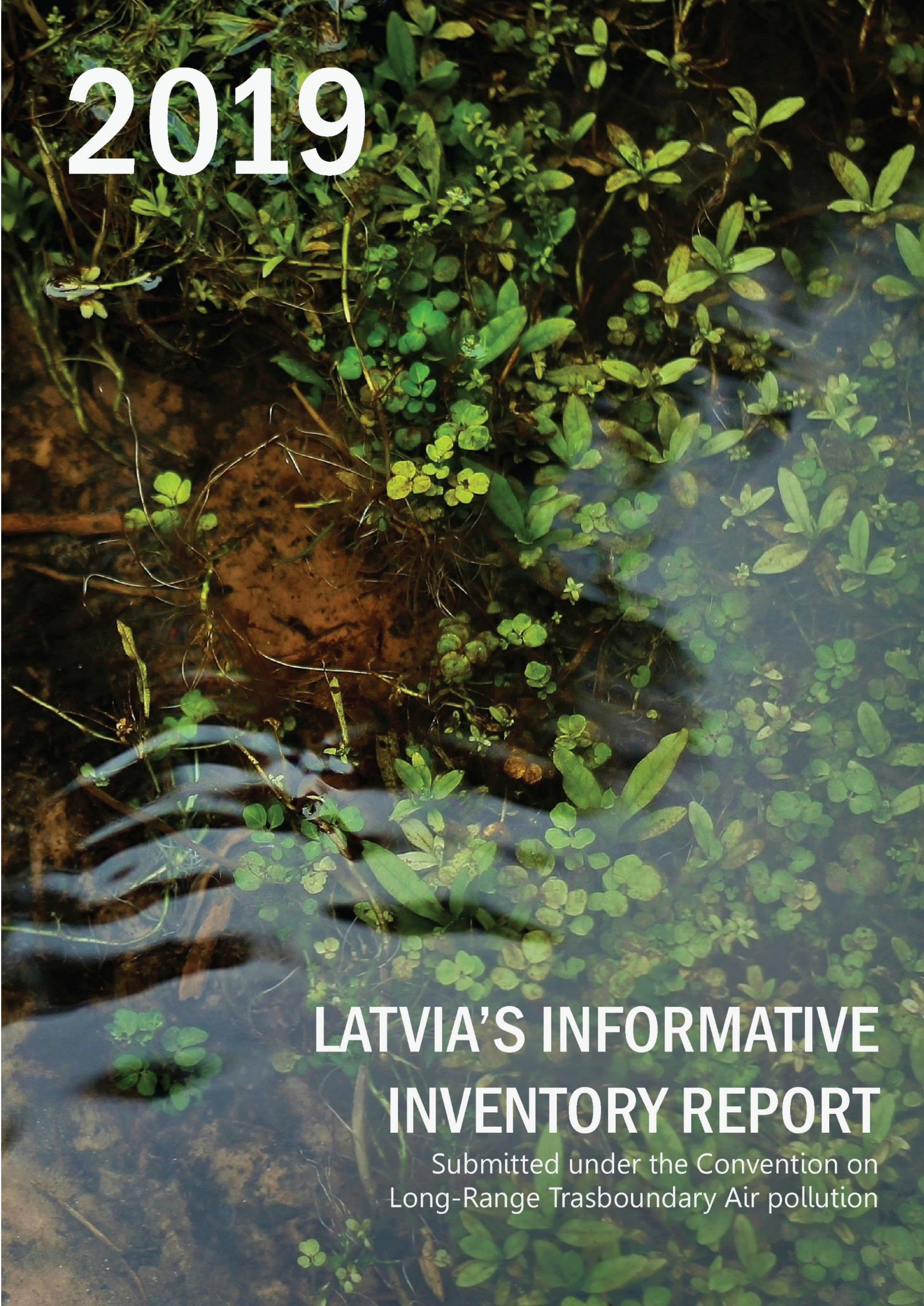

2019

LATVIA'S INFORMATIVE INVENTORY REPORT

Submitted under the Convention on Long-Range Trasboundary Air pollution

Data sheet

Title

Latvia's Informative Inventory Report 1990 - 2017
Submitted under the Convention on Long-Range Transboundary Air Pollution

Date

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Abbreviations

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
GHG – Greenhouse gases
HDD – Heating degree days
IPCC – Intergovernmental Panel on Climate Change
IPCC GPG 2000 – IPCC Good Practice Guidance and Uncertainty management in national Greenhouse Gas Inventories (2000)
IPCC GPG LULUCF 2003 – IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (2003)
2006 IPCC Guidelines – 2006 IPCC Guidelines for National Greenhouse Gas Inventories
IPPU – Industrial processes and Product use
KCA – Key category analysis
LEGMC – Latvian Environment, Geology and Meteorology Centre
LULUCF – Land Use, Land Use Change and Forestry
MEPRD – Ministry of the Environmental Protection and Regional Development
MoA – Ministry of Agriculture
NCV – Net calorific value
NFR – Nomenclature For Reporting
QA – Quality assurance
QC – Quality control
REBs – Regional Environmental Boards
RTSD – Road Traffic Safety Department
SFS – State Forest Service
TERT – Technical Expert Review Team
UN – United Nations
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 byphenils
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

Inventory report of air pollution in Latvia has been prepared by Latvian Environment, Geology and Meteorology Centre 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 and revised Gothenburg Protocol and NEC directive. The Informative Inventory Report (IIR) is submitted to the UNECE Secretariat and EEA annually.

This report includes information on the emission data from 1990 to 2017 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 2019 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 by CSB, EU ETS, national databases "2-Air", "2-Water", "3-Waste", other different databases and directly from enterprises and institutions.

Comparing emissions between Submission 2018 and Submission 2019, some 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 2018 Comprehensive Technical Review of National Emission Inventories results. Detailed information about recalculations done in IIR Submission 2019 can be found in Chapter 8.1. Implementation status of 2019 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 III.

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 have the year 2005 as 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 informative inventory report, which describes the emission calculations made in more detail.

Local legislation acts regarding air quality monitoring:

- No. 614 of Cabinet on Ministers (02.10.2018) – Regulations for reducing and recording the total air pollutant emissions;
- No. 737 of Cabinet on Ministers (12.12.2017) - Development and Management of National System for Greenhouse Gas Inventory and Projections.

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 have to annually submit emission inventory to the secretariat of the Convention on Long-Range Transboundary Air Pollution (CLRTAP).

This report is prepared based on emission data submitted on 15 March 2019 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 2017 for anthropogenic emissions of:

Main pollutants: NOx, 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 (**NFR14**) format as requested in the Reporting Guidelines.

The latest recalculations in emission inventory were done for the time period from 1990 to 2016. They were done because of the change of activity data, implementation of research, as well as implementing recommendations received after 2018 Comprehensive Technical Review of National Emission Inventories. Detailed information about recalculations done in each sector is described in appropriate subsector.

1.2 Description of the institutional arrangement for inventory preparation

Latvian IIR is prepared by the state Ltd "Latvian Environment, Geology and Meteorology Centre" (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 and 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.

1.3 Description of the process of inventory preparation

The process of 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 needed for final emission estimation is collected.

Emission inventory of Latvia is generally based on the EMEP/EEA 2016 with a few exceptions in particular sectors where previous versions of EMEP emission inventory guidebooks and data and methodologies from 2006 IPCC Guidelines are used.

NFR 2014-2 format is used to prepare inventory for years 1990-2017. For all sectors, except Road transport, 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 5.2), 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.

Activity data is obtained from CSB, Ministry of Agriculture, Ministry of Economics, Ministry of Transport and other enterprises and institutions.

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 balances for EUROSTAT according to additional agreement.

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

1.4 Description of key source categories

The Key category analysis (KCA) for 1990 and 2017 was done by LEGMC according to the EMEP/EEA 2016 Level and Trend assessment. According to EMEP/EEA 2016, 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 2017 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 10.9%	1A1a 10.8%	1A3bi 10.1%	1A3c 9.3%	1A4aii 6.5%	3Da1 5.5%	1A4ai 5.5%	1A2gviii 5.0%	1A2gvii 4.6%	1A2e 4.4%	1A4cii 4.0%	1A4ciii 3.5%			80.2%
NMVOC	1A3bi 20.4%	1A4bi 12.0%	3B1a 10.7%	2D3d 6.4%	1A3biii 4.4%	2H2 4.3%	1A4ai 4.0%	3B1b 3.7%	1A4cii 3.7%	1B2b 2.7%	2D3a 2.4%	1A3bii 2.4%	1A2gvii 2.3%	1A3bv 2.2%	81.6%
SO_2	1A1a 35.8%	1A4ai 22.3%	1A4bi 8.4%	1A2e 8.0%	1A2gviii 7.6%										82.1%
NH_3	3B1a 24.7%	3B3 18.8%	3Da1 18.0%	3Da2a 17.2%	3B1b 5.8%										84.5%
$PM_{2.5}$	1A4bi 56.9%	1A4ai 12.0%	6A 6.1%	1A1a 3.6%	1A4aii 1.9%										80.5%
PM_{10}	1A4bi 49.2%	1A4ai 10.6%	6A 6.2%	3Dc 5.2%	1A1a 4.0%	2A2 3.0%	2C1 1.8%								80.0%
TSP	1A4bi 39.7%	1A4ai 8.5%	3Dc 7.8%	6A 7.3%	2A2 5.9%	1A1a 4.2%	3B3 4.2%	3B4gi 3.0%							80.6%
CO	1A3bi 48.7%	1A4bi 25.1%	1A4cii 6.3%												80.1%
Pb	2C1 70.0%	1A3bi 16.5%													86.4%
Cd	2C1 46.6%	1A4bi 30.0%	1A4ai 10.6%												87.2%
Hg	1A4ai 44.5%	1A4bi 17.9%	1A1a 11.5%	1A4ci 6.0%	2D3a 5.1%										85.0%
PCDD/ PCDF	1A4bi 55.8%	1A4ai 14.3%	5C1biii 12.8%												82.9%
PAHs	1A4bi 66.2%	1A4ai 13.9%													80.1%
HCB	1A4bi 53.3%	1A4ai 18.3%	1A1a 13.7%												85.3%
PCBs	1A4ai 61.8%	1A4bi 27.1%													88.8%

In 1990, Energy sector was a key source for the largest part of pollutants. For SO_2, $PM_{2.5}$, PM_{10}, TSP, Hg, PCDD/PCDF, PAHs, HCB and PCBs emissions the main contributor was Stationary combustion (NFR 1A1, 1A2, 1A4), especially Residential subsector (NFR 1A4b). For NO_x, NMVOC, CO and Cu emissions – Transport sector (NFR 1A3), particularly Road transport (NFR 1A3b). The main contributor for NH_3 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 2017

	Key categories (Sorted from high to low from left to right)										Total (%)
NOx	1A3biii 15.2%	1A3bi 11.0%	1A1a 10.8%	1A4cii 9.7%	3Da1 8.3%	1A3c 7.3%	1A4bi 5.1%	2A1 4.5%	1A3bii 4.0%	1A2gviii 4%	1A2gvii 3%	82.9%
NMVOC	1A4bi 21.0%	1A2gviii 10.7%	2D3d 10.5%	3B1a 10.2%	2D3i 6.4%	1A3bi 4.7%	2D3g 3.9%	1A4ai 3.9%	2D3a 3.8%	2H2 3.4%	3De 2.7%	81.4%
SO_2	1A4bi 27.7%	1A1a 21.5%	1A2gviii 15.5%	1A2f 9.2%	1A4ai 7%							81.3%
NH_3	3Da1 23.4%	3B1a 22.5%	3Da2a 16.0%	1A4bi 8.0%	3B3 5.6%	3B1b 4.3%	1A2gviii 3%					82.9%

[2] Full list of NFR codes can be seen on Annex IV.

	Key categories (Sorted from high to low from left to right)											Total (%)
$PM_{2.5}$	1A4bi 55.1%	1A1a 13.5%	1A2gviii 10.5%	1A4ai 3.7%								82.8%
PM_{10}	1A4bi 40.6%	2D3b 14.2%	1A1a 11.3%	1A2gviii 7.7%	3Dc 4.7%	2A5b 3.6%						82.1%
TSP	2D3b 37.5%	1A4bi 24.1%	1A1a 7.1%	2A5b 6.7%	1A2gviii 4.6%	3Dc 4%						84.3%
CO	1A4bi 64.6%	1A3bi 9.4%	1A2gviii 6.2%									80.2%
Pb	1A3bi 25.1%	1A4bi 19.3%	1A3bvi 10.9%	1A1a 10.8%	1A2gviii 11%	2A3 10%						86.9%
Cd	1A4bi 45.3%	1A2gviii 28.2%	1A4ai 9.5%									83.0%
Hg	1A1a 28.1%	2A1 14.7%	1A4bi 14.1%	2D3a 10.1%	1A2gviii 8.1%	1A4ai 7%						81.7%
PCDD/ PCDF	1A4bi 60.3%	5E 13.2%	1A2gviii 7.5%									81.0%
PAHs	1A4bi 77.1%	6A 8.4%										85.6%
HCB	1A4bi 35.5%	1A1a 29.7%	1A2gviii 22.1%									87.3%
PCBs	1A4bi 37.8%	1A1a 33.7%	1A4ai 19.0%									90.5%

Table 1.2 and Table 1.3 show that the key sources have slightly changed in 2017 in comparison with 1990. The main source for the majority of pollutants has remained to be the Energy sector, (NFR 1) especially the Residential subsector (NFR 1A4b). Also, the Road transport (NFR 1A3b) has remained as a key category for NO_x, and Agriculture sector for NH_3 emissions. In comparison with key categories from 1990 main contributor for NMVOC emissions in 2017 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 2017 can be seen in Table 1.4.

Table 1.4 Trend assessment key categories in 2017

	Key categories (Sorted from high to low from left to right)														Total (%)
NOx	1A1a 10.6%	1A3c 9.8%	1A3bi 9.6%	1A3biii 9.3%	1A4aii 7.7%	1A4ai 6.4%	1A2e 5.6%	1A2gviii 5.3%	1A2gvii 4.9%	3Da1 4.5%	1A4ciii 4.0%	1A2f 2.9%			80.5%
NMVOC	1A3bi 24.4%	3B1a 9.6%	1A4bi 6.9%	1A3biii 5.4%	1A4cii 4.4%	2H2 4.1%	1A2gviii 4.1%	2D3d 4.0%	3B1b 3.8%	1A4ai 3.5%	1B2b 3.1%	1A3bii 2.9%	1A2gvii 2.8%	1A3bv 2.7%	81.6%
SO_2	1A1a 36.1%	1A4ai 22.6%	1A2e 8.1%	1A4bi 8.0%	1A2gviii 7.4%										82.3%
NH_3	3B1a 24.5%	3B3 23.2%	3Da2a 16.9%	3Da1 15.0%	3B1b 6.1%										85.7%
$PM_{2.5}$	1A4bi 24.7%	1A4ai 15.5%	1A1a 12.8%	1A2gviii 12.2%	6A 7.4%	2D3b 3.3%	1A4aii 2.8%	2C1 2.7%							81.4%
PM_{10}	2D3b 21.3%	1A4bi 12.0%	1A4ai 11.9%	1A1a 11.3%	1A2gviii 10.4%	6A 6.3%	2A2 4.6%	2C1 2.7%							80.5%
TSP	2D3b 57.6%	1A4bi 8.2%	1A2gviii 6.1%	1A1a 4.6%	2A2 4.5%										81.0%
CO	1A3bi 54.3%	1A4bi 16.9%	1A4cii 7.0%	1A3bii 5.5%											83.7%
Pb	2C1 70.2%	1A3bi 16.3%													86.5%
Cd	2C1 56.8%	1A2gviii 16.8%	1A4bi 9.3%												82.9%
Hg	1A4ai 52.2%	1A4bi 17.9%	1A4ci 6.9%	1A1a 6.4%											83.4%
PCDD/ PCDF	1A4bi 39.2%	1A4ai 21.6%	5C1biii 15.7%	1A2gviii 6.4%											83.0%
PAHs	1A4bi	1A4ai	6A												88.9%

	Key categories (Sorted from high to low from left to right)														Total (%)
	56.1%	18.5%	14.4%												
HCB	1A2gviii 35.6%	1A4bi 30.1%	1A1a 27.0%												92.7%
PCBs	1A4ai 61.8%	1A4bi 26.4%													88.2%

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 emissions.

1.5 Quality assurance/Quality control

The following 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 as it is being developed. The QC system is designed to:

- Provide routine and consistent 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, 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 and the Kyoto Protocol.

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.

Before report submission it is sent to external organizations (MEPRD, CSB, MoA, MoT) for quality control. Comments received after inventory review are then analysed and implemented in report.

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. Some specific quality control procedures related to check of activity data and emission factors were carried out.

1.6 General uncertainty evaluation

The calculation of uncertainty estimates was made according to Tier 1 method presented in EMEP/EEA 2016. Tier 1 method is based on emission estimates and uncertainty coefficients for activity data and emission factors (Table 1.5).

Uncertainty coefficients have been assigned based on expert judgement or on default uncertainty estimates according to IPCC GPG 2000, 2006 IPCC Guidelines, EMEP/EEA 2009, EMEP/EEA 2013 and EMEP/EEA 2016 Guidebook, because there is not enough information about background data to make actual calculations. 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 2017

	Overall uncertainty, %	Trend uncertainty, %
NOx	10.57%	2.16%
NMVOC	14.25%	4.66%
SO_2	5.85%	0.23%
NH_3	19.20%	3.63%
CO	33.42%	6.63%
$PM_{2.5}$	31.19%	40.52%
PM_{10}	24.55%	43.86%
TSP	25.29%	56.70%
BC	26.77%	13.52%
Pb	10.57%	2.16%
Cd	27.75%	13.02%
Hg	16.90%	7.79%
PCDD/F	31.52%	9.08%
PAHs	43.65%	10.18%
HCB	32.46%	39.70%
PCBs	27.45%	1.23%

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 2017 (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 2016
1A1c Manufacture of solid fuels and other energy industries	NH_3	no methodology available, NE according to EMEP/EEA 2016
1A2a Stationary combustion in manufacturing industries and construction: Iron and steel	NH_3, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2016
1A2b Stationary combustion in manufacturing industries and construction: Non-ferrous metals	NH_3	no methodology available, NE according to EMEP/EEA 2016
1A2gvii Mobile Combustion in manufacturing industries and construction	Hg, As, PCDD/PCDF, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2016
1A3ai(i) International aviation LTO (civil)	NH_3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn	no methodology available, NE according to EMEP/EEA 2016
1A3aii(i) Domestic aviation LTO (civil)	NH_3, 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

NFR14 code	Substance(s)	Reason for not estimated
1A3c Railways	Pb, Hg, As	no methodology available, NE according to EMEP/EEA 2016
1A3di(ii) International inland waterways	NOx, NMVOC, SO_2, NH_3	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 2016
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 2016
1Acii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Hg, As, PCDD/PCDF, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2016
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 2016
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 2016
1B1a Fugitive emission from solid fuels: Coal mining and handling	NMVOC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn	no methodology available, NE according to EMEP/EEA 2016
1B2av Distribution of oil products	So_2, PCDD/PCDF	no methodology available, NE according to EMEP/EEA 2016
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 2016
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 2016
2D3b Road paving with asphalt	NOx, 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 2016
2D3c Asphalt roofing	Pb, Cd, Hg, 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 2016
2G Other product use	BC	no methodology available, NE according to EMEP/EEA 2016
2H2 Food and beverages industry	$PM_{2.5}$, PM_{10}, TSP, BC	no methodology available, NE according to EMEP/EEA 2016
2I Wood processing	NOx, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO, As, Cu	no methodology available, NE according to EMEP/EEA 2016
3Df Use of pesticides	HCB	no methodology available, NE according to EMEP/EEA 2016
5A Biological treatment of waste - Solid waste disposal on land	NH_3, CO, Hg	no methodology available, NE according to EMEP/EEA 2016
5B1 Biological treatment of waste - Composting	NOx, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO	no methodology available, NE according to EMEP/EEA 2016
5B2 Biological treatment of waste – Anaerobic digestion at biogas facilities	NOx, NMVOC, SO_2, NH_3, $PM_{2.5}$, 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 2016
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 2016
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 2016
5C1bv Cremation	BC	no methodology available, NE according to EMEP/EEA 2016
5E Other waste (please specify in IIR)	NOx, NMVOC, SO_2, BC, CO, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene,	no methodology available, NE according to EMEP/EEA 2016

NFR14 code	Substance(s)	Reason for not estimated
	benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB, PCBs	

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 2017 (IE)

NFR14 code	Substance(s)	Included in NFR category
1A3bii Road transport: Light duty vehicles	PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene , PAHs, HCB, PCBs	1A3bi Road transport: Passenger cars
1A3biii Road transport: Heavy duty vehicles and buses	PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene , PAHs, HCB, PCBs	1A3bi Road transport: Passenger cars
1A3biv Road transport: Mopeds & motorcycles	PCDD/F, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene , PAHs, HCB, PCBs	1A3bi Road transport: Passenger cars
1A3ei Pipeline transport	All pollutants	1A4ai Commercial/institutional: Stationary
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 and for various Solvents (2D3e Degreasing, 2D3f Dry cleaning, 2D3g Chemical products, 2D3h Printing).

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, nitrogen oxides, carbon monoxide, non-methane volatile organic compounds, ammonia, 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.

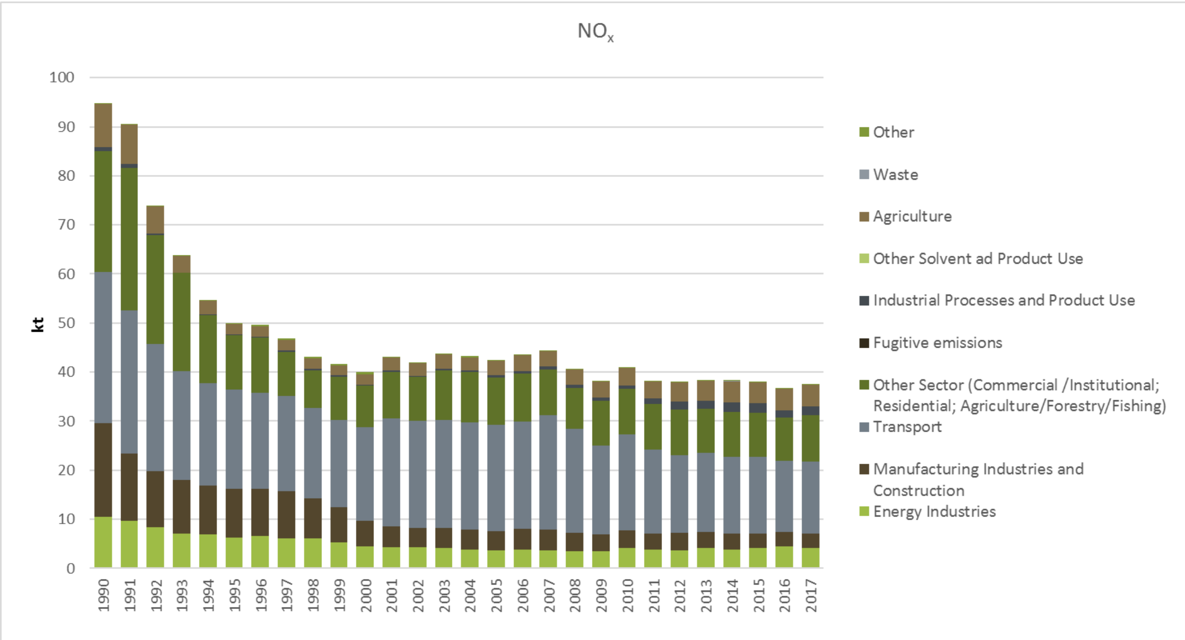

Figure 2.1 Total NO_x emissions (kt)

The total NO_x emissions have decreased by 60.5% from 1990 to 2017 (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 2005-2017 NO_x emissions have decreased by 11.5% mainly due to the emission reduction in Energy (-3.8%) and Transport (-32.8%) sector. Meanwhile emissions in IPPU and Agriculture sector in this period have almost doubled. In 2016-2017 total NO_x emissions have increased by 2.3%, mainly due to increased fuel consumption in Energy sector. Emissions have also increased in IPPU and Agriculture sector by 24.2% and 1.2% accordingly.

In 2017, the main emission source is Transport (38.9%), especially Road transport (NFR 1A3b), which is responsible for 30.2% of total NO_x emissions. NOx emissions from Transport sector have decreased by 35.8% 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, LDV and HDV.

The second largest emission source is from fuel combustion in Other Sector (Commercial /Institutional; Residential; Agriculture/Forestry/Fishing) with 9.49 kt or 25.4% of total emissions. Since 2005 emissions have decreased by 2.6% due to the implementation of energy efficiency improvements in buildings which allowed for reduction in fuel consumption.

Agriculture sector is the third largest emitter in 2017 with 4.43 kt or 11.8% of total emissions. Since 2005 emissions have increased by 57.0%. Amount of NO_x emission is linked to the number of produced animals and crops.

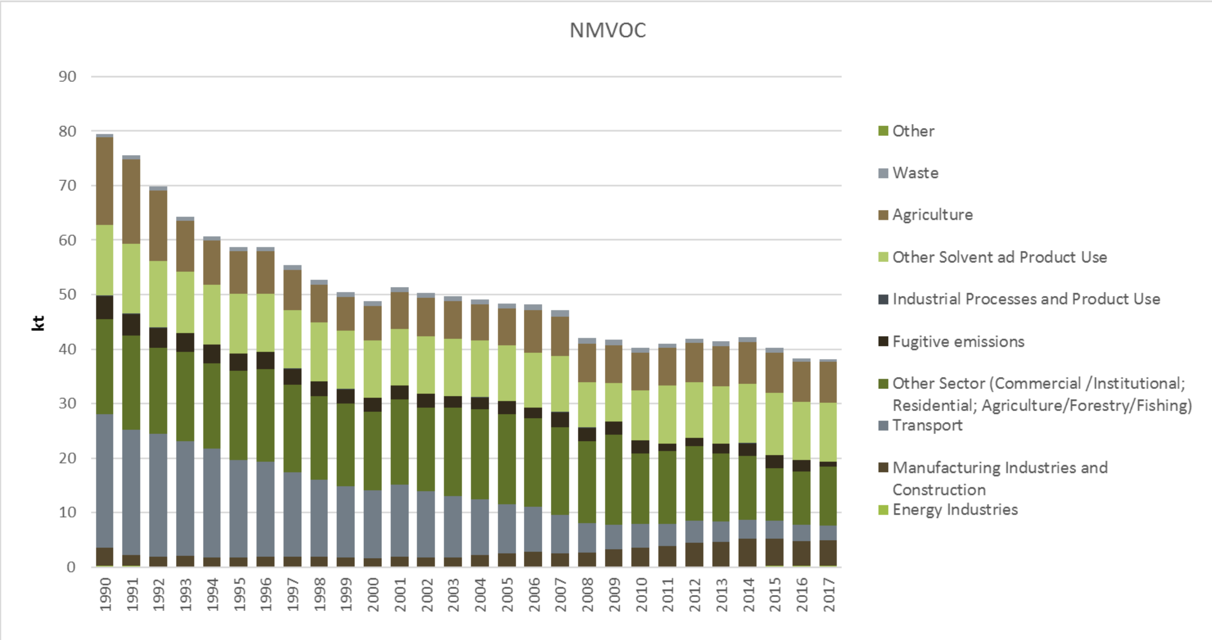

Figure 2.2 Total NMVOC emissions (kt)

The total NMVOC emissions in 2017 were 38.10 kt and since 1990 they have decreased by 52.1% (Figure 2.2). Since 2005 emissions have decreased by 21.3%. The emissions continue to decrease also in 2016-2017 where a 0.4% decline in emissions can be observed. The overall decrease in total NMVOC emissions has happened mainly due to the Transport sector (88.8% since 1990).

In 2017, the largest NMVOC emission producer is Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) which is responsible for 28.5% from total emissions. Since 2005 emissions in Other Sector have decreased by 34.8% which resulted from energy efficiency improvements in buildings.

IPPU in 2017 is the second largest NMVOC emission source with 28.4% from total emissions. Main NVMOC emission source in IPPU is Other Solvent and Product Use (NFR 2D; 28.3% from total emissions) and since 2005 emissions in this sector have increased by 5.2%. Emission fluctuation in Solvent Use sector is related to the to the welfare of the economic state of the country.

Agriculture sector contributes 19.9% from total NMVOC emissions in 2017. The largest part of NMVOC emissions is related to manure management – 85.9%, crop production and agricultural soils accounted for 13.8%. Since 2005 NMVOC emissions from Agriculture have increased by 13.3%. Similar as with NOx 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 (-69.4%). In 2005 Transport sector made up 18.5% from total NMVOC emissions, but in 2017 it is 7.2%. 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 decreasing of gasoline consumption by passenger cars.

Energy Industries (NFR 1A1) and Manufacturing Industries and Construction (NFR 1A2) constitutes 0.6% and 12.2% accordingly in 2017. Since 2005 emissions from fuel combustion in these sectors have increased and main cause is transfer from natural gas to biomass in energy production.

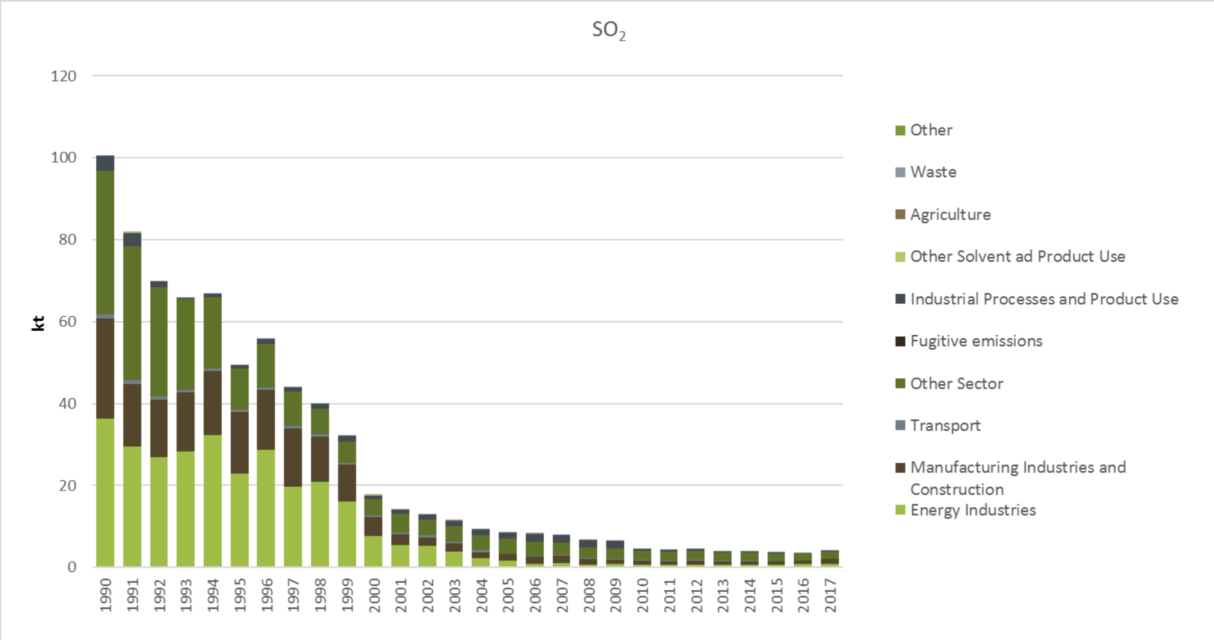

Figure 2.3 Total SO_2 emissions (kt)

Since 1990, total SO_2 emissions have decreased from approximately 100.46 kt to 4.00 kt (-96.5%) (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 2016-2017 the total SO_2 emissions have increased by 15.2% mainly from increased activity in Energy sector (production of non-metallic minerals in particular); however, the absolute values are very low (3.47 kt in 2016 comparing with 4.0 kt in 2017).

In 2017, the largest SO_2 emission producer is Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) which is responsible for 45.6% of total emissions. Since 2005 SO_2 emissions in Other Sector have decreased by 50.5% as fuel consumption in sector have also decreased due to the energy efficiency improvements. Solid fossil fuel consumption in sector has also significantly decreased since 2005.

Energy Industries (NFR 1A1) and Manufacturing Industries and Construction (NFR 1A2) constitutes 22.8% and 28.0% accordingly. SO_2 emissions form fuel combustion in these sectors have also decreased since 2005 by 43.4% and 28.5%. Solid fuels and liquid fuels with high sulphur content was replaced with natural gas and biomass.

SO_2 emission reduction in Transport sector (-63.3% since 2005) is due to the implementation of stronger fuel quality requirements. In 2017 Transport and IPPU sector is responsible for 1.4% and 2.1% of SO_2 emissions accordingly.

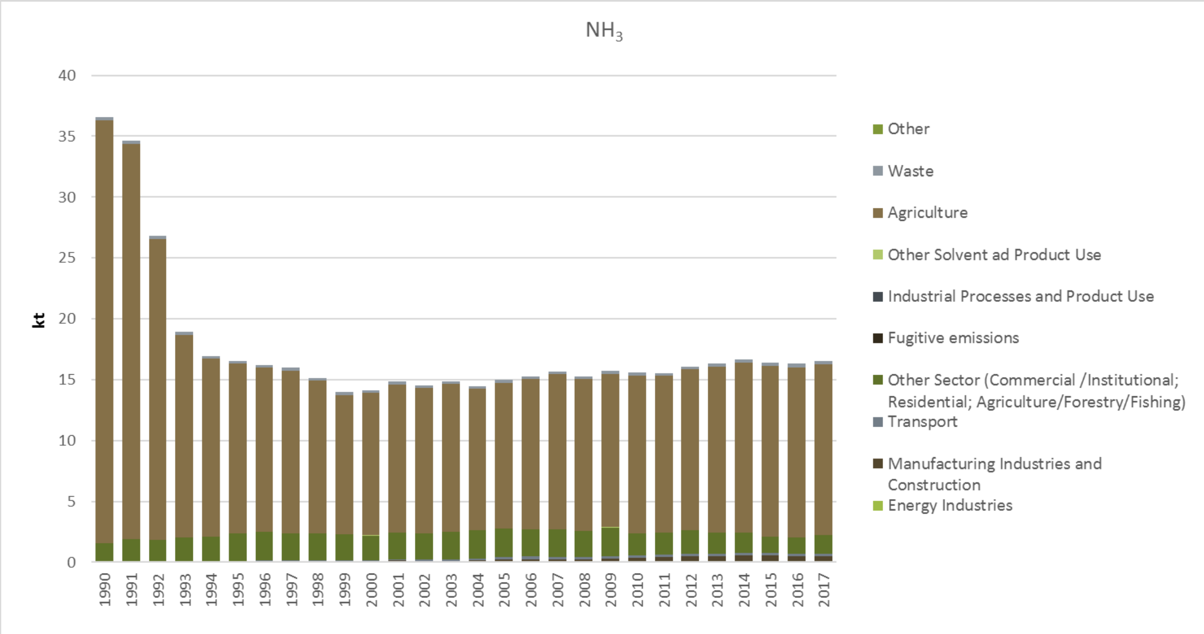

Figure 2.4 Total NH_3 emissions (kt)

The total ammonia emissions have decreased by 54.8% from 1990 to 2017 (Figure 2.4). In 2017, the amount of total NH_3 emissions produced was 16.52 kt, and in 2016-2017 the emissions have slightly increased by 1.3%. The large decrease in the beginning of 90ties can be explained with the collapse of USSR, when as a result many farms were closed and because of that agricultural activities reduced.

In 2017, the largest part – 85.0% of NH_3 emissions are produced from 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 2017, emissions from crop production and agricultural soils constituted 50.9% (7.14 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 17.1%.

Second largest NH_3 emission emitter in 2017 is Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) which is responsible for 9.3%. Since 2005 emissions in Other Sector (NFR 1A4) have decreased by 34.3%, 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 1A5) sector with 3.2%, 1.0% and 1.6%. Insignificant amount of NH_3 is also produced in IPPU (NFR 2) sector.

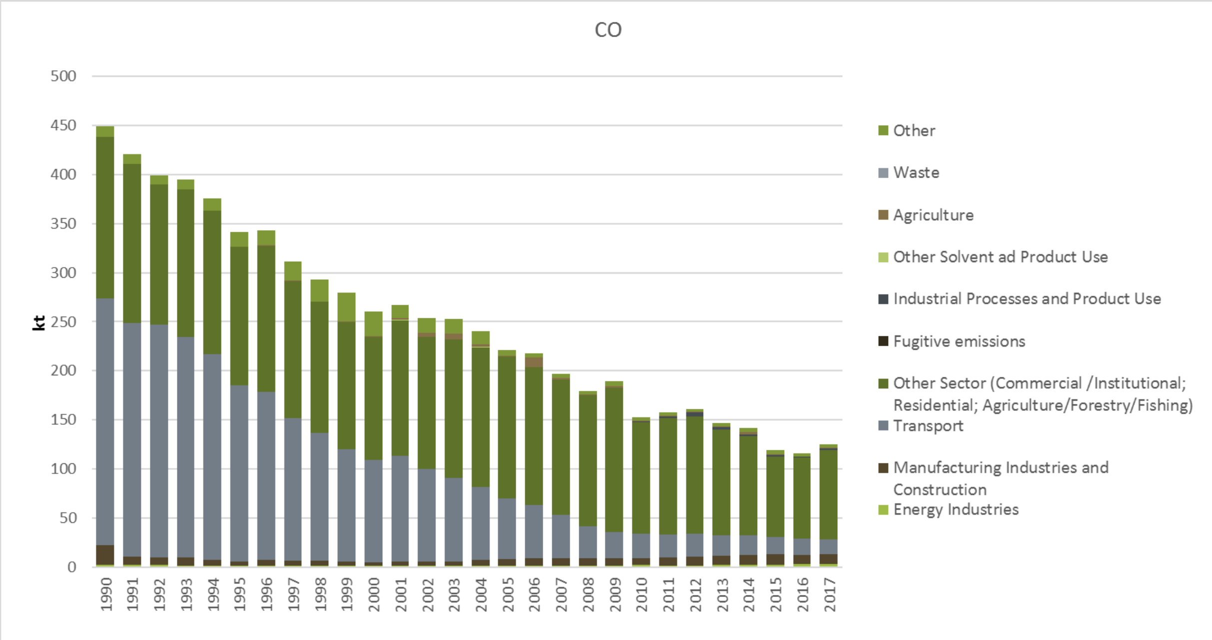

Figure 2.5 Total CO emissions (kt)

Carbon monoxide emission trend shows a decrease in emissions for period 1990- 2017 by 72.2% (Figure 2.5) with slight fluctuations in recent years. In 2016-2017 emissions of CO have increased by 7.5%.

In 2017, CO emissions, total 125.0 kt, originate generally from the Other Sector (Commercial/Institutional; Residential; Agriculture/Forestry/Fishing) with 72.9% of total emissions. Since 2005 CO emissions have decreased by 36.8%.

Second largest contributor is Transport sector (NFR 1A3) with 12.4% in 2017. Since 2005 CO emissions in Transport sector have decreased by 75.1%. The overall decrease in CO emissions can be mainly 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 2.2%, 8.1%, 1.1% and 2.9%. Small amount of CO is also produced in Waste (NFR 5) sector.

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

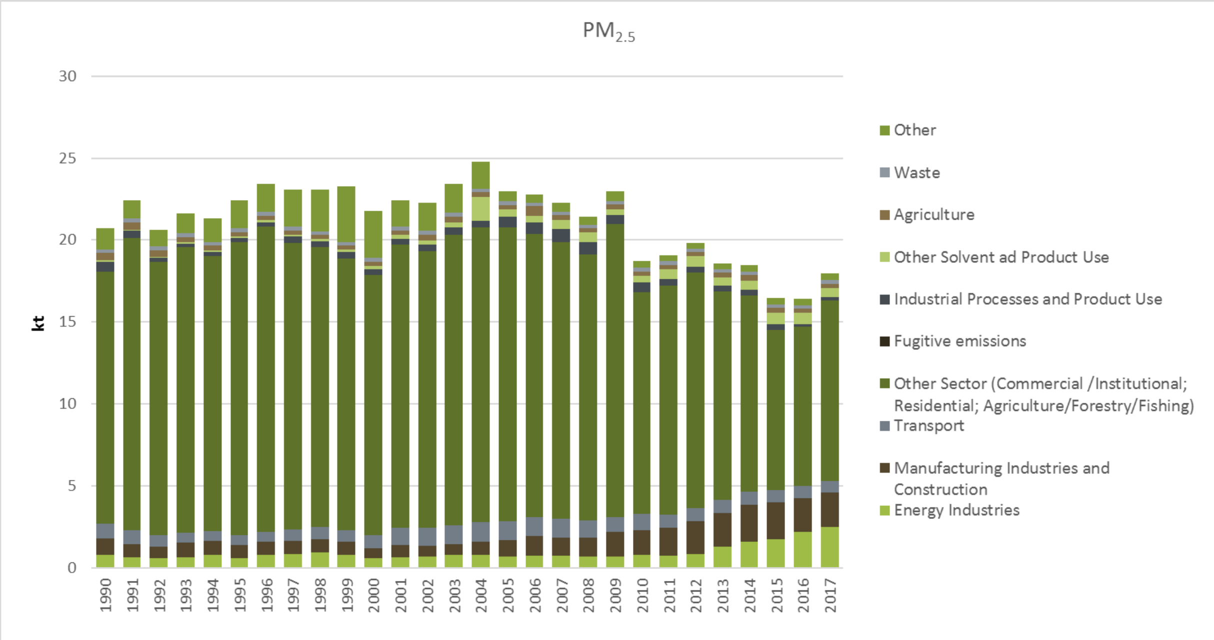

Figure 2.6 Total $PM_{2.5}$ emissions (kt)

Total $PM_{2.5}$ emissions since 1990 have decreased from 20.70 kt to 17.97 kt or -13.2% (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 2005-2017 by 21.7%, mostly due to decrease in fuel consumed in households. In 2016-2017 $PM_{2.5}$ emissions have increased by 9.4%.

