70*	*40*	*NO*	*NO*	*NO*	*NO*	*10*	*NO*	*20*	*40*	*60*	*30*	*10*
Peat briquettes	*511*	*356*	*449*	*248*	*155*	*62*	*139*	*93*	*31*	*15*	*31*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*1*	*6*
Natural gas	*5004*	*5328*	*4916*	*2625*	*1903*	*2328*	*2271*	*1805*	*2175*	*2536*	*3054*	*3347*	*4103*	*4278*	*4680*	*4598*	*4851*	*5676*	*5679*	*5415*
Wood	*5218*	*5162*	*5282*	*5508*	*5630*	*8282*	*8029*	*7636*	*5615*	*6179*	*4991*	*5497*	*5663*	*5803*	*6652*	*6485*	*6382*	*6955*	*4691*	*4482*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*11*	*16*	*14*	*29*
Biofuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Landfill gas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*46*	*162*	*242*	*251*	*259*	*271*	*290*	*314*
Other biogas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*126*	*58*	*117*	*29*	*58*	*29*	*29*	*NO*
1.A.4.b. Residential																				
Total	***35751***	***42489***	***39047***	***40790***	***38562***	***37659***	***38588***	***36043***	***35336***	***34027***	***32851***	***36298***	***35666***	***37702***	***38261***	***38948***	***37955***	***37271***	***37067***	***40809***
Liquid Fuels	*4908*	*5671*	*5003*	*4010*	*2848*	*1402*	*1272*	*1363*	*1454*	*1406*	*1443*	*1441*	*1441*	*1398*	*1443*	*1577*	*1621*	*1438*	*1393*	*2025*
Solid Fuels	*6404*	*7542*	*4440*	*5037*	*4411*	*1821*	*1964*	*1708*	*797*	*683*	*512*	*1338*	*854*	*787*	*787*	*944*	*813*	*813*	*813*	*813*
Peat	*425*	*332*	*379*	*258*	*144*	*252*	*241*	*179*	*195*	*51*	*10*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*4004*	*4275*	*4905*	*5089*	*4359*	*4181*	*3762*	*3063*	*2896*	*2829*	*2659*	*3001*	*3293*	*3667*	*3958*	*4193*	*4326*	*4587*	*4693*	*4304*
Biomass	*20010*	*24669*	*24320*	*26396*	*26800*	*30003*	*31349*	*29730*	*29994*	*29058*	*28227*	*30518*	*30078*	*31850*	*32073*	*32234*	*31195*	*30433*	*30168*	*33667*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*2869*	*2823*	*2368*	*2140*	*1913*	*1275*	*1230*	*1321*	*1412*	*1321*	*1184*	*1139*	*1139*	*1139*	*1184*	*1230*	*1230*	*1047*	*1002*	*911*
Gasoline	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*132*	*132*	*132*	*132*	*132*	*220*	*264*	*264*	*264*	*264*
Other kerosene	*86*	*86*	*43*	*43*	*43*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*1912*	*2762*	*2592*	*1827*	*892*	*127*	*42*	*42*	*42*	*85*	*127*	*170*	*170*	*127*	*127*	*127*	*127*	*127*	*127*	*850*
RFO	*41*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*6404*	*7542*	*4440*	*5037*	*4411*	*1821*	*1964*	*1708*	*797*	*683*	*512*	*1338*	*854*	*787*	*787*	*944*	*813*	*813*	*813*	*813*
Peat	*131*	*131*	*131*	*10*	*20*	*20*	*40*	*40*	*40*	*20*	*10*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*294*	*201*	*248*	*248*	*124*	*232*	*201*	*139*	*155*	*31*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*4004*	*4275*	*4905*	*5089*	*4359*	*4181*	*3762*	*3063*	*2896*	*2829*	*2659*	*3001*	*3293*	*3667*	*3958*	*4193*	*4326*	*4587*	*4693*	*4304*
Wood	*20010*	*24669*	*24320*	*26396*	*26800*	*30003*	*31349*	*29730*	*29994*	*29058*	*28227*	*30518*	*30078*	*31850*	*32043*	*32174*	*31165*	*30388*	*30108*	*33607*
Charcoal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*30*	*60*	*30*	*45*	*60*	*60*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.4.c. Agriculture/Forestry/Fisheries																				
Total	***25995***	***26331***	***10533***	***9255***	***8599***	***6005***	***6094***	***5424***	***4837***	***4937***	***4910***	***5365***	***4983***	***5716***	***6025***	***5815***	***5939***	***6077***	***5088***	***5436***
Liquid Fuels	*9468*	*10186*	*7310*	*6752*	*5852*	*4526*	*4731*	*4027*	*3476*	*3687*	*3730*	*3994*	*3660*	*4282*	*4326*	*4370*	*4546*	*4548*	*4125*	*4167*
Solid Fuels	*1081*	*939*	*541*	*456*	*655*	*456*	*285*	*199*	*114*	*85*	*85*	*113*	*113*	*78*	*78*	*52*	*52*	*52*	*52*	*26*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Peat	*31*	*31*	*31*	*71*	*45*	*25*	*15*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*14195*	*13945*	*1380*	*670*	*739*	*641*	*699*	*566*	*599*	*500*	*505*	*712*	*702*	*850*	*1014*	*841*	*806*	*764*	*587*	*521*
Biomass	*1220*	*1229*	*1271*	*1306*	*1307*	*358*	*365*	*617*	*648*	*665*	*590*	*546*	*508*	*506*	*607*	*552*	*535*	*713*	*324*	*722*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*46*	*46*	*NO*	*91*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*46*	*45*
Gasoline	*1628*	*132*	*132*	*132*	*132*	*88*	*88*	*88*	*44*	*44*	*44*	*11*	*17*	*44*	*44*	*44*	*44*	*44*	*NO*	*NO*
Other kerosene	*86*	*86*	*43*	*43*	*43*	*NO*	*43*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*6161*	*8583*	*6161*	*5269*	*4419*	*3951*	*3909*	*3654*	*3229*	*3399*	*3442*	*3739*	*3399*	*3994*	*4079*	*4164*	*4461*	*4504*	*4079*	*4122*
RFO	*1421*	*1339*	*974*	*1217*	*1258*	*487*	*691*	*285*	*203*	*244*	*244*	*244*	*244*	*244*	*203*	*162*	*41*	*NO*	*NO*	*NO*
Other liquid	*126*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*1081*	*939*	*541*	*456*	*655*	*456*	*285*	*199*	*114*	*85*	*85*	*113*	*113*	*78*	*78*	*52*	*52*	*52*	*52*	*26*
Peat	*NO*	*NO*	*NO*	*40*	*30*	*10*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*31*	*31*	*31*	*31*	*15*	*15*	*15*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*14195*	*13945*	*1380*	*670*	*739*	*641*	*699*	*566*	*599*	*500*	*505*	*712*	*702*	*850*	*1014*	*841*	*806*	*764*	*587*	*521*
Wood	*1220*	*1229*	*1271*	*1306*	*1307*	*358*	*365*	*617*	*648*	*665*	*590*	*546*	*508*	*506*	*607*	*552*	*535*	*713*	*324*	*722*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Biofuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other biogas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.A.4 Other Sectors													
Total	***52858***	***51546***	***53990***	***50171***	***49303***	***44410***	***44491***	***47842***	***48527***	***46901***	***44450***	***45376***	***44100***
Liquid Fuels	*8230*	*8269*	*8268*	*8413*	*8648*	*8775*	*8504*	*9140*	*9041*	*9033*	*9892*	*9968*	*10504*
Solid Fuels	*2098*	*1861*	*983*	*1075*	*962*	*831*	*799*	*608*	*441*	*327*	*123*	*117*	*85*
Peat	*21*	*32*	*32*	*NO*	*11*	*NO*	*NO*	*11*	*32*	*23*	*20*	*21*	*15*
Gaseous Fuels	*11819*	*10343*	*10477*	*9809*	*9670*	*9101*	*9888*	*9948*	*10345*	*10125*	*10063*	*10802*	*9696*
Biomass	*30682*	*31042*	*34230*	*30874*	*30012*	*25703*	*25296*	*28132*	*28664*	*27382*	*24341*	*24456*	*23798*
Other Fossil Fuels	*8*	*NO*	*NO*	*NO*	*NO*	*NO*	*4*	*3*	*4*	*11*	*12*	*12*	*NO*
1.A.4.a. Commercial/Institutional													
Total	***13247***	***11743***	***13020***	***12833***	***12495***	***12381***	***11862***	***11968***	***11533***	***10582***	***10616***	***11490***	***11284***
Liquid Fuels	*1515*	*1315*	*1777*	*1876*	*2024*	*2131*	*1451*	*1405*	*1346*	*904*	*1502*	*1797*	*1854*
Solid Fuels	*1023*	*891*	*354*	*519*	*407*	*323*	*292*	*197*	*165*	*132*	*68*	*64*	*33*
Peat	*1*	*32*	*32*	*NO*	*11*	*NO*	*NO*	*11*	*31*	*23*	*20*	*21*	*15*
Gaseous Fuels	*5623*	*5055*	*4952*	*4477*	*4401*	*4166*	*4514*	*4651*	*4837*	*5021*	*5058*	*5441*	*5086*
Biomass	*5077*	*4451*	*5905*	*5961*	*5652*	*5761*	*5603*	*5701*	*5150*	*4500*	*3966*	*4164*	*4293*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Other Fossil Fuels	*8*	*NO*	*NO*	*NO*	*NO*	*NO*	*2*	*3*	*4*	*2*	*3*	*3*	*3*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*7*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*99*	*54*	*98*	*96*	*161*	*144*	*249*	*332*	*281*	*218*	*218*	*229*	*413*
Gasoline	*44*	*88*	*44*	*88*	*44*	*44*	*33*	*43*	*36*	*29*	*27*	*25*	*29*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*6*	*4*	*4*	*1*	*NO*	*NO*	*NO*
Diesel oil	*1331*	*1171*	*1635*	*1692*	*1819*	*1942*	*1152*	*1022*	*1023*	*654*	*1250*	*1537*	*1385*
RFO	*41*	*2*	*NO*	*NO*	*NO*	*1*	*4*	*4*	*2*	*2*	*2*	*1*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*5*	*6*	*27*
Anthracite	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*27*	*7*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*1023*	*891*	*354*	*519*	*407*	*323*	*265*	*190*	*165*	*132*	*68*	*64*	*33*
Peat	*NO*	*29*	*28*	*NO*	*10*	*NO*	*NO*	*NO*	*16*	*19*	*5*	*1*	*9*
Peat briquettes	*1*	*3*	*4*	*NO*	*1*	*NO*	*NO*	*11*	*15*	*4*	*15*	*20*	*6*
Natural gas	*5623*	*5055*	*4952*	*4477*	*4401*	*4166*	*4514*	*4651*	*4837*	*5021*	*5058*	*5441*	*5086*
Wood	*4679*	*3997*	*5163*	*5087*	*4603*	*4512*	*4455*	*4509*	*3876*	*3333*	*2815*	*3076*	*3469*
Straws	*57*	*43*	*24*	*44*	*53*	*30*	*15*	*10*	*23*	*24*	*21*	*8*	*3*
Biofuel	*4*	*31*	*34*	*54*	*12*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Landfill gas	*314*	*327*	*325*	*357*	*353*	*409*	*395*	*408*	*389*	*351*	*350*	*354*	*273*
Other biogas	*23*	*53*	*359*	*419*	*631*	*795*	*738*	*774*	*862*	*792*	*780*	*726*	*548*
Waste oils	*8*	*NO*	*NO*	*NO*	*NO*	*NO*	*2*	*3*	*4*	*2*	*3*	*3*	*NO*
							1.A.4.b. Residential						
Total	***33561***	***33797***	***35117***	***31228***	***30846***	***25862***	***26012***	***28556***	***30002***	***28432***	***25883***	***26477***	***25281***
Liquid Fuels	*2237*	*2229*	*2236*	*2237*	*2283*	*2055*	*2140*	*2314*	*2277*	*2218*	*2236*	*2221*	*2265*
Solid Fuels	*1049*	*944*	*577*	*530*	*531*	*501*	*498*	*410*	*276*	*195*	*55*	*53*	*52*
Peat	*20*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*5219*	*4480*	*4481*	*4266*	*4252*	*4116*	*4510*	*4673*	*4998*	*4647*	*4598*	*4844*	*4392*
Biomass	*25036*	*26144*	*27823*	*24195*	*23780*	*19190*	*18864*	*21159*	*22451*	*21372*	*18994*	*19359*	*18572*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*911*	*903*	*911*	*911*	*957*	*773*	*766*	*794*	*679*	*621*	*656*	*688*	*733*
Gasoline	*264*	*264*	*263*	*264*	*264*	*220*	*220*	*220*	*220*	*220*	*220*	*198*	*198*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*1062*	*1062*	*1062*	*1062*	*1062*	*1062*	*1154*	*1300*	*1378*	*1377*	*1360*	*1335*	*1334*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*1049*	*944*	*577*	*530*	*531*	*501*	*498*	*410*	*276*	*195*	*55*	*53*	*52*
Peat	*20*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*5219*	*4480*	*4481*	*4266*	*4252*	*4116*	*4510*	*4673*	*4998*	*4647*	*4598*	*4844*	*4392*
Wood	*24974*	*26084*	*27764*	*24105*	*23690*	*19130*	*18799*	*21093*	*22383*	*21285*	*18904*	*19270*	*18504*
Charcoal	*60*	*60*	*59*	*90*	*90*	*60*	*65*	*66*	*68*	*87*	*90*	*89*	*68*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Straws	*2*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.4.c. Agriculture/Forestry/Fisheries													
Total	***6050***	***6006***	***5853.337***	***6110***	***5962***	***6167***	***6617***	***7318***	***6992***	***7887***	***7951***	***7409***	***7535***
Liquid Fuels	*4478*	*4725*	*4255.337*	*4300*	*4341*	*4589*	*4913*	*5421*	*5418*	*5911*	*6154*	*5950*	*6384*
Solid Fuels	*26*	*26*	*52*	*26*	*24*	*7*	*9*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*977*	*808*	*1044*	*1066*	*1017*	*819*	*864*	*624*	*510*	*457*	*407*	*517*	*218*
Biomass	*569*	*447*	*502*	*718*	*580*	*752*	*829*	*1272*	*1063*	*1510*	*1381*	*933*	*933*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*2*	*NO*	*NO*	*9*	*9*	*9*	*NO*
LPG	*13*	*45*	*46.336996*	*48*	*47*	*92*	*109*	*127*	*76*	*101*	*104*	*85*	*98*
Gasoline	*NO*	*88*	*88*	*88*	*46*	*25*	*82*	*22*	*27*	*29*	*28*	*25*	*25*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*4462*	*4589*	*4121*	*4164*	*4248*	*4472*	*4722*	*5272*	*5223*	*5761*	*6022*	*5840*	*6261*
RFO	*3*	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*92*	*20*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*26*	*26*	*52*	*26*	*24*	*7*	*9*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*
Natural gas	*977*	*808*	*1044*	*1066*	*1017*	*819*	*864*	*624*	*510*	*457*	*407*	*517*	*218*
Wood	*568*	*361*	*299*	*460*	*292*	*401*	*462*	*877*	*710*	*1093*	*931*	*582*	*555*
Straws	*NO*	*NO*	*14*	*14*	*46*	*76*	*105*	*150*	*65*	*124*	*91*	*82*	*78*
Biofuel	*1*	*48*	*56*	*54*	*59*	*75*	*66*	*57*	*79*	*85*	*166*	*111*	*122*
Other biogas	*NO*	*38*	*133*	*190*	*183*	*200*	*196*	*188*	*209*	*208*	*193*	*158*	*178*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*2*	*NO*	*NO*	*9*	*9*	*9*	*NO*