In 2017 $PM_{2.5}$ emissions are mainly produced in Other Sector (Commercial /Institutional; Residential; Agriculture/Forestry/Fishing) with 61.3% from total emissions. Since 2005 emissions in Other Sector have decreased by 38.5% due to the implementation of energy efficiency improvements in buildings which allowed for reduction in fuel consumption.

Second and third largest $PM_{2.5}$ emitters in 2017 are Energy Industries (NFR 1A1) and Manufacturing Industries and Construction (NFR 1A2) with 13.9% and 11.5% 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) sectors contributes 4.0% of total $PM_{2.5}$ emissions in 2017, IPPU (NFR 2) – 4.1%, Agriculture (NFR 3) – 1.5%, Waste (NFR 4) – 1.3% and Other (NFR 6) – 2.3%.

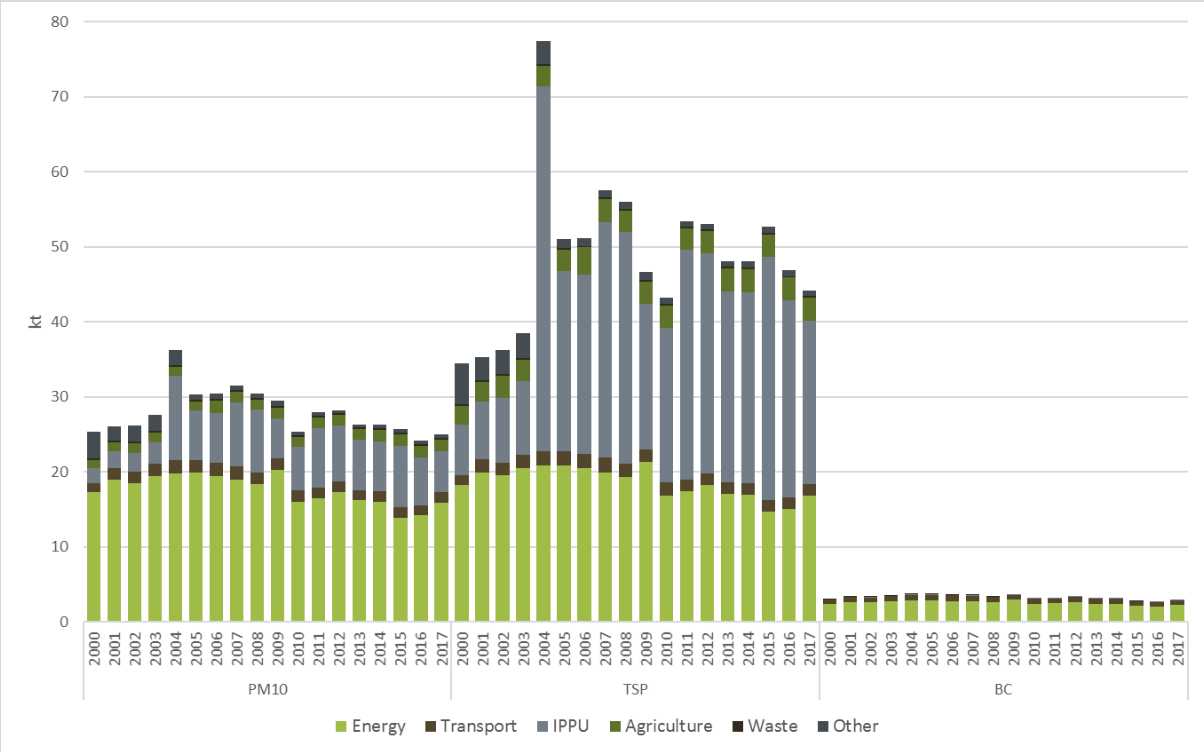

Figure 2.7 Total PM emissions (kt)

PM_{10} emissions in 2017 have decreased by 1.5% and TSP emissions have increase by 28.1% since 2000 (Figure 2.7), due to increased activity in IPPU (NFR 2) sector. The largest part of PM_{10} emissions are produced in Energy sector (including Transport) – 68.9%, but 49.1% of TSP emissions where produced in IPPU from total emissions in 2017 and 41.7% in Energy sector (including Transport). PM emissions from Energy sector are connected with intensive combustion of wood, especially in Residential sector (NFR 1A4b). 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. In 2016-2017 PM_{10} emissions have increased by 3.4% and TSP emissions decreased by 5.7%.

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

Emissions of heavy metals are shown in the Figure 2.8-Figure 2.10. In IIR, only priority HMs are described, but emissions for additional heavy metals can be found in NFR tables.

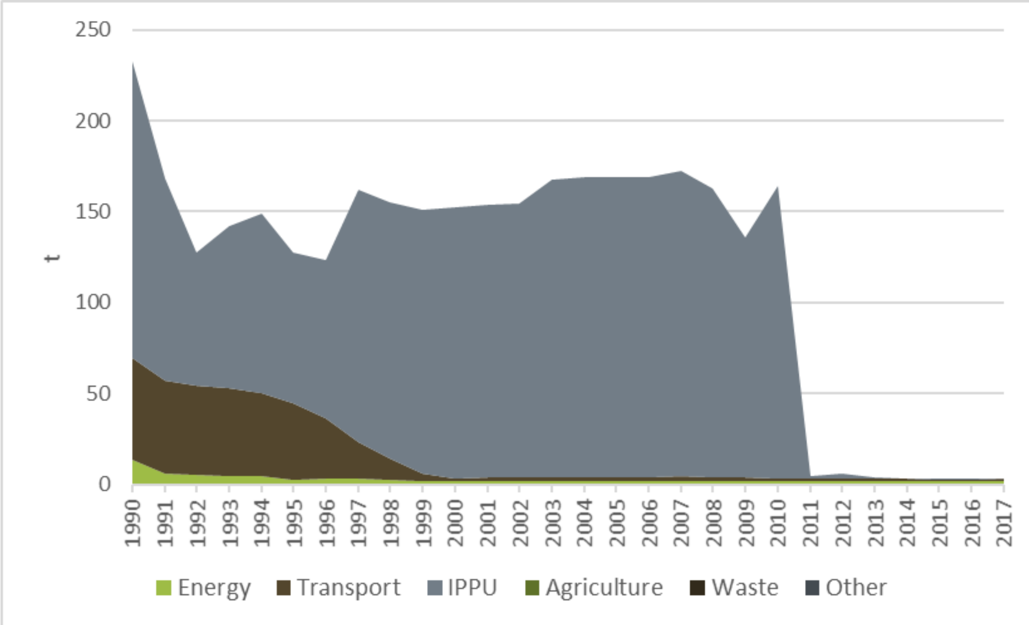

Figure 2.8 Total Pb emissions (t)

The most relevant changes can be seen in lead emissions (Figure 2.8). In comparison with 1990, Pb emissions have decreased by 98.5% in 2017. The amount of Pb emitted in 2017 is 3.45 tonnes, and it has increased by 3.0% comparing with previous year's emissions. Largest Pb emitter in 2017 is Energy sector including Transport (85.4%). 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 97.4% happened in 2011 due to change of furnace type in metal production (NFR 2C1), other fluctuation in lead trend from IPPU sector can be explained with amount of metal produced.

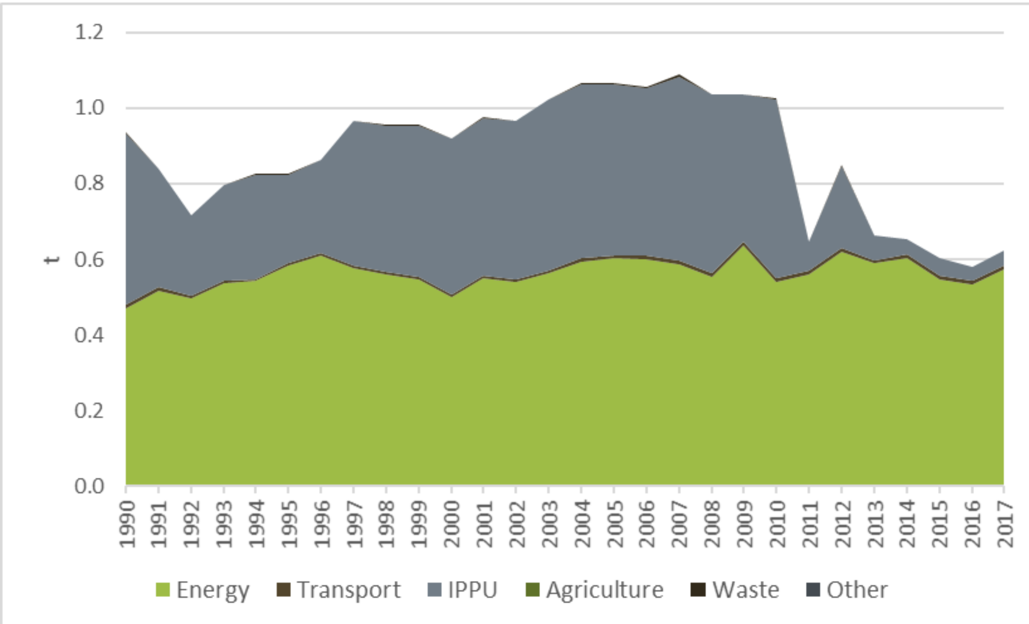

Figure 2.9 Total Cd emissions (t)

In 1990-2017, Cd emissions have decreased by 33.3%, and in 2017 total amounts of Cd emitted are 0.62 tonnes (Figure 2.9), which is by 7.5% more than in 2016. Energy sector (including Transport) contributes to 93.7% of total Cd emissions in 2017. Significant decrease of emissions can be seen in IPPU (91.8%) 1990-2017 due to the bankruptcy of the local metal production company.

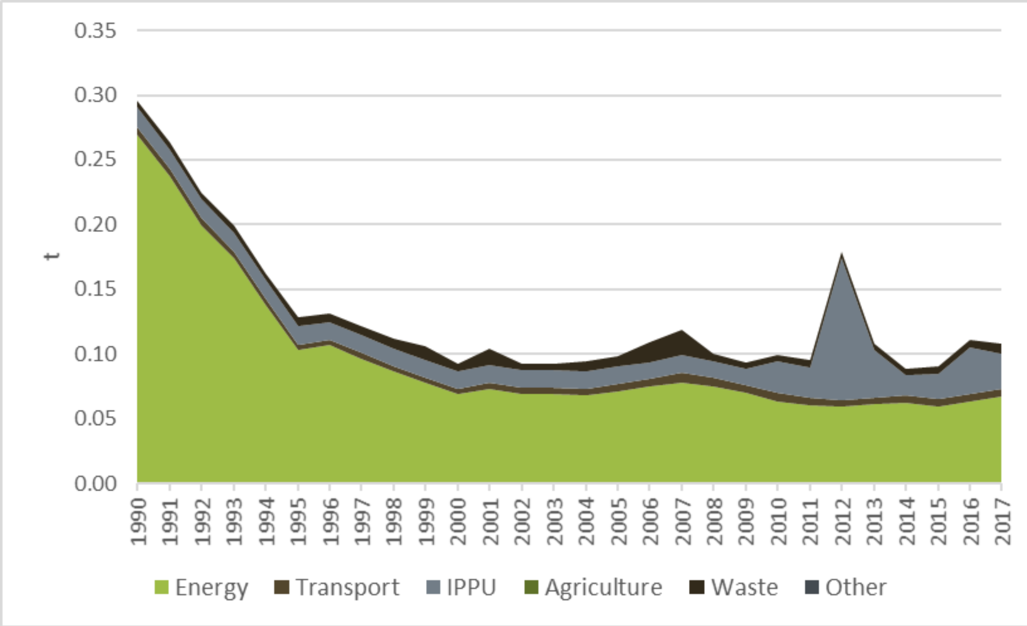

Figure 2.10 Total Hg emissions (t)

Mercury emission trend shows a decrease by 63.5% in emissions for period 1990-2017 (Figure 2.10). Hg emissions, 0.11 t in total (2017), originates generally from the Energy sector (62.2%). The decrease in Hg emissions can be mainly explained with decreasing amounts 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 local Cement production (NFR 2A1).

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

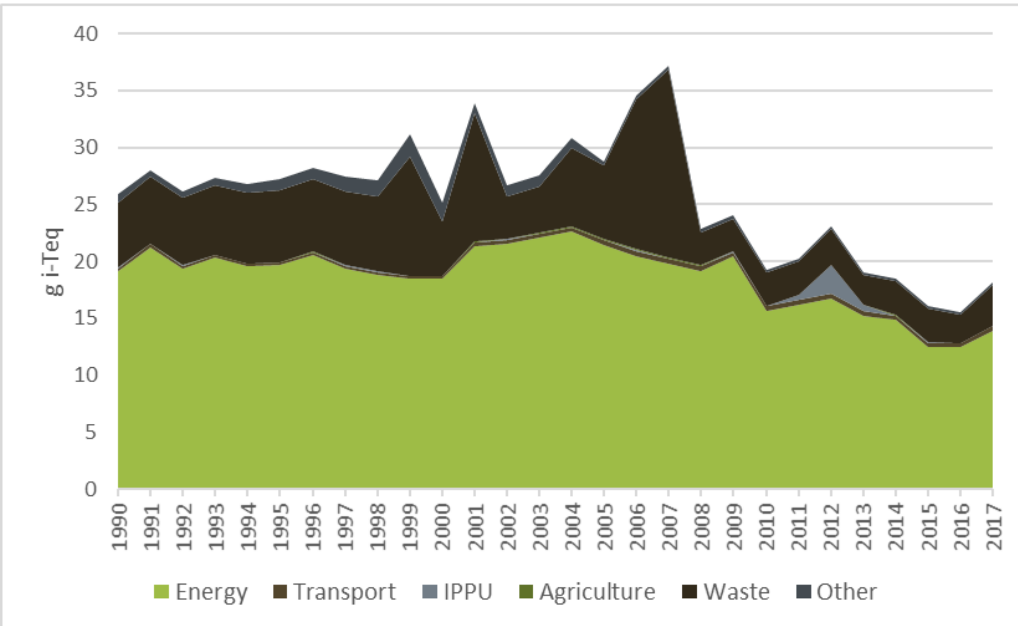

Figure 2.11 Total PCDD/F emissions (g i-Teq)

PCDD/F emissions have decreased by 29.8% in 1990-2017 and have a fluctuating trend (Figure 2.11). It is connected with waste incineration processes, as well as biomass combustion. In 2017, approximately 78.8% emissions from all PCDD/F emissions are generated in the Energy sector (including Transport), but the remaining part of emissions are generated by the 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 Energy sector the emissions have increased due to larger amounts of biomass combusted, for example, in 2016-2017 the emissions have increased by 16.6%. In Latvia wood is a local fuel, therefore it is widely used.

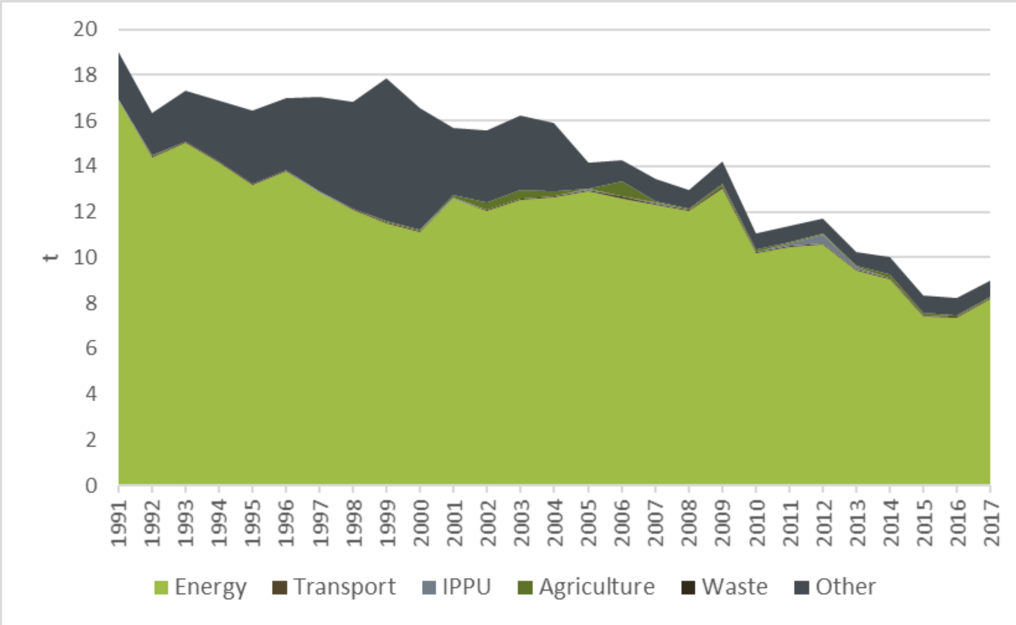

Figure 2.12 Total PAH emissions (t)

PAH emissions in 1990-2017 have decreased by 49.3%, reaching 9.01 tonnes in 2017 (Figure 2.12) which is by 9.8% more comparing with year 2016. 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 2017 91.2% from PAHs were generated in Energy (including Transport) sector and mainly in solid biomass combustion processes.

It has to be noted that since 1999 total PAH emissions slightly differ from summarized benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene emissions (can be seen in NFR reporting tables, columns X to AA). It is because of unavailability of segregated emission factors for each pollutant and emission factor only for total PAH emissions can be found.

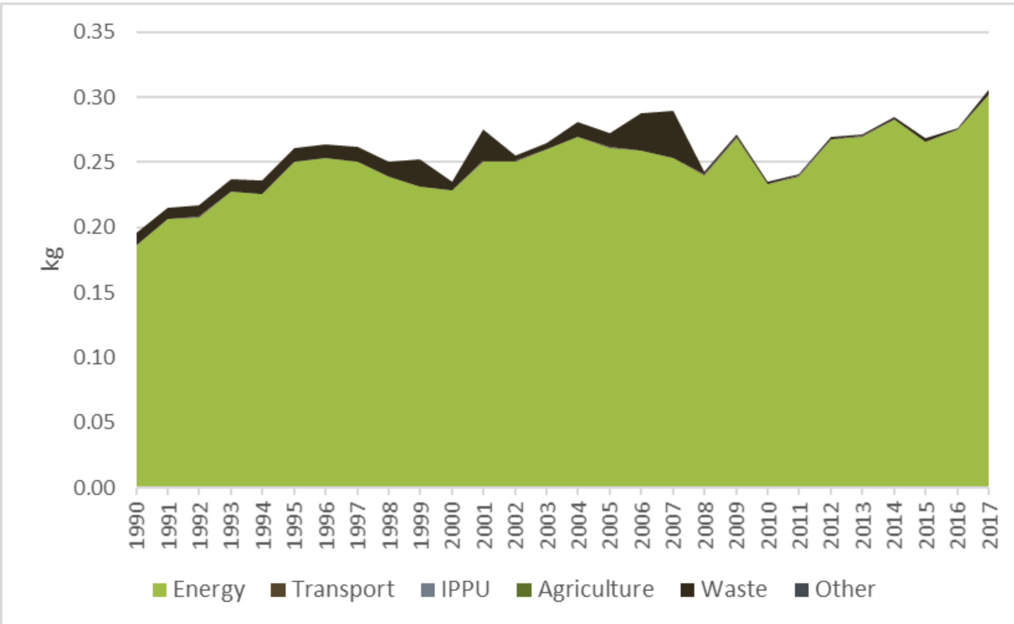

Figure 2.13 Total HCB emissions (kg)

HCB emissions have increased by 56.2% from 1990-2017, reaching 0.31 kg in 2017 (Figure 2.13) and continue to rise in 2016-2017 where an increase of 10.4% can be seen. Emissions have risen because of increased use of wood and wood waste in stationary fuel combustion sector. HCB emissions from stationary fuel combustion are estimated only from solid fuels – coal and coke, and solid biomass combustion activities. 98.9% from HCB emissions in 2017 are generated in Energy (including Transport) and mainly in solid biomass combustion processes.

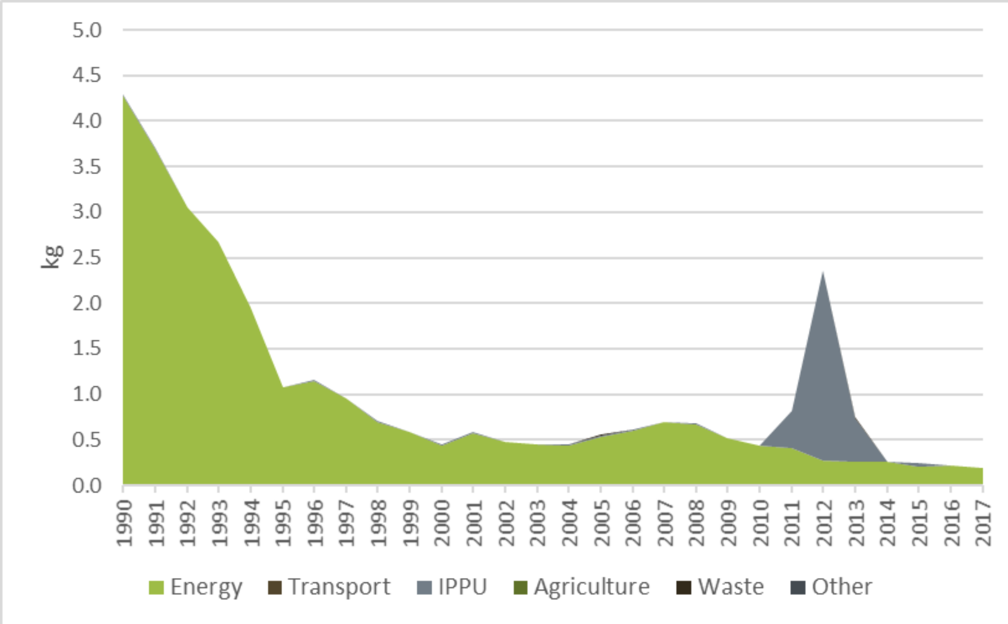

Figure 2.14 Total PCB emissions (kg)

PCB emission trend shows a decrease by 95.6% in emissions for period 1990-2017 (Figure 2.14). In 2016-2017 the emissions continue to fall reaching 0.19 kg (-13.6%). In 2017, PCB emissions originate generally from the Energy sector (including Transport), contributing 99.2% from all emissions. The decrease in emissions can be mainly explained with less amounts of fossil fuels used in combustion. Spike of emissions in 2012 from IPPU can be explained with significant activity increase in the particular year in Iron and steel production (NFR 2C1).

3 Energy sector (NFR 1)

3.1 Sector overview

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 heat generation. Smaller boiler houses burn local fuel (wood) and coal as well.

Table 3.1 Consumption of energy resources in Latvia (TJ) [3]

Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
Energy consumption	**318551**	**176155**	**143521**	**178702**	**185740**	**173193**	**175846**	**176162**	**175156**	**175871**	**180650**	**182083**
Liquid fuels, total	161188	81669	53515	68088	72127	64491	64454	64721	65592	68728	72178	73372
RFO	76326	41290	9462	10231	8661	6535	6942	6852	6821	5467	6258	5154
Gasoline	26753	18131	14836	15137	12667	11926	10146	9286	9023	8922	8751	8362
Jet Kerosene	3068	1171	1142	2525	4946	4943	5033	5209	4646	4530	5204	5934
Other Kerosene	647	432	43	NO	NO	NO	NO	NO	NO	NO	6	4
Shale Oil	NO	78	2440	157	39	79	39	NO	NO	NO	7	1
Diesel Oil	48023	18273	20907	36791	42013	38536	38959	39434	40770	45638	47586	49574
LPG	3691	1548	2095	2552	2103	2414	3279	3840	4235	4103	4174	4226
Petroleum Coke	NO	NO	NO	429	627	NO	NO	NO	NO	NO	124	44
Other Oil Products	2680	746	2590	266	1070	58	56	100	97	67	69	72
Solid fuels, total	26249	7225	2785	3199	4378	4509	3645	2905	2473	1950	1678	1689
Anthracite	NO	NO	NO	NO	NO	NO	82	27	NO	NO	27	7
Oil Shale	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	237	53	26	54	NO	NO	NO	NO	NO	NO	NO	3
Coal	25984	7172	2759	3145	4378	4509	3563	2878	2473	1950	1651	1679
Peat products, total	3217	3836	2392	80	46	43	34	64	35	11	34	40
Peat briquettes	867	401	31	NO	6	3	4	4	5	1	NO	11
Peat	2350	3435	2361	80	40	40	30	60	30	10	34	29
Natural gas	99517	41304	44962	56685	61044	53528	50301	49994	44798	45758	46751	41193
Biomass, total	27501	42120	39774	49678	47647	49871	56535	57362	60979	58177	59093	64621
Wood	27501	42102	39695	49120	45376	46594	52169	52676	55531	52231	53905	59118
Straws	NO	NO	NO	NO	60	43	38	58	99	135	161	223
Charcoal	NO	NO	NO	60	60	60	59	90	90	60	65	66
Biofuel	NO	NO	NO	107	1158	1067	938	895	998	1047	500	453
Landfill Gas CH4	NO	NO	NO	251	331	349	347	371	369	420	409	422
Sludge Gas CH4	NO	18	41	90	114	100	105	97	91	99	107	106
Other Biogas CH4	NO	NO	NO	NO	37	465	1629	2140	2535	3053	3137	3266
Municipal wastes (biomass fraction)	NO	NO	37	49	510	1193	1250	1035	1266	1130	808	968
Other fuels, total	879	NO	94	972	499	752	877	1115	1279	1248	917	1169
Municipal Waste (non-biomass fraction)	NO	NO	NO	NO	320	332	577	707	915	946	743	962
Industrial Waste	NO	NO	94	125	84	331	242	379	335	273	148	180
Waste Oil	879	NO	NO	847	95	88	58	29	29	29	25	27

Liquid fossil fuels have an important place in the Latvian energy resource market. Its market share was about 40.3% in 2017. The essential decrease of heavy oil 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 biggest part of the liquid fuel consumption contributes diesel oil with approximately 67.6% from total liquid fuel consumption in 2017; diesel oil is mostly used in Transport sector. The total consumption of liquid fuels in 2017 has decreased by 54.5% since 1990. Reason

[3] Excluding electricity.

for such drastic decrease can be explained with changes in technology, with exception of Transport sector and Other (NFR 1A5), that, technology that uses liquid fuel, is replaced with one that uses natural gas and biomass.

Total share of _solid fuels_ in national market is low – approximately 0.9% in 2017. The solid fuel consumption in recent years is stable. The total consumption of solid fuels in 2017 has decreased by 93.6% since 1990. A decrease (19.3%) in solid fuel consumption can be seen in 2008-2009 due to the global economic crisis. Decrease of solid fuel consumption can be explained with technology change, when solid fuel combustion 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 amounts of peat products used for stationary burning have decreased and has 0.01% of total share in 2017. 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 combined heat and power plants, 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 22.6% in 2017. Natural gas consumption has decreased by 58.6% in 1990-2017. In recent years (2010-2014) natural gas consumption had a decreasing trend and 11.9% decrease can be seen in 2016-2017. Decrease in natural gas use could be explained with switching from natural gas combustion to biomass as well as advances in 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 - 32.5% of total energy consumption in 2017, while in 1990 all biomass fuels in total made up only 8.6% from total energy consumption. In 2010-2017 use of wood and wood products have increased by 30.3%. Such fuels as straws are used more often and have an increasing trend in the past few years (38.5% in 2016-2017).

Industrial and _municipal waste_[4] was also consumed in the recent years, and the most significant consumption increase can be observed in 2010 – comparing with 2009 the consumption of waste increased five times, and it reached 0.5% share from the total energy consumption in 2010. In the following years the increase of other fuels consumed was not as rapid as in previous 2009-2010, and the increase in the use of particular fuels in 2013-2014 was 15%. In 2017 increase was 23.9% in comparison with 2016. Waste oils are reported as other fuels and this fuel type has a decreasing trend.

Hydroelectric power plants (HPP) and combined heat and power plants (CHP) produce part of the electrical power, while part is imported (Table 3.2, Table 3.3). Volume of electricity generation directly depends on the through-flow of the river Daugava. Also, the import and export of electricity from Estonia, Lithuania and Russia 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
2001	33937	7038	641	26258	26899
2002	33048	6541	630	25877	26507
2003	33516	6409	626	26481	27107
2004	31093	6174	608	24311	24919
2005	31144	5886	684	24574	25258
2006	30056	5454	634	23968	24602
2007	28685	4911	554	23220	23774
2008	26402	4010	356	22036	22392

[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
2009	26308	4099	298	21911	22209
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	5453	2506	22030	24536

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
1991	20318	6681	15217	7	10807	785	17255	28847
1992	13803	5646	14688	7	8316	745	13777	22838
1993	14126	6101	9619	612	5440	688	10904	17032
1994	15984	6681	9533	2988	5076	670	10102	15848
1995	14324	6371	9529	1408	5130	677	10267	16074
1996	11254	7989	12377	760	4975	641	9266	14882
1997	16218	7692	6566	4	5519	634	8935	15088
1998	20869	6559	3290	1382	5296	612	10310	16218
1999	14796	5775	9349	2311	5130	554	10375	16059
2000	14890	5203	7589	1159	5159	547	10411	16117
2001	15408	5688	8424	1645	5562	623	10314	16499
2002	14310	5188	10217	1764	5494	518	11563	17575
2003	14310	5065	9616	137	5778	490	12456	18724
2004	16881	4976	9839	2290	5882	500	13072	19454
2005	17658	4766	10278	2545	6120	533	13972	20625
2006	17607	4522	10116	1087	6332	540	15242	22114
2007	17176	4194	17870	7070	6538	504	16740	23782
2008	18987	4198	16715	7643	6066	497	17298	23861
2009	20048	4032	15333	9378	5421	436	16114	21971
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	18508	3146	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

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 and consist of:

- 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;
- residual fuel oil (RFO);
- other liquids;
- petroleum coke.

Solid fuels consist of coal and coke imported from Commonwealth of Independent States (countries of former Union of Soviet Socialist Republics);

Peat products consists of peat and peat briquettes and mainly are domestic;

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

Biomass fuels:

- solid biomass – wood and other wood products, charcoal, straw and is mainly domestic,
- methane obtained from 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 Overview of sector

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, reported emissions are reported in Table 3.5

Table 3.4 Source categories and methods for Fuel combustion

NFR code	Description	Method	AD	EF
1A1a	Public electricity and heat production	Tier 1	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	NS	D
1A3a	Domestic and international Civil aviation	Tier 1, 2	NS[8]	D[9]
1A3b	Road transport	Tier 2	NS	D

[5] National statistics
[6] Default EF from EMEP/EEA 2016
[7] Plant specific (AD – data obtained from plant)
[8] National Statistics
[9] Default emission factor from guidelines

NFR code	Description	Method	AD	EF
1A3c	Railways	Tier 1	NS	D
1A3d	National navigation and international maritime navigation	Tier 1	NS	D
1A4a	Commercial/Institutional	Tier 1	NS	D
1A4b	Residential	Tier 1, Tier 2	NS	D
1A4c	Agriculture/Forestry/Fishing	Tier 1	NS	D

Table 3.5 Reported emissions in Stationary fuel combustion sectors in 2017

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
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
1A3aii(i)	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO
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
1A3biii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn
1A3biv	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn
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, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs
1A3ei	IE
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 2017, 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, households and 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.

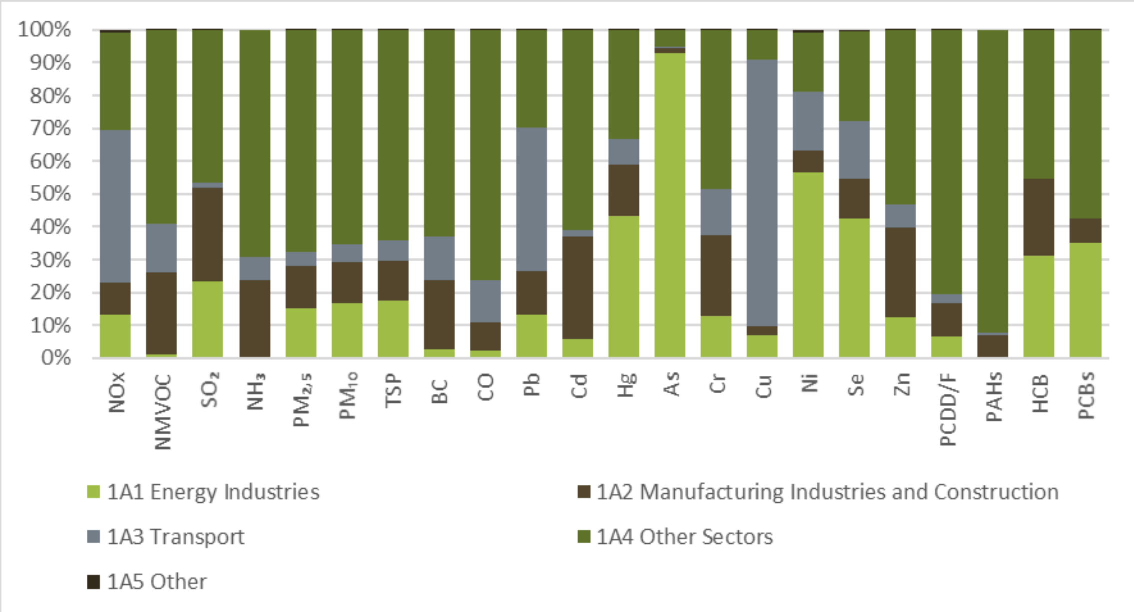

Figure 3.1 Distribution of emissions from Fuel combustion in 2017 (%)

Main pollutants

NO_x emissions generated in fuel combustion made up 83.3% from total emissions generated in Latvia in 2017. The largest part were produced in 1A3 Transport (46.7%) sector. **SO_2** emissions from fuel combustion were 97.8% from total SO_2 emissions in 2017, and 1A4 Other Sector was the most significant with 46.4%. **NMVOC** emissions from Energy sector contributed to 48.4% of the total Latvia's NMVOC emissions in 2017. 1A4 Other Sector contributed to the largest part with 58.8%. 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 2017 9.3% of total NH_3 emissions or 69.2% from fuel combustion. In EMEP/EEA 2016, there are no emission factors for NH_3 emission estimation in 1A1 sector, therefore notation key NE in the particular sector was used.

In 2017, fuel combustion sectors accounted for 95.7% of the total **CO** emissions in Latvia. 1A4 Other Sector was the largest emission source accounting for 76.0% of fuel combustion emissions.

Particulate matter

Fuel combustion generated 90.8% of **$PM_{2.5}$** emissions, 68.9% of **PM_{10}** emissions, 41.7% of **TSP** emissions and 99.1% of total **black carbon** emissions in Latvia in 2017. The largest part of PM emissions is generated in 1A4 Other Sectors (around 60-68%). Mainly particulate matter emissions are produced in biomass combustion process.

Heavy metals

Lead emissions from fuel combustion were 85.4% from total Pb emissions in 2017, and 1A3 Transport was the one with the highest contribution 43.7%. **Cadmium** emissions from fuel combustion account for 93.7% from total emissions, and 1A4 Other Sector is the biggest producer of cadmium emissions with 61.1% from total Cd emissions in the energy sector. In 2017 fuel combustion accounted for 67.4% of the total **mercury** emissions in Latvia. 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 (43.4%).

POPs

Fuel combustion is the main producer of POPs emissions in Latvia – **PCDD/F** (78.8%), **PAHs** (91.2%), **HCB** (98.9%) and **PCB** (99.2%). 1A4 Other Sector is the largest sector of HCB emissions with 45.3% of total fuel combustion emissions. Solid biomass combustion is the main source of PAHs emissions in 2017, and 1A4 Other Sector is the largest contributor to PAH emissions with 92.3% from fuel combustion respectively. In fuel combustion, 1A4 Other Sectors is 80.7% 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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990 -2017, %
NOx	kt	84.95	47.44	37.25	38.94	36.66	33.44	32.29	32.49	31.92	31.64	30.75	31.19	-63.3
NMVOC		45.48	36.01	28.58	28.12	20.87	21.24	22.26	20.91	20.37	18.20	17.55	18.45	-59.4
SOx		96.89	48.45	16.63	7.00	4.14	3.88	3.95	3.69	3.67	3.34	3.36	3.91	-96.0
NH_3		1.57	2.38	2.20	2.75	2.34	2.44	2.61	2.42	2.40	2.12	2.04	2.21	40.8
$PM_{2.5}$		18.06	19.84	17.86	20.75	16.80	17.21	18.00	16.85	16.62	14.50	14.69	16.32	-9.6
PM_{10}		19.08	20.64	18.53	21.53	17.52	17.89	18.70	17.59	17.41	15.26	15.52	17.24	-9.6
TSP		20.57	21.95	19.60	22.76	18.59	18.95	19.78	18.66	18.49	16.27	16.57	18.41	-10.5
BC		3.27	3.26	2.97	3.60	3.10	3.12	3.30	3.09	3.05	2.74	2.66	2.88	-11.9
CO		438.20	326.19	234.57	214.61	147.38	151.98	153.89	140.10	133.10	112.51	111.61	119.57	-72.7
Pb	t	69.79	44.49	3.40	3.83	3.41	3.28	3.07	2.95	3.00	2.87	2.88	2.95	-95.8
Cd		0.48	0.59	0.51	0.61	0.55	0.57	0.63	0.60	0.61	0.56	0.54	0.58	22.0
Hg		0.27	0.11	0.07	0.08	0.07	0.07	0.06	0.07	0.07	0.06	0.07	0.07	-73.6
PCDD/F	g I-Teq	19.36	19.91	18.68	21.86	16.06	16.59	17.16	15.60	15.23	12.84	12.84	14.30	-26.2
PAHs	t	15.41	13.23	11.17	12.98	10.25	10.53	10.60	9.48	9.11	7.48	7.43	8.22	-46.7
HCB	kg	0.19	0.25	0.23	0.26	0.23	0.24	0.27	0.27	0.28	0.27	0.28	0.30	61.8
PCBs		4.27	1.07	0.43	0.54	0.44	0.40	0.27	0.26	0.26	0.21	0.22	0.19	-95.7

The majority of total emissions from stationary fuel combustion have decreased in 1990-2017, with exception of NH_3, Cd and HCB emissions (Table 3.6). An increase in particular emissions is directly related with the increased use of biomass in 1990-2017.

SO_2 emissions have the biggest decrease (96.0%) in 1990-2017 (Table 3.6). The emission decrease can be explained with fuel switch from heavy liquid fuels and solid fuels to natural gas and biomass use to cut the increased costs of these fuels and to meet the commitments of EU ETS.

There is also a large decrease (63.3%) in NO_x emissions, that can be explained with change in fuel types – solid fuels widely used previously were changed to biomass that have lower NO_x emission factor, therefore the emissions decreased.

NH_3 emissions have increased by 40.8% in 1990-2017, 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 10% in 2000-2017. 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 60-95% in 1990-2017, except Cd, which has increased by 22.0%. Decrease of emissions can be explained with a decrease of total fuel consumption in early nineties due to economic crisis in the country. In recent years heavy metal emissions decreased due to fuel switch from heavy liquid and solid fuels to natural gas and biomass consumption, except for Cd, which has relatively high emission factor for biomass.

From 1990 to 2017 PAH emissions have decreased by 46.7%, HCB emissions increased by 61.7% and PCDD/F emissions decreased by 26.2%, which can be explained with sharp increase of solid biomass consumption and decrease of fossil fuel consumption. The decrease of PCB emissions by 95.7% can be explained with decrease of solid fuel consumption – solid 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 production. Fuel consumption in autoproducer combustion installations is excluded from this sector and included in particular sectors of NFR 1A2, 1A4a and 1A4c sectors according to 2006 IPCC Guidelines.

Emissions from combustion installations with NACE 2 codes 35.11 and 35.30 are reported in NFR 1A1a Public electricity and heat production sector. There are no petroleum refineries in Latvia, therefore notation key NO is reported in NFR 1A1b Petroleum refining. NFR 1A1 Energy Industries 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) – these emissions are reported under NFR 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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	10.543	6.249	4.404	3.698	4.097	3.806	3.618	4.075	3.818	4.057	4.418	4.136	-60.8
NMVOC		0.217	0.123	0.116	0.124	0.142	0.132	0.132	0.163	0.168	0.180	0.207	0.212	-2.7
SOx		36.393	22.828	7.635	1.612	0.685	0.632	0.633	0.651	0.605	0.635	0.798	0.912	-97.5
$PM_{2.5}$		0.752	0.564	0.563	0.653	0.762	0.705	0.839	1.298	1.569	1.715	2.164	2.498	232.0
PM_{10}		0.993	0.728	0.683	0.764	0.886	0.820	0.977	1.511	1.825	1.994	2.518	2.908	192.8
TSP		1.375	0.970	0.810	0.861	0.987	0.913	1.086	1.676	2.024	2.211	2.792	3.225	134.5
BC		0.041	0.027	0.021	0.022	0.025	0.023	0.028	0.043	0.052	0.056	0.071	0.082	102.9
CO	t	2.612	1.387	1.558	1.735	2.016	1.872	1.850	2.254	2.286	2.455	2.793	2.809	7.6
Pb		0.238	0.177	0.138	0.103	0.118	0.109	0.131	0.201	0.241	0.263	0.333	0.385	62.1
Cd		0.056	0.034	0.020	0.011	0.011	0.010	0.012	0.018	0.021	0.023	0.029	0.033	-41.0
Hg		0.037	0.023	0.020	0.011	0.013	0.012	0.014	0.019	0.021	0.023	0.028	0.032	-13.6
PCDD/F	g I-Teq	0.176	0.163	0.216	0.243	0.293	0.272	0.324	0.498	0.597	0.651	0.820	0.945	437.6
PAHs	t	0.002	0.002	0.004	0.005	0.007	0.006	0.007	0.012	0.014	0.016	0.020	0.023	1358.2
HCB	kg	0.032	0.038	0.034	0.023	0.030	0.028	0.034	0.051	0.059	0.064	0.081	0.094	196.6
PCB		0.002	0.004	0.011	0.015	0.019	0.017	0.021	0.033	0.041	0.044	0.056	0.065	4120.7

Part of emissions from NFR 1A1 Energy Industries sector have decreased in 1990-2017, but emissions have increased of PMs, CO, 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 method was used to calculate emissions from the stationary fuel combustion. Calculation of all emissions from fuel combustion is done in Excel database.

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 2016 (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 III: Summary Information on Condensable in PM.

SO_2 emission factors were calculated by formula taken from EMEP/EEA 2016 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 2016 (Annex I, Table 1). Emission factors for sludge gas and landfill gas were equalized to natural gas emission factors due to unavailability of particular emission factors for sludge gas. 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. In previous submissions the Annual Questionnaires sent to EUROSTAT were used, but after an internal third party review in 2014 an expert's conclusion was to use CSB Energy Balance, if possible, to ensure more precise data. As in the EUROSTAT tables fuel consumption mainly is in natural units (kt, millions m^3) NCV provided by CSB were used to calculate fuel consumption into terajoules (TJ). However, there were differences between Annual Questionnaires' and CSB Energy Balance data due to rounding and conversion of units therefore it was decided to use CSB Energy Balance data with accuracy up to 1 TJ (instead of Annual Questionnaire accuracy 1 kt). In CSB Energy Balance values in terajoules are calculated from rough data, which is used in emission calculations instead of natural units that are rounded up for reporting purposes. 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 kind of economic activity) that are included in the lists of suppliers of statistical information.

Approximately 6000 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 well as enterprises with largest statistical units with turnover of 50% of total industry turnover , 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 abovementioned selection were surveyed by random sampling and the acquired results were extrapolated afterwards. 2–EK represents the basic tool for creating energy balances at a country level. The amount of methane from combusted landfill gas is described in Chapter 6.2 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 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 1990-2017 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 and in the beginning of 2000 the use of them noticeably decreased. The amounts of biomass consumed are constantly increasing, while the consumption of solid fuels and peat have decreased.

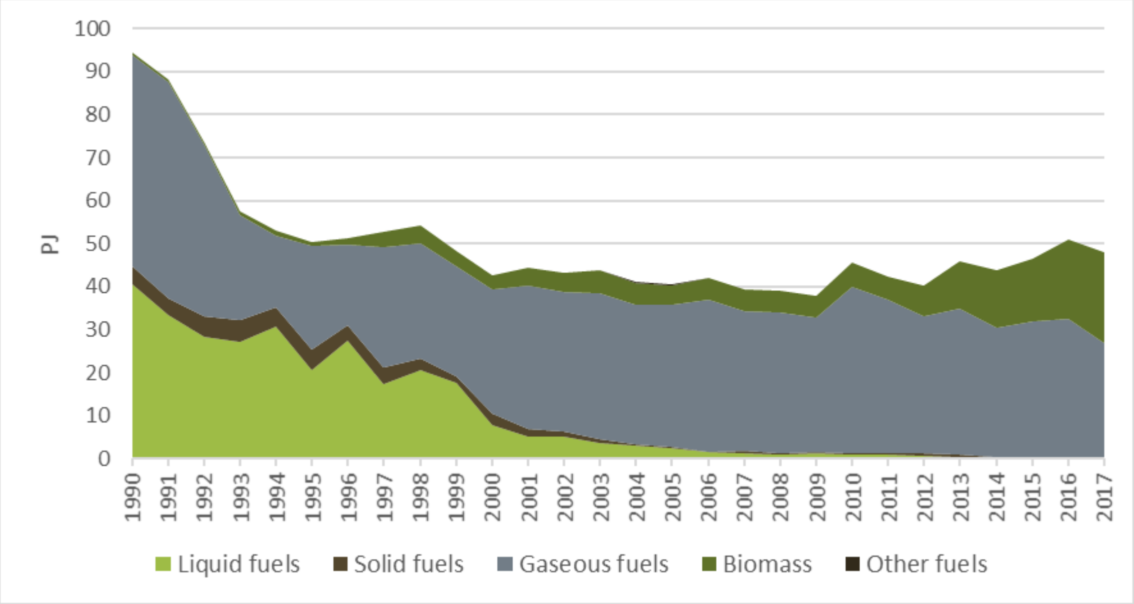

Figure 3.2 Fuel consumption in NFR 1A1 Energy Industries in 1990-2017 (PJ)

The largest decrease in 1990-2017 for the two sub-sectors of 1A1 Energy Industries sector was for liquid fuel (by 99.3%) due to changes in technology used for fuel combustion. It can be explained with fuel switching processes 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. However, in 2007-2013 the consumption of solid fuels increased that is explained with the increase of coal consumption in NFR 1A1a Public electricity and heat production subsector. The increase of solid fuel consumption was promoted by increase of oil price in world when coal combustion became cheaper than combustion of residual fuel oil, diesel oil and natural gas. In 2016-2017 decrease in fuel consumption can be seen for liquid fuels (4.7%), solid fuels (19.7%) and gaseous fuels (17.3%). Consumption of biomass fuel has significantly increased in 1990-2017. Solid biomass is a local fuel and has lower costs therefore liquid and solid fuels were replaced with biomass and natural gas. And due to biomass CO_2 neutrality, enterprises switched from fossil fuels to biomass. As biomass keeps replacing fossil fuels, consumption of biomass in 2017 have increased by 14.4% in comparison with 2016.

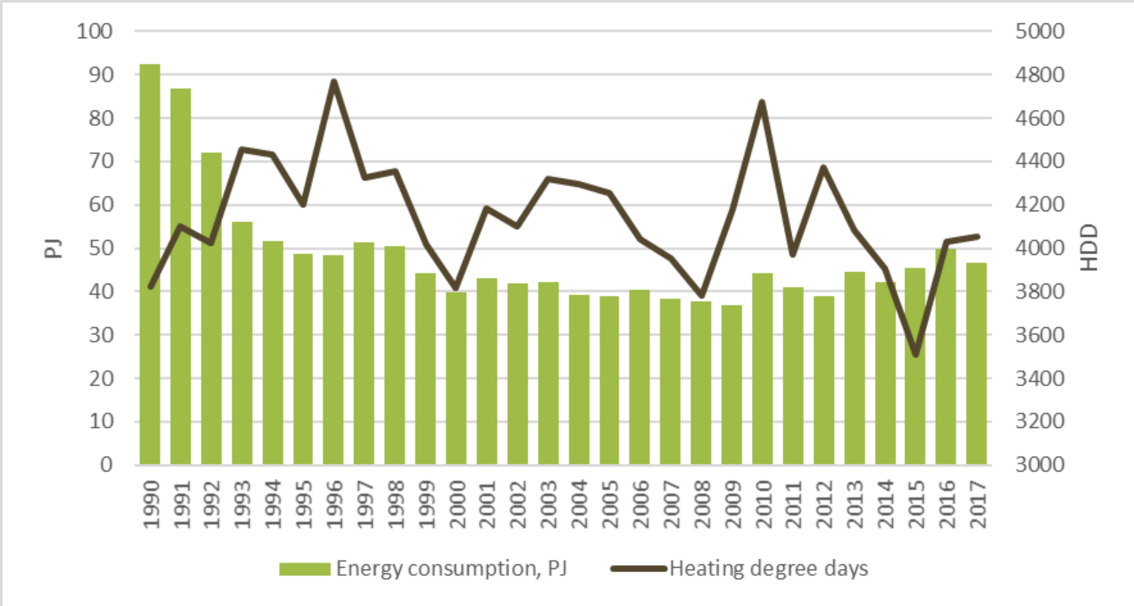

Figure 3.3 Fuel consumption in NFR 1A1a Public electricity and heat production and heating degree days in Latvia

As it can be seen in Figure 3.3 the fuel consumption in 1A1a sector can be related with the HDD with an exception 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. Years 2006-2008 had quite high average temperature 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), which could be explained with better heat insulation installed in houses and therefore less heat needed to be produced. In 2017 fuel consumption decreased but amount of HDD increased.

3.2.4.6 Uncertainties

Uncertainty of activity data for fuel combustion in 1A1 sector is ±2% in 2017. 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 and peat combustion was assigned as 5% because biomass activity data was collected by CSB with questionnaires sent by enterprises consumed biomass. Also, according to the 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19, biomass data is generally more uncertain than other data in national energy statistics, because a large fraction of the biomass may be part of the informal economy, and the trade in these types of fuels is frequently not registered in the national energy statistics and balances. That was a reason for higher uncertainty for biomass than for other fuel types. 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 methane percentage amount in combusted sludge gas is given approximately, therefore final uncertainty of combusted sludge gas is assumed as 5%. The same applies to landfill gas.

Emission factor uncertainty is assumed as 50%, as these are default emission factors taken from EMEP/EEA 2016.

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 emissions consistency to display all significant and illogical changes in the activity data and emissions. The emissions for substances reported also under UNFCCC as indirect GHGs are cross-checked for verification purposes.

Calculated NOx emissions are compared with data from national database "2-Air". Due to the lack of good quality data creation of a consistent time series is not possible, therefore data from database is used for verification purposes only.

3.2.4.8 Recalculations

No recalculations.

3.2.4.9 Planned improvements

No improvements planned.

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 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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	18.99	9.99	5.25	3.84	3.55	3.19	3.57	3.38	3.25	3.08	2.99	3.01	-84.1
NMVOC		3.38	1.58	1.42	2.40	3.43	3.79	4.34	4.47	4.98	5.01	4.59	4.64	37.1
SOx		24.33	15.08	4.70	1.56	0.99	0.81	0.94	0.83	0.90	0.84	0.79	1.12	-95.4
NH_3		0.02	0.09	0.10	0.21	0.36	0.41	0.48	0.50	0.57	0.58	0.53	0.52	2083.9
$PM_{2.5}$		1.05	0.79	0.61	1.00	1.51	1.71	1.97	2.03	2.27	2.27	2.09	2.07	97.3
PM_{10}		1.07	0.81	0.62	1.03	1.55	1.74	2.01	2.07	2.32	2.32	2.13	2.12	98.5
BC		1.08	0.83	0.64	1.07	1.62	1.82	2.10	2.17	2.43	2.43	2.23	2.22	104.9
TSP		0.48	0.31	0.22	0.29	0.45	0.50	0.57	0.60	0.66	0.66	0.61	0.61	27.1
CO		20.20	4.39	3.56	6.41	7.37	8.14	9.27	9.38	10.35	10.35	9.45	10.14	-49.8

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
Pb	t	3.26	0.31	0.12	0.30	0.31	0.36	0.41	0.40	0.46	0.44	0.40	0.40	-87.9
Cd		0.012	0.033	0.036	0.075	0.128	0.147	0.169	0.177	0.201	0.203	0.185	0.184	1376.6
Hg		0.029	0.014	0.010	0.019	0.014	0.013	0.015	0.013	0.014	0.013	0.012	0.011	-61.4
PCDD/F	g I-Teq	0.42	0.40	1.59	2.43	1.05	1.20	1.38	1.40	1.60	1.58	1.45	1.43	238.5
PAHs	t	0.90	0.55	0.39	0.56	0.49	0.50	0.58	0.56	0.62	0.60	0.55	0.54	-39.8
HCB	kg	0.004	0.012	0.021	0.038	0.049	0.056	0.065	0.068	0.077	0.078	0.071	0.071	1648.0
PCB		0.26	0.11	0.04	0.17	0.06	0.06	0.07	0.04	0.05	0.02	0.02	0.01	-94.8

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 increased in 1990-2017, which can be explained with increased use of biomass and other fossil fuels comparing to 1990. 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. In 2012 a decrease of fossil fuels, but increase in biomass usage can be seen, therefore NMVOC, NH_3, PM, Cd and POPs emissions have increased, because biomass has larger emission factors for particular pollutants, while other pollutant emissions have decreased due to use of less fossil fuels. In 2017 use of fossil fuel have increased, but use of biomass slightly decreased in comparison with 2016.

3.2.5.3 Methods

Tier 1 method was used to calculate emissions from the fuel combustion. Calculation of all emissions from fuel combustion was done in Excel database.

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 1990-2017. But in 2009 cement production plant “SIA CEMEX” 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. Emission measurements are done 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.

3.2.5.4 Emission factors

The main source of emission factors is EMEP/EEA 2016 (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 III: 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 2016 (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

Mainly emissions from fuel combustion are calculated 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).

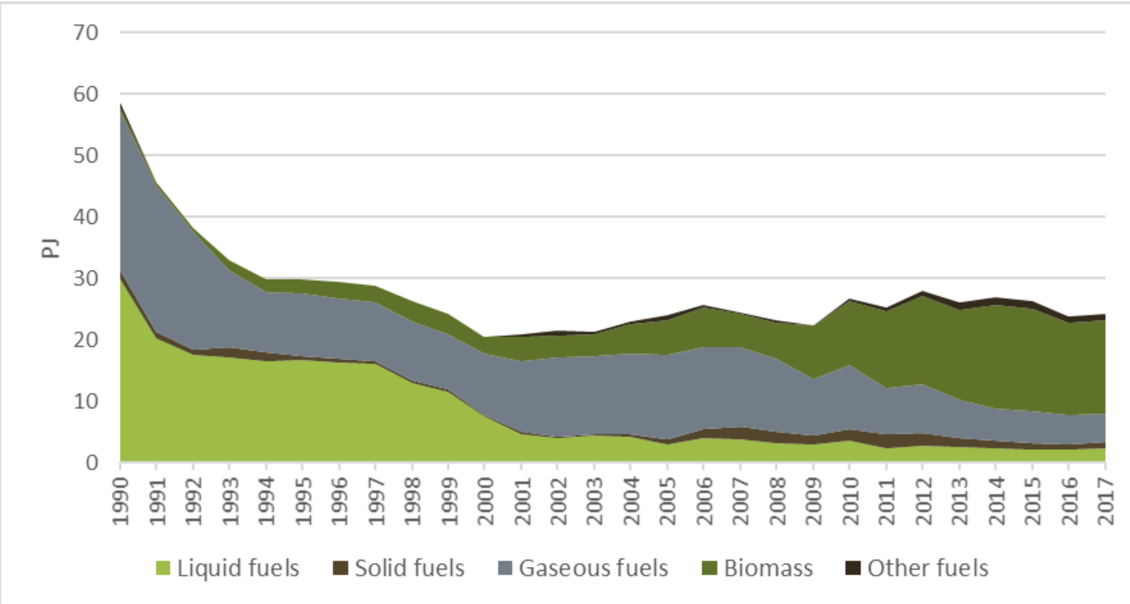

Figure 3.4 Fuel consumption in NFR 1A2 Manufacturing Industries and Construction in 1990-2017 (PJ)

Most of the fuel types with an exception of biomass and other fossil fuels have decreased in 1990-2017 (Figure 3.4). Liquid fuels have the biggest decrease 92.3%. 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 reflects the total decrease of industrial production if compared with 1990.

The consumption of solid fuels (mainly coal) decreased in 1990-2004 with an exception of 1992-1993, mainly due to increased use of coal in Construction and Textiles and Leather sectors. Solid fuels consumption was growing approximately 7 times from 2004 until 2008 because of the growth in national economy, and decreased by 31.7% in 2009 due to global crisis. However, from 2010, the consumption of solid fuels grew until year 2012. The increase of solid fuel consumption was caused by the increase of oil price in the world when coal combustion was cheaper than combustion of residual fuel oil and diesel oil. The increase in Latvia is also explained with the development of mineral production sector – cement production – where coal is consumed. In 2012-2016 a drop in solid fuel consumption can be seen – in Non-metallic minerals sector as well as in Iron and steel subsector. In 2017 coal consumption increased by 33.6% mainly due to the increased fuel consumption in NFR 1A2f Non-metallic mineral sector.

After the crisis in the beginning of 1990s natural gas consumption started decreasing steadily with some small exceptions due to fuel replacement processes and development of national economy or due to the changes in demand. In 1990-2017 natural gas consumption have decreased by 81.9% and by 1.4% in 2016-2017.

Consumption of biomass have increased significantly, it is approximately 24 times bigger than it was in 1990 with some fluctuations in 2000-2008. Lower costs of solid and liquid biomass, free and large availability of the fuel in-country as well as development of EU ETS were the main reasons for liquid and solid fuels' replacement with biomass and natural gas.

Consumption of used tires and municipal waste in Mineral production (information about wastes burnt in cement production company taken from „CEMEX", the only company which combusts used tires and municipal waste for energy purposes) reported as other fossil fuels have increased approximately 50 times since 1999. The increase was influenced by intensified cement production that was 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 amounts of this fuel are fluctuating over the years with a decreasing trend in recent years. Increase can be seen in 2016-2017 by 24.1%, it can be explained with increase of cement demand.

3.2.5.6 Uncertainties

Uncertainty for activity data of fuel combustion in 1A2 sector is ±2% in 2017. 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 and peat combustion was assigned as 5% because biomass activity data was collected by CSB with questionnaires sent by enterprises consumed biomass. Also, according to the 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19, biomass data is generally more uncertain than other data in national energy statistics, because a large fraction of the biomass may be part of the informal economy, and the trade in these type of fuels is frequently not registered in the national energy statistics and balances.

Uncertainty of other fuels 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 2016.

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 for substances reported also under UNFCCC as indirect GHGs are cross-checked with for verification purposes.

3.2.5.8 Recalculations

In Submission 2019, following recalculations were done:

- Diesel oil reallocation from complete stationary combustion to split between stationary combustion and combustion in off-roads after review and consultation with CSB - 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), 1990-2016.

3.2.5.9 Planned improvements

No improvements planned.

3.2.6 Transport (NFR 1A3)

3.2.6.1 Sector overview

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 emissions in 2017. 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 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 compromises 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 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[10]	D[11]
1A3b	Road transport	Tier 2	NS	D
1A3c	Railways	Tier 1	NS	D
1A3d	National navigation and international maritime navigation	Tier 1	NS	D

Table 3.10 Reported emissions in Transport sector in 2017

NFR code	Emissions
1A3ai(i)	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO
1A3aii(i)	NO_x, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, CO
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
1A3biii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn
1A3biv	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn
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, benzo(a)pyrene, benzo(b)fluoranthene, total PAHs

[10] National Statistics
[11] Default emission factor from guidelines

3.2.6.1.2 Key sources

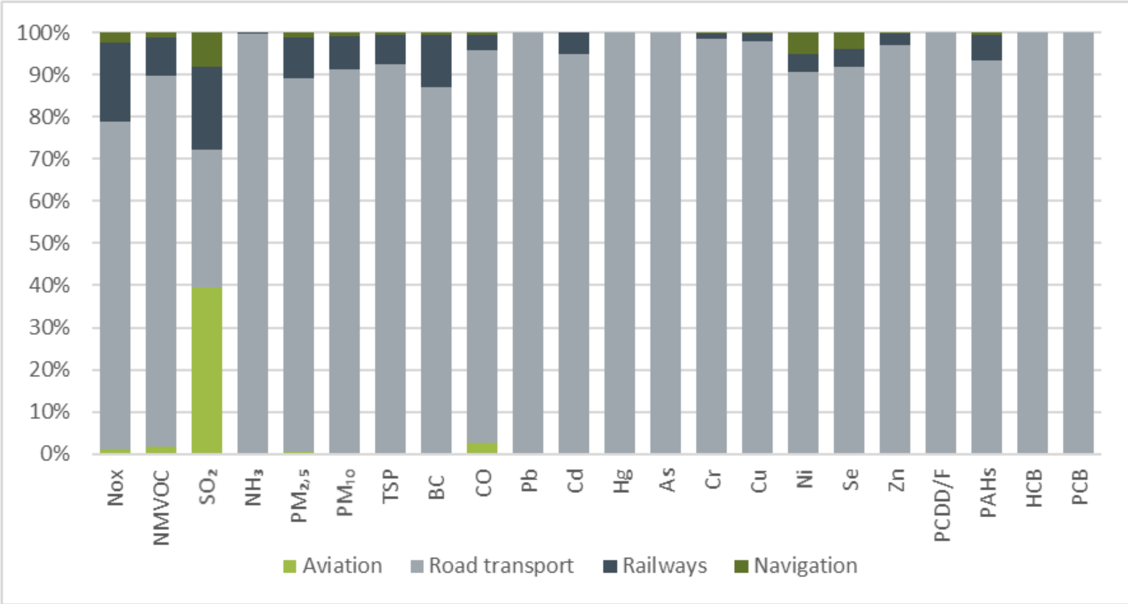

Figure 3.5 Distribution of emissions in Transport sector by subsectors in 2017 (%)

Road transport takes up the biggest part of Transport sector emissions followed by Railways (Figure 3.5). Domestic aviation and national navigation contribute just a small part of transport emissions. Exception is SO_2 emissions where railway (19.7%), aviation (39.4%) and navigation (8.0%), in addition to road transport (32.8%), are significant sources of emissions in transport sector.

3.2.6.1.3 Trends in emissions

Table 3.11 Fuel consumption in Transport sector in 2016 and 2017 (TJ)

	Liquid fuel		Change in 2017/2016, %	Biofuel		Change in 2017/2016, %
	2016	2017		2016	2017	
Aviation	559.26	613.65	9.7	NO	NO	NO
Road transport	39946.00	42040.00	5.2	365.00	359.00	-1.6
Railways	2335.00	2193.00	-6.1	67.00	29.00	-56.7
Navigation	181.00	192.00	6.1	NO	NO	NO

In 2017, total fuel consumption in the Transport sector (excluded off-road), compared to 2016, has increased by 4.5% (Table 3.11). In different subsectors various changes have taken place in 2017. The main impact to changes was in total fuel consumption related to road transport where the fuel consumption has increased by around 5.2%. Fuel consumption in railway has decreased by around 8.7% in 2017 compared to 2016.

In total, Road transport consumes around 93.3, railway – around 4.9%, civil aviation – around 1.4% (including domestic and international LTO), national navigation – the remaining share of fuel.

Diesel oil is the main fuel type in the transport sector and it constitutes around 74.7 %. It is followed by gasoline – 17.7%, LPG constitutes to 5.4% and biofuels (biodiesel and bioethanol) to 0.9% of the total fuel consumption in the transport sector.

Table 3.12 Trends in emissions from Transport sector in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	30.89	20.15	19.11	21.65	19.67	17.18	15.91	16.06	15.71	15.57	14.58	14.55	-52.9
NMVOC		24.44	17.90	12.54	8.93	4.29	3.95	3.97	3.74	3.55	3.27	2.97	2.74	-88.8
SOx		1.05	0.59	0.36	0.15	0.18	0.20	0.20	0.19	0.18	0.05	0.05	0.06	-94.6
NH_3		0.01	0.03	0.07	0.21	0.20	0.20	0.19	0.20	0.20	0.20	0.17	0.16	988.9

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
$PM_{2.5}$		0.88	0.61	0.81	1.17	0.99	0.83	0.81	0.79	0.78	0.77	0.72	0.72	-17.7
PM_{10}		1.04	0.73	0.94	1.36	1.20	1.01	0.98	0.97	0.96	0.97	0.92	0.93	-10.3
TSP		1.22	0.85	1.08	1.56	1.43	1.21	1.17	1.15	1.16	1.18	1.14	1.16	-4.9
BC		0.40	0.27	0.39	0.60	0.52	0.44	0.44	0.42	0.42	0.41	0.38	0.38	-6.1
CO		250.67	179.34	103.94	62.11	24.92	23.17	22.93	20.94	19.72	18.17	16.72	15.46	-93.8
Pb	t	56.20	41.76	1.86	1.99	1.77	1.61	1.40	1.31	1.31	1.33	1.30	1.29	-97.7
Cd		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	32.9
Hg		0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	-2.9
As		0.0002	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	-27.8
Cr		0.13	0.10	0.11	0.16	0.18	0.15	0.15	0.15	0.16	0.17	0.17	0.18	38.4
Cu		3.26	2.35	2.61	3.79	4.33	3.78	3.60	3.72	3.95	4.25	4.27	4.50	37.9
Ni		0.06	0.04	0.05	0.07	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.09	40.0
Se		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	41.1
Zn		1.39	1.01	1.11	1.63	1.86	1.65	1.58	1.63	1.73	1.86	1.88	1.97	42.3
PCDD/F	*g I-Teq*	0.26	0.20	0.25	0.39	0.44	0.37	0.37	0.37	0.39	0.40	0.38	0.39	46.6
PAHs	t	0.05	0.03	0.04	0.06	0.07	0.06	0.05	0.06	0.06	0.07	0.07	0.07	45.9
HCB	kg	0.0002	0.0001	0.0002	0.0003	0.0004	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004	0.0004	124.9
PCBs		0.0001	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	17.8

Generally, most of emissions have decreased in 1990-2017 (Table 3.12) with an exception of NH_3, Cr, Cu and PAHs and some other metal emissions. Emissions from heavy metal species have increased due to increase in fuel consumption as well as change in road transport fuel mix. During last ten years the share of diesel fuel in the total consumption in road transport has increased per 12.5% points and in 2017 constituted 74.5%. 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 and PM 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 national and international aviation LTO cycles. This category does not include military aviation, which is reported under 1A5b sector. In Latvia, civil aviation constitutes a small part of total emissions therefore it is not considered as a key source. 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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NO_x	kt	0.12	0.04	0.04	0.07	0.14	0.15	0.14	0.14	0.13	0.14	0.14	0.15	29.6
NMVOC		0.07	0.03	0.03	0.02	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.05	-36.7
SO_x		0.01	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	74.2
$PM_{2.5}$		0.0016	0.0006	0.0006	0.0012	0.0024	0.0025	0.0024	0.0024	0.0023	0.0024	0.0024	0.0026	63.1
PM_{10}		0.0016	0.0006	0.0006	0.0012	0.0024	0.0025	0.0024	0.0024	0.0023	0.0024	0.0024	0.0026	63.1
TSP		0.0016	0.0006	0.0006	0.0012	0.0024	0.0025	0.0024	0.0024	0.0023	0.0024	0.0024	0.0026	63.1
BC		0.0008	0.0003	0.0003	0.0006	0.0011	0.0012	0.0012	0.0011	0.0011	0.0011	0.0011	0.0013	63.1
CO		0.24	0.09	0.09	0.19	0.38	0.41	0.38	0.38	0.37	0.38	0.38	0.41	71.1

Different trend tendencies during the time span 1990-2017 have to be noted for emissions in civil aviation (Table 3.13). Until 2005 most emissions have decreased due to decreasing of 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 about 2 times in the last 10 years. In 2017, the number of arriving and departing international flights have increased by around 10%, compared to 2016 level.

3.2.6.2.3 Methods

EMEP/EEA 2016 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 2004-2017. 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 2016 methodology and are presented in Table 3.14. Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex III: Summary Information on Condensable in PM.

Table 3.14 Emission factors used in the calculation of emissions from Civil aviation (kt/PJ)

	NO_x	CO	NMVOC	SO_2	PM
Aviation petrol	0.25	0.1	0.05	0.005	0.21

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 2016.

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 as of year 2004 (Figure 3.6). For the time period 1990-2003 the data is used from the study (IPE, 2004[12]). For 2004 onwards, air flight statistics are provided by Riga International Airport.

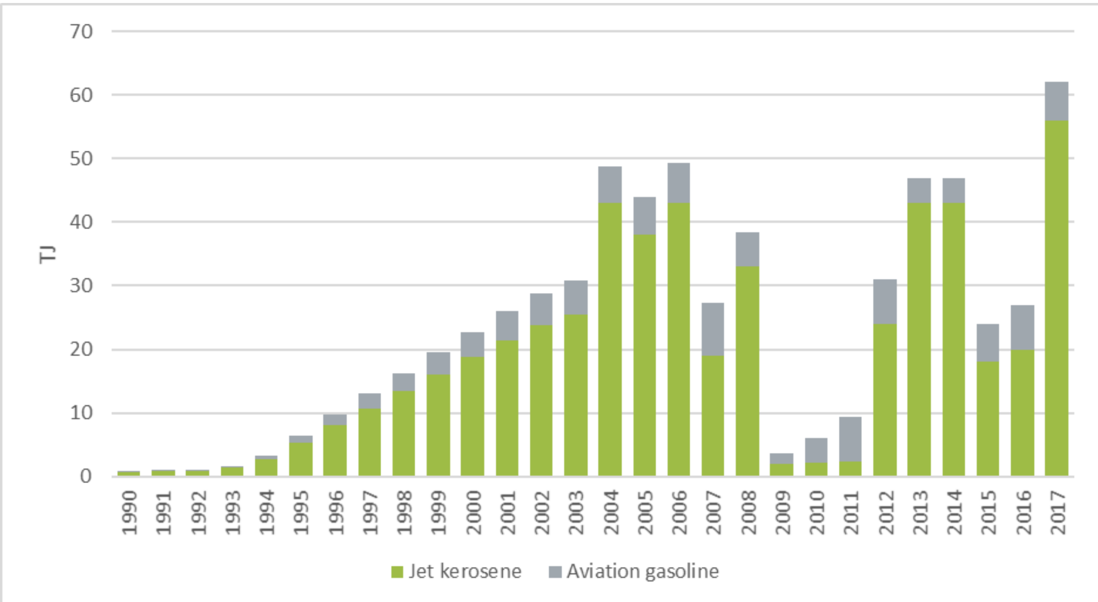

Figure 3.6 Fuel consumption in Civil aviation (TJ)

3.2.6.2.6 Uncertainties

CSB gives approximately 2% statistical sample error for statistical data. Considering this uncertainty in total fuel consumption for 2004-2017 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

[12] "Research on fuel consumption by domestic aviation and private boats in domestic navigation"

and cruise cycle is ±10%. For the rest of time period uncertainty in 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.

3.2.6.2.8 Recalculations

No recalculations were carried out for this submission.

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, light (LDV) and heavy duty vehicles (HDV), buses as well as mopeds and motorcycles. 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 3.15 Trends and emissions in Road transport in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	21.90	16.12	15.65	17.27	15.64	12.65	11.23	11.51	11.60	11.69	11.15	11.31	-48.3
NMVOC		23.57	17.50	12.19	8.51	3.91	3.52	3.53	3.32	3.15	2.90	2.63	2.41	-89.8
SOx		0.360	0.284	0.288	0.086	0.019	0.016	0.015	0.015	0.016	0.017	0.017	0.019	-94.9
NH_3		0.013	0.029	0.068	0.209	0.203	0.197	0.194	0.195	0.200	0.197	0.173	0.158	1082.3
$PM_{2.5}$		0.643	0.502	0.717	1.055	0.890	0.716	0.695	0.676	0.672	0.672	0.637	0.640	-0.4
PM_{10}		0.794	0.614	0.842	1.235	1.098	0.891	0.859	0.846	0.852	0.866	0.833	0.847	6.6
TSP		0.960	0.737	0.977	1.431	1.323	1.081	1.036	1.030	1.047	1.076	1.042	1.069	11.4
BC		0.248	0.201	0.328	0.526	0.462	0.371	0.371	0.356	0.354	0.347	0.328	0.326	31.0
CO		248.58	178.40	103.11	60.99	23.76	21.86	21.61	19.68	18.51	17.02	15.65	14.39	-94.2
Pb	t	56.201	41.765	1.865	1.991	1.767	1.615	1.398	1.308	1.307	1.328	1.305	1.288	-97.7
Cd	t	0.006	0.005	0.005	0.008	0.009	0.008	0.008	0.008	0.008	0.009	0.009	0.010	61.8
PCDD/F	g I-Teq	0.263	0.203	0.252	0.387	0.442	0.370	0.374	0.373	0.392	0.398	0.380	0.386	46.6
PAHs	t	0.035	0.025	0.031	0.049	0.059	0.050	0.049	0.050	0.055	0.060	0.061	0.066	89.6

Despite the total fuel consumption in road transport in 2017 was per 26.8% higher, compared to 1990, all main emissions have decreased in 1990-2017 with an exception of NH_3 and PM_{10} TSP, BC and Cd (Table 3.15). NH_3 emission increase is likely due to the increasing number of vehicles equipped with catalytic systems for combustion gas treatment. Development of PM during the time span 1990-2017 determined two main trends. First, a sharp increase in number of vehicles and vehicle kilometres travelled (VKT) by passenger cars and LDV with diesel engines. Second, development of requirements and technologies concerning exhaust of particles. Increase of Cd emissions is determined, first, by increase in total fuel consumption and, second, by increased share of diesel fuel in the total fuel consumption in road transport per about 12% points during last ten years.

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

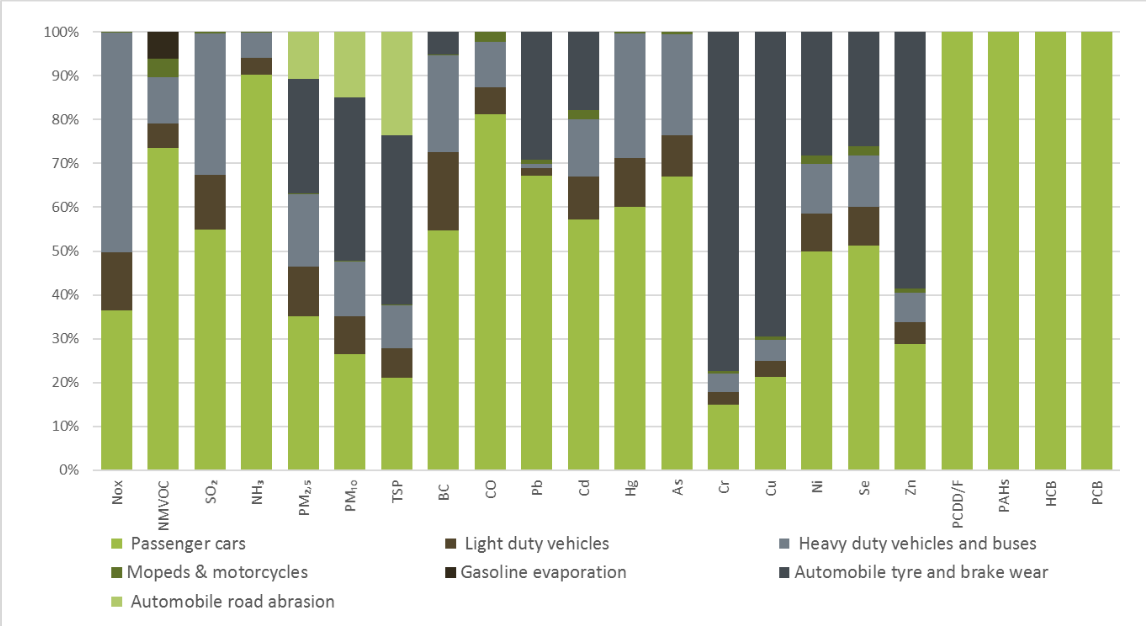

Figure 3.7 Emissions in Road transport, 2017

When analysing the development of emissions in road transport in 2017 following trends could be mentioned:

- Compared to 2016, NMVOC and CO emissions have decreased in 2017 by 8.4% and 8.1% respectively. The main 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 decreasing of gasoline consumption by passenger cars. Detailed analysis of the vehicle fleet's structure is provided below.
- Compared to 2016, in 2017 $PM_{2,5}$ emissions in road transport have increased by 0.4%. It is due to two reasons. First, increase in diesel fuel consumption can be seen and VKT by passenger cars, LDV and HDV. Second, different trend related to passenger cars and HDV vehicles fleets: the total $PM_{2,5}$ emissions of passenger cars fleet has increased by 3.8% mainly due to increase in diesel car share, the total $PM_{2,5}$ emissions of HDV vehicles fleet has decreased by 4.2% due to increase of share of new HDV vehicles.
- NMVOC emissions in 2017 have decreased by around 8.4% in comparison with 2016, which is mainly due to decrease in gasoline consumption.

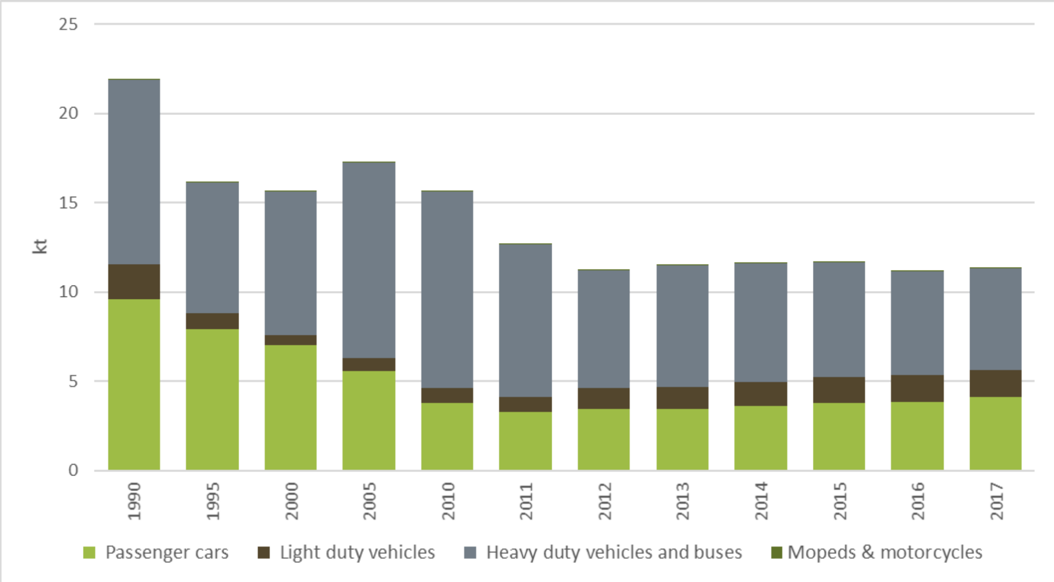

Figure 3.8 Development of NOx emissions in Road transport (kt)

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

- The main sources of NO_x emissions are HDV (50.3%) followed by passenger cars (36.4%) and LDV (13.2%);
- The main sources of NMVOC emissions are passenger cars - around 73.5%, gasoline evaporation is responsible for 6.2% no total NMVOC emissions;
- The main sources of SO_2 emissions are passenger cars - around 55%, HDV - around 32.4% and LDV – around 12.4%.
- The major part of CO emissions in road transport are created by passenger cars, - 81.3%, followed by HDV – 10.5%;
- In total $PM_{2,5}$ emissions passenger cars contributed to 35.1%, automobile tyre and break wear to 26.2%, HDV to 16.5%, LDV to 11.2% and automobile road abrasion to 10.6% of emissions.

Though total NO_x emissions in road transport in 2017 are per 27.7% lower, compared to 2010, emissions related to passenger cars during this period have increased per 8.8%. On the one hand, the positive impact has been caused due to increased share of EURO4, EURO5 and EURO6 passenger cars from 15 % (in 2010) up to 35% in 2017. 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 35% (in 2010) up to 58% in 2017, important is also to note that large share of them is ten and more years old.

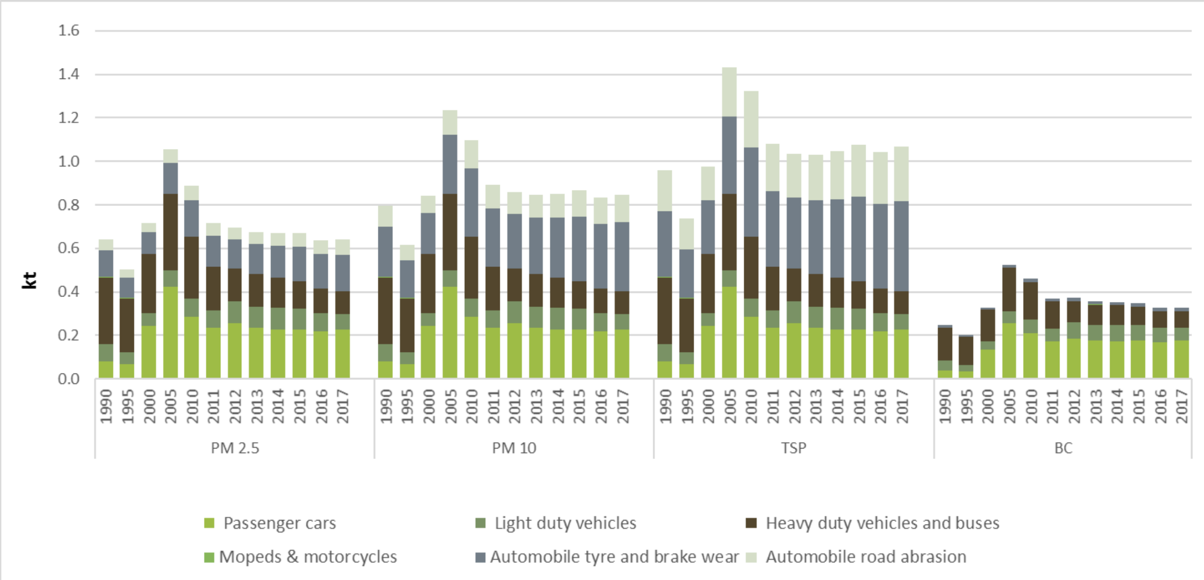

Figure 3.9 Distribution of solid particle emissions by sources in Road transport (kt)

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, liquid petroleum gases (LPG), natural gas 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 Latvia inventory are from the COPERT 5 model.

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 1996-2017 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. Thus all biofuel is used in blend with fossil fuel and all calculation of emissions have been performed for blend fuel.