1.A.5 Other

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1.A.5 Other (Not elsewhere specified)																				
Total	***NO***	***NO***	***NO***	***NO***	***NO***	***86***	***46***	***174***	***46***	***132***	***2***	***2***	***92***	***87***	***157***	***104***	***122***	***39***	***47***	***73***
Liquid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*86*	*46*	*174*	*46*	*132*	*2*	*2*	*92*	*87*	*157*	*104*	*122*	*39*	*47*	*73*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Biomass	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gasoline	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*3*	*1*	*3*	*2*	*2*	*2*	*NO*	*5*	*3*	*2*	*6*	*1*	*5*	*1*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*86*	*43*	*173*	*43*	*130*	*NO*	*NO*	*17*	*17*	*43*	*24*	*43*	*24*	*21*	*23*
Diesel oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*75*	*65*	*111*	*77*	*73*	*14*	*21*	*49*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.A.5 Other (Not elsewhere specified)													
Total	***107***	***98***	***100***	***88***	***128***	***130***	***155***	***178***	***269***	***322***	***199***	***324***	***331***
Liquid Fuels	*107*	*98*	*100*	*88*	*128*	*130*	*155*	*178*	*269*	*322*	*199*	*324*	*331*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Biomass	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gasoline	*0*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0*	*1*	*1*	*1*	*2*	*3*
Jet fuel	*20*	*18*	*21*	*24*	*23*	*18*	*34*	*10*	*35*	*57*	*12*	*35*	*101*
Diesel oil	*87*	*80*	*79*	*63*	*105*	*112*	*121*	*168*	*233*	*264*	*186*	*286*	*227*

Annex III: Additional methodological description – Manure management

Example of the N-flow implemented for dairy cattle for 2022

Step 1

Number of dairy cattle in Latvia in 2022 is 127,800

Step 2

The total annual excretion of N by the animals (N_{ex}; kg AAP^{-1} a^{-1}) is calculated according the 2006 IPCC Guidelines Tier 2 methodology described also in Methodology chapter. In 2022 N_{ex} for dairy cattle was 120.38 kg N $head^{-1}year^{-1}$.