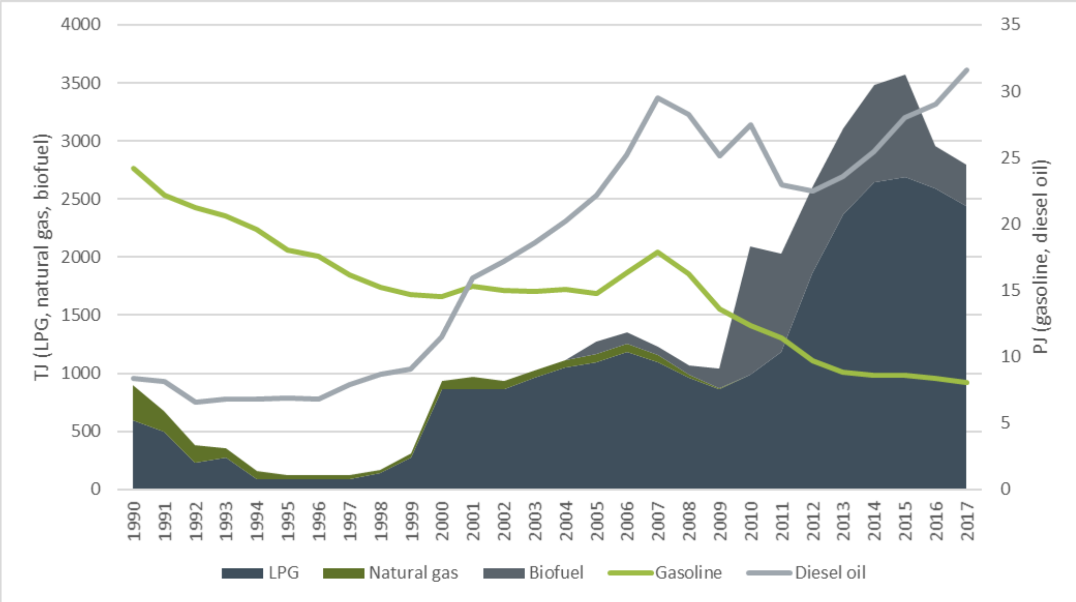

Figure 3.10 Development of fuel consumption in Road transport (TJ)

As seen in Figure 3.10 the fuel consumption has changed essentially in 1990-2017. 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 by 4% in 2017 compared to 2016. 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 by 8.9% in 2017 compared to 2016. Substantial LPG consumption increase in road transport was observed starting from 2011 but in 2016 and 2017 we can constitute a small decreasing.

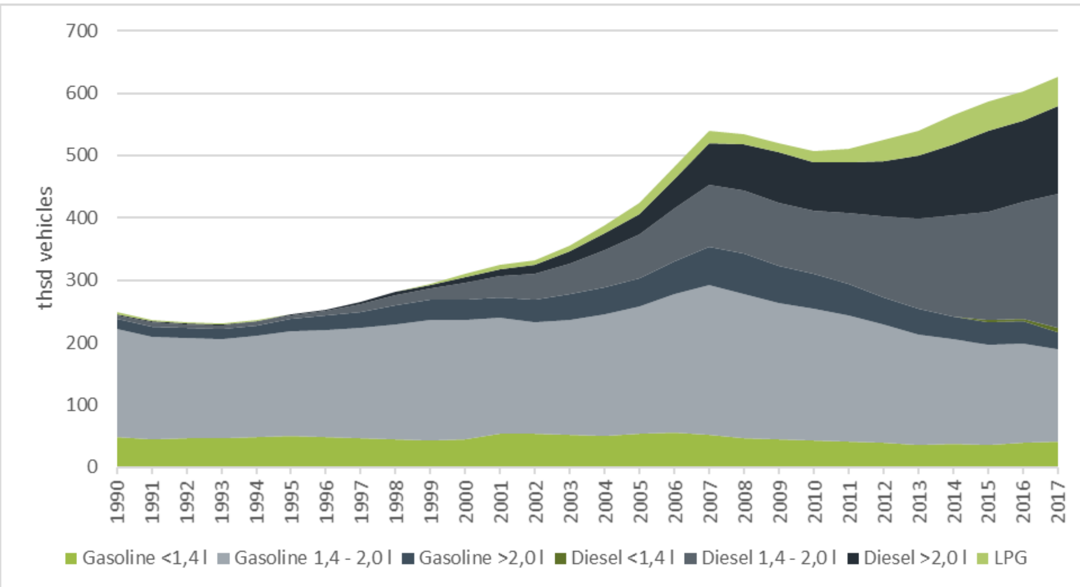

Figure 3.11 Distribution of passenger cars fleet by sub-classes

Analysing the development of the passenger car fleet in 1990-2017, following features can be noted (Figure 3.11, Figure 3.12, Figure 3.13):

- Cars with a diesel engine of a capacity < 2.0l constitute the major part, the second leading group is cars with a gasoline engine of a capacity 1.4l - 2.0l and after - cars with a diesel engine of a capacity > 2.0l;
- Cars with a gasoline engine of a capacity < 1.4l during the whole period have small changes and it constitutes approximately 6.5% in year 2017 from total passenger cars;
- Cars with a gasoline engine of a capacity >2.0l starting from 2010 have a small decrease in their share of total passenger cars;
- As of 2000, the number of cars with diesel engines, both, < 2.0l and > 2.0l, grow rapidly and its share is 57.9% from the total number of passenger cars in 2017;
- As of 2005, in the car fleet with a gasoline engine, the number of EURO 4 and EURO 5 cars grows rapidly. In 2017 a share of EURO4 and EURO5 and EURO6 cars constitute to 34%;
- As of 2005, in the car fleet with a diesel engine, the number of EURO 4 and EURO 5 cars grows rapidly. In 2017 a share of EURO4, EURO5 and EURO6 cars constitute to 36%.

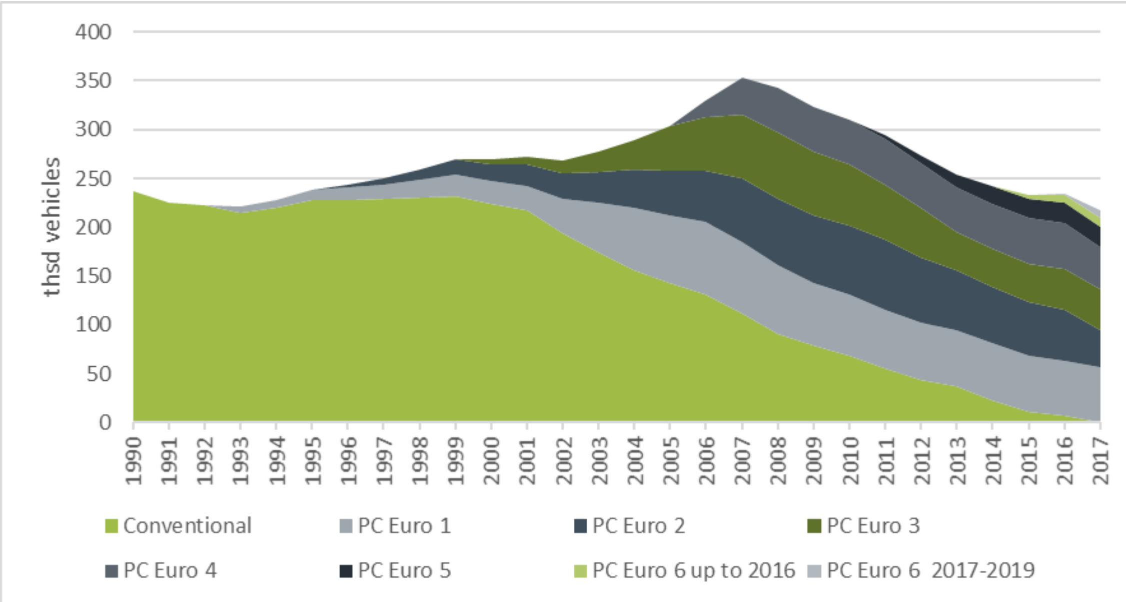

Figure 3.12 Distribution of gasoline passenger cars fleet by layers

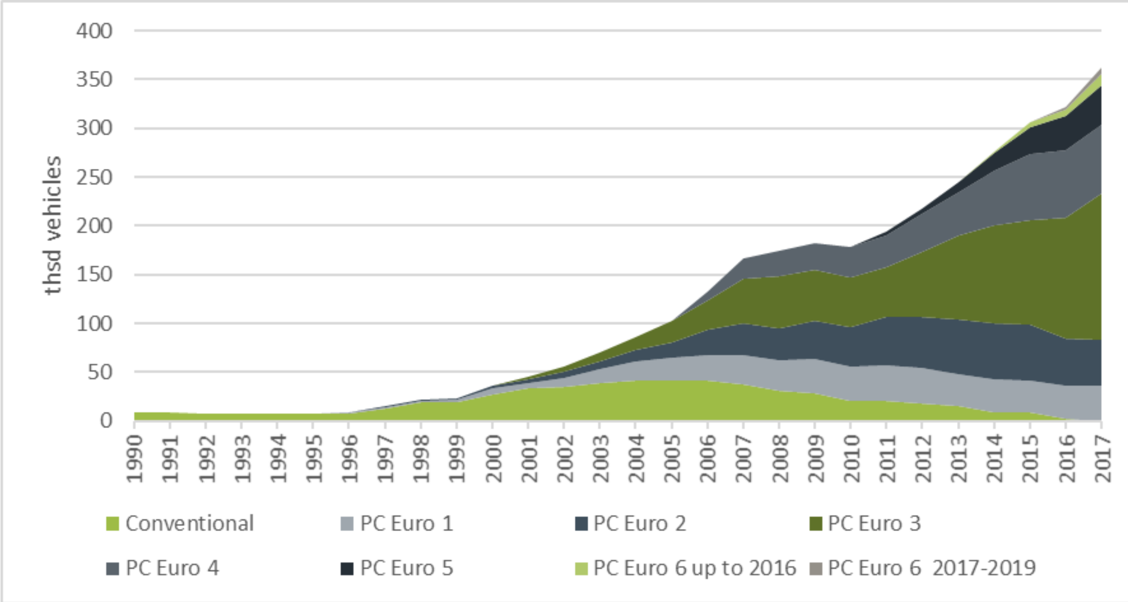

Figure 3.13 Distribution of diesel oil passenger cars fleet by layers

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 engine have decreased;
- As of 2000, the number of cars with a diesel engine rapidly increased. In 2017 the share of diesel cars is 93.5%;
- As of 2005, the number of EURO4, EURO5 and EURO6 cars have increased. In 2017 the share of EURO4, EURO5 and EURO6 cars constitute to 59.0%.

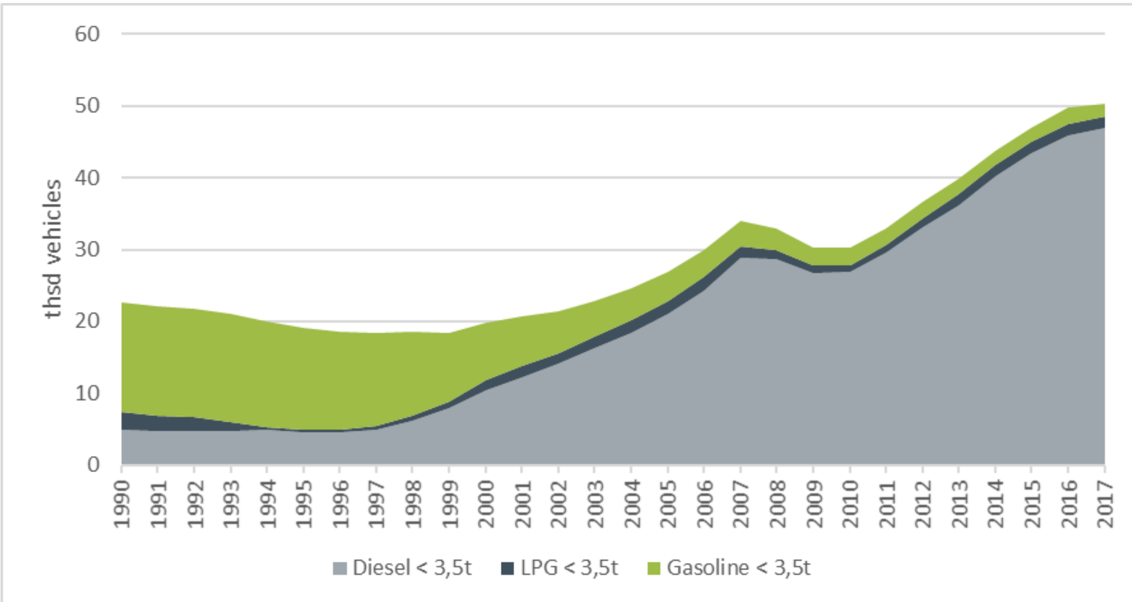

Figure 3.14 Distribution of light duty vehicles fleet by sub-classes

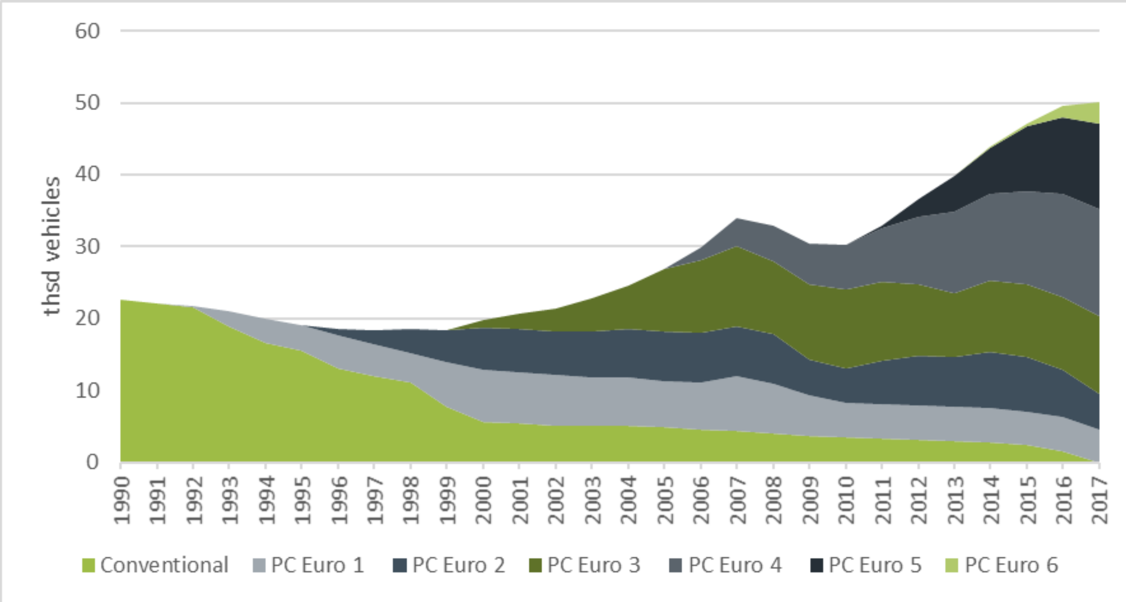

Figure 3.15 Distribution of light duty vehicles fleet by layers

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 cars with a gasoline engine have rapidly decreased. The share of gasoline cars has decreased from 35% to 3.1 % corresponding years 2000 and 2017;
- Since 2000, the number of HDV cars with tonnage 14-34 t and a diesel engine start to increase;
- As of 2000, the average age of cars reduces gradually. In 2017 the share of EURO IV, EURO V and EURO VI cars constituted 51%.

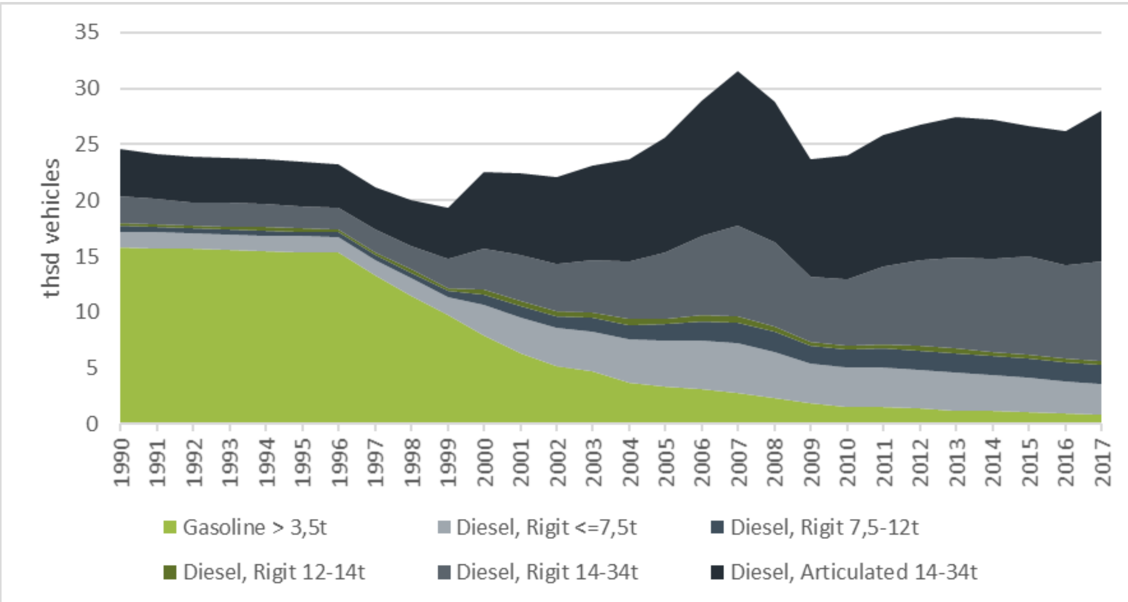

Figure 3.16 Distribution of heavy duty vehicles fleet by sub-classes

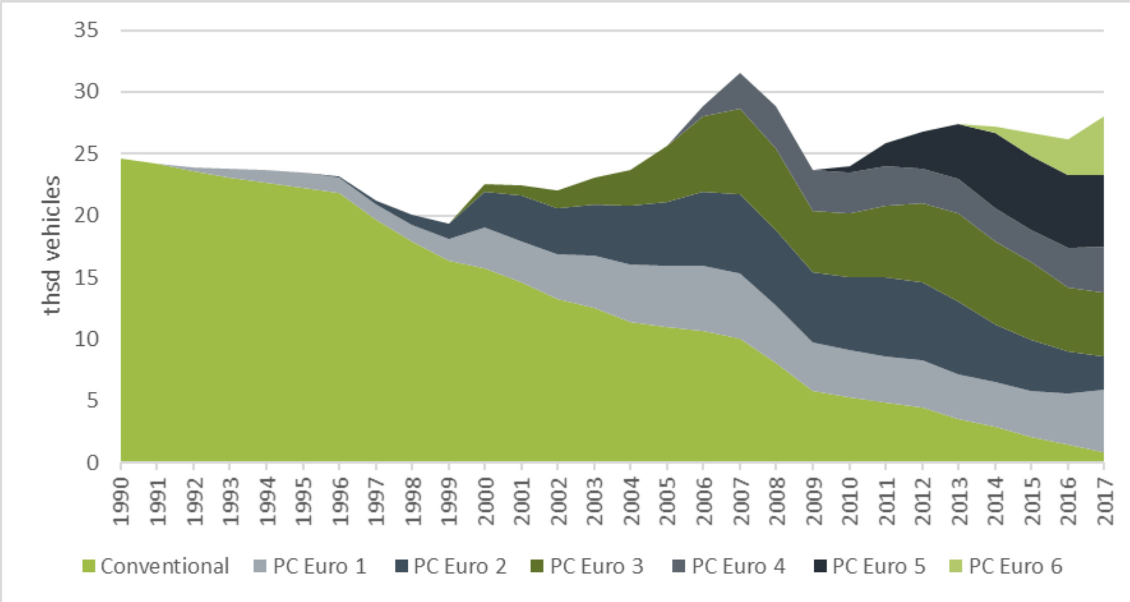

Figure 3.17 Distribution of heavy duty vehicles fleet by layers

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 were 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.

3.2.6.3.7 Recalculations

All emissions for 1990-2016 were recalculated. Recalculations were done due to switch from COPERT 5.0 model version to COPERT 5.2 model version and corrected distribution of vehicles fleet by sub-classes (2014-2016) according to additional statistical information of the Road Traffic Safety Directorate of Latvia.

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. Freight transport has a dominant role in railway. The railway transport accomplishes around 50% (2017) of the total freight transport in Latvia (traffic of goods in ton-km) and the transit transport traffic is dominant. Since 2012, the transported freight along the railway (measured in tonne-kilometres) have decreased by around 31% due to dependence on transit transport of goods from Russia and other neighboring countries. Fuel consumption has decreased by approximately 7.5% in 2017 compared to 2016.

3.2.6.4.2 Trends in emissions

When analysing the development of emissions trends in railway (Table 3.16), following features could be noted:

- Due to the decrease of diesel oil consumption by around 69% in railway in time period 1990-2017 all emissions decreased by 69–98%;
- From total emissions in transport sector, railway contributes respectively 18.8% in NO_x, 8.9% in NMVOC, 19.7% in SO_2 and 8% in $PM_{2,5}$ emissions.

In 2000-2017 diesel fuel consumption decreased in railway by around 19.5%. It is a reason for PM and TSP emission decrease by around 19.5%. However, SO_2 emissions decreased by about 82.8% at the same time due to implementation of stronger fuel quality requirements;

Table 3.16 Trends and emissions in Railway in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	8.86	3.98	3.41	4.30	3.50	3.99	4.22	3.78	3.67	3.50	2.96	2.74	-69.1
NMVOC		0.79	0.35	0.30	0.38	0.31	0.36	0.37	0.34	0.33	0.31	0.26	0.24	-69.1
SO_2		0.68	0.30	0.06	0.06	0.13	0.16	0.16	0.14	0.14	0.01	0.01	0.01	-98.4
NH_3		0.0012	0.0006	0.0005	0.0006	0.0005	0.0005	0.0006	0.0005	0.0005	0.0005	0.0004	0.0004	-69.1
$PM_{2.5}$		0.232	0.104	0.089	0.112	0.090	0.106	0.108	0.099	0.096	0.092	0.077	0.072	-69.1
PM_{10}		0.243	0.109	0.094	0.118	0.095	0.112	0.114	0.104	0.101	0.096	0.081	0.075	-69.1
TSP		0.257	0.116	0.099	0.125	0.100	0.118	0.120	0.110	0.106	0.102	0.086	0.079	-69.1
BC		0.150	0.068	0.058	0.073	0.059	0.069	0.070	0.064	0.062	0.059	0.050	0.047	-69.1
CO		1.808	0.813	0.696	0.877	0.706	0.830	0.845	0.772	0.748	0.715	0.605	0.560	-69.1
Cd	t	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-69.1
PAHs		0.014	0.006	0.005	0.007	0.005	0.006	0.005	0.006	0.006	0.005	0.005	0.004	-69.1

Due to the decrease of fuel consumption in railway all emissions decreased by approximately 7.5% in 2017 compared to 2016.

3.2.6.4.3 Methods

When calculating emissions from railway, Tier 1 method was applied.

3.2.6.4.4 Emission factors

Default emission factors for Railway (Table 3.17, Table 3.18) are taken from EMEP/EEA 2016. The emission factors for Particulate Matters are taken from CEPMEIP/TNO database (Table 3.10). The SO_2 emissions factors are used consistent with sulphur content in diesel oil by years (Table 3.19).

Table 3.17 Emission factors used for emissions calculation from Railway

Pollutant	Unit	Diesel oil
NO_X	kt/PJ	1.233
CO		0.252
NMVOC		0.109
NH_3	t/PJ	0.000165
Cd		0.00024
Cr		0.00118
Cu		0.04001
Ni		0.00165
Se		0.00024
Zn		0.02353
benzo(a)pyrene		0.000706
benzo(b)fluoranthene		0.0011767

Table 3.18 Emission factors used in the calculation of Particulate Matters emissions from Railway, kt/PJ

	$PM_{2.5}$	PM_{10}	TSP
Diesel oil	0.03224	0.03389	0.03577

Table 3.19 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

	Sulphur content (%)	NCV (TJ/kt)	EF (kt/PJ)
2003-2004	0.05	42.49	0.0235
2008-2014	0.1	42.49	0.0471
2015-2017	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). Fuel consumption decreased by around 7.5% in 2017 compared to 2016.

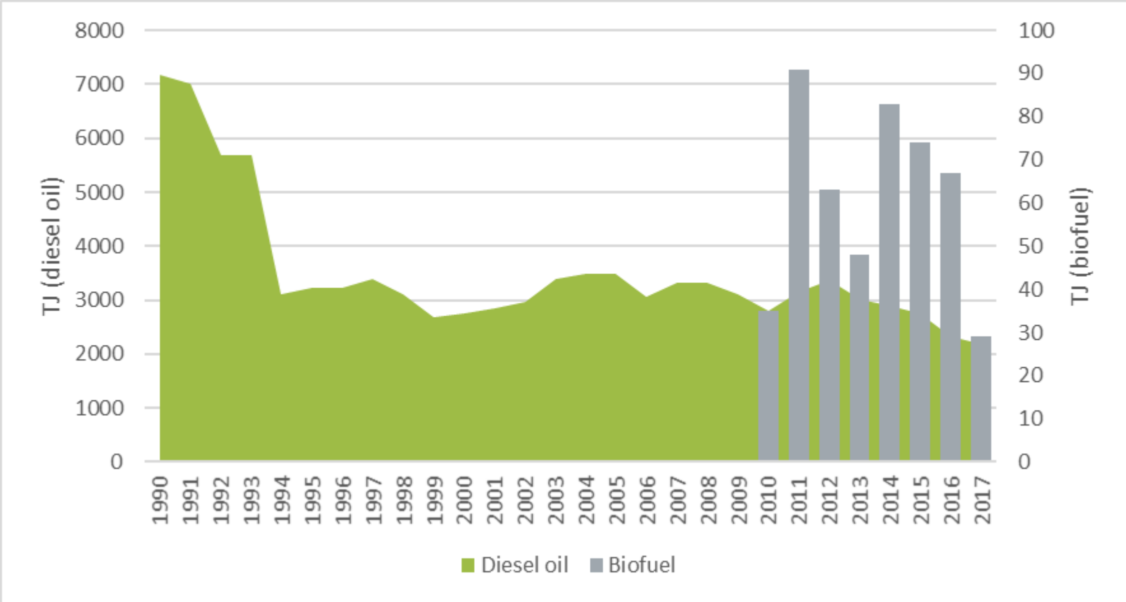

Figure 3.18 Fuel consumption in Railway transport (TJ)

3.2.6.4.6 Uncertainties

Uncertainty in activity data of fuel consumption is ±2% in 2017. 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.

3.2.6.4.8 Recalculations

SO_2 emissions were recalculated for 2015 in railway due to corrected EF as the national regulation concerning stronger requirements for maximum allowed sulphur content for diesel oil (10mg/kg) used in railway is in force from 01.01.2015.

3.2.6.4.9 Planned improvements

No improvements are planned for the next submission.

3.2.6.5 Navigation (NFR 1A3d)

3.2.6.5.1 Overview

Although Latvia has several ports, national 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). Diesel oil consumption increased by approximately 6.3% in 2017 compared to 2016.

3.2.6.5.2 Trends in emissions

Table 3.20 Trends and emissions in Navigation in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	0.021	0.011	0.012	0.011	0.392	0.392	0.315	0.629	0.315	0.239	0.326	0.347	1524
NMVOC		0.011	0.012	0.014	0.017	0.026	0.026	0.030	0.039	0.032	0.021	0.032	0.033	199
SOx		0.0003	0.0002	0.0002	0.0001	0.0051	0.0051	0.0041	0.0082	0.0041	0.0031	0.0042	0.0045	1496
NH_3		1.8E-06	9.4E-07	9.9E-07	8.5E-07	3.4E-05	3.4E-05	2.7E-05	5.4E-05	2.7E-05	2.1E-05	2.8E-05	3.0E-05	1561
$PM_{2.5}$		0.0009	0.0008	0.0009	0.0010	0.0076	0.0078	0.0066	0.0121	0.0067	0.0049	0.0069	0.0072	696
PM_{10}		0.0009	0.0008	0.0009	0.0010	0.0081	0.0083	0.0070	0.0129	0.0071	0.0052	0.0073	0.0077	720
TSP		0.0009	0.0008	0.0009	0.0010	0.0081	0.0083	0.0070	0.0129	0.0071	0.0052	0.0073	0.0077	720
BC		0.0001	0.0001	0.0001	0.0001	0.0022	0.0022	0.0018	0.0035	0.0018	0.0014	0.0019	0.0020	1284
CO		0.035	0.039	0.045	0.052	0.076	0.076	0.088	0.111	0.095	0.0616	0.0959	0.0978	184
Cd	t	3.2E-09	2.0E-09	2.2E-09	2.1E-09	7.1E-08	5.1E-08	4.0E-08	9.9E-07	1.2E-06	7.1E-07	1.2E-06	1.2E-06	36616
PAHs		2.6E-05	1.6E-05	1.8E-05	1.7E-05	0.0006	0.0004	0.0003	0.0006	0.0003	0.0002	0.0003	0.0004	1303

Analysing the development of the emission trends in domestic navigation (Table 3.20), following features can be noted:

- Due to remarkable increase (more than 10 times) in fuel consumption in 1990-2017 all emissions increased several times;
- In 2017 NO_x and SO_2 emissions increased by around 6.2% compared to 2016 due to increase in fuel consumption. NMVOC emissions increased by around 2.2% but $PM_{2.5}$ and PM_{10} emissions by around 5.3%.

3.2.6.5.3 Methods

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

3.2.6.5.4 Emission factors

Default EFs (Table 3.21) for navigation is used (EMEP/EEA 2016):

Table 3.21 Emission factors used in the calculation of emissions from 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. The SO_2 emission factors are used consistent with sulphur content in diesel oil and gasoline.

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 consumption 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 navigation is presented in Figure 3.19 below.

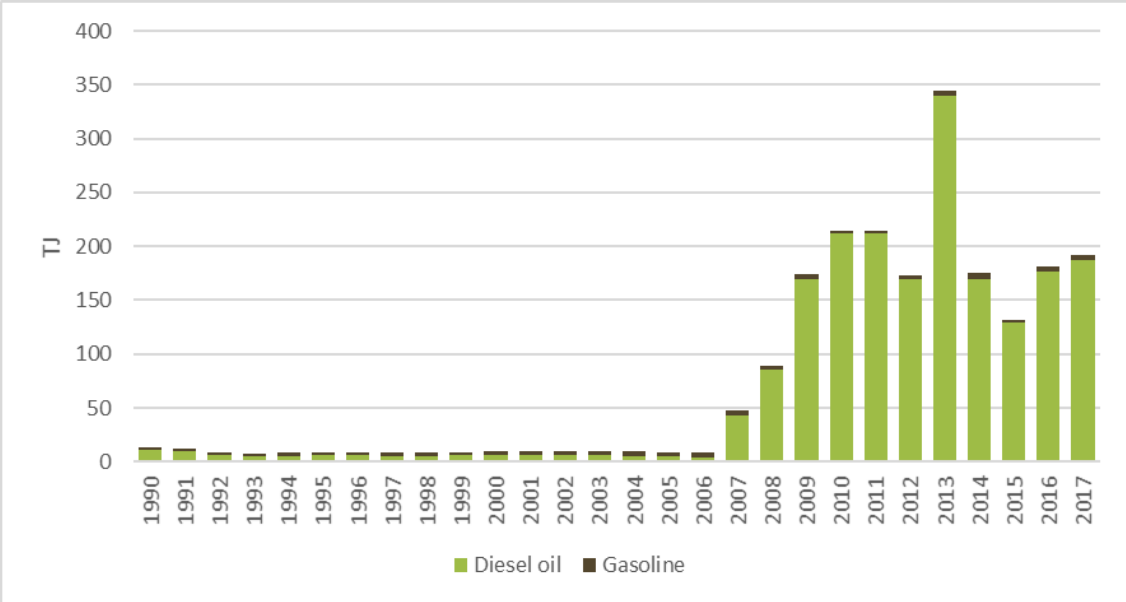

Figure 3.19 Development of gasoline and diesel oil fuel consumption in Navigation

3.2.6.5.6 Uncertainties

Uncertainty in activity data of fuel consumption for time period 2006-2017 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.

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 3.22 Trends in emissions from NFR 1A4 Other Sectors in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	24.53	11.06	8.49	9.60	9.18	9.11	9.05	8.86	8.94	8.73	8.54	9.18	-62.6
NMVOC		17.43	16.41	14.50	16.65	13.00	13.36	13.80	12.53	11.66	9.72	9.76	10.85	-37.8
SOx		35.12	9.95	3.93	3.67	2.28	2.24	2.17	2.02	1.98	1.80	1.71	1.81	-94.8
NH_3		1.53	2.26	2.03	2.33	1.78	1.83	1.93	1.73	1.63	1.34	1.34	1.53	-0.1
$PM_{2.5}$		15.38	17.88	15.89	17.92	13.53	13.96	14.37	12.74	12.00	9.74	9.71	11.02	-28.3
PM_{10}		15.98	18.38	16.29	18.38	13.88	14.31	14.72	13.05	12.29	9.97	9.94	11.28	-29.4

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
BC		16.90	19.30	17.07	19.26	14.55	15.00	15.42	13.66	12.87	10.44	10.41	11.80	-30.1
TSP		2.35	2.65	2.35	2.69	2.10	2.15	2.25	2.03	1.92	1.61	1.60	1.81	-22.9
CO		164.73	141.07	125.46	143.59	112.49	118.29	119.25	106.84	100.09	81.01	81.69	90.86	-44.8
Pb		10.10	2.24	1.28	1.44	1.21	1.20	1.13	1.04	0.99	0.84	0.84	0.88	-91.3
Cd	t	0.40	0.52	0.45	0.52	0.40	0.40	0.44	0.40	0.38	0.32	0.32	0.36	-11.3
Hg		0.203	0.066	0.039	0.041	0.036	0.035	0.030	0.029	0.027	0.024	0.024	0.024	-88.2
PCDD/F	g I-Teq	18.50	19.14	16.62	18.80	14.27	14.75	15.08	13.33	12.65	10.21	10.20	11.54	-37.6
PAHs	t	14.46	12.64	10.74	12.36	9.69	9.97	9.96	8.85	8.41	6.79	6.79	7.58	-47.5
HCB	kg	0.15	0.20	0.17	0.20	0.15	0.16	0.17	0.15	0.15	0.12	0.12	0.14	-9.2
PCBs		4.01	0.96	0.38	0.36	0.36	0.32	0.17	0.18	0.17	0.14	0.14	0.11	-97.3

All emissions have decreased in 1990-2017 NFR 1A4 Other Sectors (Table 3.22). 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 method was used to calculate emissions from the stationary fuel combustion. Calculation of all emissions from fuel combustion is done in 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 III: 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)

For residential sector Tier 2 method was used to calculate emissions, taking into account also the combustion installations. Data about installations are taken from CSB 5-yearly household questionnaires and calculations are made, using expert's judgement. The following method for estimation of emissions from EMEP/EEA 2016 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 Excel database.

3.2.7.4 Emission factors

The main source for emission factors is EMEP/EEA 2016. 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 2016 (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

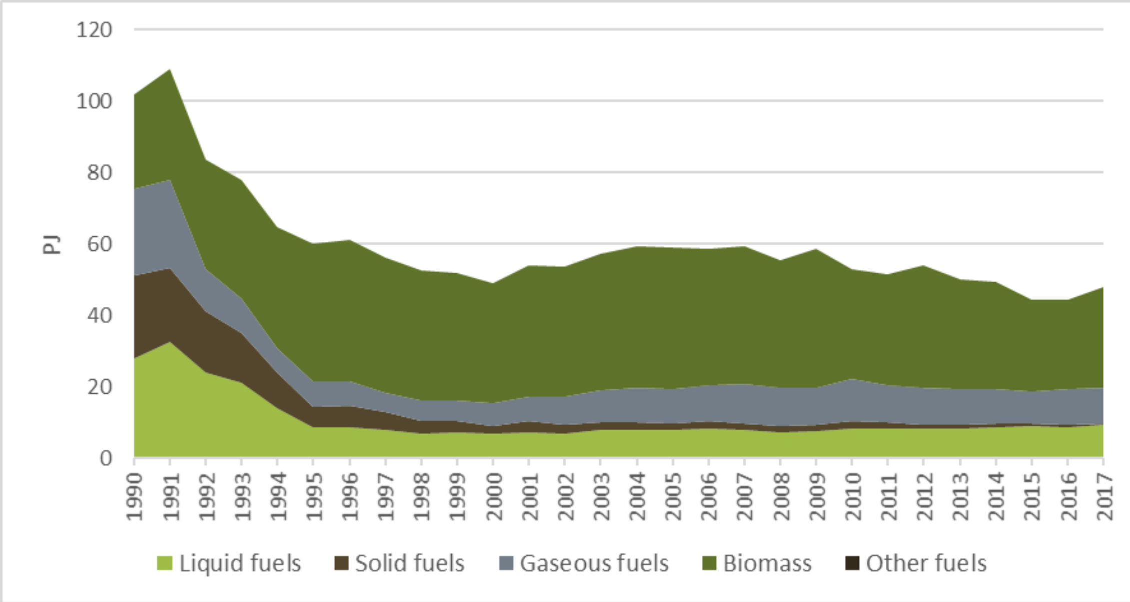

Figure 3.20 Fuel consumption in NFR 1A4 Other Sectors in 1990-2017 (PJ)

The biggest decrease in 1990-2017 was for solid fuel consumption – 97.4%, liquid fuels consumption – 66.5% (Figure 3.20) and gaseous fuels by 59.0%. 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 Other 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 increased by 6.0% in 1990-2017 in Other Sector. It can be seen that the amounts of biomass have been fluctuating over the recent years which can mainly be explained with temperature fluctuations during winter. In recent years amount of biomass used in sector have decreased and in 2017 it was by 11.2% higher than in 2016.

Since 1997 gaseous fuel consumption was constantly increasing until 2007, due to lower costs and the fact that liquid and solid fuels were replaced with natural gas. The increase in fuel consumption in NFR 1A4 Other Sectors is linked to decrease in fuel consumption in NFR 1A1 Energy Industries when central heating supply consumers switched to individual heating supply. In the recent years a decreased consumption in natural gas is observed, which was influenced by increasing costs of particular fuel.

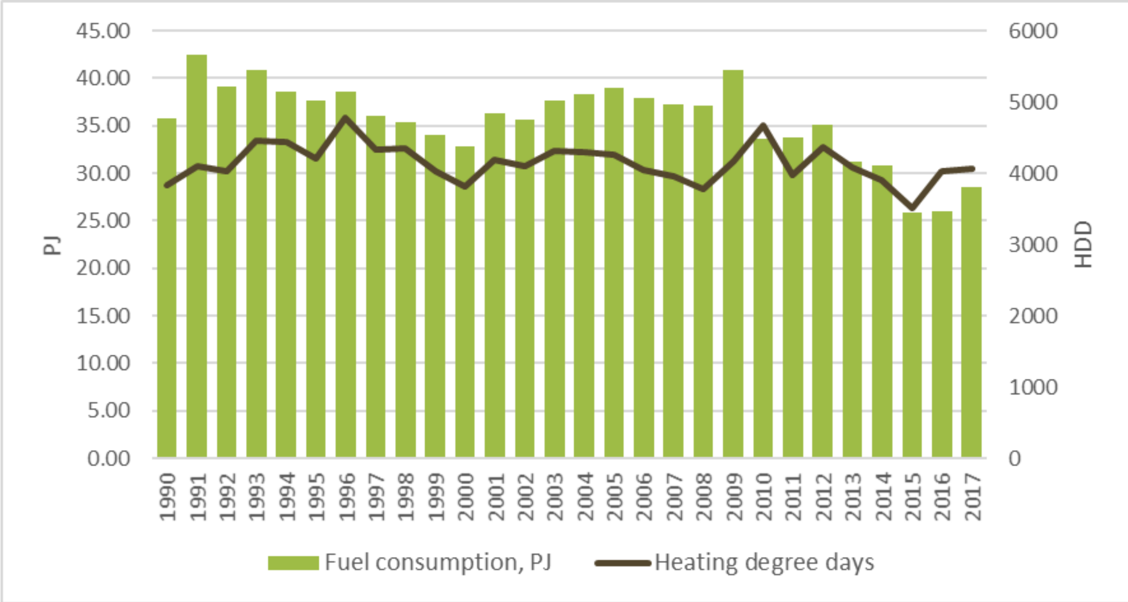

Figure 3.21 Fuel consumption in NFR 1A4b Residential sector and heating degree days in Latvia

As it can be seen in Figure 3.21, fuel consumption in 1A4.b 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 and in the most recent years. In 2008 there was considerably low number of HDDs, and also the fuel consumed was less than in 2007. However, in 2009-2010 the correlation between HDDs and consumption is less visible because of impact of global crisis, which clearly affected the Residential sector. In 2011-2013 there can be seen a correlation in HDDs and fuel consumption. In 2017 number of HDDs was higher than in 2016 and amount of fuel used have increased as well. 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. Also, energy efficiency is increasing due to building new and renovating residential buildings to be more energy efficient.

3.2.7.6 Uncertainties

Uncertainty for activity data of fuel combustion in 1A4 sector is ±2% in 2017. 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 and peat combustion was assigned as 5% because biomass activity data was collected by CSB with questionnaires sent by enterprises consumed biomass. As fuel consumption in NFR 1A4b Residential sector is obtained only every 5 years using questionnaire and data is extrapolated until the next survey, therefore the uncertainty of all fuel consumption in residential sector is assumed 15%. According to the 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19, biomass data is generally more uncertain than other data in national energy statistics, because a large fraction of the biomass may be part of the informal economy, and the trade in these type of fuels is frequently not registered in the national energy statistics and balances. Uncertainty of landfill gas stationary combusted in enterprises covered by 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. Still the methane percentage amount in combusted landfill gas is given approximately, therefore final uncertainty of biomass fuels is assumed as 5%.

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 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 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 for substances reported also under UNFCCC as indirect GHGs are cross-checked with for verification purposes.

3.2.7.8 Recalculations

In Submission 2019, the following recalculations were done:

- Diesel oil reallocation from complete stationary combustion to split between stationary combustion and combustion in off-roads after review and consultation with CSB - total diesel oil combustion is reported as off-road in NFR 1A4b and for NFR 1A4a it was assumed that 99% combust in off-road and 1% stationary, 1990-2016.

3.2.7.9 Planned improvements

No improvements 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 1996 before notation key NE is used.