Step 3

Housed period = 347 d a^{-1}

Proportion of N excreted as TAN = 0.60

Proportion of N excreted on yards = 0.00

$m_{graz\_N} = x_{graz} \cdot N_{ex} = 758{,}662.20$ kg N

$m_{hous\_N} = x_{hous} \cdot N_{ex} = 14{,}625{,}321.24$ kg N

Step 4

$m_{graz\_TAN} = x_{TAN} \cdot m_{graz_N} = 455{,}197.32$ kg N

$m_{hous\_TAN} = x_{TAN} \cdot m_{hous_N} = 8{,}775{,}192.74$ kg N

Step 5

$X_{house\_slurry} = 0.5$

$m_{hous\_slurry\_TAN} = x_{slurry} \cdot m_{hous_{TAN}} = 5{,}300{,}216.42$ kg N

$m_{hous\_slurry\_N} = x_{slurry} \cdot m_{hous_N} = 8{,}833{,}694.03$ kg N

$m_{hous\_solid\_TAN} = (1 - x_{slurry}) \cdot m_{hous_{TAN}} = 3{,}474{,}976.33$ kg N

$m_{hous\_solid\_N} = (1 - x_{slurry}) \cdot m_{hous_N} = 5{,}791{,}627.21$ kg N

Step 6

$EF_{NH3\_house\_slurry}$ = 0.24 NH_3-N (kg TAN)$^{-1}$

$EF_{NH3\_house\_solid}$ = 0.08 NH_3-N (kg TAN)$^{-1}$

$E_{hous\_slurry} = m_{hous\_slurry\_TAN} \cdot EF_{hous_{slurry}}$ = 1,272,051.94 kg NH_3-N

$E_{hous\_solid} = m_{hous\_solid\_TAN} \cdot EF_{hous_{solid}}$ = 277,998.11 kg NH_3-N

Step 7

Straw = 146,343,780.00 kg yr^{-1}

$N_{added\_in\_straw}$ = 11.57 kg a^{-1} yr^{-1}

$m_{bedding}$ = 585,375.12 kg N

f_{imm} = 0.0067 kg N (kg straw)$^{-1}$

$m_{ex-hous\_solid\_TAN} = m_{hous\_solid\_TAN} - \left(E_{hous_{solid}} + \left(m_{bedding} \cdot f_{imm}\right)\right)$ = 2,216,474.89 kg N

$m_{ex-hous\_solid\_N} = m_{hous\_solid\_N} + m_{bedding\_N} - E_{hous_{solid}}$ = 6,099,004.23 kg N

Step 8

x_{store_slurry} = 0.83

x_{store_solid} = 1.00

x_{biogas_slurry} = 0.18

x_{biogas_solid} = 0.00

For slurry:

$m_{storage\_slurry\_TAN} = \left(m_{hous_{slurry\_TAN}} - E_{hous\_slurry}\right) \cdot x_{store_{slurry}}$ = 3,323,235.69 kg N

$m_{storage\_slurry\_N} = \left(m_{hous\_slurry\_N} - E_{hous\_slurry}\right) \cdot x_{store_{slurry}}$ = 6,238,354.72 kg N

$m_{biogas\_slurry\_TAN} = \left(m_{hous\_slurry\_TAN} - E_{hous\_slurry}\right) \cdot x_{biogas\_slurry}$ = 704,928.78 kg N

$m_{biogas\_slurry\_N} = \left(m_{hous\_slurry\_N} - E_{hous\_slurry}\right) \cdot x_{biogas_{slurry}}$ = 1,323,287.37 kg N

For solid:

$m_{storage\_solid\_TAN} = m_{ex-hous\_solid\_TAN} \cdot x_{store_{solid}}$ = 2,216,474.89 kg N

$m_{storage\_solid\_N} = m_{ex-hous\_solid\_N} \cdot x_{store\_solid}$ = 6,099,004.23 kg N

$m_{biogas\_solid\_TAN} = m_{ex-hous\_solid\_TAN} \cdot x_{biogas\_solid} = 0.00$ kg N

$m_{biogas\_solid\_N} = m_{ex-hous\_solid\_N} \cdot x_{biogas\_solid} = 0.00$ kg N

Step 9

f_{min} = 0.1 kg N kg^{-1}

$mm_{storage\_slurry\_TAN} = m_{storage\_slurry\_TAN} + \left(\left(m_{storage\_slurry\_N} - m_{storage\_slurry\_TAN}\right) \times f_{min}\right)$ = 3,614,747.5970 kg N

Step 10

$EF_{\_NH3\_storage\_slurry}$ = 0.149 NH_3-N (kg TAN)$^{-1}$

$EF_{\_N2O\_storage\_slurry\_with\_natural\_crust}$ = 0.01 N_2O-N (kg TAN)$^{-1}$

Proportion with natural crust = 1.0

$EF_{NO\_storage\_slurry}$ = 0.0001 NO-N (kg TAN)$^{-1}$

$EF_{N2\_storage\_slurry}$ = 0.0030 N_2-N (kg TAN)$^{-1}$

$EF_{NH3\_storage\_solid}$ = 0.3200 NH_3-N (kg TAN)$^{-1}$

$EF_{N2O\_storage\_solid}$ = 0.0200 N_2O-N (kg TAN)$^{-1}$

$EF_{NO\_storage\_solid}$ = 0.0100 NO-N (kg TAN)$^{-1}$

$EF_{N2\_storage\_solid}$ = 0.3000 N_2-N (kg TAN)$^{-1}$

For slurry:

$E_{storage\_slurry\_NH3} = mm_{storage\_slurry\_TAN} \cdot EF_{storage_{slurry_{NH3}}} = 538{,}597.3920$ kg NH_3-N

$E_{storage\_slurry\_N2O} = mm_{storage\_slurry\_TAN} \cdot EF_{storage_{slurry_{N2O}}} = 36{,}147.4760$ kg N_2O-N

$E_{storage\_slurry\_NO} = mm_{storage\_slurry\_TAN} \cdot EF_{storage_{slurry_{NO}}} = 361.4748$ kg NO-N

$E_{storage\_slurry\_N2} = mm_{storage\_slurry\_TAN} \cdot EF_{storage\_slurry\_N2} = 10{,}844.2428$ kg N_2-N

For solid manure emissions:

$E_{storage\_solid\_NH3} = m_{storage\_solid\_TAN} \cdot EF_{storage_{solid_{NH3}}} = 709{,}271.9663$ kg NH_3-N

$E_{storage\_solid\_N2O} = mm_{storage\_solid\_TAN} \cdot EF_{storage\_solid\_N2O} = 44{,}329.4979$ kg N_2O-N

$E_{storage\_solid\_NO} = mm_{storage\_solid\_TAN} \cdot EF_{storage\_solid\_NO} = 22{,}164.7489$ kg NO-N

$E_{storage\_solid\_N2} = mm_{storage\_slurry\_TAN} \cdot EF_{storage_{solid_{N2}}} = 664{,}942.4685$ kg N_2-N

Intermediate step - 5B2 - Calculate the digestate created by the anaerobic digestion of manure, that is returned from chapter 5B2.