3.2.8.2 Trends in emissions

Table 3.23 Trends in emissions from NFR 1A5 Other in 1996-2017

	Unit	1996	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Changes in 1996-2017, %
NOx	kt	0.0002	0.0002	0.1449	0.1620	0.1499	0.1473	0.1195	0.1970	0.2079	0.2274	0.3114	125564.3
NMVOC		0.0012	0.0008	0.0168	0.0146	0.0131	0.0144	0.0149	0.0170	0.0153	0.0227	0.0155	1214.8
SOx		0.0000	0.0000	0.0084	0.0050	0.0046	0.0047	0.0041	0.0060	0.0061	0.0073	0.0084	44954.6
NH_3		0.0012	0.0008	0.0252	0.0196	0.0177	0.0191	0.0190	0.0230	0.0214	0.0300	0.0239	1894.7
$PM_{2.5}$		NO	NO	0.0025	0.0029	0.0026	0.0026	0.0021	0.0035	0.0037	0.0040	0.0055	100
PM_{10}		NO	NO	0.0027	0.0031	0.0028	0.0028	0.0022	0.0037	0.0039	0.0043	0.0059	100
TSP		NO	NO	0.0027	0.0031	0.0028	0.0028	0.0022	0.0037	0.0039	0.0043	0.0059	100
BC		NO	NO	0.0008	0.0009	0.0008	0.0008	0.0006	0.0011	0.0011	0.0012	0.0017	100
CO		0.0743	0.0528	0.7538	0.5761	0.5079	0.5962	0.6891	0.6501	0.5234	0.9523	0.3073	313.3
Pb	t	NO	NO	0.0002	0.0003	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0005	100
Cd		NO	NO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	100
Hg		NO	NO	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	100
PCDD/F	g I-Teq	NO	NO	0.0002	0.0003	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0005	100
HCB	kg	NO	NO	0.0001	0.0002	0.0002	0.0001	0.0001	0.0002	0.0002	0.0002	0.0003	100
PCBs		NO	NO	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	100

All emissions have increased in 1990-2017 NFR 1A5 Other (Table 3.23). 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 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 III: 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 2016. 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 1A, 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 2016 (Annex I, Table 1).

3.2.8.5 Activity data

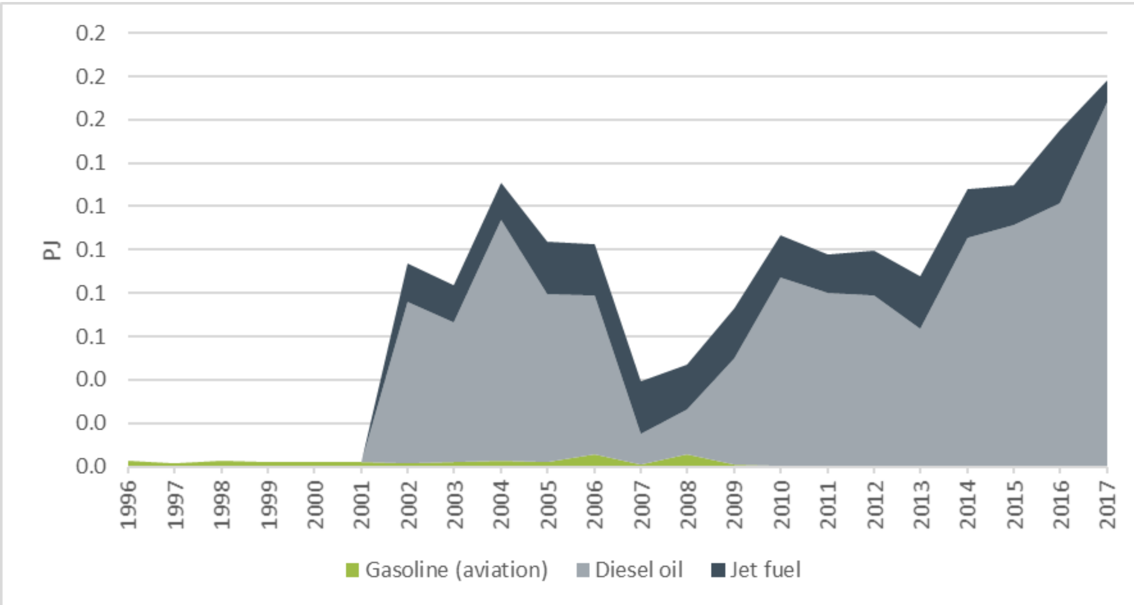

Figure 3.22 Fuel consumption in NFR 1A5 Other in 1990-2017 (PJ)

Fuel consumption in Other (NFR 1A5) have increased more than 60 times from 1996-2017 (Figure 3.22).

3.2.8.6 Uncertainties

Uncertainty for activity data of fuel combustion in 1A5 sector is ±2% in 2017. 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) are imported and import and export statistics are fairly accurate.

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 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 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 for substances reported also under UNFCCC as indirect GHGs are cross-checked with for verification purposes.

3.2.8.8 Recalculations

No recalculations done.

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 emission from solid fuels: Coal mining and handling includes fugitive particulate matters 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 from gasoline distribution were calculated for the time period 1990–2017.

Fugitive particulate matters emissions in 1990-2017 from the operations of solid fuels – coal and coke, transportation via railways and storage and handling, are estimated.

3.3.2 Trends in emissions

Table 3.24 Fugitive emissions in 1990-2017, kt

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NMVOC	4.18	3.19	2.48	2.28	2.35	1.40	1.44	1.71	2.34	2.40	2.06	0.91	-78.2
$PM_{2.5}$	0.00028	0.00008	0.00003	0.00004	0.00005	0.00005	0.00004	0.00004	0.00003	0.00002	0.00002	0.00002	-92.5
PM_{10}	0.0028	0.0008	0.0003	0.0004	0.0005	0.0005	0.0004	0.0004	0.0003	0.0002	0.0002	0.0002	-92.5
TSP	0.0070	0.0020	0.0008	0.0010	0.0013	0.0013	0.0011	0.0009	0.0008	0.0006	0.0005	0.0005	-92.5

NMVOC emissions are decreasing due to decrease in use of gasoline (Table 3.24). 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" calculates 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 3 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 starting 2017 is received from new companies. 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 2016 Tier 1 methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in 1990–2017. 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 2016.

3.3.4 Emission factors

NMVOC emission factor – 2 kg/t oil – for emission from gasoline distribution was taken from EMEP/EEA 2016, Chapter 1.B.2.a.v Distribution of oil products, Table 3-1.

Emission factors for particulate matters emission estimation are taken from EMEP/EEA 2016, Chapter 1.B.1.a Fugitive emissions from solid fuels: Coal mining and handling, Table 3-6 (Table 3.25). Detailed information about inclusion or exclusion of the condensable component from PM_{10} and $PM_{2.5}$ emission factors can be found in Annex III: Summary Information on Condensable in PM.

Table 3.25 PM emission factors (g/t)

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

3.3.5 Activity data

In Figure 3.23 and Figure 3.24 and Table 3.26 activity data used for calculation can be seen.

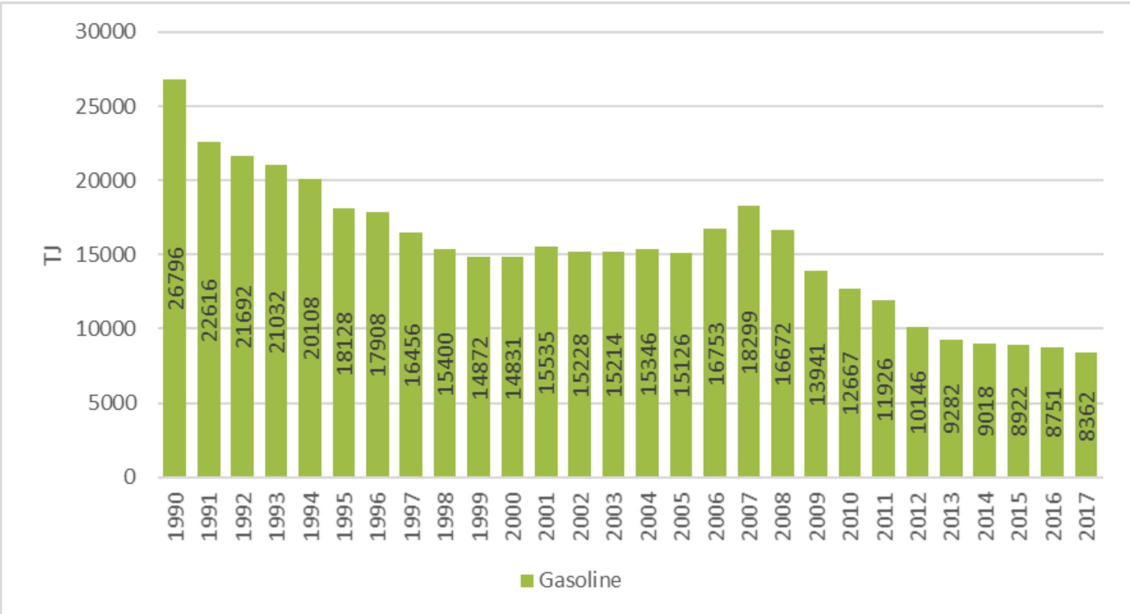

Figure 3.23 Gasoline consumption in Latvia in 1990-2017 (TJ)

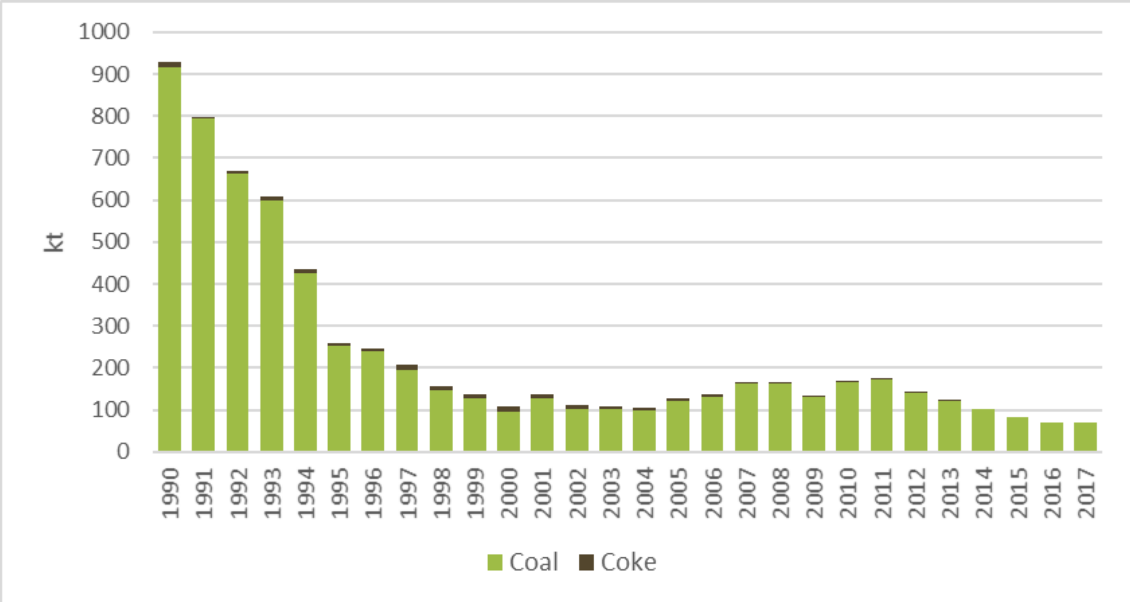

Figure 3.24 Activity data used for particulate matters emissions calculation in 2000–2017 (kt)

Table 3.26 Amounts of natural gas leaked in 1990-2017 (10^6 m^3)

	Venting	Transmission and storage	Distribution	Other	Total
1990	5.61	0.13	0.69	12.44	18.87
1991	5.38	0.13	0.69	11.98	18.17
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

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 representative of the only natural gas distributing company „Latvijas Gāze" determined the level of uncertainty. The total uncertainty of NMVOC emissions from natural gas leakages in gas distribution and transmission systems, as well as in gas storage facility is assigned as quite low – 20%, as emissions were measured and estimated by the only enterprise operated with natural gas in Latvia – "Latvijas Gāze" by methodology developed for enterprise.

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 2016, no additional verification procedures were performed.

To verify the NMVOC emissions, logical mistakes are checked 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 are also cross-checked with emissions reported within UNFCCC for verification purposes.

3.3.8 Recalculations

No recalculations.

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 Navigation according to the IPCC GPG 2000. Emissions from International Aviation and Navigation are not included into national total emissions.

3.4.2 Trends in emissions

International maritime navigation contributed around 95%, 81% and 97% in total international emissions correspondingly for NOx and SO_2 and PM emissions in 2017.

3.4.3 Emission factors

Default emission factors for International Aviation and Navigation are taken from EMEP/EEA 2016 methodology and are presented in Table 3.27 and Table 3.28. The emission factors for Particulate Matters for International Navigation are taken from CEPMEIP/TNO database (Table 3.29).

Table 3.27 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 3.28 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 3.29 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 emissions factors are used consistent with sulphur content in diesel oil (Table 3.30, Table 3.31).

Table 3.30 SO_2 emission factors used for Diesel oil in the SO_2 calculation of emissions for International Bunkers

	Fuel content (%)	NCV (TJ/kt)	EF (kt/PJ)
1990-2007	0.2	42.49	0.094
2008-2017	0.1	42.49	0.0471

Table 3.31 SO_2 emission factors used for RFO in the SO_2 calculation of emissions for International Bunkers

RFO	Fuel content (%)	NCV (TJ/kt)	EF (kt/PJ)
1990-2006	2.8	40.6	1.352
2007-2017	1.5	40.6	0.7241

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.

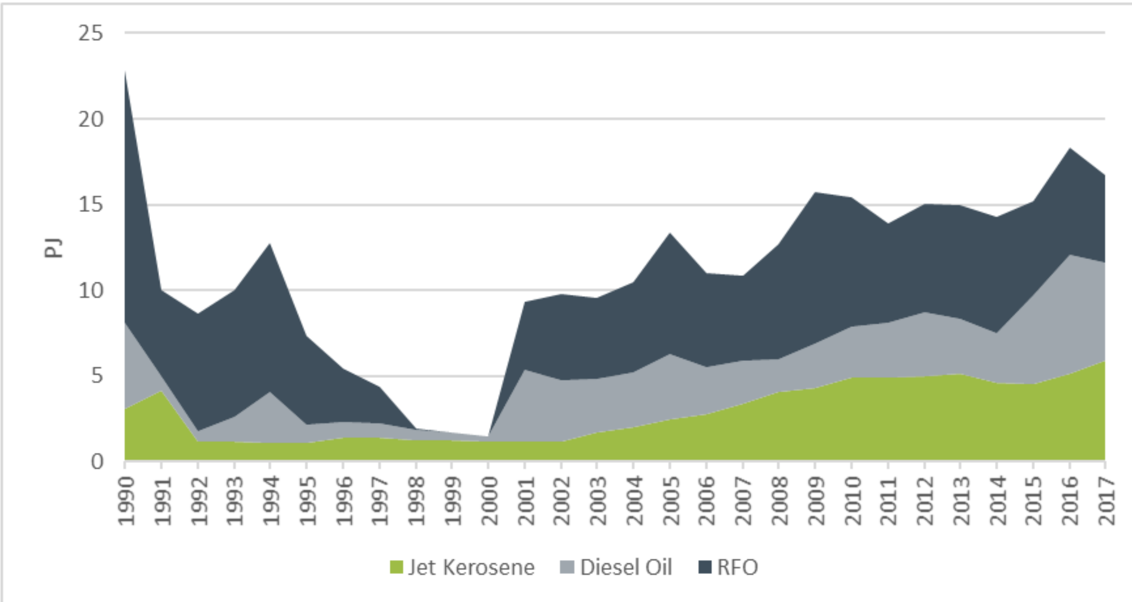

Figure 3.25 Fuel consumption in International Transport (PJ)

Considering the fact that ports in Latvia are focused on transit cargo transport, 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. At the same time fuel consumption and emissions from aviation are more stable, and recent trend depicts a persistent increase from year 2003. 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 fulfill requirement concerning sulphur content limit, from 2015 ships have used more diesel oil (Figure 3.25).

4 Industrial processes and product use (NFR 2)

4.1 Sector overview

4.1.1 Overview of sector

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 1	NS	D
2H3	Other industrial processes (please specify in the IIR)	NO	NO	NO
2I	Wood processing	NE	NE	NE
2J	Production of POPs	NO	NO	NO

NFR code	Description	Method	AD	EF
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 2017

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, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn
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, 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

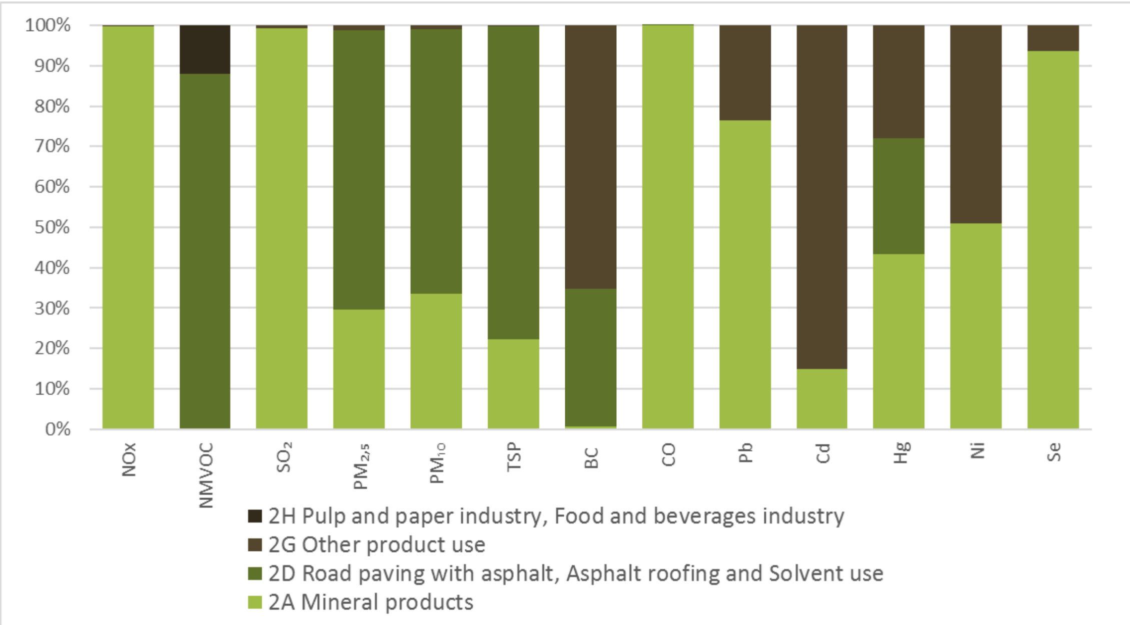

Figure 4.1 Emissions from Industrial processes and product use sector by subsectors in 2017

There are three main categories in IPPU sector – mineral production dominates in NO_x, SO_2, CO; Other solvent and product use dominates in NMVOC and particulate matter emissions and Mineral products 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.

Cement production sector is a key source category for Hg emissions with 14.7% from total Hg emissions in 2017.

The main share of total NMVOC emissions was contributed by Coating (2D3d) – 10.5% or 4.01 kt and Domestic solvent use (2D3a) – 3.8% or 1.45 kt.

4.1.3 Trends in emissions

Table 4.3 Change in emissions from Industrial processes and product use sector in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	0.910	0.243	0.233	0.470	0.597	1.137	1.714	1.672	1.901	1.970	1.410	1.750	92.3
NMVOC		13.090	10.885	10.564	10.349	9.243	10.699	10.254	10.613	10.917	11.309	10.653	10.809	-17.4
SO_2		3.570	0.943	0.933	1.481	0.205	0.425	0.495	0.240	0.215	0.255	0.104	0.085	-97.6
NH_3		0.010	0.009	0.009	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	-19.5
$PM_{2.5}$		0.684	0.384	0.574	1.140	1.017	1.016	0.996	0.879	0.880	1.053	0.857	0.743	8.6
PM_{10}		1.698	1.446	1.981	6.616	5.795	7.986	7.492	6.687	6.616	8.213	6.402	5.500	223.9
TSP		3.399	3.425	6.644	24.028	20.584	30.614	29.345	25.421	25.401	32.334	26.248	21.700	538.4
BC		0.013	0.007	0.017	0.033	0.027	0.031	0.033	0.026	0.027	0.036	0.035	0.028	114.2
CO		0.132	0.124	0.119	0.111	0.954	1.868	3.668	2.714	2.362	1.773	0.815	1.386	950.6
Pb	t	163.02	82.76	149.12	164.86	160.83	1.004	2.865	0.879	0.557	0.564	0.474	0.502	-99.7
Cd		0.454	0.235	0.411	0.453	0.473	0.076	0.217	0.065	0.040	0.044	0.036	0.037	-91.8
Hg		0.0154	0.014	0.014	0.013	0.025	0.024	0.110	0.037	0.016	0.020	0.036	0.027	77.0
As		16.301	8.274	14.895	16.459	16.078	0.052	0.071	0.028	0.0449	0.0478	0.0376	0.0394	-99.8
Cr		1.260	0.637	1.147	1.272	1.294	0.079	0.157	0.053	0.057	0.061	0.048	0.050	-96.0
Cu		0.180	0.098	0.254	0.321	0.234	0.086	0.126	0.100	0.100	0.071	0.091	0.098	-45.4
Ni		5.464	2.771	4.983	5.515	5.486	0.254	0.746	0.210	0.126	0.140	0.107	0.112	-98.0
Se		0.035	0.008	0.006	0.018	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	–
Zn		4.448	2.258	4.098	4.563	4.474	0.746	3.186	0.799	0.144	0.177	0.124	0.132	-97.0
PCDD/ PCDF	g I-teq	0.057	0.029	0.045	0.055	0.039	0.503	2.509	0.580	0.0004	0.038	0.0002	0.0002	-99.7
PAHs	kg	0.009	0.005	0.007	0.009	0.006	0.081	0.402	0.093	0.0005	0.006	0.0004	0.0005	-94.9
PCBs		NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.419	2.091	0.483	0.000	0.031	NO,NA	NO,NA	-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 reduction in purchase capacity which can be explained with decrease of population welfare. As a result, the activity in building and construction sector 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 2017 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 2016 submission 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.

In 2010-2017 CO emissions are fluctuating, from 2014-2016 the downward trend can be observed due to decrease in cement and glass production but in 2017 CO emissions are higher than 2016 because cement production is higher. 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 1990-2017 has mostly occurred due to the welfare of the economic state of the country. A slight decrease in emissions occurred between years 1990 and 2002. From 2002 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 2017 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 production processes:

- 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, BC and heavy metals 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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	0.9025	0.2372	0.2257	0.4635	0.5912	1.1126	1.6023	1.6444	1.8980	1.9658	1.4062	1.7470	93.6
NMVOC		0.1550	0.0420	0.0412	0.0724	0.0291	0.0333	0.0135	0.0145	0.0210	0.0170	0.0165	0.0147	-90.5
SO_2		3.4094	0.8960	0.8526	1.3919	0.1186	0.4140	0.4439	0.2273	0.2140	0.2538	0.1033	0.0848	-97.5
$PM_{2.5}$		0.2807	0.1191	0.0624	0.3357	0.3033	0.4241	0.3467	0.3701	0.3602	0.3730	0.1893	0.2064	-26.5
PM_{10}		1.1025	0.8752	0.3653	2.9386	2.7514	3.8793	3.0802	3.2001	3.0361	3.4443	1.7466	1.8398	66.9
TSP		2.3422	1.7412	0.6845	8.5676	8.0431	11.6618	9.0472	9.3558	8.8952	10.2908	4.7494	4.8433	106.8
BC		0.0043	0.0010	0.0009	0.0016	0.0005	0.0006	0.0007	0.0004	0.0006	0.0005	0.0004	0.0005	-89.0
CO		NA/NE	NA/NE	NA/NE	NA/NE	0.8525	3.5645	3.5645	2.6223	2.2661	1.6784	0.7120	1.2781	-
Pb	t	0.0741	0.0173	0.0125	0.0385	0.4676	0.4417	0.5184	0.2230	0.3989	0.4248	0.3343	0.3498	372.3
Cd		0.0057	0.0013	0.0010	0.0029	0.0358	0.0338	0.0396	0.0171	0.0305	0.0325	0.0256	0.0267	372.3
Hg		0.0001	0.0000	0.0000	0.0001	0.0128	0.0042	0.0569	0.0164	0.0043	0.0084	0.0248	0.0164	12445.4
As		0.0083	0.0019	0.0014	0.0043	0.0523	0.0494	0.0579	0.0249	0.0446	0.0475	0.0374	0.0391	372.3
Cr		0.0100	0.0023	0.0017	0.0052	0.0633	0.0598	0.0701	0.0302	0.0540	0.0575	0.0452	0.0473	372.3
Cu		0.0003	0.0001	0.0001	0.0002	0.0019	0.0018	0.0021	0.0009	0.0016	0.0017	0.0014	0.0014	372.3
Ni		0.0213	0.0050	0.0036	0.0111	0.1348	0.1273	0.1494	0.0643	0.1150	0.1224	0.0964	0.1008	372.3
Se		0.0349	0.0082	0.0059	0.0181	0.2201	0.2079	0.2439	0.1049	0.1877	0.1999	0.1573	0.1646	372.3
Zn		0.0161	0.0038	0.0027	0.0084	0.1018	0.0961	0.1128	0.0485	0.0868	0.0925	0.0728	0.0761	372.3

During the time period 1990-2017 NO_x, PM_{10}, TSP and heavy metal emissions from Mineral products were increasing. At the same time NMVOC, SO_2, $PM_{2.5}$ and BC emissions decreased. Emission trend in 2A sector is linked with economic situation in the country which influences demand for mineral products (Table 4.4).

In 2017 NO_x emissions have increased by 94% compared to 1990 but CO emissions increased by 50% in 2017 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 particulate matter PM_{10} and TSP increased by 67% and 107% accordingly but $PM_{2.5}$ emissions decreased by 26%. To reduce particulate matter emissions, all mineral producing plants are equipped with filters.

NMVOC emissions decreased by 91% in 2017 compared to 1990. 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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	0.902	0.237	0.226	0.358	0.492	1.017	1.517	1.539	1.795	1.864	1.305	1.672	85.2
NMVOC		0.154	0.040	0.038	0.061	0.008	0.011	0.011	0.011	0.011	0.009	0.007	0.009	-94.4
SO_2		3.409	0.896	0.853	1.354	0.075	0.374	0.388	0.171	0.153	0.191	0.064	0.067	-98.0
$PM_{2.5}$		0.120	0.032	0.030	0.048	0.019	0.001	0.002	0.023	0.025	0.019	0.010	0.014	-88.0
PM_{10}		0.341	0.090	0.085	0.135	0.029	0.002	0.004	0.034	0.038	0.029	0.014	0.022	-93.6
TSP		0.401	0.105	0.100	0.159	0.030	0.005	0.004	0.035	0.039	0.030	0.015	0.023	-94.4
BC		0.004	0.001	0.001	0.001	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002	0.0002	-93.3
CO		NE	NE	NE	NE	0.812	1.738	3.532	2.584	2.230	1.644	0.685	1.267	56.1
Hg	t	NE	NE	NE	NE	0.012	0.003	0.056	0.016	0.004	0.008	0.024	0.016	32.1

There is only one cement producing company "SIA CEMEX" in Latvia. 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 2017 NMVOC, SO_2, particulate matter and CO emissions have decreased (Table 4.5) compared to 1990 because all emissions are automatically measured by plant itself. TSP are weighted and returned in further production for different types of cement.

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. But in 2017 cement production increased by 25.9% compared to 2016. 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 2017, the enterprise has replaced its raw material supplier, so in 2017 Hg emissions decreased by 34.8% compared to 2016.

As of 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 2016.

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 production company 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%[13]. 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

[13] http://old.vpvb.gov.lv/ippc/atlauja/Aatl/Cemex_meiri.pdf (page 15)

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 2010-2017 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 2016[14] (marked as “Not Estimated”) the EFs from EMEP/CORINAIR 2007[15] 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
Wet Process Kiln	0.00135	0.00023	0.0051	0.00018	0.00051	0.0006

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 not weighed in cement production plant, but 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[16] under EU ETS (Figure 4.2).

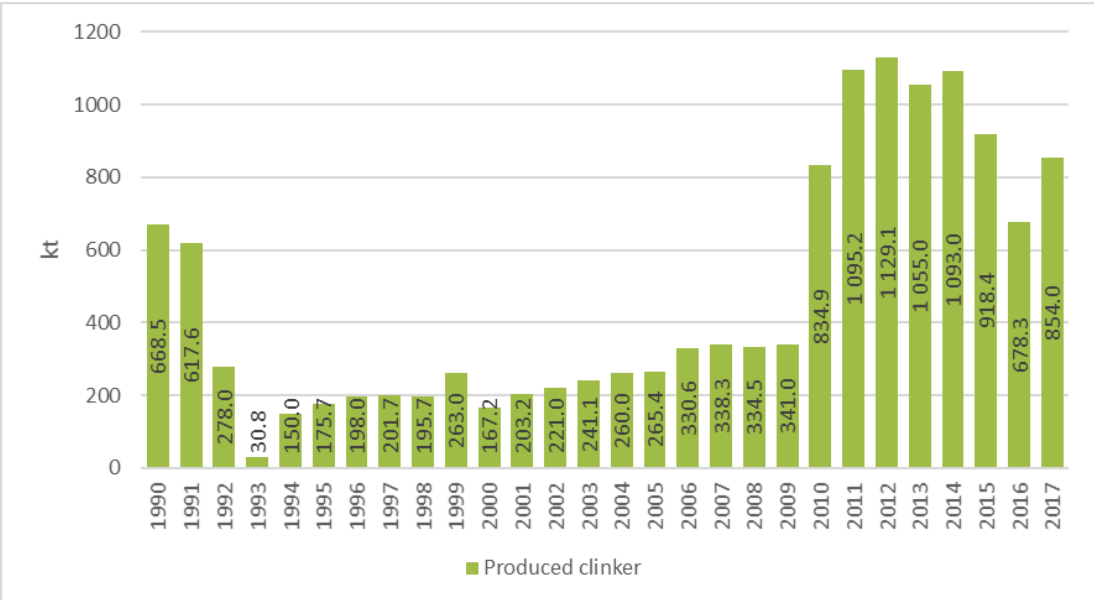

Figure 4.2 Cement production activity data in 1990-2017 (kt)

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:

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[14]https://www.eea.europa.eu/publications/emep-eea-guidebook-2016 (pages 11-12)
[15] http://www.eea.europa.eu/publications/EMEPCORINAIR5/B3311vs2.4.pdf/view (pages 12-13)
[16]http://www.vvd.gov.lv/izsniegtas-atlaujas-un-licences/seg-atlaujas/?company_name=cemex&org_id=&perm_date_from=&perm_date_to=&s=1

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

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 2019 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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
$PM_{2.5}$	kt	0.150	1.3E-02	5.5E-03	9.5E-05	2.6E-05	5.9E-06	1.6E-05	1.4E-05	2.4E-05	2.6E-05	NO	NO	-100
PM_{10}		0.750	0.06723	0.02763	0.00063	0.00017	0.00004	0.00011	0.00009	0.00016	0.00017	NO	NO	-100
TSP		1.928	0.17287	0.07105	0.00127	0.00034	0.00008	0.00022	0.00019	0.00031	0.00035	NO	NO	-100
BC		0.001	6.2E-05	2.5E-05	4.4E-07	1.2E-07	2.7E-08	7.6E-08	6.5E-08	1.1E-07	1.2E-07	NO	NO	-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). Since 1990 and compared to 2017 emissions from 2A2 sector have decreased by 100% (Table 4.7).

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 2016 for particulate matter and BC were used for 2005-2015. For 1990-2004 the uncontrolled EFs from EMEP/EEA 2016 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

	Used limestone, kt	Used dolomite (dry), kt
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

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.

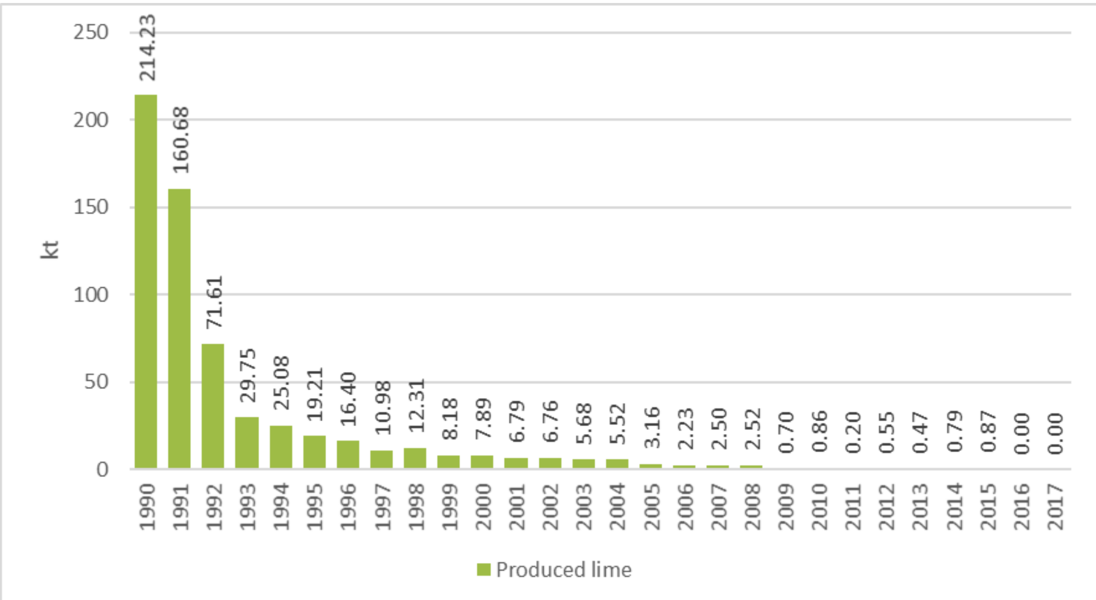

Figure 4.3 Lime production activity data in 1990-2017 (kt)

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[17]) 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 2019 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 1990-2017.

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 2016. In 1990-2004 CO, NO_x and SO_2 is NE because there is no available data from the national database "2-Air" and no EF from EMEP/EEA 2016. Since 2005 $PM_{2.5}$, PM_{10}, TSP, BC, CO, NO_x and SO_2 emissions are available from the national database "2-Air". Heavy metal emissions were reported 1990-2006 when the total produced glass amount was available, from 2007-2017 data was calculated from TSP emissions as it was suggested by TERT during 2018 NECD Comprehensive Review. Since 2007 only one glass production plant remained therefore activity data became confidential "C".

4.2.4.2 Trends in emissions

Table 4.10 Emissions from Glass production in 1990-2017

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NMVOC	0.0013	0.0016	0.0027	0.0114	0.0207	0.0224	0.0022	0.0040	0.0101	0.0078	0.0097	0.0061	380.2
CO	NE	NE	NE	0.0119	0.0410	0.0388	0.0323	0.0381	0.0361	0.0339	0.0275	0.0113	-5.4
NOx	NE	NE	NE	0.1052	0.0994	0.0953	0.0849	0.1053	0.1025	0.1021	0.1015	0.0753	-28.4
SO_2	NE	NE	NE	0.0384	0.0441	0.0403	0.0558	0.0568	0.0615	0.0632	0.0390	0.0180	-53.0
$PM_{2.5}$	0.0105	0.0024	0.0018	0.0101	0.0157	0.0148	0.0174	0.0075	0.0134	0.0142	0.0112	0.0117	12.2
PM_{10}	0.0118	0.0028	0.0020	0.0256	0.0396	0.0374	0.0439	0.0189	0.0338	0.0360	0.0283	0.0296	151.9
TSP	0.0131	0.0031	0.0022	0.0532	0.0825	0.0779	0.0915	0.0393	0.0704	0.0750	0.0590	0.0617	372.3
BC	0.0000	0.0000	0.0000	0.0002	0.0003	0.0003	0.0003	0.0001	0.0003	0.0003	0.0002	0.0002	3518.3

[17] 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

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
Pb	0.0741	0.0173	0.0125	0.0385	0.4676	0.4417	0.5184	0.2230	0.3989	0.4248	0.3343	0.3498	372.3
Cd	0.0057	0.0013	0.0010	0.0029	0.0358	0.0338	0.0396	0.0171	0.0305	0.0325	0.0256	0.0267	372.3
Hg	0.0001	0.0000	0.0000	0.0001	0.0008	0.0008	0.0009	0.0004	0.0007	0.0007	0.0006	0.0006	372.3
As	0.0083	0.0019	0.0014	0.0043	0.0523	0.0494	0.0579	0.0249	0.0446	0.0475	0.0374	0.0391	372.3
Cr	0.0100	0.0023	0.0017	0.0052	0.0633	0.0598	0.0701	0.0302	0.0540	0.0575	0.0452	0.0473	372.3
Cu	0.0003	0.0001	0.0001	0.0002	0.0019	0.0018	0.0021	0.0009	0.0016	0.0017	0.0014	0.0014	372.3
Ni	0.0213	0.0050	0.0036	0.0111	0.1348	0.1273	0.1494	0.0643	0.1150	0.1224	0.0964	0.1008	372.3
Se	0.0349	0.0082	0.0059	0.0181	0.2201	0.2079	0.2439	0.1049	0.1877	0.1999	0.1573	0.1646	372.3
Zn	0.0161	0.0038	0.0027	0.0084	0.1018	0.0961	0.1128	0.0485	0.0868	0.0925	0.0728	0.0761	372.3

In Latvia three glass producers were active 1990-2006. Since 2007 only one producer remained. 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 2017 all emissions from glass production have increased if compared to 1990 (with exception of NO_x, CO and SO_2) due to increase in the volume of production especially since 2007 till 2011. However, in 2017 NO_x, CO and SO_2 emissions have decreased compared to 2005.

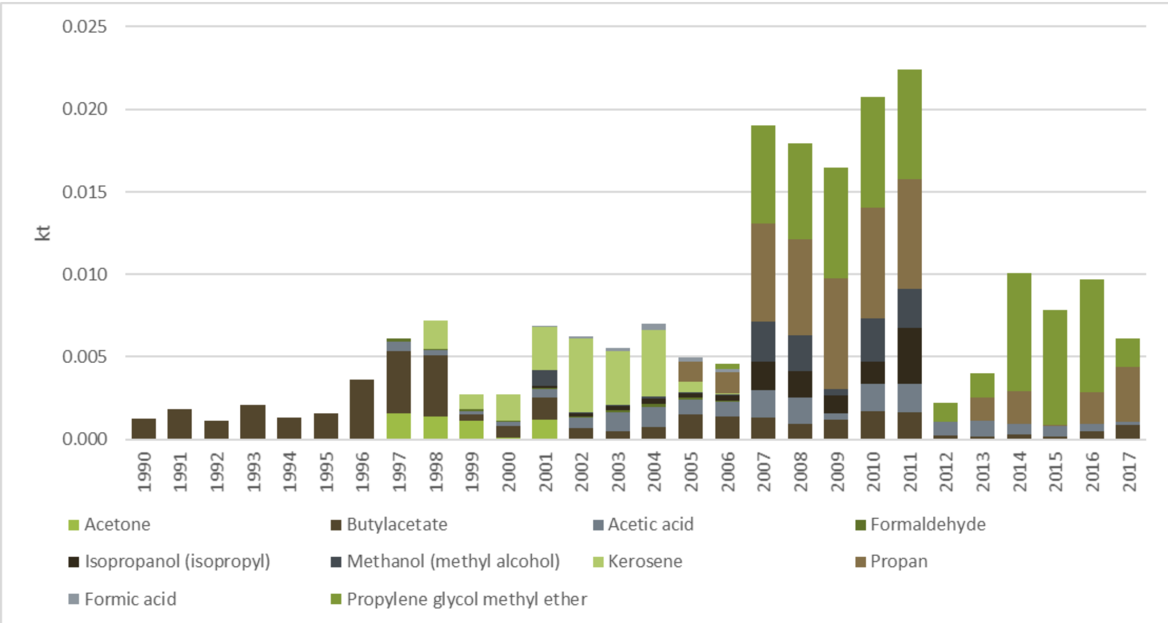

Figure 4.4 NMVOC emissions from glass fibre production in 1990-2017 (kt)

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 2017 butylacetate, acetic acid, propan (propyl alcohol) and propylene glycol methyl ether was used in glass fibre production in small amounts (Figure 4.4). NMVOC emission has decreased by 36.5% compared to 2016 due to a large reduction in used propylene glycol methyl ether.

4.2.4.3 Methods

EFs of particulate matter (1990-2004) and heavy metals (1990-2017) were taken from EMEP/EEA 2016 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 (1990-2017), EF from EMEP/EEA 2016 are used (Table 4.11). Particulate matter emissions (2005-2017) 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 1990-2017 (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	0.019	0.23	0.007	0.49	0.08	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.

Activity data for heavy metals are calculated from TSP emissions (2007-2017) and its emission factor as it was recommended by TERT during 2018 NECD Comprehensive Review.

NMVOC emissions from 1997 to 2017 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 were 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 2019 are made based on final completed NFR data table.

4.2.4.8 Recalculations

Heavy metals emissions are calculated from 2007-2017 based on TERT recommendation during 2018 NECD Comprehensive Review.

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 2018 submission.

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 1990-2017, kt

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1995-2017, %
$PM_{2.5}$	NA	0.07	0.03	0.06	0.07	0.08	0.08	0.08	0.08	0.08	0.07	0.09	19.4
PM_{10}	NA	0.72	0.25	0.65	0.73	0.84	0.79	0.83	0.76	0.77	0.70	0.85	19.4
TSP	NA	1.46	0.51	1.32	1.50	1.72	1.61	1.70	1.56	1.56	1.42	1.74	19.4

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 2017 compared to 2016 emissions from 2A5a sector have increased by 22% (Figure 4.5).

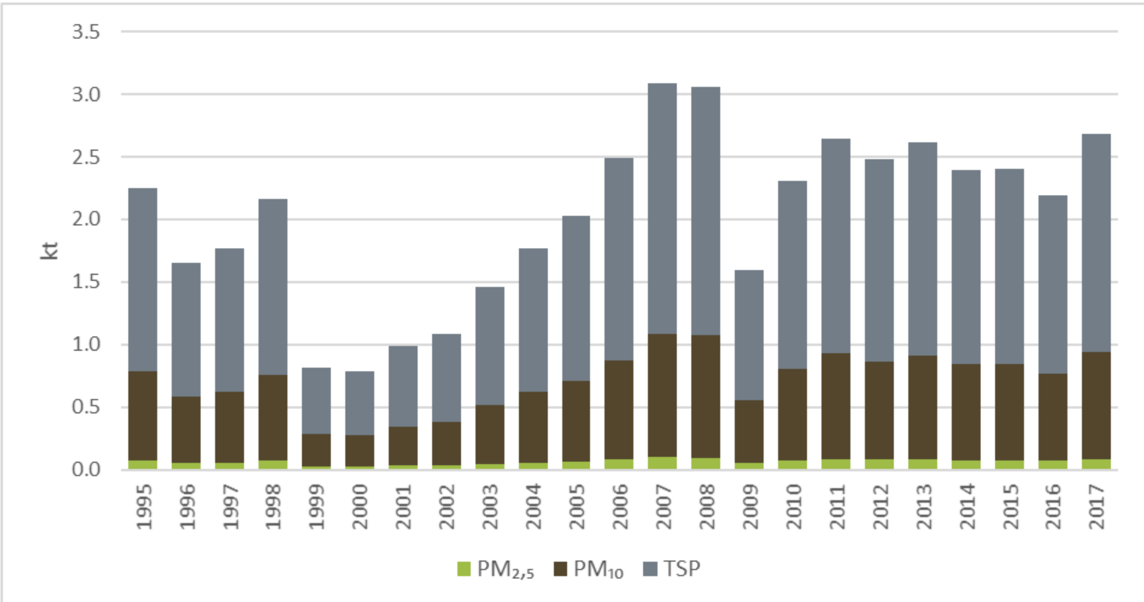

Figure 4.5 Particulate matter emissions from quarrying of minerals in 1995-2017 (kt)

4.2.5.3 Methods

Tier 1 approach from EMEP/EEA 2016 was used to estimate particulate matter emissions from quarrying of minerals in Latvia.

4.2.5.4 Emission factors

For 1995-2017 the EFs from EMEP/EEA 2016 were used to estimate particulate matter emissions (Table 4.13).

Table 4.13 Emission factors for quarrying of minerals in 1990-2017 (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)"[18].

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 2019 are made based on final completed NFR data table.

4.2.5.8 Recalculations

No recalculations were carried out.

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 in 2018 were calculated for the first time.

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 2016 – 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.

[18] https://data1.csb.gov.lv/pxweb/lv/vide/vide__vide__ikgad/VIG080.px

Table 4.14 Emissions from building and road construction in 1990-2017, kt

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 2005-2017, %
$PM_{2.5}$	NA	NA	NE	0.21	0.19	0.30	0.22	0.23	0.22	0.26	0.10	0.09	-57.7
PM_{10}	NA	NA	NE	2.13	1.95	2.96	2.20	2.27	2.16	2.58	0.97	0.90	-57.7
TSP	NA	NA	NE	7.03	6.43	9.79	7.27	7.51	7.16	8.58	3.21	2.97	-57.7

Particulate matter emissions from building construction are estimated in 2005-2017. Emission fluctuations can be associated with development of construction and building sectors in Latvia. Biggest share of these sector emissions come from road construction.

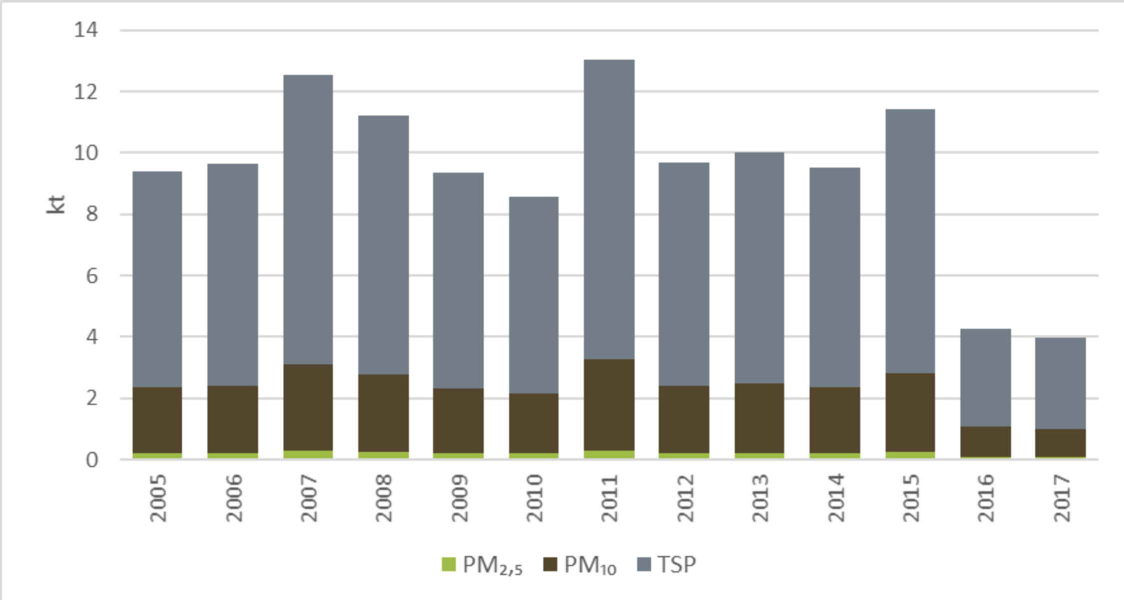

Figure 4.6 Particulate matter emissions from building and road construction in 2005-2017 (kt)

In 2017 and 2016 the amount of emission is similar but in 2017 compared to 2015 emissions from 2A5b sector decreased by 65.1% because no new roads were constructed in 2017 whereas in 2015 the maximum length of newly constructed roads was achieved due to increased funding for state road programs from state consolidated budget and EU (Figure 4.6).

4.2.6.3 Methods

Tier 1 approach from EMEP/EEA 2016 was used to estimate particulate matter emissions from building and road construction.

4.2.6.4 Emission factors

For 2005-2017 the EFs from EMEP/EEA 2016 were used to estimate particulate matter emissions (Table 4.15).

Table 4.15 Emission factors for building and road construction in 1990-2017 (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"[19]. 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.

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 2019 are made based on final completed NFR data table.

4.2.6.8 Recalculations

No recalculations were carried out.

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 2018 submission.

As the cement, lime and glass are being produced in Latvia, emissions from storage, handling and transport of minerals shall be assessed 1990-2017. Prior to 2011 emissions from particulate matter for categories 2A1, 2A2 and 2A3 are calculated using EMEP/EEA Guidebook 2016 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 Guidebook). 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 1990-2017

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 2011-2017, %
$PM_{2.5}$	IE	IE	IE	IE	IE	0.028	0.028	0.029	0.029	0.005	0.002	0.005	-82.8%
PM_{10}	IE	IE	IE	IE	IE	0.039	0.041	0.040	0.040	0.035	0.035	0.034	-12.5%
TSP	IE	IE	IE	IE	IE	0.068	0.069	0.070	0.072	0.044	0.044	0.043	-37.1%

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

[19] https://www.csb.gov.lv/lv/statistika/statistikas-temas/buvnieciba-rupnieciba-tirdznieciba/buvnieciba/tabulas/bug040/izdoto-buvatlauju-skaits-un

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. Since then fluctuations have been small.

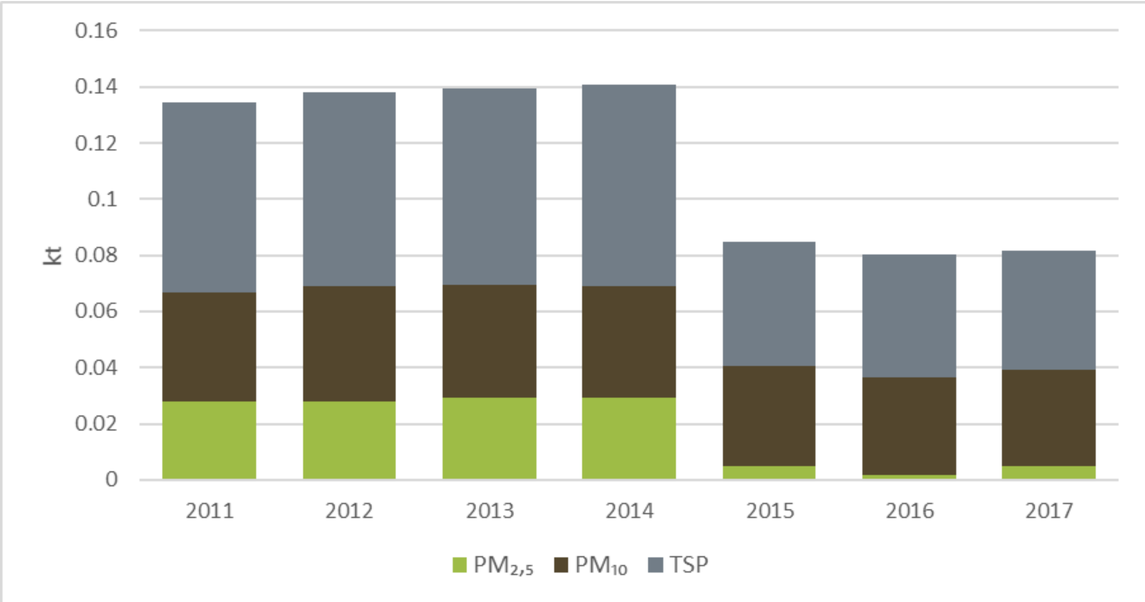

Figure 4.7 PM emissions from storage, handling and transport of mineral products 2011-2017 (kt)

4.2.7.3 Methods

In 1990-2010 Tier 1 approach from EMEP/EEA 2016 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 it is possible to use Tier 3 approach.

4.2.7.4 Emission factors

In the Tier 1 default approach according to EMEP/EEA 2016 Guidebook, 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 2019 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 2016 Guidebook were identified.

The biggest part of chemical industry is medicine production and smaller part - paint and varnishes production.

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

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 2016 Guidebook.

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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change from 1990 to 2017, %
NOx	kt	0.0037	0.0019	0.0030	0.0036	0.0029	0.0218	0.1087	0.0251	1.20E-05	0.0016	NO	NO	-100
NMVOC		0.0112	0.0057	0.0101	0.0112	0.0107	0.0077	0.0385	0.0089	4.26E-06	0.0006	NO	NO	-100
SO_2		0.0873	0.0443	0.0797	0.0881	0.0855	0.0101	0.0502	0.0116	5.55E-06	0.0007	NO	NO	-100
$PM_{2.5}$		0.3260	0.1655	0.2979	0.3292	0.3205	0.0035	0.0176	0.0041	1.94E-06	0.0003	NO	NO	-100
PM_{10}		0.4346	0.2207	0.3972	0.4389	0.4274	0.0040	0.0201	0.0046	2.22E-06	0.0003	NO	NO	-100
TSP		0.5433	0.2759	0.4965	0.5486	0.5342	0.0050	0.0251	0.0058	2.78E-06	0.0004	NO	NO	-100
BC		0.0078	0.0040	0.0071	0.0079	0.0077	0.00001	0.0001	0.00001	6.99E-09	0.000001	NO	NO	-100
CO		0.0006	0.0003	0.0005	0.0006	0.0005	0.0003	0.0014	0.0003	1.57E-07	0.0000	NO	NO	-100
Pb	t	162.94	82.73	148.94	164.56	160.25	0.436	2.175	0.502	2.4E-04	0.032	NO	NO	-100
Cd		0.436	0.221	0.398	0.440	0.428	0.034	0.167	0.039	1.85E-05	0.0025	NO	NO	-100
Hg		0.000	0.000	0.000	0.000	0.000	0.008	0.042	0.010	4.63E-06	0.0006	NO	NO	-100
As		16.292	8.272	14.893	16.454	16.025	0.003	0.013	0.003	1.39E-06	0.0002	NO	NO	-100
Cr		1.250	0.635	1.142	1.262	1.229	0.017	0.084	0.019	9.25E-06	0.0012	NO	NO	-100
Cu		0.163	0.083	0.149	0.165	0.160	0.003	0.017	0.004	1.85E-06	0.0002	NO	NO	-100
Ni		5.436	2.760	4.967	5.489	5.342	0.117	0.586	0.135	6.48E-05	0.0087	NO	NO	-100
Zn		4.424	2.246	4.035	4.464	4.331	0.603	3.011	0.695	3.33E-04	0.0449	NO	NO	-100
PCDD/ PCDF	g i-Teq	0.057	0.029	0.045	0.054	0.039	0.503	2.509	0.580	2.78E-04	0.0374	NO	NO	-100
PAHs	t	0.009	0.004	0.007	0.008	0.006	0.080	0.401	0.093	4.44E-05	0.0060	NO	NO	-100
PCBs	kg	NA	NA	NA	NA	NA	0.419	2.091	0.483	2.31E-04	0.0312	NO	NO	-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 Russia 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 95% and BC emissions decreased by 99% 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 2016 submission. PCBs emissions are applicable only from 2011 as all crude steel is produced in EAF. 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 2016 (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 2016 for OHF technology. Particulate matter and heavy metal EFs are taken from EMEP/EEA 2016. 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 2016 are applicable. After 2011 all crude steel was produced in EAF and EFs applicable to this production technology are taken from EMEP/EEA 2016. According to EMEP/EEA 2016, 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	EF for 1990-2010	EF for 2011-2015
NO_x	kt/kt	0.0051	0.00013
NMVOC		0.00002	0.000046
SO_2		0.00016	0.00006
$PM_{2.5}$		0.0006	0.000021
PM_{10}		0.0008	0.000024
TSP		0.001	0.00003
BC	% of $PM_{2.5}$	2.4	0.36
CO	kt/kt	0.000001	1.7E-09
Pb	t/t	0.0003	0.0000026
Cd		0.0000008	0.0000002
Hg		0.00000005	0.00000005

	Unit	EF for 1990-2010	EF for 2011-2015
As		0.00003	0.000000015
Cr		0.0000023	0.0000001
Cu		0.0000003	0.00000002
Ni		0.00001	0.0000007
Zn		0.00001	0.0000036
PCDD/F		6.7E-08	0.000003
Total 4 PAHs		0.01	0.00000048
PCB		NA	0.00000025

4.4.5 Activity data

Activity data was taken from the CSB and metal plant`s GHG report under EU ETS [20] (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 1990-2017 (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.

[20] *http://www.vvd.gov.lv/izsniegtas-atlaujas-un-licences/seg-atlaujas/?company_name=KVV+Liep%C4%81jas+metalurgs&org_id=&perm_date_from=&perm_date_to=&s=1*

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.

Uncertainty of emission factors taken from EMEP/EEA 2016 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 Submission 2019 are made based on final completed NFR data table.

4.4.8 Recalculations

Recalculations were done for NOx, CO, NMVOC, SO_2, $PM_{2.5}$, PM_{10}, TSP, BC, Pb, Cd, As, Cr, Cu, Ni, Zn (1990-2010), PCDD/F (dioxins/ furans) and Total 4 PAHs (all time series) as well as PCBs (2011-2015) due to mistake in use of units of emission factors. Based on suggestion by TERT during 2018 NECD Comprehensive Review Hg was calculated (all time series).

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.

4.5.1.2 Trends in emissions

Table 4.19 Emissions from Other solvent and product use in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NMVOC	kt	12.923	10.837	10.512	10.265	9.203	10.658	10.202	10.590	10.896	11.292	10.636	10.795	-16.5
SO_2		0.073	0.003	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.001	-99.2
$PM_{2.5}$		0.077	0.100	0.213	0.475	0.394	0.589	0.632	0.505	0.520	0.679	0.668	0.536	592.8
PM_{10}		0.161	0.350	1.218	3.239	2.617	4.103	4.392	3.483	3.580	4.769	4.655	3.660	2172.8
TSP		0.514	1.408	5.463	14.912	12.007	18.947	20.273	16.059	16.506	22.043	21.499	16.857	3182.0
BC		0.001	0.002	0.009	0.024	0.019	0.030	0.033	0.026	0.026	0.035	0.034	0.027	3698.8
CO		0.131	0.123	0.119	0.099	0.101	0.092	0.103	0.091	0.096	0.094	0.103	0.108	-17.6

Other solvent and product use sector in 2017 covered 28.3% (10.8 kt) from the total Latvia's NMVOC emissions.

Since 1990, NMVOC emissions have decreased in the solvent sector by 0.8%. Categories where a decrease in NMVOC emissions has occurred in recent years include Domestic solvent use (other than paint application) (2D3a), Paint application (2D3d) (except year 2017), Degreasing (2D3e) and Chemical products (2D3g) (except year 2017). The fluctuation of NMVOC emissions in the period 1990-2017 has mostly occurred due to the welfare of the economic state of the country taking into account that Latvia is too small country. The slightly decrease in emissions occurred between years 1990 and 2005/2006. From 2005/2006 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 34.95% in comparison with 2007. As shown there is increase of NMVOC emissions during the later period of 2010 till 2015. In 2016 NMVOC emissions decrease by 6.14% in comparison with 2015. However, in 2017 NMVOC emissions of Solvent sector have increased by 1.64% in comparison with 2016 (Table 4.19).

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 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Trend in 1990-2017, %
NMVOC	kt	0.0015	0.0045	0.0116	0.0319	0.0257	0.0406	0.0434	0.0344	0.0353	0.0472	0.0461	0.0361	2285
$PM_{2.5}$		0.0393	0.0131	0.1559	0.4287	0.3449	0.5452	0.5833	0.4619	0.4747	0.6344	0.6186	0.4847	1133
PM_{10}		0.0967	0.2901	1.1608	3.1921	2.5679	4.0593	4.3428	3.4391	3.5345	4.7238	4.6059	3.6086	3631
TSP		0.4493	1.3477	5.4057	14.8656	11.9584	18.9037	20.2243	16.0156	16.4600	21.9982	21.4496	16.8049	3640
BC		0.0007	0.0021	0.0087	0.0239	0.0192	0.0304	0.0325	0.0258	0.0265	0.0354	0.0345	0.0270	3699
CO		0.0001	0.0002	0.0004	0.0011	0.0009	0.0014	0.0015	0.0012	0.0012	0.0016	0.0016	0.0013	1588

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

The main factor, which influences the road paving activities, is availability of funding for road construction. This caused sharp emission increase after Latvia joining the EU in 2004 when EU funding became available and the new highway "Via Baltica" was built. In 2017 emissions from road paving and asphalt roofing decreased by 22% compared to 2016 due to decreased amount of used asphalt.

4.5.2.3 Methods

EMEP/EEA 2016 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 2016. Due to lack of information about the technology Tier 1 EFs was implemented (Table 4.21). According to EMEP/EEA 2016 Tier 1, the 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	5.7
Road Paving with Asphalt	NE	0.000016	0.0004	0.003	0.014	0.013

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.[21] 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
1996	214.81	80%	20%	171.85	42.96
1997	225.00	80%	20%	180.00	45.00

[21] 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
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

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 estimations of emissions 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 2016 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 2019 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 2017 covered over 24.9% (9.45 kt) from the total Latvia's NMVOC emissions. From Solvent use sector the main share of total NMVOC emissions contributed Coating applications 42.4% or 4.01 kt and Other solvent use – 25.78% or 2.44 kt (Figure 4.9).

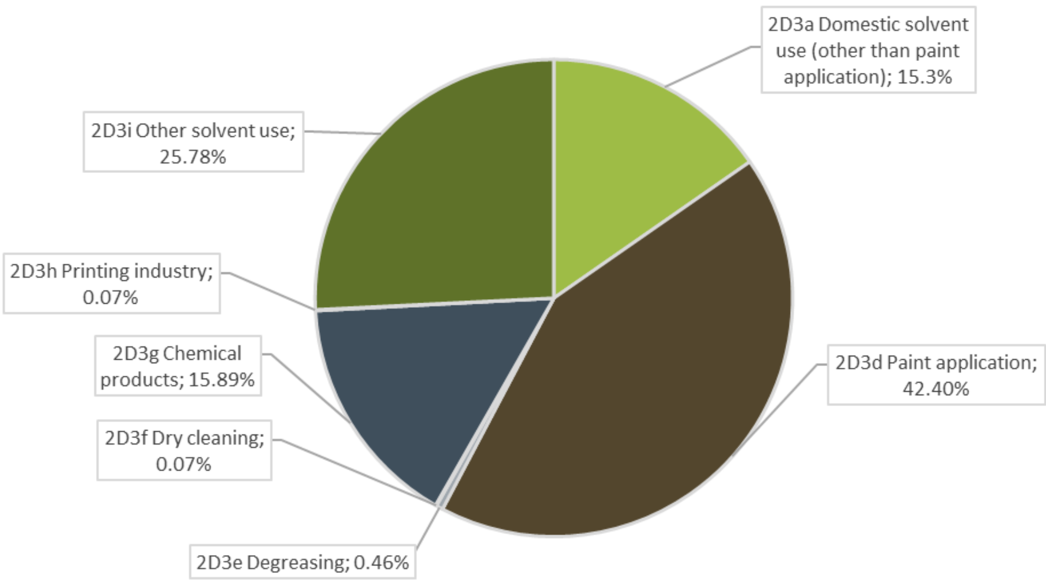

Figure 4.9 Distribution of NMVOC emissions in Solvent use sector in 2017 (kt)

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 product use* (NFR 2D3i) includes emissions from application of underseal treatment and conservation of vehicles, glues and adhesives, preservation of wood and other solvent use.

To divide the NMVOC containing products by NFR subsectors EMEP/EEA 2016 was used.

4.5.3.2 Trends in emissions

Solvent Use sector in 2017 covered 24.9% (9.45 kt) from the total Latvia's NMVOC emissions. Since 1990, NMVOC emissions have decreased in the solvent sector by 0.84%. Categories where a decrease in NMVOC emissions has occurred in recent years include Domestic solvent use (other than paint application) (2D3a), Paint application (2D3d) (except year 2017), Degreasing (2D3e) and Chemical products (2D3g) (except year 2017). The fluctuation of NMVOC emissions in the period 1990-2017 has mostly occurred due to the welfare of the economic state of the country. The slight decrease in emissions occurred between years 1990 and 2005/2006. From 2005/2006 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 decreased by 35.05% in comparison with 2007. As shown there is increase of NMVOC emissions during the later period of 2010 till 2015. In 2016 NMVOC emissions increased by 15.76% in comparison with 2005. The most increase were applied to 2D3i Other solvent use and 2D3e Degreasing subsector. In 2017 NMVOC emissions of Solvent sector have increased by 1.66% in comparison with 2016. The most increase were applied to 2D3d Coating applications and 2D3i Other product use subsector (Table 4.23).

For category 2D3a Domestic Solvent use including fungicides first time Hg emissions are reported, taking into account the availability of Hg emission factor from fluorescent tubes in the 2016 EMEP/EEA Guidebook. As shown in Table 4.23 Hg emissions have decreased by 27.21% in comparison with 1990 and by 1.36% in comparison with 2016.

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 1990-2017, kt

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
Domestic solvent use including fungicides (NMVOC)	1.89	1.77	1.68	1.59	1.03	1.41	1.41	1.49	1.66	1.82	1.68	1.45	23.23
Domestic solvent use including fungicides (Hg)	0.015	0.014	0.013	0.013	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	-27.21
Coating applications (NMVOC)	5.09	4.77	4.54	4.29	4.51	3.91	4.11	4.90	4.40	3.90	3.81	4.01	21.28
Degreasing (NMVOC)	0.04	0.03	0.03	0.03	0.03	0.07	0.07	0.06	0.05	0.04	0.05	0.04	-23.04
Dry cleaning (NMVOC)	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	70.46
Chemical products (NMVOC)	1.32	1.24	1.18	1.12	1.23	2.60	1.90	1.76	1.65	1.54	1.45	1.50	-13.55
Printing (NMVOC)	0.12	0.11	0.10	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	94.18
Other solvent use (NMVOC)	1.05	0.98	0.94	0.89	0.98	1.28	1.32	0.96	1.78	2.59	2.30	2.44	-132.13

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 2016 methodology based on Tier 1 or Tier 2 approach (Table 4.25).

NMVOC emissions (kt) from these subcategories of Solvent Use sector were calculated for the time series 2006-2017 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 2016*;

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" at Ltd. Latvian Environment, Geology and Meteorology Centre (LEGMC) for 2006-2017. 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 274 licences currently in force in Latvia (Category A – 6 licences, category B – 268 licences). From these enterprises data is used only from the enterprises that produced NMVOC emissions according to the EMEP/EEA 2016. The enterprises have been reporting their produced NMVOC emissions dividing in a particular NMVOC.

Hg emissions from 2D3a Domestic solvent use including fungicides were estimated according to EMEP/EEA 2016 methodology based on Tier 1 approach. Inhabitants were taken from database provided by CSB (Table 4.24).

Table 4.24 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

4.5.3.4 Emission factors

The NMVOC emission factors (Table 4.25) for Domestic solvent use including fungicides (2D3a), Paint application (2D3d) and Other solvent use (2D3i) are taken from the EMEP/EEA 2016.

Table 4.25 Approaches and emission factors for Solvent Use sector

NFR	Subcategories	Tier	EF	Unit	Subcategories
2D3a	2D3a_1	2	0.83	t/t solvent	Cosmetics and toiletries (all)
	2D3a_2	2	0.65	t/t solvent	Household products (all)
	2D3a_2_1	2	0.95	t/t solvent	Household products (soaps: liquid or paste, polishes and creams for floors, show polishes and creams)
	2D3a_3	2	0.95	t/t solvent	DIY/buildings (all), Adhesives, Paint/varnish removers and solvents
	2D3a_3_1	2	0.975	t/t solvent	DIY/buildings (sealants, filling agents)
	2D3a_4	2	0.94	t/t solvent	Car care products (all)
	2D3a_4_1	2	0.5	t/t solvent	Car care products (antifreeze agents in windscreen wiper systems)
	2D3a_5	2	0.865	t/t solvent	Pesticides
	2D3a_6	2	0.6	t/t product	Domestic use of pharmaceutical products
2D3d	2D3d_1	2	0.23	t/t paint applied	Paint application: construction and buildings
	2D3d_2	2	0.23	t/t paint applied	Paint application: domestic use
	2D3d_3	1	0.4	t/t paint applied	Coating applications: manufacture of automobiles
	2D3d_4	2	0.72	t/t paint applied	Paint application: car repairing
	2D3d_5	2	0.48	t/t paint applied	Paint application: coil coating
	2D3d_6	1	0.4	t/t paint applied	Coating applications: Boat building
	2D3d_7	2	0.8	t/t paint applied	Paint application: wood
	2D3d_8	1	0.4	t/t paint applied	Coating applications: Other industrial paint application
	2D3d_9	2	0.74	t/t paint applied	Other non industrial paint application
2D3i	2D3i_1	2	0.25	t/t solvent	Glass Wool Enduction
	2D3i_2	1	0.002	t/t product used	Fat, edible and non-edible oil extraction

NFR	Subcategories	Tier	EF	Unit	Subcategories
	2D3i_3	2	0.562		Application of glues and adhesives
	2D3i_4	2	0.945	t/t preservative (organic solvent-borne preservative)	Preservation of wood (Organic solvent-borne preservative)
	2D3i_5	2	0.005	t/t preservative (waterborne preservative)	Preservation of wood (Water-borne preservative)
	2D3i_6	2	0.342	t/t product	Other solvent and product use

For Hg under 2D3a Domestic solvent use including fungicides, no Tier 2 emission estimate is available for fluorescent tubes in accordance with the EMEP/EEA 2016. Therefore the Tier 1 emission factor (5.6 mg/person) for Hg emissions from this source is used.

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 2006-2017 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 4.26. As shown NMVOC emissions have decreased for all time series between 14.6% in 2013 and 30.65% in 2005.

Table 4.26 Share of export as percentage, calculated on NMVOC emissions

	Share of export as percentage, calculated from NMVOC emissions, %	Without export, last submission, kt	With export, kt
2006	23.86	10.52	8.01
2007	21.31	11.16	8.78
2008	28.44	9.60	6.87
2009	26.89	7.80	5.71
2010	19.17	9.64	7.80
2011	13.77	10.78	9.29
2012	14.65	10.34	8.82
2013	14.6	10.77	9.19
2014	15.19	11.27	9.56
2015	15.77	11.77	9.91
2016	18.03	11.35	9.30
2017	19.61	11.76	9.45

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 4.24).

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.

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 percent according to the IPCC 2006 Guidelines. Emission factor uncertainty is assumed to be ± 20% according to EMEP/EEA 2016, 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 2016, 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

NMVOC emissions from Solvent use sector were recalculated for all time series taking into account that estimation of exported NMVOC containing products from the country for the period 2006-2017 was carried out. Also the activity data for year 2016 was specified and therefore emissions were recalculated for this year.

According to Review Report first time Hg emissions from 2D3a Domestic Solvent use including Fungicides are estimated.

4.5.3.9 Planned improvements

It is planned to review submitted data for year 2017 in CR again to get more precise data considering that some enterprises have submitted their notifications with delay.

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, 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. Under this sector Lubricant use is reported (a residue from transport sector (non energy use)). There are no emission factors in EMEP/EEA 2016, therefore emissions cannot be calculated.

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 4.27).

Table 4.27 Emissions from Other product use sector in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NO_x	kt	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	-18.4
NMVOC		0.012	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	-19.5
SO_2		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	2374.8
NH_3		0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.008	-19.5
$PM_{2.5}$		0.064	0.060	0.060	0.050	0.050	0.040	0.050	0.040	0.050	0.050	0.050	0.052	-19.5
PM_{10}		0.064	0.060	0.060	0.050	0.050	0.040	0.050	0.040	0.050	0.050	0.050	0.052	-19.5

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
TSP		0.064	0.060	0.060	0.050	0.050	0.040	0.050	0.040	0.050	0.050	0.050	0.052	-19.5
CO		0.131	0.120	0.120	0.100	0.100	0.090	0.100	0.090	0.090	0.090	0.100	0.107	-18.5
Pb	t	0.006	0.010	0.160	0.260	0.110	0.130	0.170	0.150	0.160	0.110	0.140	0.152	2374.8
Cd		0.013	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.011	-17.3
Hg		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2374.8
As		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2374.8
Cr		0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	2374.8
Cu		0.016	0.020	0.100	0.160	0.070	0.080	0.110	0.100	0.100	0.070	0.090	0.097	491.0
Ni		0.007	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.011	65.1
Zn		0.008	0.010	0.060	0.090	0.040	0.050	0.060	0.060	0.060	0.040	0.050	0.056	557.4
PCDD/F	g I-Teq	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-19.5
PAH	t	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-19.5

4.5.4.3 Methods

Emissions from Use of fireworks and Tobacco combustion were calculated according to EMEP/EEA 2016 methodology and based on Tier 2 approach.

Emissions (kt) from Use of fireworks sector were calculated for the time series 1995-2017 and from Tobacco combustion for the time series 2003-2017 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 2016;
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 2016. In EMEP/EEA 2016 there are no emission factors for Lubricant use.

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 1995-2016 the quantity of used fireworks (CN code 3604) and for 1995-2017 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 1995-2017 and 2003-2017, respectively. Assuming that base year for NMVOC emissions for Use of fireworks is year 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 4.24).

4.5.4.6 Uncertainties

Emission factor uncertainty is assumed to be ± 20% according to EMEP/EEA Guidebook 2016, 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 1990-2017.

According to information from CSB currently there are no companies producing pulp or paper in processes described in the EMEP/EEA 2016 Guidebook 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 4.28 Emissions from Pulp and paper industry (NFR 2H1) and Food and beverages industry (NFR 2H2) production sectors in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NMVOC	kt	3.38	1.89	2.00	2.19	1.37	1.32	1.33	1.35	1.30	1.33	1.28	1.30	-62
SO_2		0.07	0.003	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-100

The biggest fluctuations in emissions were observed in 1991-1993 due to the change of economic situation in the country (Table 4.28). 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 5.99%, 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 2017 the NMVOC emissions constitute 1.30 kt which is 1.5% higher than in 2016 because of higher amount of beer and animal forage.

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 2016 was used to calculate emissions from Pulp and paper industry and Food and beverages industry.

4.5.5.4 Emission factors

NMVOC emission factors (Table 4.29) are taken from the EMEP/EEA 2016. 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 4.29 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
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 4.30). 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 2007-2017. The same situation with spirits since 2012.

Table 4.30 Activity data for 2H sector

	Pulp and Paper	Wine	Beer	Spirits	Meat, fish, poultry	Sugar	Cakes, biscuits, breakfast cereals	Bread	Animal feed
	kt	1000 hl	1000 hl	1000 hl	kt	kt	kt	kt	kt
1990	36.6	19.9	87.4	324.5	569.3	31	54.8	314	200
1991	44.7	197.5	1295.3	330	490.4	35	39.2	293	200
1992	30.8	179.8	858.9	259.3	281.6	39	22.1	240	200
1993	4.7	87.7	545.9	217.4	154	26	15.8	177.4	245.4
1994	0.2	134.2	637.9	314.8	95.6	15.8	22.7	161.5	174
1995	1.5	159.2	652.8	341.5	82.8	29.3	24.4	145.4	214.4
1996	1.5	154.7	644.9	379.6	100.5	31.2	13.1	137.1	206.2
1997	NO	114.7	714.8	456.4	129.1	41.2	16.9	132.1	205
1998	NO	99.6	721	417.4	110.9	64.9	18.1	124.8	203.3
1999	NO	65.9	953.2	416	166.9	66.5	20.8	121.5	144.5
2000	NO	68.9	945.1	269.5	197.3	62.8	24.3	121.1	173.8
2001	NO	52.5	996.6	168.5	244.6	56	24.4	123.1	184.9
2002	NO	56.8	1199.2	237.9	262.9	76.8	29	122.6	201.3
2003	NO	45.9	1336.6	226.6	264.4	74.9	37.3	124	201.4
2004	NO	59.7	1313.1	238.8	262.5	67	43.6	119.3	211.8
2005	NO	73.4	1293.3	308.2	243.8	71.1	53.6	116.3	248.6
2006	NO	77.1	1383	360.6	288.4	59.9	45	107.3	244.2
2007	NO	C	1414.3	232.5	286	NO	46.5	102.3	336.8
2008	NO	C	1333.8	220.7	297.7	NO	38.5	100.7	307.3
2009	NO	C	1292.4	180.1	253.5	NO	33.3	95.9	299.3
2010	NO	C	1484.9	177.7	242.2	NO	37.5	89.9	405.8
2011	NO	C	1626.6	166.5	261.5	NO	39.7	88.6	360.9
2012	NO	C	1488.5	C	264.3	NO	44.5	91.4	348.2
2013	NO	C	1513.7	C	286.2	NO	56.4	88.1	380.1
2014	NO	C	967.5	C	270.7	NO	50.4	84.9	379.5
2015	NO	C	887.8	C	260.4	NO	51.8	86.9	396.8
2016	NO	C	760.8	C	234.9	NO	58.4	82.9	389.7
2017	NO	C	845.9	C	235.7	NO	61.3	80.7	415.3

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 2007-2017 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 2016 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 2019 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.

5 Agriculture (NFR 3)

5.1 Sector overview

5.1.1 Overview

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 and crop cultivation;
• 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[22], CS[23]	NS[24]
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 1	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	NE		
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) and PAH (polycyclic aromatic hydrocarbons) emissions from agriculture sector are included in the submission 2019 report (Table 5.2).

[22] Default value from EMEP/EEA 2016 or 2006 IPCC Guidelines
[23] Country specific value
[24] National statistics

Table 5.2 Reported emissions in agriculture sector in 2017

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
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 (85%) in 2017. 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 11.8%, but for NMVOC emission – 19.8%.

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 2017, emissions from crop production and agricultural soils constituted 50.88% (7.14 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 emissions from manure management in 2017 reached 49.10% (6.89 kt). 96.07% (3.23 kt) of NOx emissions were reported from crop production and agricultural soils and 3.73% of emissions were linked to manure management.

In 2017, the largest part of NMVOC emissions were related to manure management – 85.86% (6.48 kt). Crop production and agricultural soils accounted for 13.83% (1.04 kt) of NMVOC. 56.93% (0.15 kt) of $PM_{2.5}$, 77.14% (1.18 kt) of PM_{10} and 61.62% (1.89 kt) of TSP emissions originated from crop production and agricultural soils, while 36.52% (0.10 kt) of $PM_{2.5}$, 21.47% (0.33 kt) of PM_{10} and 37.31% (1.15 kt) of TSP were related to manure management (Figure 5.1).

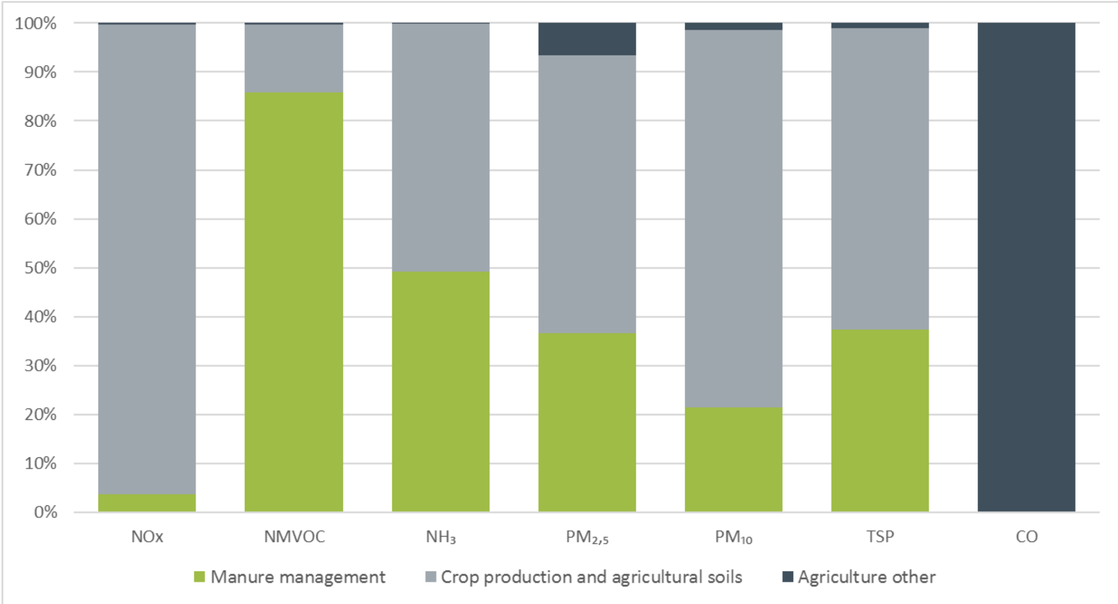

Figure 5.1 Distribution of emissions in Agriculture sector by subsectors in 2017 (%)

5.1.3 Trends in emissions

The NH_3 emissions from Agriculture have decreased by 59.58% over the period of 1990-2017 (Table 5.3). The general reason for this is transition to a market economy during 1991-1995, when the number of livestock in farms significantly decreased as well as the use of nitrogen fertilizers. In the recent years, it is possible to observe positive trends of mineral N fertilizer consumption due to increase of agriculture land use, expansion of crop production and number of livestock.

Table 5.3 Emissions from Agriculture sector in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Changes in 1990-2017, %
NOx	kt	8.78	2.05	2.10	2.82	3.57	3.56	3.82	4.07	4.31	4.33	4.37	4.43	-49.60
NMVOC		16.07	7.84	6.25	6.68	6.89	6.85	7.12	7.31	7.70	7.49	7.43	7.57	-52.90
NH_3		34.73	13.92	11.71	11.99	12.97	12.86	13.22	13.64	13.98	14.03	13.97	14.04	-59.58
$PM_{2.5}$		0.46	0.24	0.23	0.23	0.25	0.24	0.25	0.26	0.34	0.29	0.26	0.26	-42.75
PM_{10}		2.25	1.20	1.11	1.21	1.37	1.32	1.39	1.41	1.56	1.53	1.55	1.53	-32.31
TSP		6.03	2.93	2.56	2.82	3.03	2.91	2.99	3.05	3.16	3.06	3.07	3.07	-49.02
BC		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO		0.21	0.20	0.84	0.76	0.93	0.60	0.70	0.70	2.54	1.21	0.25	0.46	122.71
PCDD/ PCDF	g i-Teq	0.00	0.00	0.02	0.02	0.02	0.01	0.01	0.01	0.05	0.03	0.01	0.01	122.69
PAHs	t	0.01	0.01	0.06	0.05	0.06	0.04	0.05	0.05	0.18	0.08	0.02	0.03	122.70

The amount of PM, NMVOC and NO_x emissions depend on the number of produced animals and crops. In the time period 1990-2017, PM emissions have decreased by 32-49%. Similarly, emissions of NO_x and NMVOC have decreased by 49.60% and 52.90%, respectively (Table 5.3).

Emissions from grassland burning were determined according to EMEP/EEA 2016 and 2006 IPCC Guidelines. In Latvia it occurs 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 2007-2014 and 2014-2020.

The area of grassland burning was taken from the State Fire and Rescue Service – 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 2017, the majority of NH_3 emissions from manure management in different livestock categories were related to production of the dairy cattle (53.91%), swine (13.40%), non–dairy cattle (10.27%) and laying hens (7.17%) (Figure 5.2).

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. Emissions of PM occur also from free-range animals, but EMEP/EEA 2016 methodology has focused on housed animals.