$EF_{NH3\ Pre\text{-}storage}$ = 0.0009 kg NH_3-N per kg N in feedstock

$N_{H3\text{-}N\ Storage\ of\ digestate}$ = 0.0266 kg NH_3-N per kg N in feedstock

f_{min_biogas} = 0.32 kg N kg^{-1}

$AR_{feedstock} = m_{storage\_slurry\_N} + m_{biogas\_slurry\_N} = 1{,}678{,}412.61$ kg N

$E_{NH3} = AR_{feedstock} \cdot \sum_{stages} EF_{NH3-N_i} \cdot \frac{17}{14} = 44{,}188.35$ kg NH_3

$TAN_{sub} = m_{biogas\_slurry\_TAN} + m_{biogas\_solid\_TAN} = 704{,}928.78$ kg N

$N_{sub} = m_{biogas\_slurry\_N} + m_{biogas\_solid\_N} = 1{,}323{,}287.37$ kg N

$m_{dig\_TAN} = TAN_{sub} + f_{\min biogas} \cdot (N_{tot} + TAN_{sub}) - \left(E_{NH3} \cdot \frac{14}{17}\right) = 866{,}413.13$ kg N (TAN in digestate after storage)

$m_{dig\_N} = N_{tot\_dig} - \left(E_{NH3} \cdot \frac{14}{17}\right) = 1{,}286{,}896.96$ kg N (total-N in in digestate that is returned to application to soil)

Step 11

For slurry and digestate:

$m_{applic\_slurry\_TAN} = m_{appl\_direct\_slurry\_TAN} + mm_{storage\_slurry\_TAN} + mm_{dig\_TAN} - E_{storage\_slurry} = 3{,}895{,}210.14$ kg N

$m_{applic\_slurry\_N} = m_{appl\_direct\_slurry\_N} + mm_{storage\_slurry\_N} + mm_{dig\_N} - E_{storage\_slurry} = 6{,}939{,}301.10$ kg N

For solid:

$m_{applic\_solid\_TAN} = m_{appl\_direct\_solid\_TAN} + mm_{storage\_solid\_TAN} - E_{storage_{solid_{TAN}}} = 775{,}766.21$ kg N

$m_{applic\_solid\_N} = m_{appl\_direct\_solid\_N} + mm_{storage\_solid\_N} - E_{storage\_slurry\_solid\_N} = 4{,}658{,}295.54$ kg N

Step 12

$EF_{NH3\_applic\_slurry}$ = 0.30 NH_3-N $(kg\ TAN)^{-1}$

$EF_{NH3\_applic\_solid}$ = 0.39 NH_3-N (kg TAN)$^{-1}$

For slurry:

$$E_{applic\_slurry} = m_{applic\_slurry\_TAN} \cdot EF_{applic_{slurry}} = 1{,}184{,}143.88 \text{ kg } NH_3\text{-N}$$

For solid:

$$E_{applic\_solid} = m_{applic\_solid\_TAN} \cdot EF_{applic_{solid}} = 303{,}324.59 \text{ kg } NH_3\text{-N}$$

Step 13

For slurry:

$$m_{returned\_slurry\_TAN} = m_{applic\_slurry\_TAN} - E_{applic\_slurry} = 2{,}711{,}066.26 \text{ kg N}$$

$$m_{returned\_slurry\_N} = m_{applic\_slurry\_N} - E_{applic\_slurry} = 5{,}755{,}157.22 \text{ kg N}$$

For solid:

$$m_{returned\_solid\_TAN} = m_{applic\_solid\_TAN} - E_{applic\_solid} = 472{,}441.62 \text{ kg N}$$

$$m_{returned\_solid\_N} = m_{applic\_solid\_N} - E_{applic\_solid} = 4{,}354{,}970.95 \text{ kg N}$$

Step 14

$EF_{NH3\_grazing}$ = 0.14 NH_3-N (kg TAN)$^{-1}$

$$E_{graz} = m_{graz\_TAN} \cdot EF_{grazing} = 63{,}727.62 \text{ kg } NH_3\text{-N}$$

Step 15

Results are prepared for the reporting. Respective results are converted using conversion factors.

Table 1 Manure Management Systems (MMS) distribution, 1990 – 2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
																Dairy cows																	
Pasture/Range/ Paddock	*0.12*	*0.12*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.09*	*0.09*	*0.09*	*0.08*	*0.08*	*0.08*	*0.08*	*0.07*	*0.07*	*0.06*	*0.06*	*0.06*	*0.06*	*0.06*	*0.05*	*0.05*
Solid storage	*0.83*	*0.83*	*0.82*	*0.82*	*0.81*	*0.81*	*0.8*	*0.79*	*0.78*	*0.77*	*0.76*	*0.72*	*0.72*	*0.71*	*0.7*	*0.7*	*0.69*	*0.67*	*0.64*	*0.62*	*0.6*	*0.58*	*0.56*	*0.54*	*0.53*	*0.48*	*0.46*	*0.44*	*0.44*	*0.42*	*0.41*	*0.37*	*0.35*
Liquid/ Slurry	*0.054*	*0.06*	*0.07*	*0.07*	*0.08*	*0.08*	*0.09*	*0.1*	*0.11*	*0.12*	*0.13*	*0.18*	*0.19*	*0.19*	*0.2*	*0.21*	*0.22*	*0.24*	*0.27*	*0.29*	*0.27*	*0.28*	*0.25*	*0.24*	*0.27*	*0.33*	*0.35*	*0.36*	*0.31*	*0.36*	*0.32*	*0.36*	*0.43*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.04*	*0.05*	*0.11*	*0.14*	*0.13*	*0.13*	*0.13*	*0.14*	*0.19*	*0.16*	*0.22*	*0.23*	*0.17*
Sheep																																	
Pasture/Range/ Paddock	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.24*	*0.26*	*0.29*	*0.32*	*0.35*	*0.38*	*0.38*	*0.38*
Solid storage	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.77*	*0.74*	*0.71*	*0.68*	*0.65*	*0.62*	*0.62*	*0.62*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Goats																																	
Pasture/Range/ Paddock	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
Solid storage	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Horses																																	
Pasture/Range/ Paddock	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.14*	*0.18*	*0.21*	*0.25*	*0.30*	*0.35*	*0.35*	*0.35*
Solid storage	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.86*	*0.82*	*0.79*	*0.75*	*0.70*	*0.65*	*0.65*	*0.65*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Sows and boars																																	
Pasture/Range/ Paddock	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Solid storage	*0.72*	*0.71*	*0.69*	*0.68*	*0.66*	*0.64*	*0.62*	*0.6*	*0.57*	*0.55*	*0.53*	*0.48*	*0.44*	*0.4*	*0.37*	*0.33*	*0.3*	*0.28*	*0.25*	*0.23*	*0.21*	*0.18*	*0.16*	*0.14*	*0.12*	*0.10*	*0.09*	*0.08*	*0.05*	*0.05*	*0.04*	*0.04*	*0.04*
Liquid/ Slurry	*0.28*	*0.29*	*0.31*	*0.32*	*0.34*	*0.36*	*0.38*	*0.41*	*0.43*	*0.45*	*0.47*	*0.52*	*0.56*	*0.6*	*0.63*	*0.67*	*0.7*	*0.72*	*0.75*	*0.77*	*0.71*	*0.71*	*0.61*	*0.56*	*0.52*	*0.60*	*0.60*	*0.56*	*0.56*	*0.50*	*0.46*	*0.50*	*0.46*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.08*	*0.11*	*0.24*	*0.3*	*0.36*	*0.31*	*0.32*	*0.36*	*0.39*	*0.45*	*0.50*	*0.46*	*0.5*
Pigs till 4 month age																																	
Pasture/Range/ Paddock	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Solid storage	*0.72*	*0.71*	*0.7*	*0.68*	*0.67*	*0.65*	*0.63*	*0.6*	*0.58*	*0.56*	*0.53*	*0.49*	*0.45*	*0.41*	*0.37*	*0.34*	*0.31*	*0.28*	*0.26*	*0.23*	*0.21*	*0.19*	*0.16*	*0.14*	*0.12*	*0.10*	*0.09*	*0.08*	*0.05*	*0.05*	*0.04*	*0.04*	*0.04*
Liquid/ Slurry	*0.28*	*0.29*	*0.3*	*0.32*	*0.33*	*0.35*	*0.38*	*0.4*	*0.42*	*0.45*	*0.47*	*0.51*	*0.55*	*0.59*	*0.63*	*0.67*	*0.69*	*0.72*	*0.74*	*0.77*	*0.71*	*0.71*	*0.60*	*0.56*	*0.52*	*0.59*	*0.60*	*0.56*	*0.56*	*0.50*	*0.46*	*0.50*	*0.46*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.08*	*0.11*	*0.23*	*0.3*	*0.36*	*0.31*	*0.32*	*0.36*	*0.39*	*0.45*	*0.50*	*0.46*	*0.50*
Fattening and young breeding pigs																																	
Pasture/Range/ Paddock	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Solid storage	*0.71*	*0.7*	*0.68*	*0.67*	*0.65*	*0.63*	*0.61*	*0.58*	*0.56*	*0.54*	*0.52*	*0.47*	*0.43*	*0.39*	*0.35*	*0.32*	*0.29*	*0.27*	*0.24*	*0.22*	*0.20*	*0.17*	*0.15*	*0.13*	*0.11*	*0.09*	*0.08*	*0.07*	*0.05*	*0.05*	*0.04*	*0.04*	*0.04*
Liquid/ Slurry	*0.29*	*0.3*	*0.32*	*0.33*	*0.35*	*0.37*	*0.39*	*0.42*	*0.44*	*0.46*	*0.49*	*0.53*	*0.57*	*0.61*	*0.65*	*0.68*	*0.71*	*0.73*	*0.76*	*0.78*	*0.72*	*0.72*	*0.61*	*0.56*	*0.52*	*0.60*	*0.60*	*0.57*	*0.56*	*0.50*	*0.46*	*0.49*	*0.46*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.09*	*0.11*	*0.24*	*0.31*	*0.36*	*0.31*	*0.32*	*0.36*	*0.39*	*0.45*	*0.50*	*0.47*	*0.50*
Laying hens																																	
Pasture/Range/ Paddock	*0.06*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.04*	*0.04*	*0.04*	*0.04*	*0.04*	*0.04*	*0.04*	*0.04*	*0.04*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.04*	*0.04*	*0.04*	*0.04*	*0.04*
Solid storage	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.95*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.97*	*0.97*	*0.87*	*0.84*	*0.71*	*0.63*	*0.46*	*0.61*	*0.55*	*0.27*	*0.16*	*0.20*	*0.36*	*0.44*	*0.45*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.10*	*0.13*	*0.26*	*0.35*	*0.51*	*0.36*	*0.42*	*0.70*	*0.80*	*0.77*	*0.60*	*0.50*	*0.51*
Broilers																																	
Pasture/Range/ Paddock	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Solid storage	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Turkeys																																	
Pasture/Range/ Paddock	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.17*	*0.20*	*0.22*	*0.25*	*0.26*	*0.30*	*0.30*	*0.30*
Solid storage	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.86*	*0.83*	*0.81*	*0.78*	*0.75*	*0.74*	*0.70*	*0.70*	*0.70*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Ducks																																	
Pasture/Range/ Paddock	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.17*	*0.19*	*0.21*	*0.24*	*0.26*	*0.29*	*0.31*	*0.31*	*0.31*
Solid storage	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.83*	*0.81*	*0.79*	*0.76*	*0.74*	*0.71*	*0.69*	*0.69*	*0.69*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Geese																																	
Pasture/Range/ Paddock	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.18*	*0.19*	*0.22*	*0.24*	*0.27*	*0.29*	*0.29*	*0.29*
Solid storage	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.84*	*0.83*	*0.81*	*0.78*	*0.76*	*0.73*	*0.71*	*0.71*	*0.71*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Fur animals																																	
Pasture/Range/ Paddock	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Solid storage	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Dairy cattle calves under 1 year																																	
Pasture/Range/ Paddock	*0.117*	*0.12*	*0.12*	*0.12*	*0.12*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.09*	*0.09*	*0.09*	*0.09*	*0.08*	*0.08*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.06*	*0.06*	*0.06*
Solid storage	*0.883*	*0.88*	*0.88*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.91*	*0.91*	*0.88*	*0.88*	*0.84*	*0.81*	*0.82*	*0.83*	*0.83*	*0.82*	*0.78*	*0.81*	*0.76*	*0.76*	*0.8*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.03*	*0.04*	*0.08*	*0.11*	*0.10*	*0.10*	*0.10*	*0.11*	*0.15*	*0.13*	*0.18*	*0.18*	*0.14*
Beef cattle calves under 1 year																																	
Pasture/Range/ Paddock	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Solid storage	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Dairy cow young cattle, aged 1-2 years																																	
Pasture/Range/ Paddock	*0.12*	*0.12*	*0.12*	*0.12*	*0.12*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.11*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.09*	*0.09*	*0.09*	*0.09*	*0.08*	*0.08*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.06*	*0.06*	*0.06*
Solid storage	*0.88*	*0.88*	*0.88*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.91*	*0.91*	*0.88*	*0.88*	*0.84*	*0.81*	*0.82*	*0.83*	*0.83*	*0.82*	*0.78*	*0.81*	*0.76*	*0.76*	*0.8*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.03*	*0.04*	*0.08*	*0.11*	*0.097*	*0.10*	*0.10*	*0.11*	*0.15*	*0.13*	*0.18*	*0.18*	*0.14*
Beef young cattle, aged 1-2 years																																	
Pasture/Range/ Paddock	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*
Solid storage	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Bulls over 2 year																																	
Pasture/Range/ Paddock	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*
Solid storage	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Heifers over 2 years																																	
Pasture/Range/ Paddock	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*
Solid storage	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Other cows over 2 year																																	
Pasture/Range/ Paddock	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*	*0.79*
Solid storage	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*	*0.21*
Liquid/ Slurry	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anaerobic digester	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