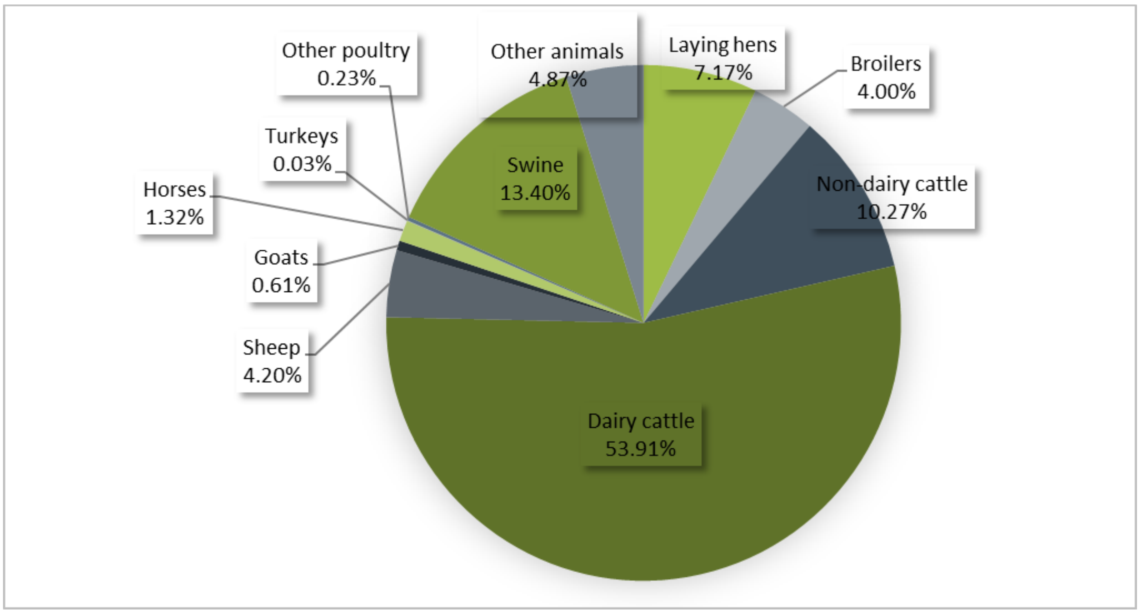

Figure 5.2 NH_3 emissions from manure management in 2017

5.2.2 Trends in emissions

Latvian livestock industry has been influenced by historical events and the changing economic situation[25]. As seen in Table 5.4, emissions from manure management has 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 67.0%, NO_x - 74.4%, NMVOC – 55.8%, $PM_{2.5}$ – 68.7%, PM_{10} – 65.3%, TSP – 67.0% over the period of 1990-2017 (Table 5.4).

Table 5.4 Trends in emissions from Manure management in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Changes in 1990-2017, %
NOx	kt	0.64	0.30	0.23	0.21	0.19	0.19	0.19	0.19	0.19	0.17	0.17	0.16	-74.4
NMVOC		14.65	7.02	5.41	5.75	5.86	5.86	6.10	6.26	6.48	6.37	6.34	6.48	-55.8

[25] 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

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Changes in 1990-2017, %
NH_3		20.91	9.78	7.46	7.33	7.06	6.95	7.02	7.10	7.18	7.03	6.90	6.89	-67.0
$PM_{2.5}$		0.31	0.15	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-68.7
PM_{10}		0.94	0.42	0.31	0.34	0.34	0.32	0.33	0.34	0.33	0.32	0.32	0.33	-65.3
TSP		3.48	1.47	1.13	1.21	1.24	1.18	1.19	1.22	1.19	1.15	1.13	1.15	-67.0

Predominant part of PM emissions is related to cattle, swine and poultry. The amount of emissions in the trend of PM emissions from 1990, depends on changes in the number of livestock due to significant changes in livestock industry (Figure 5.3).

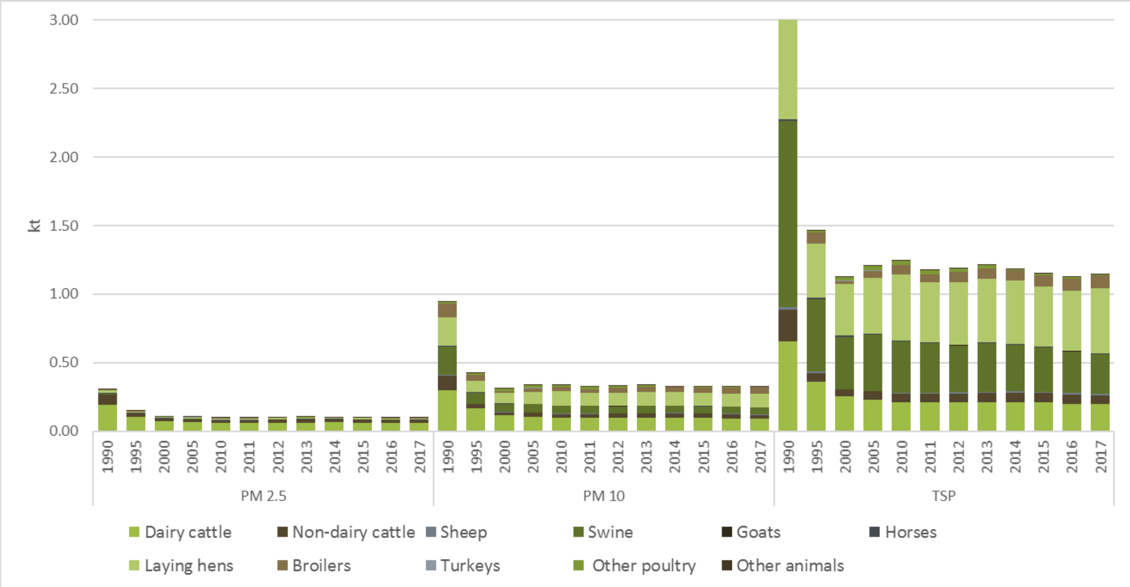

Figure 5.3 PM emissions from housing 1990-2017

In 2017, majority of PM emissions from manure management in different livestock categories were related to cattle, laying hens and swine. The biggest contributors for $PM_{2.5}$ emissions were dairy cattle – 60.02% (0.06 kt), non-dairy cattle – 20.28% (0.02 kt) and laying hens 7.82% (0.01 kt). The biggest contributors for PM_{10} emissions were laying hens – 30.72% (0.10 kt), dairy cattle – 27.17% (0.09 kt), swine – 14.71% (0.05 kt) and broilers– 14.07% (0.05 kt). Laying hens – 41.66% (0.48 kt), swine – 25.21% (0.29 kt) and dairy cattle – 16.99% (0.19 kt) constituted the major fraction of TSP emission.

All emissions related to manure management were strongly related to the livestock numbers. At the end of 2017, agricultural holdings were breeding 405.8 thousand cattle, which were by 6.5 thousand less than the year before, according to the information from Central Statistical Bureau (CSB)[26] of Latvia. The number of dairy cows fell by 3.6 thousand or 2.34%. Swine number decreased the numbers of fattening pig's by 6 thousand or 4.23% over the year, pigs in age below 4 months by 8.5 thousand or 5.07% and sows, boars by 1.4 thousand or 5.17%. Overall number of pigs decreased by 15.9 thousand or 4.73%. In 2017, the number of sheep and poultry continued to grow – by 5.6% and 4.93%, respectively. The number of fur animals increased by 55.1 thousand or 22.65% compared to 2016.

Trends in manure management of cattle time series show that the share of slurry-based systems increase. 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 show 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.

[26] The collection of statistics "Agriculture in Latvia" (2018). Available at https://www.csb.gov.lv/en/statistics/statistics-by-theme/agriculture/agricultural-prices/search-in-theme/321-agriculture-latvia-2018

5.2.3 Methods

Emissions calculations are based on EMEP/EEA 2016. Estimation Tier 2 (mass flow approach) is used for NH_3 and NOx emissions, which is described in the EMEP/EEA methodology. Calculations were done using MS Office 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. Emission 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) due to emission factor not available. Calculated NO emissions were converted to NO_2 due to the reporting requirements.

NMVOC emission estimations for sheep, swine, goats, horses, poultry and other animal livestock categories, except cattle, are based on Tier 1 methodology described in the EMEP/EEA 2016. Also, 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 NMVOC emission estimations were done by using Tier 2 methodology described in the EMEP/EEA 2016.

5.2.4 Emission factors

The emission factors used to estimate NH_3 emissions from manure management are default Tier 2 from EMEP/EEA 2016, 3B Manure management (Table 5.5). To estimate emissions from poultry deposited by grazing, emission factors are assumed as for housing conditions, because they are not available in EMEP/EEA 2016 guidebook.

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

Animal type	Manure type	EF housing	EF storage	EF spreading	EF grazing
Dairy cattle	slurry	0.20	0.20	0.55	0.10
	solid	0.19	0.27	0.79	
Other cattle	slurry	0.20	0.20	0.55	0.06
	solid	0.19	0.27	0.79	
Fattening pigs and young breeding sows	slurry	0.28	0.14	0.40	-
	solid	0.27	0.45	0.81	
Sows	slurry	0.22	0.14	0.29	-
	solid	0.25	0.45	0.81	
Sheep, goats	solid	0.22	0.28	0.90	0.09
Horses	solid	0.22	0.35	0.90	0.35
Laying hens	solid	0.41	0.14	0.69	0.41
Broilers	solid	0.28	0.17	0.66	0.28
Turkeys	solid	0.35	0.24	0.54	0.35
Ducks	solid	0.24	0.24	0.54	0.24
Geese	solid	0.57	0.16	0.45	0.57
Other poultry	solid	0.28	0.17	0.66	0.28
Fur animals	solid	0.27	0.09	NA	-

Emission factors used to estimate NOx emissions from manure management are the default values from EMEP/EEA 2016 (Table 5.6). Emission factors for pigs of age till 4 moths are estimated as weighted mean based on share of piglets of 8 kg[27] 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 (EF) 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 (EF) 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
Fattening pigs (8-110 kg)	-	0.551	0.551
Sows (and piglets to 8kg, boars)	-	1.704	1.704
Sheep	0.279	0.169	0.224
Goats	0.624	0.542	0.583
Horses	7.781	4.275	4.275
Layers	-	0.165	0.165
Broilers	-	0.108	0.108
Turkeys	-	0.489	0.489
Ducks	-	0.489	0.489
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	0.0000069
Non-dairy cattle	0.0002002	0.0000353	0.0000069

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 missions reported together with ducks and geese in 3B4giv Manure management - Other poultry.

The NH_3 emission calculations also include evaluation of emission reduction measures influence. Assumptions of emission reduction based on available statistical data and relatable national legal acts, defined to be respected by all farmers.

The estimation of emission reduction is linked to measures for dairy cattle and swine slurry storage. According to Regulations No 829[28] of the Cabinet of Ministers of Latvia, all animal housings must have slurry storages with at least natural coverage. Therefore, NH_3 emission reduction potential is included in the emission calculation and based on the Guidance Document on Control Techniques for Preventing and Abating Emissions of Ammonia recommendations it is set as 40%[29] for storage of slurry with natural crust or cover with straw, as implementation of it definitely occur in the largest farms, where is the biggest share of slurry based manure management. The biggest swine farms include more than 2000 places for fattening pigs and belongs to A category operators[30] (Table 5.8).

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

[28] *National regulations No 829 Regarding Special Requirements for the Performance of Polluting Activities in Animal Housing https://likumi.lv/ta/id/271374-ipasas-prasibas-piesarnojoso-darbibu-veiksanai-dzivnieku-novietnes*

[29] United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions, 24 March2015 https://undocs.org/ECE/EB.AIR/129

[30] *Law On Polution https://likumi.lv/ta/id/6075-par-piesarnojumu*

Table 5.8 Swine farm groups according to number of livestock

	Parameter	Other pig farms											A category operators	
		1	2	3-4	5-9	10-19	20-49	50-99	100 -199	200 -399	400-999	1000 -1999	2000 -4999	>=5000
2001	Farms	14154	20897	10931	5658	2771	1375	292	91	58	37	6	7	11
	Livestock	14154	41793	39592	39882	39746	41588	21281	13853	16498	21909	8026	19911	104220
2002	Farms	14117	21353	10948	5198	2822	1267	304	101	66	34	8	12	12
	Livestock	14122	42706	37465	32700	37786	39171	22886	16075	19124	18828	10135	35395	124436
2003	Farms	12548	19050	8860	4300	1970	1184	286	131	67	34	13	11	13
	Livestock	12548	38100	33881	27926	26775	35174	19275	18493	18692	19806	16527	37773	131501
2004	Farms	12310	16415	7854	3705	1854	955	277	151	70	31	11	10	14
	Livestock	12310	32830	26521	23910	24041	28470	17879	20216	18866	20372	16023	34474	154863
2005	Farms	10405	15945	7085	3174	1400	855	257	161	64	24	10	12	16
	Livestock	10405	31890	24176	19835	18501	26619	17756	23750	17806	15292	14328	38413	169147
2006	Farms	5975	9632	5486	2151	1138	676	199	112	60	29	15	13	20
	Livestock	5975	19264	18544	13557	15160	20723	13294	15489	15445	17458	19416	43984	194274
2007	Farms	6155	10470	4496	1595	959	591	225	116	57	28	11	11	22
	Livestock	6155	20940	15144	9737	12393	17336	15120	14742	15230	16898	16697	36890	213133
2008	Farms	3981	9635	6596	1104	642	365	99	69	38	16	14	12	18
	Livestock	3981	19270	22703	7162	8895	11731	7338	9246	10479	9978	20514	46778	205649
2009	Farms	2895	8883	7335	1004	659	333	131	68	23	21	7	11	19
	Livestock	2895	17766	24924	6529	8544	10139	8982	9260	6847	14214	10804	40788	214851
2010	Farms	5019	8538	4798	1110	609	386	106	57	28	14	15	11	21
	Livestock	5019	17076	16441	6970	8065	11939	7322	8072	8063	9139	20349	36378	234910
2011	Farms	3206	7549	2924	1659	636	402	192	75	26	18	8	12	17
	Livestock	3206	15098	10802	10936	7474	11358	13326	10173	7386	12047	12212	43793	217173
2012	Farms	2147	6548	3449	1471	551	243	136	68	18	13	8	10	18
	Livestock	2147	13095	12954	8902	6726	7370	8968	9553	4721	7729	12091	31796	229170
2013	Farms	2256	5718	2413	1287	528	166	135	49	19	16	7	10	18
	Livestock	2256	11437	8517	7861	6953	4579	9216	6907	5492	9815	9589	32832	252082
2014	Farms	2142	4086	1105	567	380	93	79	27	5	12	4	11	18
	Livestock	2142	8172	3838	3836	5160	2929	5248	4155	1317	7175	5440	34449	265571
2015	Farms	1569	2516	882	544	386	292	47	14	13	14	5	9	17
	Livestock	1569	5032	5099	5590	7858	8191	5747	1831	3026	8018	6599	33714	241885
2016	Farms	979	1322	1094	326	421	177	57	25	7	9	7	8	17
	Livestock	979	2644	3655	2168	5957	5434	3538	3639	2004	5396	10509	26351	264112
2017	Farms	895	1421	705	625	358	139	58	23	6	9	5	9	16
	Livestock	895	2842	2428	3742	4174	4329	3469	3190	1597	5395	7873	26072	254557

For dairy cattle there are included farms with more than 100 cows according to research of animal breeding technology parameters. Research results show that for dairy cattle marginal size of the herds at which the transition from obtaining of solid manure to slurry takes place is close to 100[31]. The influence of techniques on emissions is estimated by statistical data of animal distribution in different scale farms[32] (Table 5.9).

Table 5.9 Dairy cattle farm groups according to number of livestock

	Parameter	Small farms								Large farms		
		1	2	3 - 5	6 - 9	10-19	20-29	30-49	50-99	100-199	200-299	>=300
2002	Farms	39228	17984	9877	2442	1175	228	134	102	52	19	28
	Livestock	39228	35968	44470	19721	18240	6811	5697	7617	7730	4986	12656
2003	Farms	32469	15623	8793	2051	1376	377	190	124	53	20	32
	Livestock	32469	31246	36072	15419	18158	9022	7216	8565	7221	5040	13840
2004	Farms	32484	15246	8952	2273	1439	372	223	147	50	26	27
	Livestock	32484	30492	33978	16401	19112	8669	8220	9985	7021	6574	12288
2005	Farms	32185	14058	8268	2483	1704	396	240	148	51	28	33
	Livestock	32185	28116	29227	17557	21730	9263	8755	10065	6659	7006	14612
2006	Farms	22991	10655	5884	2038	1692	459	300	206	80	34	34

[31] Laurs A., Priekulis J., Markovics Z., Aboltins A. (2016) Research in farms animal breeding tehnological parameters. Engineering for rural development, Jelgava, 25. 27.05. 2016, pp 1054 -1058

[32] Agriculture, Forestry and Fishery. http://data.csb.gov.lv/pxweb/en/lauks/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8

	Parameter	Small farms								Large farms		
		1	2	3 - 5	6 - 9	10-19	20-29	30-49	50-99	100-199	200-299	>=300
	Livestock	22991	21310	22991	15478	24171	11701	11898	14755	11077	8627	15786
2007	Farms	19939	7045	5769	2406	2122	680	427	278	97	32	30
	Livestock	19939	14090	19948	16446	26262	15159	14757	17767	12583	8166	14302
2008	Farms	18823	6782	4965	2055	1641	501	393	270	95	27	40
	Livestock	18823	13564	18267	14819	21911	11927	14630	18486	13278	6721	17971
2009	Farms	17506	6176	4454	1901	1535	518	383	276	103	27	40
	Livestock	17506	12352	16382	13802	20594	12308	14338	18800	14138	6668	18623
2010	Farms	15855	5543	3784	1857	1578	512	408	291	104	31	41
	Livestock	15855	11086	13894	13409	21176	12200	15332	19892	14397	7538	19281
2011	Farms	14037	4805	3440	1824	1593	533	406	308	113	34	44
	Livestock	14037	9610	12706	13199	21439	12729	15234	20966	15201	8283	20692
2012	Farms	12529	4425	3341	1759	1583	527	432	308	117	40	43
	Livestock	12529	8850	12422	12768	21457	12537	16117	21046	15795	9718	21325
2013	Farms	10978	3929	3227	1710	1563	532	457	315	125	35	46
	Livestock	10978	7858	11962	12499	21028	12482	17069	21617	17037	8576	23905
2014	Farms	9752	3605	3030	1675	1549	532	451	312	128	42	49
	Livestock	9752	7210	11232	12230	20805	12687	17098	21418	17252	10024	26163
2015	Farms	8775	3230	2796	1644	1467	540	417	313	137	37	52
	Livestock	8775	6460	10398	11963	19873	12838	15872	21200	18480	8906	27649
2016	Farms	7643	2809	2437	1574	1432	463	400	306	131	41	50
	Livestock	7643	5618	9037	11419	19374	11075	15065	20758	17605	10016	26414
2017	Farms	6594	2425	2199	1503	1354	436	375	315	124	42	49
	Livestock	6594	4850	8193	10963	18323	10449	14123	21536	16945	10207	28172

Estimated reduction potential for dairy cattle and swine storage of slurry is summarized in Table 5.10.

Table 5.10 NH_3 reduction from storage of slurry (%)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dairy cows	-	26.8	29.2	27.8	29.5	35.5	32.0	33.4	32.9	32.1	32.0	31.7	31.6	32.1	29.7	29.4	29.5
Swine	22.3	25.2	25.4	27.3	28.9	32.7	33.3	35.1	35.1	35.0	34.0	34.9	35.9	38.9	36.4	37.7	37.8

It is stated that application of slurry has to be done within 12 h by national regulations No 834 of the Cabinet of Ministers of Latvia[33], therefore, in this category reduction of emissions is set to be 30%[27] for cattle and swine. Solid manure has to be incorporated within 24 h, and reduction rate by this activity is set to be 30 %[27]. Statistical data for dairy cattle distribution in farms is available only from 2002, but for swine also for 2001, which is the implementation time of legislation[34].

The calculation of PM and TSP emissions is based on EMEP/EEA 2016 methodology. Emission factors by type are shown in the Table 5.11.

Table 5.11 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
Sheep	0.140	0.060	0.020
Goats	0.140	0.060	0.020
Horses	0.480	0.220	0.140
Layers	0.190	0.040	0.003
Broilers	0.040	0.020	0.002

[33] *National regulations No. 834 Regulation Regarding Protection of Water and Soil from Pollution with Nitrates Caused by Agricultural Activity https://likumi.lv/ta/en/en/id/271376-regulation-regarding-protection-of-water-and-soil-from-pollution-with-nitrates-caused-by-agricultural-activity*

[34]*National regulations No. 531 Regulations regarding Protection of Water and Soil from Pollution with Nitrates Caused by Agricultural Sources* https://likumi.lv/ta/id/56960-noteikumi-par-udens-un-augsnes-aizsardzibu-no-lauksaimnieciskas-darbibas-izraisita-piesarnojuma-ar-nitratiem

	EF TSP	EF PM_{10}	EF $PM_{2.5}$
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 Database[35] of CSB of Latvia and statistical yearbooks[36]. 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[37].

Statistical information about the livestock number in Latvia is included in Table 5.12. 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 Central Statistical Bureau (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 only number of quail. Ostrich number is as well included in the group of other poultry from 2010 but the number is not significant.

Table 5.12 Number of livestock (thousand heads), 1990-2017

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
Dairy cows	535.1	291.9	204.5	185.2	164.1	164.1	164.6	165.0	165.9	162.4	154.0	150.4
Beef cattle under 1 year	257.7	47.2	22.2	26.3	23.6	21.9	26.1	26.8	35.5	36.4	37.3	35.7
Dairy cattle under 1 year	267.6	87.6	75.7	92.6	82.1	82.1	82.3	82.5	83.0	77.2	75.7	72.5
Beef cattle 1- 2 years old	88.6	17.8	10.7	17.0	13.4	12.5	15.7	20.9	20.2	21.4	21.8	20.2
Dairy cattle 1 - 2 years old	214.0	64.2	40.9	42.6	54.2	54.2	54.3	54.5	54.7	54.8	50.8	49.5
Cattle after 2 years old	76.4	20.7	12.7	21.5	42.2	46.0	50.1	56.9	62.9	66.9	72.8	77.5
Fattening pigs	759.2	287.7	191.7	175.7	156.3	144.8	141.5	142.6	151.7	155.4	141.7	135.7
Sows, boars	146.5	75.8	35.3	37.7	36.0	34.3	28.6	29.8	27.7	25.0	27.1	25.7
Pigs till 4 months	495.4	189.3	166.5	214.5	197.4	195.9	185.1	195.2	169.9	153.9	167.6	159.1
Sheep	164.6	72.2	28.6	41.6	76.8	79.7	83.6	84.8	92.5	102.3	106.6	112.2
Goats	5.4	8.9	10.4	14.9	13.5	13.4	13.3	12.6	12.3	12.7	13.2	12.8
Horses	30.9	27.2	19.9	13.9	12.0	11.5	10.9	10.7	10.1	9.6	9.3	8.9
Layers	5160.6	2071.2	1980.5	2121.8	2549.5	2315.9	2395.0	2430.5	2443.8	2335.3	2310.3	2515.1
Broilers	5089.3	2055.8	570.2	1365.0	1638.3	1417.7	1898.3	1906.4	1796.6	2035.9	2170.8	2303.5
Turkeys	10.1	10.1	12.5	15.1	1.0	1.1	1.4	1.7	2.0	3.1	18.1	3.3
Ducks	48.6	48.6	51.0	38.4	2.9	2.9	3.1	3.8	5.5	6.6	6.2	6.1
Geese	12.6	12.6	14.4	16.2	1.6	1.8	1.9	2.1	2.7	3.3	3.3	2.9
Other poultry	-	-	476.0	535.8	755.4	678.5	611.2	641.3	163.3	147.8	203.0	112.9
Fur animals	260.2	213.5	97.2	140.80	166.1	183.7	231.6	231.6	313.9	272.2	243.3	298.4

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 Gas Inventory and Reporting on Policies, Measures and Projections" under 2009-2014 EEA Grants

[35] Agriculture, Forestry and Fishery. http://data.csb.gov.lv/pxweb/en/lauks/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8
[36] The collection of statistics "Agriculture in Latvia" (2017). Available at http://www.csb.gov.lv/dati/e-publikacijas/latvijas-lauksaimnieciba-2017-45757.html
[37] 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

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 5.13 and Table 5.14. Detailed description of country specific Nex is available at Latvia Inventory Report 2018 and in previous submissions[38].

Table 5.13 Average N excretions (N, kg year^{-1}) per head of animal

<table>
<tr><th></th><th>Livestock category</th><th></th><th>N, kg year-1</th><th>Source</th></tr>
<tr><td rowspan="7">Non-dairy cattle sub-groups</td><td rowspan="2">Young cattle under 1 year</td><td>dairy cattle calves</td><td>15.7</td><td>National studies</td></tr>
<tr><td>beef cattle calves</td><td>18.5</td><td>National studies</td></tr>
<tr><td rowspan="2">Young cattle aged from 1 to 2 years</td><td>dairy cattle</td><td>24.7</td><td>National studies</td></tr>
<tr><td>beef cattle</td><td>26.4</td><td>National studies</td></tr>
<tr><td rowspan="3">Cattle after 2 years old</td><td>bulls</td><td>93.9</td><td>National studies</td></tr>
<tr><td>heifers</td><td>49.4</td><td>National studies</td></tr>
<tr><td>other cows</td><td>65.9</td><td>National studies</td></tr>
<tr><td colspan="3">Fattening pigs</td><td>14</td><td>National studies</td></tr>
<tr><td colspan="3">Sows, boars</td><td>27.6</td><td>National studies</td></tr>
<tr><td colspan="3">Pigs till 4 months</td><td>5.1</td><td>National studies</td></tr>
<tr><td colspan="3">Sheep</td><td>15.3</td><td>National studies</td></tr>
<tr><td colspan="3">Goats</td><td>15.8</td><td>National studies</td></tr>
<tr><td colspan="3">Horses</td><td>44.0</td><td>National studies</td></tr>
<tr><td colspan="3">Layers</td><td>0.55</td><td>National studies</td></tr>
<tr><td colspan="3">Broilers</td><td>0.35</td><td>National studies</td></tr>
<tr><td colspan="3">Turkeys</td><td>1.64</td><td>EMEP/EEA 2016</td></tr>
<tr><td colspan="3">Ducks</td><td>0.58</td><td>National studies</td></tr>
<tr><td colspan="3">Geese</td><td>1.12</td><td>National studies</td></tr>
<tr><td colspan="3">Other poultry</td><td>0.35</td><td>National studies</td></tr>
<tr><td colspan="3">Fur animals</td><td>4.60</td><td>EMEP/EEA 2016</td></tr>
</table>

Average N excretion data during the year for dairy cattle vary in all emission reporting period depending on productivity indicators (Table 5.14).

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

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
Dairy cows	85.77	84.74	99.62	104.00	106.56	107.11	108.17	109.64	110.52	108.80	111.78	113.91

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 were reduced for all livestock groups, except beef cattle. Most of the large livestock farms refuse from grazing to keep high productivity of animals and arrange resources in economically feasible way. Table 5.15 represents the share of each manure management system in 2017.

Table 5.15 Share of each manure management system per animal type (%), 2017

	Pasture	Solid storage	Slurry	Anaerobic digester
Dairy cows	6.1	44.1	36.0	13.8
Beef cattle under 1 year old	78.7	21.3	0.0	0.0
Dairy cattle under 1 year old	6.8	82.3	0.0	10.9
Beef cattle 1- 2 years old	78.7	21.3	0.0	0.0
Dairy cattle 1 - 2 years old	6.8	82.3	0.0	10.9
Cattle after 2 years old	78.7	21.3	0.0	0.0
Fattening pigs	0.0	6.9	56.6	36.5

[38] Latvia Inventory Report submissions https://www.meteo.lv/lapas/sagatavotie-un-iesniegtie-zinojumi?&id=1153&nid=393

	Pasture	Solid storage	Slurry	Anaerobic digester
Sows, boars	0.0	7.6	56.1	36.3
Pigs till 4 months	0.0	7.7	56.1	36.2
Sheep	29.4	70.6	0.0	0.0
Goats	10.1	89.9	0.0	0.0
Horses	21.2	78.8	0.0	0.0
Layers	3.3	26.5	0.0	70.2
Broilers	0.0	100.0	0.0	0.0
Turkeys	22.2	77.8	0.0	0.0
Ducks	23.6	76.4	0.0	0.0
Geese	21.7	78.3	0.0	0.0
Fur animals	0.0	100.0	0.0	0.0

NMVOC emission calculation for dairy and non-dairy cattle is based on Tier 2 approach of EMEP/EEA 2016. Feed intake values in MJ used for NMVOC emission calculation are calculated using IPPC 2006 methodology (Table 5.16).

Table 5.16 Feed intake values in MJ per year

	Dairy cattle	Young cattle	Adult cattle
1990	88168	29330	55803
1995	86267	28699	55825
2000	96435	27745	53880
2005	102604	27789	61061
2010	107976	28277	63445
2011	108541	28171	64328
2012	110134	28436	65486
2013	112335	28883	65743
2014	113824	28741	66569
2015	113407	29050	67679
2016	117665	28999	68536
2017	120879	28966	68686

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 2016.

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

Changes between last year's submission and this year submission resulted from:

- calculation of emissions for other poultry reported under 3B4giv due to an under-estimation in previous submissions;
- correction of the number of fur animals reported under 3B4h Other animals for years 2002, 2003, 2004, 2005, 2006, 2007 and 2010 according data of the CBS.

5.2.9 Planned improvements

It is planned to continue to quantify and prepare detailed documentations of abatement strategies for ammonia emissions to provide implementation of them in the inventory.

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.

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 5.17).

Table 5.17 Emissions from fertilizers, urine and dung deposited by grazing animals and crop production, 1990-2017 (kt)

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Changes in 1990-2017, %
NOx	kt	8.13	1.75	1.85	2.58	3.35	3.35	3.61	3.86	4.04	4.12	4.20	4.25	-47.8
NMVOC		1.40	0.80	0.76	0.86	0.95	0.93	0.97	0.99	0.99	1.01	1.06	1.04	-25.4
NH_3		13.82	4.14	4.25	4.66	5.90	5.90	6.20	6.53	6.78	6.99	7.07	7.14	-48.3
$PM_{2.5}$		0.15	0.09	0.09	0.10	0.12	0.12	0.13	0.13	0.14	0.15	0.15	0.15	3.2
PM_{10}		1.30	0.77	0.76	0.85	0.99	0.97	1.02	1.04	1.12	1.15	1.21	1.18	-9.4
TSP		2.54	1.45	1.37	1.56	1.72	1.70	1.75	1.79	1.79	1.82	1.92	1.89	-25.4

NH_3 emissions

In 2017, agricultural soils contributed 7.14 kt of NH_3. The main source of NH_3 emissions was application of inorganic N-fertilizers, contributing 54.2% or 3.87 kt of NH_3 emissions from agricultural soils. NH_3 emissions from application of inorganic N-fertilizers are reported in category 3Da1. NH_3 emissions from pastures (3Da3) had a share of 5.0% (0.36 kt). Application of manure (3Da2a), sludge (3Da2b) and other organic fertilizers (3Da2c) emitted 2.9 kt of NH_3 or 40.8% of total NH_3 emissions from agricultural soils. In 2017, the total emission of NH_3 from agricultural soils increased by 1.0%, compared to 2016. Emissions of NH_3 rose by 2.8% from pastures and by 153.7% from other organic fertilizers application; however NH_3 emissions decreased from manure application by 1.5%, from sludge application by 22.0% and by 1.1% of inorganic N-fertilizers application.

NO_x emissions

NO_x emissions from agricultural soils reached 4.25 kt in 2017. 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. 72.9% of NO_x emission formed from the use of inorganic N-fertilizers, 17.8% from manure application, 6.2% from pastures and 3.1% from sludge and other organic fertilizers application. Comparing to previous submission year, NO_x emissions increased by 1.2%. The most important source of emissions increase was other organic fertilizers (+153.7%) pastures (+3.0%) and application of animal manure to soils (+0.7%).

NMVOC and PM emissions

In 2017, agricultural soils contributed 1.04 kt of NMVOC (by 1.6% less than in 2016) emission in Latvia. The only source for NMVOC was emissions from cultivated crops (3De). Agricultural soils also contributed 1.89 kt, 1.18 kt and 0.15 kt of the total agricultural TSP, PM_{10} and $PM_{2.5}$ emissions, respectively. These emissions were reported in category 3Dc (Farm-level agricultural operations including storage, handling and transport of agricultural products). These emissions decrease by 1.6%, 2.7% and 2.3%, comparing to previous submission.

Trends of agricultural production

However, emissions from agricultural soils are increasing since 2000. This could be explained by an increase of area covered by crops and fertilizer use. NH_3 emissions rapidly increased in relation to inorganic N-fertilizer application. According to CSB information from Collection of Statistical Data the total sown area in 2017 was 1214.3 thousand ha, the number of total sown area decreased by 1.6% compared to 2016. In 2017, 703.5 thousand ha of land were covered with cereals – 12.5 thousand ha or 1.7 % fewer than a year before. Regardless the fact that sown area of cereals was reduced, the harvested production of cereals reached 2.7 million t, which is only 0.4 % less than in 2016. In 2017, compared to 2016, sown area of rape grew by 16.3 thousand ha or 16.1 %. As the average yield stayed at the level registered last year, the increase in the areas resulted in higher rape seed yield. The sown areas of pulses kept growing. In 2017, the total area of pulses increased by 15.6 thousand ha or 37.4 %. The rise was encouraged by the support payment for climate and environment-friendly farming practices or agricultural greening in 2015. Autumn of 2017 was unfavorable also to holdings producing potatoes and vegetables. Compared to 2016, in 2017 planted areas and harvested production of potatoes reduced by 2.6 % and 16.9 %, respectively. In 2017, 157.1 thousand t of vegetables were produced which is 20.1 % less than in 2016.

According to CSB information in 2017, 133.5 thousand t of mineral fertilizers (expressed as 100% of nutrients) were used on the sown area of agricultural crops – 0.6% less than in 2016. Use of mineral fertilizers per one hectare of sown area increased from 109 kg/ha in 2016 to 110 kg/ha in 2017 or by 0.9%. In 2017, use of nitrogen per one hectare of sown area increased slightly – from 63 kg/ha in 2016 to 64 kg/ha in 2017. Straight nitrogen fertilizers still were used very commonly, since their prices are significantly lower than those of complex mineral fertilizers. In 2017, the share of straight nitrogen fertilizers in the total volume of mineral fertilizers applied (in physical weight) constituted 48.8% (47.3% in 2016).

All statistical information is adopted from the collection of statistics "Agriculture in Latvia" (2018)[39] 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

Emissions calculation of NH_3 from inorganic N-fertilizer is based on the consumption data of different fertilizer types and related emission factors. Emissions 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 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 2016. NH_3 and NO_x emissions from crop production and agricultural soils are calculated using the following equation:

$$E_{pollutant} = AR_{nitrogen\ applied} \times EF_{pollutant}$$

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.

NMVOC and 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}).

[39] Agriculture in Latvia. Collection of Statistical Data. Rīga (2018) 74 p. Available at: https://www.csb.gov.lv/lv/statistika/statistikas-temas/lauksaimnieciba/lauksaimniecibas-cenas/meklet-tema/321-latvijas-lauksaimnieciba-2018

5.3.4 Emission factors

The default (Tier 1) emissions factors for NMVOC, TSP and NO_X were used for calculations as given in EMEP/EEA 2016 guidelines and the same emission factors are used for all years 1990-2017:

- 0.86 kg ha^{-1} for NMVOC;
- 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 2016 methodology. NH_3 emissions from inorganic N-fertilizers application for the period of 1990-2017 was calculated by using EF 0.05 (kg NH_3 kg^{-1} fertilizer N applied). NH_3 emissions from sewage sludge applied to soils was estimated by the default emission factor of sewage sludge taken from (EMEP/EEA 2016, Annex 1) as 0.13 kg NH_3 kg^{-1} fertilizer N applied. Emissions of NO_x are calculated by Tier 1 methodology according to the EMEP/EEA 2016. For all fertilizer types the default emission factor of 4% (i.e. 0.04 kg NO_2 per kg applied fertilizer-N) is used. For 1990-2017, emissions of PM 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 5.18.

Table 5.18 PM emission factors (EF) 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	0.49	0.19	0.56	0.015	0.02	0.009	0.168
Ray	0.25	0.37	0.16	0.37	0.015	0.015	0.008	0.111
Barley	0.25	0.41	0.16	0.43	0.015	0.016	0.008	0.129
Oat	0.25	0.62	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.

5.3.5 Activity data

Information regarding inorganic N-fertilizer use and the area covered by crops is provided by CSB of Latvia for the period of 1990-2017. The data about the use of N with inorganic fertilizers are included in Figure 5.4.

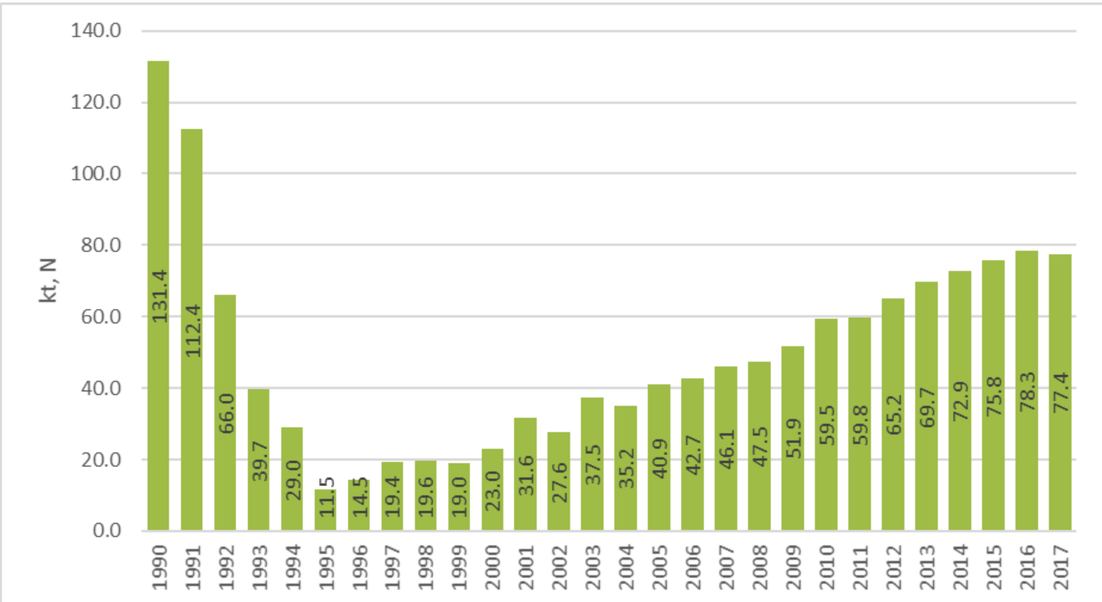

Figure 5.4 Used N with inorganic N-fertilizer (kt), 1990-2017

The area covered by crops for period 1990-2017 is represented in Figure 5.5.

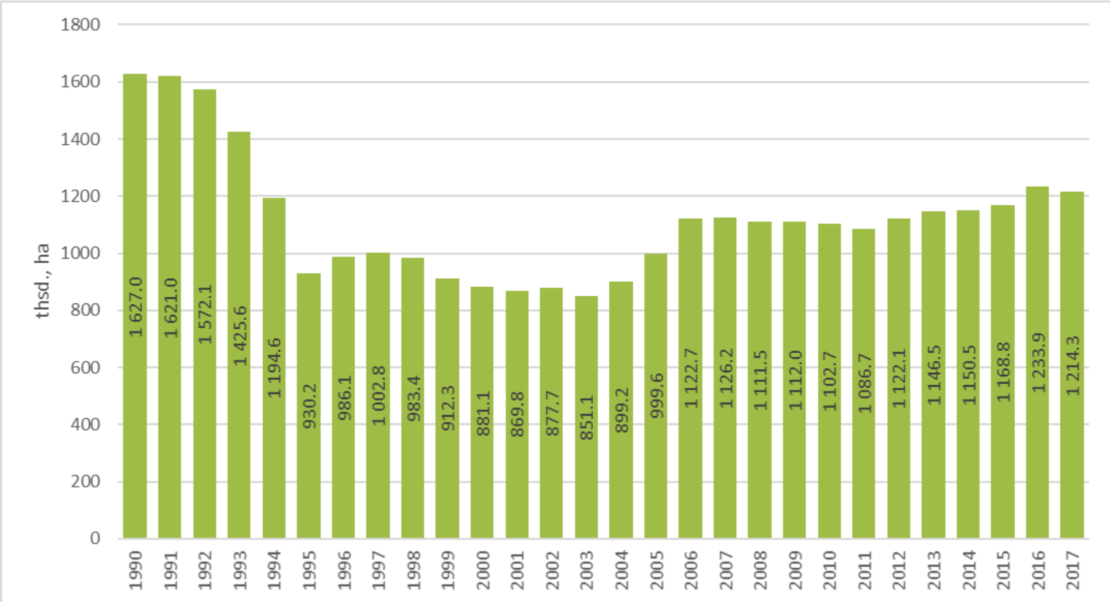

Figure 5.5 Area covered by crops (thsd. ha), 1990-2017

Data on the amount of sewage sludge applied to agricultural soils are provided by State Ltd "Latvian Environment, Geology and Meteorology Centre" (LEGMC), other data of organic N fertilizer applied to soils are obtained from CSB of Latvia. The amount of nitrogen in sewage sludge and other organic fertilizers is calculated based on available research projects outcomes[40;41]. Available data are represented in Figure 5.6.