Table 2 Average gross energy (GE) intake (MJ day^{-1}) and cattle weight (kg head^{-1} year^{-1}) 1990-2022

Year	Dairy cows		Growing cattle		Other mature cattle	
	Weight	GE	Weight	GE	Weight	GE
1990	*550*	*241.6*	*272*	*80.4*	*581*	*152.9*
1991	*550*	*236.1*	*271*	*79.7*	*581*	*152.9*
1992	*550*	*225.2*	*268*	*77.6*	*581*	*152.9*
1993	*550*	*224.6*	*267*	*77.0*	*581*	*152.9*
1994	*550*	*230.9*	*269*	*77.9*	*582*	*153.0*
1995	*550*	*236.3*	*272*	*78.6*	*580*	*152.9*
1996	*550*	*242.3*	*270*	*77.9*	*581*	*152.9*
1997	*550*	*253.9*	*268*	*77.5*	*573*	*153.9*
1998	*550*	*258.0*	*271*	*77.7*	*555*	*150.1*
1999	*550*	*257.7*	*269*	*76.8*	*552*	*149.7*
2000	*555*	*264.2*	*262*	*76.0*	*542*	*147.6*
2001	*555*	*268.9*	*254*	*74.8*	*566*	*152.9*
2002	*555*	*265.9*	*264*	*76.1*	*557*	*154.4*
2003	*555*	*285.0*	*270*	*77.2*	*559*	*155.9*
2004	*555*	*276.3*	*261*	*75.6*	*563*	*158.7*
2005	*555*	*281.1*	*261*	*76.1*	*563*	*167.3*
2006	*560*	*286.2*	*268*	*76.4*	*564*	*168.8*
2007	*560*	*291.5*	*271*	*77.1*	*557*	*174.8*
2008	*560*	*296.9*	*269*	*76.5*	*561*	*165.2*
2009	*560*	*299.4*	*271*	*77.1*	*567*	*170.5*
2010	*560*	*295.8*	*272*	*77.5*	*570*	*173.8*
2011	*565*	*297.4*	*272*	*77.2*	*569*	*176.2*

Year	Dairy cows		Growing cattle		Other mature cattle	
	Weight	GE	Weight	GE	Weight	GE
2012	*565*	*301.7*	*274*	*77.9*	*572*	*179.4*
2013	*565*	*307.8*	*278*	*79.1*	*575*	*180.1*
2014	*565*	*311.8*	*274*	*78.7*	*575*	*182.4*
2015	*565*	*310.7*	*278*	*79.6*	*576*	*185.4*
2016	*570*	*323.3*	*276*	*79.5*	*576*	*187.8*
2017	*570*	*332.1*	*276*	*79.4*	*576*	*188.2*
2018	*570*	*334.7*	*273*	*79.0*	*574*	*189.7*
2019	*570*	*342.8*	*272*	*78.7*	*576*	*192.0*
2020	*570*	*348.0*	*271*	*78.5*	*578*	*194.4*
2021	*570*	*354.7*	*276*	*79.3*	*579*	*194.9*
2022	*570*	*357.0*	*274*	*79.1*	*580*	*194.5*

Table 3 Average milk yield and fat content, 1990 - 2022

Year	Average milk yield, kg $year^{-1}$	Fat content, %
1990	*3437*	*3.50*
1991	*3205*	*3.58*
1992	*2793*	*3.67*
1993	*2741*	*3.75*
1994	*2923*	*3.84*
1995	*3074*	*3.92*
1996	*3237*	*4.01*
1997	*3585*	*4.09*
1998	*3733*	*4.06*
1999	*3754*	*4.00*
2000	*3898*	*4.08*
2001	*4055*	*4.08*
2002	*3958*	*4.08*
2003	*4261*	*4.11*
2004	*4251*	*4.17*
2005	*4364*	*4.25*
2006	*4492*	*4.26*
2007	*4636*	*4.31*
2008	*4822*	*4.29*
2009	*4892*	*4.31*
2010	*4998*	*4.29*

Year	Average milk yield, kg year^{-1}	Fat content, %
2011	*5064*	*4.22*
2012	*5250*	*4.16*
2013	*5508*	*4.08*
2014	*5812*	*3.86*
2015	*5905*	*3.99*
2016	*6182*	*4.15*
2017	*6525*	*4.10*
2018	*6614*	*4.10*
2019	*6891*	*4.10*
2020	*7163*	*4.01*
2021	*7362*	*4.04*
2022	*7492*	*3.99*

Table 4 Dairy cattle slurry storage abatement measures implementation proportion, %

	1990 - 2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Store with no cover or crust (reference technique) *	100	93.82	88.63	83.45	78.26	73.08	67.90	62.71	57.53	52.35	47.16	41.98	36.79	31.54	26.28	21.02	15.77	10.51	5.26	0.00	0.00	0.00
Allowing formation of natural crust	0	6.18	11.37	16.55	21.74	26.92	32.10	37.29	42.47	47.66	52.84	58.02	63.21	68.39	73.58	78.76	83.94	89.13	94.31	99.50	99.50	99.50
"Tight" lid, roof or tent structure	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.22	0.29	0.36	0.43	0.51	0.51	0.51

* or there is not enough data to assume other option

Table 5 Pig slurry storage abatement measures implementation proportion, %

	1990 - 2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Store with no cover or crust (reference technique) *	100	80.00	60.00	40.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Floating covers (e.g., chopped straw, peat, bark, etc.)	0	13.00	26.00	39.00	52.00	64.99	62.65	51.51	42.96	42.24	42.80	42.50	40.38	45.33	47.12	48.33	42.53	38.64	32.01	19.22	19.22	19.22
Plastic sheeting (floating cover)	0	3.17	6.33	9.50	12.67	15.84	18.24	30.86	36.15	36.73	38.41	33.27	31.05	23.63	22.01	19.14	22.63	30.10	29.05	39.81	39.81	39.81
“Tight” lid, roof or tent structure	0	3.83	7.67	11.50	15.34	19.17	19.11	17.63	20.90	21.03	18.79	24.23	28.57	31.04	30.87	32.53	34.84	31.26	38.95	40.97	40.97	40.97

* or there is not enough data to assume other option

Table 6 Implementation proportion for dairy cattle abatement techniques for solid manure application to land, %

	1990 -2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Incorporation within 4 hours	0	2.59	5.18	7.78	10.37	12.96	15.55	18.15	20.74	23.33	25.92	28.51	31.11	33.70	36.29	38.88	41.47	41.47	41.47
Incorporation within 24 hours	0	3.66	7.32	10.97	14.63	18.29	21.95	25.61	29.26	32.92	36.58	40.24	43.89	47.55	51.21	54.87	58.53	58.53	58.53
Manure spread not followed by incorporation *	100	93.75	87.50	81.25	75.00	68.75	62.50	56.25	50.00	43.75	37.50	31.25	25.00	18.75	12.50	6.25	0.00	0.00	0.00

* or there is not enough data to assume other option

Table 7 Implementation proportion for non-dairy cattle abatement techniques for solid manure application to land, %

	1990 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Incorporation within 4 hours	0	2.13	4.26	6.39	8.53	10.66	12.79	14.92	17.05	19.18	21.31	23.44	25.57	27.71	29.84	31.97	34.10	34.10	34.10
Incorporation within 24 hours	0	4.12	8.24	12.36	16.48	20.59	24.71	28.83	32.95	37.07	41.19	45.31	49.43	53.54	57.66	61.78	65.90	65.90	65.90
Manure spread not followed by incorporation *	100	93.75	87.50	81.25	75.00	68.75	62.50	56.25	50.00	43.75	37.50	31.25	25.00	18.75	12.50	6.25	0.00	0.00	0.00

* or there is not enough data to assume other option

Table 8 Implementation proportion for pig abatement techniques for solid manure application to land, %

	1990 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Incorporation within 4 hours	0	1.23	2.47	3.70	4.93	6.17	7.40	8.63	9.87	11.10	12.33	13.57	14.80	16.03	17.27	18.50	19.73	19.73	19.73
Incorporation within 24 hours	0	5.02	10.03	15.05	20.07	25.08	30.10	35.12	40.13	45.15	50.17	55.18	60.20	65.22	70.23	75.25	80.27	80.27	80.27
Manure spread not followed by incorporation *	100	93.75	87.50	81.25	75.00	68.75	62.50	56.25	50.00	43.75	37.50	31.25	25.00	18.75	12.50	6.25	0.00	0.00	0.00

* or there is not enough data to assume other option

Table 9 Implementation proportion for sheep abatement techniques for solid manure application to land, %

	1990 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Incorporation within 4 hours	0	1.77	3.54	5.30	7.07	8.84	10.61	12.38	14.14	15.91	17.68	19.45	21.21	22.98	24.75	26.52	28.29	28.29	28.29
Incorporation within 24 hours	0	4.48	8.96	13.45	17.93	22.41	26.89	31.38	35.86	40.34	44.82	49.30	53.79	58.27	62.75	67.23	71.72	71.72	71.72
Manure spread not followed by incorporation *	100	93.75	87.50	81.25	75.00	68.75	62.50	56.25	50.00	43.75	37.50	31.25	25.00	18.75	12.50	6.25	0.00	0.00	0.00

* or there is not enough data to assume other option

Table 10 Implementation proportion for goat abatement techniques for solid manure application to land, %

	1990 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Incorporation within 4 hours	0	1.73	3.46	5.19	6.92	8.65	10.37	12.10	13.83	15.56	17.29	19.02	20.75	22.48	24.21	25.94	27.66	27.66	27.66
Incorporation within 24 hours	0	4.52	9.04	13.56	18.08	22.61	27.13	31.65	36.17	40.69	45.21	49.73	54.25	58.77	63.29	67.82	72.34	72.34	72.34
Manure spread not followed by incorporation *	100	93.75	87.50	81.25	75.00	68.75	62.50	56.25	50.00	43.75	37.50	31.25	25.00	18.75	12.50	6.25	0.00	0.00	0.00

* or there is not enough data to assume other option

Table 11 Implementation proportion for hoarse abatement techniques for solid manure application to land, %

	1990 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Incorporation within 4 hours	0	1.14	2.28	3.42	4.57	5.71	6.85	7.99	9.13	10.27	11.41	12.55	13.70	14.84	15.98	17.12	18.26	18.26	18.26
Incorporation within 24 hours	0	5.11	10.22	15.33	20.43	25.54	30.65	35.76	40.87	45.98	51.09	56.20	61.30	66.41	71.52	76.63	81.74	81.74	81.74
Manure spread not followed by incorporation *	100	93.75	87.50	81.25	75.00	68.75	62.50	56.25	50.00	43.75	37.50	31.25	25.00	18.75	12.50	6.25	0.00	0.00	0.00

* or there is not enough data to assume other option

Table 12 Implementation proportion for dairy cattle abatement techniques for slurry and digestate application to land, %

	1990 -2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Band spreading with a trailing hose and incorporation within 4 hours	0	1.39	2.77	4.16	5.55	6.93	8.32	9.71	11.10	12.48	13.87	15.26	16.64	18.03	19.42	20.80	22.19	22.19	22.19
Band spreading with trailing shoe and incorporation within 4 hours	0	0.28	0.56	0.84	1.12	1.40	1.68	1.96	2.24	2.52	2.80	3.08	3.36	3.64	3.92	4.20	4.48	4.48	4.48
Band spreading with a trailing hose and incorporation after 4 hours	0	1.22	2.45	3.67	4.89	6.11	7.33	8.56	9.78	11.00	12.22	13.45	14.67	15.89	17.11	18.33	19.56	19.56	19.56
Band spreading with trailing shoe and incorporation after 4 hours	0	0.19	0.37	0.56	0.75	0.94	1.12	1.31	1.50	1.68	1.87	2.06	2.25	2.43	2.62	2.81	2.99	2.99	2.99

	1990 -2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Band spreading slurry with a trailing hose and not followed by incorporation	0	0.73	1.46	2.19	2.92	3.66	4.39	5.12	5.85	6.58	7.31	8.04	8.77	9.50	10.23	10.97	11.70	11.70	11.70
Band spreading slurry with a trailing shoe and not followed by incorporation	0	0.09	0.18	0.27	0.36	0.45	0.53	0.62	0.71	0.80	0.89	0.98	1.07	1.16	1.25	1.33	1.42	1.42	1.42
Incorporation of surface applied slurry within 4 hours	0	0.89	1.77	2.66	3.55	4.44	5.32	6.21	7.10	7.99	8.87	9.76	10.65	11.53	12.42	13.31	14.20	14.20	14.20
Incorporation of surface applied slurry within 12 hours	0	0.68	1.35	2.03	2.71	3.39	4.06	4.74	5.42	6.09	6.77	7.45	8.12	8.80	9.48	10.16	10.83	10.83	10.83
Injecting slurry (open slot)	0	0.07	0.13	0.20	0.26	0.33	0.40	0.46	0.53	0.59	0.66	0.73	0.79	0.86	0.92	0.99	1.05	1.05	1.05
Injecting slurry (closed slot)	0	0.45	0.89	1.34	1.79	2.23	2.68	3.12	3.57	4.02	4.46	4.91	5.35	5.80	6.25	6.69	7.14	7.14	7.14
Manure spread not followed by incorporation *	100	94.03	88.06	82.08	76.11	70.14	64.16	58.19	52.22	46.25	40.27	34.30	28.33	22.36	16.38	10.41	4.44	4.44	4.44

* or there is not enough data to assume other option

Table 13 Implementation proportion for pig abatement techniques for slurry and digestate application to land, %

	1990 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Band spreading with a trailing hose and incorporation within 4 hours	0	2.10	4.19	6.29	8.38	10.48	12.57	14.67	16.76	18.86	20.95	23.05	25.15	27.24	29.34	31.43	33.53	33.53	33.53
Band spreading with trailing shoe and incorporation within 4 hours	0	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.09

	1990 - 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Band spreading with a trailing hose and incorporation after 4 hours	0	0.35	0.71	1.06	1.42	1.77	2.12	2.48	2.83	3.19	3.54	3.90	4.25	4.60	4.96	5.31	5.67	5.67	5.67
Band spreading with trailing shoe and incorporation after 4 hours	0	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.09	0.10	0.10	0.10
Band spreading slurry with a trailing hose and not followed by incorporation	0	0.53	1.05	1.58	2.10	2.63	3.15	3.68	4.20	4.73	5.25	5.78	6.30	6.83	7.35	7.87	8.40	8.40	8.40
Band spreading slurry with a trailing shoe and not followed by incorporation	0	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.09	0.09
Incorporation of surface applied slurry within 4 hours	0	1.89	3.79	5.68	7.57	9.46	11.36	13.25	15.14	17.03	18.93	20.82	22.71	24.61	26.50	28.39	30.28	30.28	30.28
Incorporation of surface applied slurry within 12 hours	0	1.08	2.15	3.23	4.31	5.39	6.46	7.54	8.62	9.69	10.77	11.85	12.93	14.00	15.08	16.16	17.23	17.23	17.23
Injecting slurry (open slot)	0	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Injecting slurry (closed slot)	0	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.06	0.06	0.06
Manure spread not followed by incorporation *	100	94.04	88.07	82.11	76.15	70.18	64.22	58.26	52.29	46.33	40.37	34.40	28.44	22.48	16.51	10.55	4.54	4.54	4.54

* or there is not enough data to assume other option

Annex IV: Summary Information on Condensable in PM

Table 1 Inclusion/exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors

NFR	Source/sector name	PM emissions: the condensable component is		EF references and comments
		included	excluded	
1A1a	*Public electricity and heat production*		*$PM_{2.5}$, PM_{10}*	*EMEP/EEA 2019 – 1.A.1 Energy Industries - Table 3-3, Table 3-4, Table 3-5, Table 3-6, Table 3-7*
1A1c	*Manufacture of solid fuels and other energy industries*		*$PM_{2.5}$, PM_{10}*	*EMEP/EEA 2019 – 1.A.1 Energy Industries - Table 3-3, Table 3-4, Table 3-5, Table 3-6, Table 3-7*
1A2a	*Iron and steel*	No information		*EMEP/EEA 2019 – 1.A.2 Manufacturing industries and construction – Table 3-2, Table 3-3, Table 3-4, Table 3-5 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*
1A2b	*Non-ferrous metals*	No information		*EMEP/EEA 2019 – 1.A.2 Manufacturing industries and construction – Table 3-2, Table 3-3, Table 3-4, Table 3-5 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*
1A2c	*Chemicals*	No information		*EMEP/EEA 2019 – 1.A.2 Manufacturing industries and construction – Table 3-2, Table 3-3, Table 3-4, Table 3-5 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*
1A2d	*Pulp, Paper and Print*	No information		*EMEP/EEA 2019 – 1.A.2 Manufacturing industries and construction – Table 3-2, Table 3-3, Table 3-4, Table 3-5 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*
1A2e	*Food processing, beverages and tobacco*	No information		*EMEP/EEA 2019 – 1.A.2 Manufacturing industries and construction – Table 3-2, Table 3-3, Table 3-4, Table 3-5 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*
1A2f	*Non-metallic minerals*	Information provided in reference column		*EMEP/EEA 2019 – 1.A.2 Manufacturing industries and construction – Table 3-2, Table 3-3, Table 3-4, Table 3-5 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM);* *EMEP/EEA 2019 - 5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge – Table 3-1 (for Industrial and Municipal waste incineration 1999-2009)*
1A2gvii	*Off-road vehicles and other machinery*	*$PM_{2.5}$, PM_{10}*		*EMEP/EEA 2019 - 1.A.4 Non road mobile machinery – Table 3-1*
1A2gviii	*Other*	No information		*EMEP/EEA 2019 – 1.A.2 Manufacturing industries and construction – Table 3-2, Table 3-3, Table 3-4, Table 3-5 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*

NFR	Source/sector name	PM emissions: the condensable component is		EF references and comments
		included	excluded	
1A3ai(i)	*International aviation LTO (civil)*	No information		*EMEP/EEA 2019 – 1.A.3.a Aviation - Table 3.4*
1A3aii(i)	*Domestic aviation LTO (civil)*	No information		*EMEP/EEA 2019 – 1.A.3.a Aviation - Table 3.4*
1A3bi	*Passenger cars*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 –COPERT 5.7.2 model*
1A3bii	*Light duty vehicles*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 –COPERT 5.7.2 model*
1A3biii	*Heavy duty vehicles and buses*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 –COPERT 5.7.2 model*
1A3biv	*Mopeds & motorcycles*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 –COPERT 5.7.2 model*
1A3bvi	*Automobile tyre and brake wear*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 –COPERT 5.7.2 model*
1A3bvii	*Automobile road abrasion*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 –COPERT 5.7.2 model*
1A3c	*Railways*	No information		*EMEP/EEA 2019 – 1.A.3.c Railways - Table 3.1*
1A3dii	*National navigation (shipping)*	No information		*EMEP/EEA 2019 - 1.A.3.d.i(i), 1.A.3.d.i(ii), 1.A.3.d.ii, 1.A.4.c.iii, 1.A.5.b International maritime navigation, international inland navigation, national navigation (shipping), national fishing, military (shipping), and recreational boats - Table 3.1, Table 3.2*
1A4ai	*Commercial/institutional - Stationary*	No information		*EMEP/EEA 2019 - 1.A.4 Small combustion - Table 3-7, Table 3-8, Table 3-9, Table 3-10 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*
1A4aii	*Commercial/institutional - Off-road vehicles and other machinery*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 - 1.A.4 Non road mobile machinery – Table 3-1*
1A4bi	*Residential - Stationary*	Information provided in reference column		*EMEP/EEA 2019 - 1.A.4 Small combustion – Table 3-15 (emission factors represent filterable PM emissions), Table 3-16 (no information), Table 3-18 (emission factors represent filterable PM emissions), Table 3-39 (emission factors includes condensable component), Table 3-40 (emission factors includes condensable component), Table 3-41 (emission factors includes condensable component), Table 3-42 (emission factors includes condensable component), Table 3-43 (emission factors includes condensable component), Table 3-44 (emission factors includes condensable component)*
1A4bii	*Residential - Off-road vehicles and other machinery*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2019 - 1.A.4 Non road mobile machinery – Table 3-1*
1A4ci	*Agriculture/Forestry/Fishing - Stationary*	No information		*EMEP/EEA 2019 - 1.A.4 Small combustion - Table 3-7, Table 3-8, Table 3-9, Table 3-10 ($PM_{2.5}$, PM_{10} emissions from biomass combustion represents filtrable PM)*

NFR	Source/sector name	PM emissions: the condensable component is		EF references and comments
		included	excluded	
1A4cii	*Agriculture/Forestry/Fishing - Off-road vehicles and other machinery*	*$PM_{2.5}$, PM_{10}*		*EMEP/EEA 2019 - 1.A.4 Non road mobile machinery – Table 3-1*
1A4ciii	*Agriculture/Forestry/Fishing*	No information		*EMEP/EEA 2019 - 1.A.3.d Navigation (shipping) - Table 3-1, Table 3-2*
1A5b	*Other, Mobile*	No information		*EMEP/EEA 2019 - 1.A.3.d Navigation (shipping) - Table 3-2*
1B1a	*Coal mining and handling*	No information		*EMEP/EEA 2023* - 1.B.1.a Fugitive emissions from solid fuels - Coal mining and handling – Table 3-7
2A1	*Cement production*		*$PM_{2.5}$, PM_{10}*	*The filter method is used in the enterprise, thus obtaining filterable PM*
2A2	*Lime production*	No information		*EMEP/EEA 2023 - 2.A.2 Lime production – Table 3-2 (1990-2004), Table 3-3 (2005-2015)*
2A3	*Glass production*		*$PM_{2.5}$, PM_{10}*	*ISO 9096:2003/Cor 1:2006 Stationary source emissions - Manual determination of mass concentration of particulate matter*
2A5a	*Quarrying mining minerals*	No information		*EMEP/EEA 2023 - 2.A.5.a Quarrying and mining of minerals other than coal – Table 3-1*
2A5b	*Construction demolition*	No information		*EMEP/EEA 2023 - 2.A.5.b Construction and demolition - Table 3-1, Table 3-2, Table 3-3, Table 3-4*
2A5c	*Storage handling transport*		*$PM_{2.5}$, PM_{10}*	*The filter method is used in the enterprise, thus obtaining filterable PM*
2C1	*Iron and steel*		*$PM_{2.5}$, PM_{10}*	*EMEP/EEA 2023 – 2.C.1 Iron and steel production – Table 3-13, Table 3-15*
2D3b	*Road paving with asphalt*		*$PM_{2.5}$, PM_{10}*	*EMEP/EEA 2023 – 2.D.3.b Road paving with asphalt – Table 3-1*
2D3c	*Asphalt roofing*	No information		*EMEP/EEA 2023 - 2.D.3.c Asphalt roofing – Table 3-1*
2G	*Other product use*	No information		*EMEP/EEA 2023 - 2.G Other solvent and product use – Table 3-13, Table 3-14*
3B1a	*Dairy cattle*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B1b	*Non-dairy cattle*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B2	*Sheep*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B3	*Swine*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B4d	*Goats*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B4e	*Horses*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B4gi	*Laying hens*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B4gii	*Broilers*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B4giii	*Turkeys*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B4giv	*Other poultry*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*
3B4h	*Other animals*	No information		*EMEP/EEA 2019 – 3B Manure Management – Table 3-5*

NFR	Source/sector name	PM emissions: the condensable component is		EF references and comments
		included	excluded	
3Dc	*Farm-level agricultural operations including storage, handling and transport of agricultural products*	No information		*EMEP/EEA 2019 – 3D Crop production and agricultural soils – Table 3-1, Table 3-5, Table 3-7*
3I	*Agriculture other*	No information		*EMEP/EEA 2023 – 11.B Forest fires - Table 3-8*
5A	*Biological treatment of waste - Solid waste disposal on land*	No information		*EMEP/EEA 2023 – 5.A Biological treatment of waste - Table 3-1*
5C1bii	*Hazardous waste incineration*	No information		*EMEP/EEA 2023 - 5.C.1.b.i, 5.C.1.b.ii, 5.C.1.b.iv Industrial waste incineration including hazardous waste and sewage sludge - Table 3- 1*
5C1bv	*Cremation*	No information		*EMEP/EEA 2023 - 5.C.1.b.v Cremation - Table 3-1*
5E	*Other waste (please specify in IIR)*	No information		*EMEP/EEA 2023 – 5.E Other waste - Table 3-2, Table 3-4, Table 3-6*
6A	*Other*	No information		*EMEP/EEA 2023 – 11.B Forest fires - Table 3-1*
11B	*Forest fires*	No information		*EMEP/EEA 2023 – 11.B Forest fires - Table 3-5*

Annex V: List of NFR codes

NFR Code	Longname
1A1a	Public electricity and heat production
1A1b	Petroleum refining
1A1c	Manufacture of solid fuels and other energy industries
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
1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)
1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)
1A3ai(i)	International aviation LTO (civil)
1A3aii(i)	Domestic aviation LTO (civil)
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
1A3c	Railways
1A3di(ii)	International inland waterways
1A3dii	National navigation (shipping)
1A3ei	Pipeline transport
1A3eii	Other (please specify in the IIR)
1A4ai	Commercial/institutional: Stationary
1A4aii	Commercial/institutional: Mobile
1A4bi	Residential: Stationary
1A4bii	Residential: Household and gardening (mobile)
1A4ci	Agriculture/Forestry/Fishing: Stationary
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery
1A4ciii	Agriculture/Forestry/Fishing: National fishing
1A5a	Other stationary (including military)
1A5b	Other, Mobile (including military, land based and recreational boats)
1B1a	Fugitive emission from solid fuels: Coal mining and handling
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
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)
1B2d	Other fugitive emissions from energy production
2A1	Cement production
2A2	Lime production
2A3	Glass production
2A5a	Quarrying and mining of minerals other than coal

NFR Code	Longname
2A5b	Construction and demolition
2A5c	Storage, handling and transport of mineral products
2A6	Other mineral products (please specify in the IIR)
2B1	Ammonia production
2B2	Nitric acid production
2B3	Adipic acid production
2B5	Carbide production
2B6	Titanium dioxide production
2B7	Soda ash production
2B10a	Chemical industry: Other (please specify in the IIR)
2B10b	Storage, handling and transport of chemical products (please specify in the IIR)
2C1	Iron and steel production
2C2	Ferroalloys production
2C3	Aluminium production
2C4	Magnesium production
2C5	Lead production
2C6	Zinc production
2C7a	Copper production
2C7b	Nickel production
2C7c	Other metal production (please specify in the IIR)
2C7d	Storage, handling and transport of metal products (please specify in the IIR)
2D3a	Domestic solvent use including fungicides
2D3b	Road paving with asphalt
2D3c	Asphalt roofing
2D3d	Coating applications
2D3e	Degreasing
2D3f	Dry cleaning
2D3g	Chemical products
2D3h	Printing
2D3i	Other solvent use (please specify in the IIR)
2G	Other product use (please specify in the IIR)
2H1	Pulp and paper industry
2H2	Food and beverages industry
2H3	Other industrial processes (please specify in the IIR)
2I	Wood processing
2J	Production of POPs
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)
3B1a	Manure management - Dairy cattle
3B1b	Manure management - Non-dairy cattle
3B2	Manure management - Sheep
3B3	Manure management - Swine
3B4a	Manure management - Buffalo
3B4d	Manure management - Goats
3B4e	Manure management - Horses
3B4f	Manure management - Mules and asses
3B4gi	Manure management - Laying hens
3B4gii	Manure management - Broilers
3B4giii	Manure management - Turkeys
3B4giv	Manure management - Other poultry
3B4h	Manure management - Other animals (please specify in IIR)

NFR Code	Longname
3Da1	Inorganic N-fertilizers (includes also urea application)
3Da2a	Animal manure applied to soils
3Da2b	Sewage sludge applied to soils
3Da2c	Other organic fertilisers applied to soils (including compost)
3Da3	Urine and dung deposited by grazing animals
3Da4	Crop residues applied to soils
3Db	Indirect emissions from managed soils
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products
3Dd	Off-farm storage, handling and transport of bulk agricultural products
3De	Cultivated crops
3Df	Use of pesticides
3F	Field burning of agricultural residues
3I	Agriculture other (please specify in the IIR)
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
5C1bi	Industrial waste incineration
5C1bii	Hazardous waste incineration
5C1biii	Clinical waste incineration
5C1biv	Sewage sludge incineration
5C1bv	Cremation
5C1bvi	Other waste incineration (please specify in the IIR)
5C2	Open burning of waste
5D1	Domestic wastewater handling
5D2	Industrial wastewater handling
5D3	Other wastewater handling
5E	Other waste (please specify in IIR)
6A	Other (included in national total for entire territory) (please specify in IIR)
	Memo items (not to be included in national totals)
1A3ai(ii)	International aviation cruise (civil)
1A3aii(ii)	Domestic aviation cruise (civil)
1A3di(i)	International maritime navigation
1A5c	Multilateral operations
1A3	Transport (fuel used)
6B	Other not included in national total of the entire territory (please specify in the IIR)
11A	Volcanoes
11B	Forest fires
11C	Other natural emissions (please specify in the IIR)