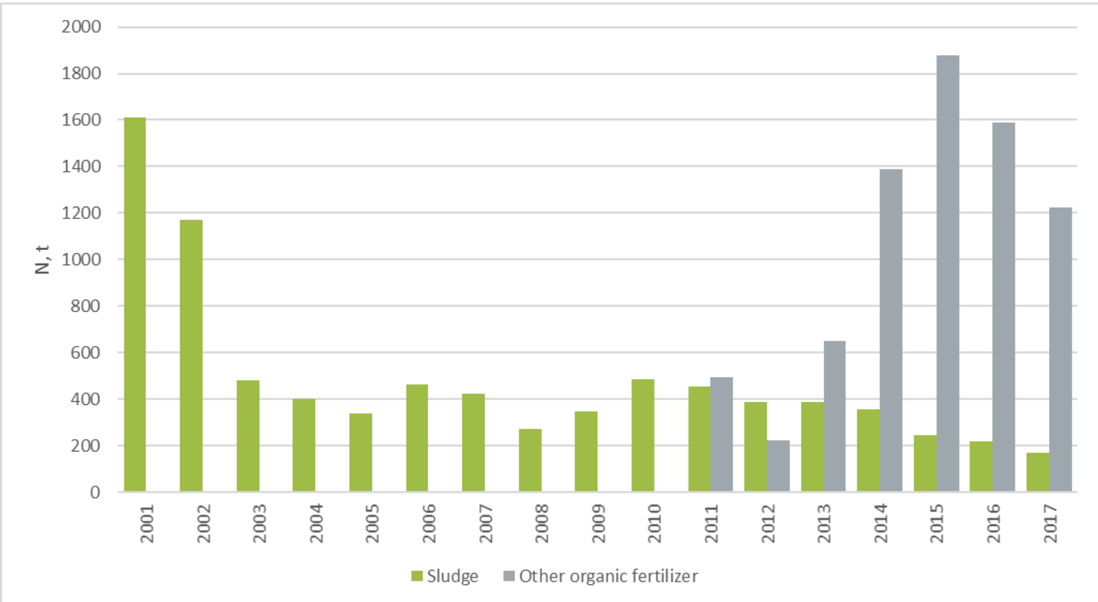

Figure 5.6 N in sewage sludge and other organic fertilizers applied to soils (t), 2001-2017

5.3.6 Uncertainties

The uncertainty associated with activity data is received from CSB of Latvia. Generally, the uncertainty of activity data provided by CSB of Latvia is set as 2%. Uncertainty of emission factors is no less than 50% for NH_3 emissions.

[40] Gemste I., Vucāns A. (2010) Notekūdeņu dūņas. Jelgava, LLU, 276 lpp.

[41] Litiņa I. (2013) Digestāta kā mēslošanas līdzekļa efektivitātes novērtējums kukurūzas sējumā. Zinātniski praktiskā konference LAUKSAIMNIECĪBAS ZINĀTNE VEIKSMĪGAI SAIMNIEKOŠANAI. Jelgava, LLU, 206-209 lpp.

5.3.7 QA/QC and verification

A sectorial expert performed assessment of trends. Statistical data are verified by CSB of Latvia.

5.3.8 Recalculations

Changes between last year's submission and this year submission resulted from calculation of emissions for other poultry reported under 3B4giv due to an under-estimation in previous submissions. It effected NOx emission reported in 3Da2a Animal manure applied to soils.

5.3.9 Planned improvements

Reporting will include final data of emissions from use of pesticides. Research activities regarding to evaluation of pesticide use in Latvia will be finished in 2019.

5.4 Other (NFR 3I)

5.4.1 Overview

Under category 3I Other NOx, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, 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 5.19 Emissions from grassland burning in 1990-2017

	Unit	1990	1995	2000	2005	2010	2015	2016	2017	Change in 1990-2017, %
NOx	kt	0.007	0.007	0.029	0.026	0.032	0.042	0.009	0.016	123
NMVOC		0.019	0.018	0.077	0.069	0.085	0.111	0.023	0.042	
SO_2		0.002	0.002	0.007	0.006	0.007	0.010	0.002	0.004	
NH_3		0.002	0.002	0.007	0.006	0.007	0.010	0.002	0.004	
$PM_{2.5}$		0.008	0.007	0.032	0.028	0.035	0.046	0.010	0.017	
PM_{10}		0.009	0.009	0.039	0.035	0.043	0.056	0.012	0.021	
TSP		0.015	0.014	0.060	0.054	0.066	0.086	0.018	0.033	
CO		0.207	0.196	0.844	0.756	0.931	1.215	0.253	0.461	
PCDD/F	g i-Teq	0.004	0.004	0.018	0.016	0.019	0.025	0.005	0.010	
PAHs	t	0.014	0.014	0.058	0.052	0.064	0.084	0.017	0.032	

Emission amount is directly dependent on the burned area of grassland (Table 5.19, Figure 5.7). 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 Riga. Concentration of wildfires in the south-east correlates with the area of abandoned farmlands. 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 15 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 2016 and IPCC 2006. Emissions from wildfires in grassland were calculated using equation 2.27 of the IPCC 2006. Mass of available fuel in grassland's fires – 2.1 t DM ha^{-1} (Table 2.4 of IPCC 2006), fraction of the biomass combusted 0.74 (Table 2.6 of IPCC 2006).

5.4.4 Emission factors

Emission factors for NO_x, CO, NMVOC, SO_2, NH_3, TSP, PM_{10} and $PM_{2.5}$ emission calculation regarding burning of grassland are shown in the Table 5.20 (EMEP/EEA 2016, 11.B Forest fires, Table 3-8). Information of condensable component inclusion in emission factors of PM is not provided by the EMEP/EEA 2016.

Table 5.20 Emission factors (EF) for grassland burning according to EMEP/EEA 2016

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

PAH emissions are calculated according to EMEP/CORINAIR Emission Inventory Guidebook, 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 5.7). 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.

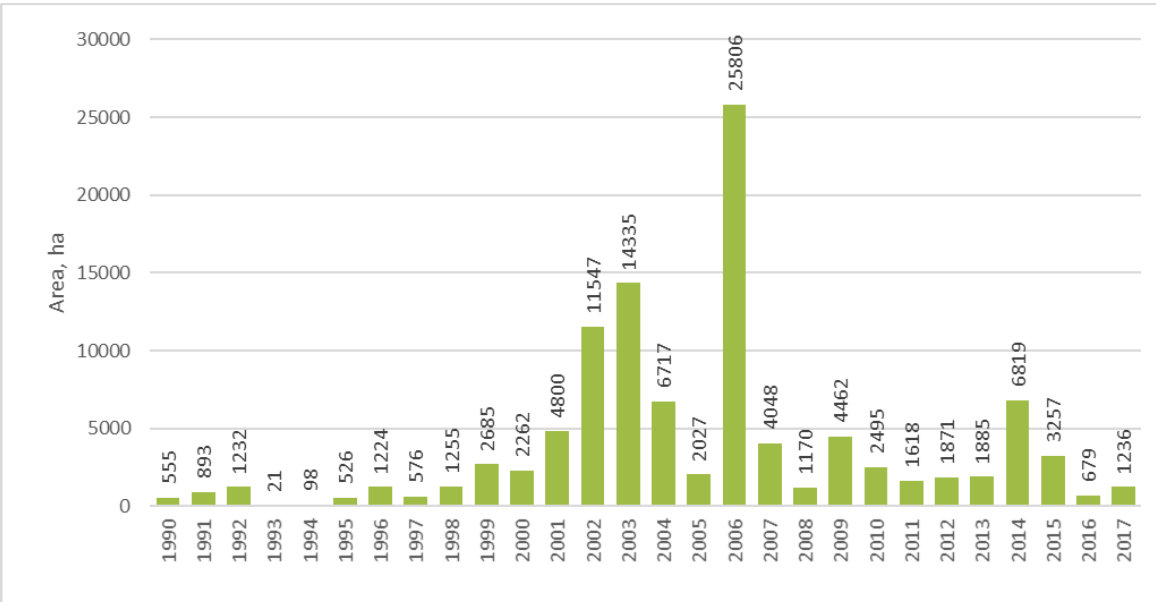

Figure 5.7 Area of last years grass burned (ha)

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 emission inventory guidebook 2016 (11.B Forest fires, Table 3-8) default values.

5.4.7 QA/QC and verification

Quality control procedures named in IPCC 2006 were done. Assessment of trends were performed. Land areas of wildfires burning were reviewed with latest statistics.

5.4.8 Recalculations

Recalculations are introduced due to improvement of activity data.

5.4.9 Planned improvements

No improvements are planned.

6 Waste (NFR 5)

6.1 Sector overview

6.1.1 Overview

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 11 non-hazardous waste polygons and 1 hazardous waste polygon have got A category 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 emissions 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	54.372	1474.832
2007	1386.57	41.605	1428.175
2008	1368.79	46.4	1415.16
2009	1033.91	55.563	1089.473
2010	1131.404	55.089	1186.493
2011	1535.057	58.476	1593.533
2012	1799.440	85.121	1884.561
2013	1902.007	109.23	2011.237
2014	2013.695	80.978	2094.673
2015	2087.507	86.603	2174.110
2016	1980.276	63.661	2043.937
2017	2141.214	68.756	2209.970

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 use, water resources use or mineral deposits quarry use, or IED permit.

Table 6.2 shows the methods and source for activity data and emission factors used for emission calculating 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	Tier1	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 2017

NFR code	Emissions
5A	NMVOC, $PM_{2.5}$,PM_{10} ,TSP
5B1	NH_3
5B2	NH_3

NFR code	Emissions
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	NH_3
5D3	NMVOC
5E	$PM_{2.5}$, PM_{10}, TSP, Pb Cd, Hg, As, Cr, Cu, PCDD/F

6.1.2 Key sources

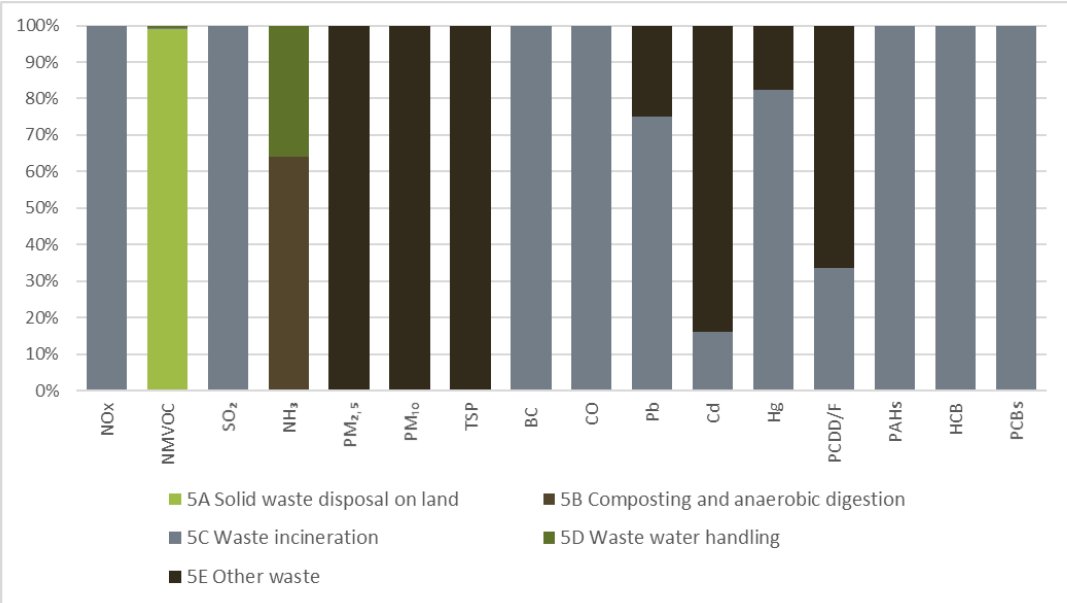

Figure 6.1 Distribution of emissions in Waste sector by subsectors in 2017 (%)

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

Emissions are increased since 1990 for NO_x and SO_2. It is due to cremation since 1994. NMVOC emission fluctuates through time series due to 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 1990-2017 (%)

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	0.00045	0.00100	0.00166	0.00168	0.00194	0.00182	0.00167	0.00179	0.00182	0.00202	0.00242	0.00303	565.0
NMVOC		0.711	0.826	0.943	0.957	0.948	0.859	0.828	0.836	0.791	0.788	0.554	0.363	-48.9
SO_2		0.00006	0.00013	0.00019	0.00024	0.00025	0.00025	0.00023	0.00025	0.00024	0.00028	0.00033	0.00041	597.1
NH_3		0.244	0.230	0.222	0.227	0.250	0.206	0.234	0.251	0.268	0.265	0.276	0.257	5.1
$PM_{2.5}$		0.22891	0.22891	0.22895	0.22896	0.22898	0.23564	0.24052	0.23354	0.24350	0.21678	0.20485	0.23688	3.5
PM_{10}		0.22899	0.22901	0.22907	0.22908	0.22910	0.23577	0.24065	0.23368	0.24363	0.21689	0.20492	0.23693	3.5
TSP		0.23051	0.23078	0.23018	0.23097	0.22947	0.23623	0.24119	0.23405	0.24402	0.21739	0.20519	0.23749	3.0
BC		0.00003	0.00004	0.00002	0.00004	0.00001	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000	0.00001	-64.9

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
CO	t	0.00023	0.00035	0.00065	0.00038	0.00044	0.00031	0.00028	0.00030	0.00040	0.00034	0.00041	0.00058	154.7
Pb		0.0062	0.0071	0.0051	0.0073	0.0018	0.0015	0.0019	0.0011	0.0016	0.0018	0.0013	0.0028	-55.3
Cd		0.00202	0.00214	0.00186	0.00218	0.00146	0.00148	0.00155	0.00141	0.00152	0.00142	0.00128	0.00164	-19.0
Hg		0.0049	0.0063	0.0055	0.0080	0.0050	0.0051	0.0051	0.0048	0.0052	0.0056	0.0060	0.0078	58.3
PCDD/F	g I-Teq	5.732	6.297	4.814	6.476	2.900	2.890	3.150	2.595	2.934	2.933	2.482	3.607	-37.1
PAHs	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29990.5
HCB	kg	0.0089	0.0104	0.0072	0.0109	0.0020	0.0016	0.0021	0.0009	0.0017	0.0022	0.0015	0.0034	-61.5
PCB		NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.0

Emission estimates 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 occurs 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 use, water resources use or mineral deposits quarry 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 disposed waste amounts.

6.2.2 Trends in emissions

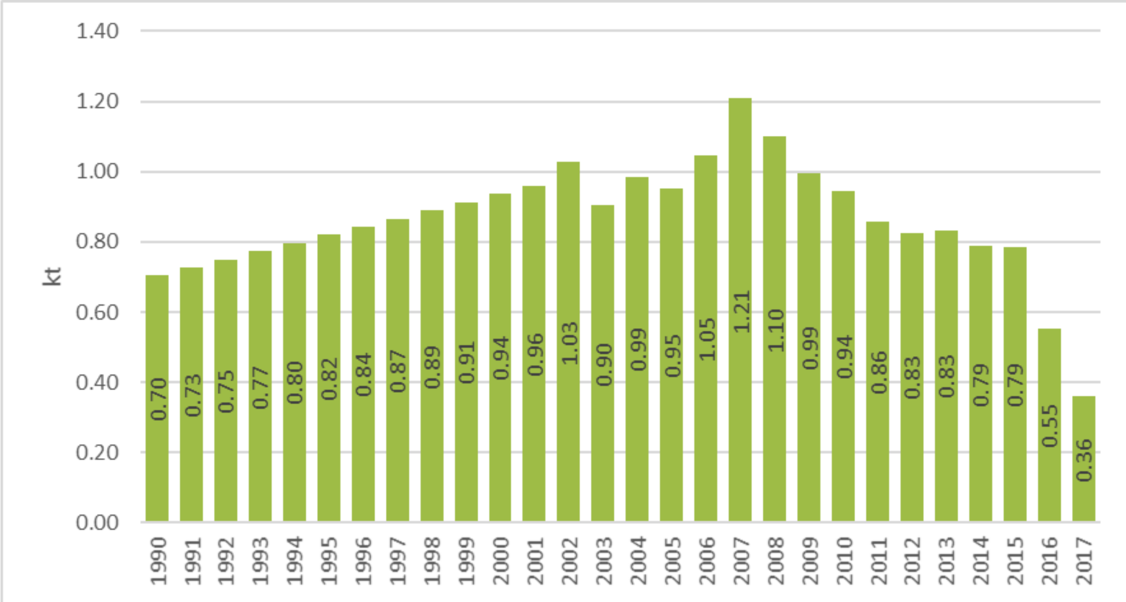

Figure 6.2 NMVOC emissions from Solid waste disposal (kt)

Emissions of NMVOC from solid waste disposal (Figure 6.2) correlate with CH_4 emissions, which are calculated according to UNFCCC requirements. These emissions mostly relate to disposed waste amount in landfills. In years 2016 and 2017 emissions decrease due to lesser amount of disposed waste in landfills.

6.2.3 Methods

NMVOC, $PM_{2.5}$, PM_{10}, TSP emissions from solid waste disposal are calculated. EMEP/EEA 2016 is used for emission calculations. To estimate NMVOC, $PM_{2.5}$, PM_{10}, TSP emissions from solid waste disposal, disposed amount is multiplied with 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 2016)

Pollutant	EF (unit/disposed waste)
NMVOC	1.56 kg/t
$PM_{2.5}$	0.033 g/t
PM_{10}	0.219 g/t
TSP	0.463 g/t

6.2.5 Activity data

To calculate NMVOC, $PM_{2.5}$, PM_{10}, TSP emissions - amount of disposed waste must be known.

Data about disposed amounts is taken from the waste statistical survey “3-Waste” (Figure 6.3).

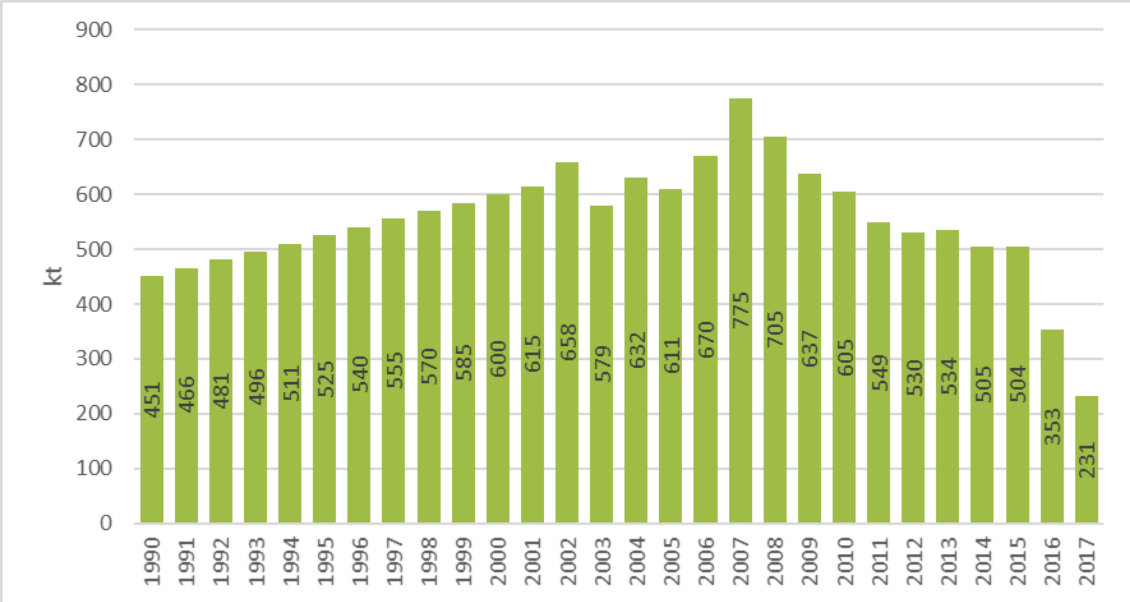

Figure 6.3 Disposed waste amounts in Latvia (kt)

Disposed amounts for 1990-2001 are estimated according to equal growth between 1975 and 2002. The base year for disposed amount estimation is 1975. According to research about Latvia landfills (LEGMC, 2016) disposed amount in 1975 was 227 152 tonnes. Data about waste disposal on land for 2002-2017 is taken from the database "3-Waste". Fluctuations in disposed waste amounts are due to economic growth in years 2007 and 2008. The disposed amount last year decreased due to waste recovery development.

6.2.6 Uncertainties

Uncertainty for activity data is estimated as 6.5%. The same uncertainty is used also for emission calculations in GHG inventory under UNFCCC.

6.2.7 QA/QC and verification

Disposed waste amounts are taken from waste database. Data in this database is checked and approved by Regional Environmental Boards. Check for emission calculations was done. Assessments of trends were performed.

6.2.8 Recalculations

Emissions for year 2016 recalculated due to changes of activity data.

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 is popular for many years. Composted amount in households is estimated according to research done by Waste Management Association of Latvia in 2015. In this research total amount of composted waste in households is estimated for years 2012-2014. Time series till 1990 are developed according to population changes.

6.3.2 Trends in emissions

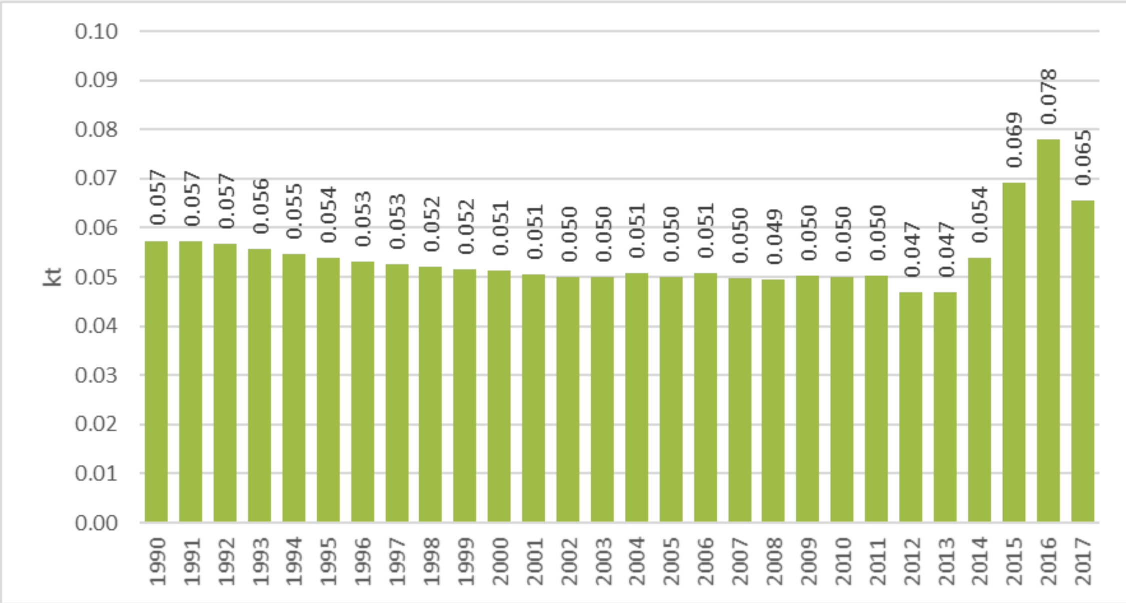

Figure 6.4 NH_3 emissions from composting (kt)

Composting NH_3 emissions increase in 2016 was due to increase of industrial composting amounts.

Manure anaerobic digestion in biogas facilities starts in 2009. NH_3 emissions are calculated. Data is obtained from agriculture sector.

6.3.3 Methods

Composted waste amount is multiplied by emission factor.

Emissions of ammonia from biological treatment of manure — anaerobic digestion at biogas facilities are based on Tier 1 methodology described in the EMEP/EEA 2016:

$$E_{NH3} = AR_{feedstock} \cdot EF_{NH3} \cdot 17/14$$

where $AR_{feedstock}$ is the feedstock's total annual amount of N resulted from NFR 3B sector manure management Tier 2 (mass flow approach) calculations according to proportion of manure used in process.

6.3.4 Emission factors

NH_3 emission factor (0.24 kg/t) for composting is taken from EMEP/EEA 2016.

For manure digestion in biogas facilities Tier 1 emission factor is 0.0286 kg NH_3-N per kg N in feedstock is used.

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 amounts was used. Not all amounts, which classified under recovery as R3, are composted. To determine composted amount, each enterprise, which reports with 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 6.6 Composted waste amounts (kt)

	Industrial waste composted	Household waste composted	Total waste composted
1990	NO	239.09	239.09
1991	NO	238.20	238.20
1992	NO	236.84	236.84
1993	NO	231.70	231.70
1994	NO	227.69	227.69
1995	NO	224.08	224.08
1996	NO	221.29	221.29
1997	NO	219.09	219.09
1998	NO	216.93	216.93
1999	NO	215.00	215.00
2000	NO	213.43	213.43
2001	NO	210.89	210.89
2002	NO	207.98	207.98
2003	2.22	206.05	208.27
2004	7.91	204.00	211.90
2005	6.56	201.60	208.16
2006	11.70	199.64	211.34
2007	9.42	197.93	207.35
2008	9.28	196.41	205.69
2009	15.11	193.81	208.92
2010	18.55	190.02	208.57
2011	23.70	185.91	209.60
2012	17.62	178.16	195.78
2013	14.37	181.35	195.72
2014	40.04	184.61	224.65
2015	67.577	190.73	258.307
2016	135.224	190.00	325.224
2017	98.9	185.062	283.962

The share of manure used in anaerobic digestion is outcome of manure management system calculation algorithm developed according to pre-defined project "Development of the National System for Greenhouse Gas Inventory and Reporting on Policies, Measures and Projections". Under the most important outcomes of 2009-2014 EEA Grants Programme National Climate Policy, based on national research results and provided by Latvia University of Life Sciences and Technologies.

Activity data of manure type and amount used for anaerobic digestion calculations is provided by Rural Support Service of Latvia.

6.3.6 Uncertainties

Uncertainty for activity data is estimated as 28.77%. 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 amounts are taken from waste data base. Data in this data base is checked and approved by Regional Environmental Boards. Assessments 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 amounts 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 amounts for years 1990-1998 are extrapolated according to the average value of incinerated amount for years 2002-2013 what is attributed to disposed waste value.

In cremation sector 5C1bv emissions from human bodies and animal waste (carcasses) incineration are calculated.

6.4.2 Trends in emissions

Emissions are increased since 1990 for PM_{10}, $PM_{2.5}$, NO_x and SO_2. It is due to cremation emissions since 1994 and emissions from animal waste burning since 2011. NMVOC emission decreases till year 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 EWC (European Waste catalogue) 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 year 2011. Bird factory and cattle remains were burned in installation without energy recovery.

Table 6.7 Emissions in Waste incineration in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NOx	kt	0.00045	0.00100	0.00166	0.00168	0.00194	0.00182	0.00167	0.00179	0.00182	0.00202	0.00242	0.00303	432.7
NMVOC		0.00231	0.00270	0.00516	0.00168	0.00152	0.00008	0.00004	0.00003	0.00127	0.00004	0.00004	0.00107	-98.1
SO_2		0.00006	0.00013	0.00019	0.00024	0.00025	0.00025	0.00023	0.00025	0.00024	0.00028	0.00033	0.00041	466.7
$PM_{2.5}$		0.00000	0.00000	0.00004	0.00005	0.00007	0.00027	0.00026	0.00033	0.00025	0.00018	0.00010	0.00012	8197.1
PM_{10}		0.00000	0.00000	0.00004	0.00005	0.00007	0.00030	0.00029	0.00038	0.00028	0.00020	0.00010	0.00012	4641.2
TSP		0.00141	0.00164	0.00101	0.00180	0.00030	0.00063	0.00070	0.00061	0.00055	0.00057	0.00029	0.00063	-79.7
BC		0.00003	0.00004	0.00002	0.00004	0.00001	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000	0.00001	-87.7
CO	t	0.00023	0.00035	0.00065	0.00038	0.00044	0.00031	0.00028	0.00030	0.00040	0.00034	0.00041	0.00058	79.0
Pb		0.00553	0.00646	0.00443	0.00666	0.00112	0.00086	0.00118	0.00043	0.00092	0.00122	0.00072	0.00208	-87.0
Cd		0.00069	0.00081	0.00053	0.00085	0.00013	0.00011	0.00015	0.00006	0.00011	0.00016	0.00010	0.00026	-86.1
Hg		0.00357	0.00501	0.00414	0.00668	0.00370	0.00376	0.00371	0.00346	0.00376	0.00436	0.00477	0.00639	33.5
PCDD/F	g I-Teq	3.41614	3.98127	2.49803	4.16042	0.58378	0.51178	0.72201	0.23554	0.47212	0.73998	0.40800	1.20989	-88.1
PAHs	t	9.4E-09	3.0E-08	5.4E-08	6.0E-08	7.6E-08	7.4E-08	6.7E-08	7.3E-08	7.9E-08	8.2E-08	0.00000	0.00000	952.4
HCB	kg	0.00888	0.01044	0.00719	0.01087	0.00200	0.00161	0.00210	0.00091	0.00170	0.00221	0.00146	0.00342	-83.6
PCB		NA	0.00023	0.00046	0.00063	0.00086	0.00088	0.00081	0.00088	0.00091	0.00098	0.00119	0.00141	100

6.4.3 Methods

For emissions calculation EMEP/EEA 2016 methodology was used. The amount of incinerated waste was multiplied with emission factors.

6.4.4 Emission factors

Table 6.8 Emission factors for waste incineration

	Units EF	Industrial EF	Clinical EF	Animal EF
NOx	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 2016.

Table 6.9 Emission factors from cremation

	EF	Units EF
NOx	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
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 6.10 Incinerated waste in Latvia

	Hazardous waste (kt)	Clinical waste (kt)	Animal waste (kt)	Total (kt)
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

	Hazardous waste (kt)	Clinical waste (kt)	Animal waste (kt)	Total (kt)
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

Emissions from cremation are calculated according to EMEP/EEA 2016.

Data about burned bodies provided by operators of crematorium.

Table 6.11 Burned bodies in Riga and Valmiera crematoriums

	Burned bodies
1994	54
1995	564
1996	819
1997	817
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	2909
2017	3443

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 45.7%. The same uncertainty is also used for calculations in GHG inventory under UNFCCC.

6.4.7 QA/QC and verification

Incinerated waste amounts are taken from waste database. Data in this database is checked and approved by Regional Environmental Boards. Assessments of trends were performed.

QA/QC and verification included:

- Quality check of activity data in the period of reporting;
- Quality check in calculation of emissions for UNFCCC NIR.

6.4.8 Recalculations

2016 cremation emissions are recalculated due to activity data changes

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 231 million m^3 of waste water discharged in Latvia, including 176 million m^3 of treated wastewater (2017). Most of national population (82%, 2017) is served by centralized urban waste water collecting and treatment.

6.5.2 Trends in emissions

Table 6.12 NMVOC and ammonia emissions from Waste water handling (kt)

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
NMVOC	0.0053	0.0032	0.0023	0.0020	0.0020	0.0026	0.0023	0.0025	0.0019	0.0019	0.0021	0.0026	-50.5
NH_3	0.187	0.176	0.171	0.177	0.180	0.129	0.131	0.127	0.127	0.118	0.116	0.092	-50.7

Both NMVOC and NH_3 emissions are decreasing over entire period (Table 6.12) due to factors as slow decrease of national population, increase of collection and treatment of waste water and measures to increase the efficiency of water use, thus decreasing amounts of waste water produced.

Domestic waste water handling is main source of NMVOC emissions in waste water handling sector, contributing on average 75% of sector emissions (59% in 2017). Industrial and other waste water handling subsectors have less significance, contributing on average 11% and 14% of emissions, correspondingly (or 5% and 36% correspondingly in 2017).

6.5.3 Methods

For emission calculation, EMEP/EEA 2016 was used as methodology source (Table 6.13). According to methodology, activity data is multiplied by according emission factors to calculate emissions, and for both substances emitted methodologies are considered to be Tier 2 methods.

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.

6.5.4 Emission factors

Table 6.13 Activity data and emission factors for calculation of NH_3 and NMVOC emission from Waste Water Handling sector

	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 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 6.14 Activity data type and value example

	Source of activity data	Activity data value (2017)
NH_3	Population using latrines	58 (thousands of people)
NMVOC	Amount of waste water treated and discharged	176 (millions of m^3)

Population using latrines was estimated through rate of urbanization (data of World Bank and CSB of Latvia) and degree of treatment and discharge pathway or method for national population not connected to waste water collecting system (IPCC Guidelines 2006). Part of national population, not connected to centralized waste water collecting and treatment system, are served with septic tanks, which, according to EMEP/EEA 2016, 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 6.15 Activity data and result of emission (NH_3 and NMVOC) calculations from Waste Water Handling sector 1990-2017

	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 m3	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	106 820	0.171	116	19.9	17.5	0.00230
2001	123 355	0.197	114	18.7	17.6	0.00226
2002	115 184	0.184	115	18.4	17.3	0.00226
2003	95 618	0.153	103	16.1	16.5	0.00204
2004	112 632	0.180	105	11.7	16.3	0.00199
2005	110 516	0.177	104	12.6	16.4	0.00199
2006	106 360	0.170	98.5	11.5	16.2	0.00189
2007	104 270	0.167	111	10.2	15.5	0.00205
2008	123 281	0.197	103	8.73	13.6	0.00187
2009	107 182	0.171	93.1	9.33	46.6	0.00227
2010	112 410	0.180	104	8.03	21.8	0.00200
2011	80 686	0.129	147	9.20	17.1	0.00260
2012	82 002	0.131	125	9.10	16.3	0.00226
2013	79 642	0.127	139	9.92	14.4	0.00245
2014	79 369	0.127	97.2	9.34	20.6	0.00191
2015	73 937	0.118	97.8	9.70	16.8	0.00186
2016	72 627	0.116	124	4.43	10.3	0.00207
2017	57 561	0.092	105	8.15	63.1	0.00264

6.5.6 Uncertainties

The following uncertainties were used for Wastewater Handling sector for activity data and emission factors. Uncertainties were estimated, using similar methodology as in the UNFCCC NIR.

Table 6.16 Uncertainties for Waste Water handling sector

Emission	Activity data	Emission factor
NH_3	10%	200%
NMVOC	11%	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 UNFCCC NIR;
- Trend analysis.

6.5.8 Recalculations

NMVOC emissions were recalculated for reporting period 1990-1999 as result of division amount of treated waste water between flows of domestic, industrial and other waste water.

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 2016 guidelines number of industrial, undetached house and car fires are used for emissions calculations. For years 1990-2010 average number of fires from years 2011 to 2017 are used as activity data.

6.6.2 Trends in emissions

Table 6.17 Emissions in Other waste in 1990-2017

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	Change in 1990-2017, %
$PM_{2.5}$	kt	0.2289	0.2289	0.2289	0.2289	0.2289	0.2353	0.2402	0.2332	0.2432	0.2166	0.2047	0.2368	3.4
PM_{10}		0.2289	0.2289	0.2289	0.2289	0.2289	0.2353	0.2402	0.2332	0.2432	0.2166	0.2047	0.2368	3.4
TSP		0.2289	0.2289	0.2289	0.2289	0.2289	0.2353	0.2402	0.2332	0.2432	0.2166	0.2047	0.2368	3.4
Pb	t	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0006	0.0006	0.0007	3.4
Cd		0.0013	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0013	0.0012	0.0014	3.4
Hg		0.0013	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0013	0.0012	0.0014	3.4
As		0.0021	0.0021	0.0021	0.0021	0.0021	0.0022	0.0022	0.0022	0.0023	0.0020	0.0019	0.0022	3.4
Cr		0.0020	0.0020	0.0020	0.0020	0.0020	0.0021	0.0021	0.0021	0.0022	0.0019	0.0018	0.0021	3.4
Cu		0.0047	0.0047	0.0047	0.0047	0.0047	0.0049	0.0050	0.0048	0.0050	0.0045	0.0042	0.0049	3.4
PCDD/F	g I-Teq	2.3158	2.3158	2.3158	2.3158	2.3158	2.3781	2.4279	2.3593	2.4620	2.1934	2.0741	2.3969	3.5

6.6.3 Methods

Number of fires multiplied with emissions factors from EMEP/EEA Guidebook 2016.

6.6.4 Emission factors

Table 6.18 Emission factors from fires

	Unit	Industrial	Undetached	Car
$PM_{2.5}$	kg/fire	27.23	61.62	2.3
PM_{10}	kg/fire	27.23	61.62	2.3
TSP	kg/fire	27.23	61.62	2.3
Pb	g/fire	0.08	0.18	-
Cd	g/fire	0.16	0.36	-
Hg	g/fire	0.16	0.36	-
As	g/fire	0.25	0.58	-
Cr	g/fire	0.24	0.55	-
Cu	g/fire	0.57	1.28	-
PCDD/F	mg/fire	0.27	0.62	0.048

6.6.5 Activity data

Table 6.19 Number of fires

	Industrial	Undetached	Car
2011	282	3678	449
2012	252	3770	468
2013	263	3647	566
2014	271	3804	633
2015	300	3359	621
2016	269	3181	610
2017	208	3727	624

Statistics show that there are 200-300 events of industrial fires and 3100-3800 fires of undetached 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

No recalculation.

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 Sectoral overview

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

	Unit	1990	1995	2000	2005	2010	2015	2016	2017	Change in 1990-2017, %
NO_x	kt	0.155	0.213	0.353	0.076	0.048	0.049	0.050	0.050	-67
$PM_{2.5}$		1.265	1.743	2.889	0.618	0.390	0.405	0.413	0.412	
PM_{10}		1.546	2.130	3.531	0.756	0.477	0.495	0.505	0.504	
TSP		2.389	3.292	5.457	1.168	0.737	0.764	0.780	0.778	
CO		10.961	15.106	25.038	5.358	3.380	3.508	3.580	3.571	
PCDD/F	g i-Teq	0.703	0.968	1.605	0.343	0.217	0.225	0.229	0.229	
PAHs	t	2.327	3.207	5.316	1.137	0.718	0.745	0.760	0.758	

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 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[42]. 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[43] are used for previous years.

7.1.2 Methodological issues

2006 IPCC Guidelines, EMEP/EEA 2016 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} and TSP emission calculation from burning on - site in the forest default emission factors according to EMEP/EEA 2016, 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 2016.

Table 7.2 Emission factors for open burning of forests

	Value	Unit
CO	78 ± 31	g kg^{-1} dry matter burnt
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

[42] 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: ReferātuTēzes. Presented at the Latvijas Universitātes 71. zinātniskā konference "Ģeogrāfija, ģeoloģija, vides zinātne", Latvijas Universitāte, Rīga, pp. 133–137.
[43] Līpiņš, L., 2004. Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resersu un to izmantošanas efektivitātes novērtējums).

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).

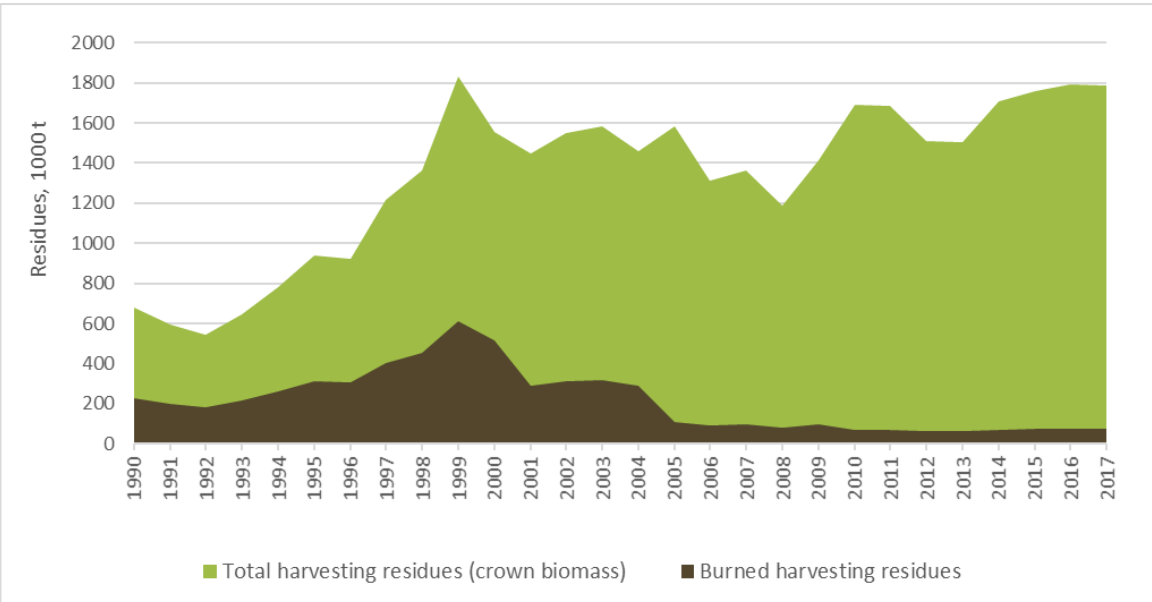

Figure 7.1 Harvesting residues (1000 tons)

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 2016 default values.

7.1.6 Recalculations

Recalculations are introduced due to improvement of activity data.

7.1.7 Planned improvements

No improvements are planned.

7.2 Forest wildfires (NFR 11B)

7.2.1 Sector overview

This source category (NFR 11B) includes NO_x, NMVOC, SO_x, NH_3, CO, $PM_{2.5}$, PM_{10}, TSP, PCDD/PCDF and PAHs emission from wildfires in forest land (Table 7.4).

Table 7.4 Emissions from forest wildfires

	Unit	1990	1995	2000	2005	2010	2015	2016	2017	Change in 1990-2017, %
NO_x	kt	0.049	0.102	0.250	0.023	0.060	0.083	0.078	0.050	3
NMVOC		0.129	0.268	0.658	0.060	0.159	0.218	0.206	0.133	
SO_x		0.010	0.020	0.050	0.005	0.012	0.017	0.016	0.010	
NH_3		0.011	0.023	0.057	0.005	0.014	0.019	0.018	0.011	
$PM_{2.5}$		0.143	0.334	0.911	0.090	0.249	0.351	0.332	0.211	47
PM_{10}		0.175	0.408	1.113	0.110	0.305	0.429	0.405	0.258	
TSP		0.270	0.631	1.721	0.171	0.471	0.662	0.626	0.398	
CO		1.393	2.889	7.106	0.648	1.712	2.360	2.227	1.431	3
PCDD/F	g i-Teq	0.080	0.185	0.506	0.050	0.138	0.195	0.184	0.117	47
PAHs	t	0.263	0.614	1.676	0.166	0.459	0.645	0.610	0.388	

7.2.2 Methodological issues

EMEP/EEA 2016, 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 (dimension-less) was considered 0.45 according to Table 2.6 of 2006 IPCC Guidelines[44].

7.2.3 Emission factors and other parameters

For NOx, NMVOC, SO_x, NH_3, CO, $PM_{2.5}$, PM_{10} and TSP emission calculations from forest wildfires were used default emission factors according to EMEP/EEA 2016, 11.B Forest fires, Table 3-5 (Table 7.5). Information of condensable component inclusion in emission factors of PM is not provided by the EMEP/EEA 2016.

Table 7.5 Emission factors for forests 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

[44] Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types.

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.

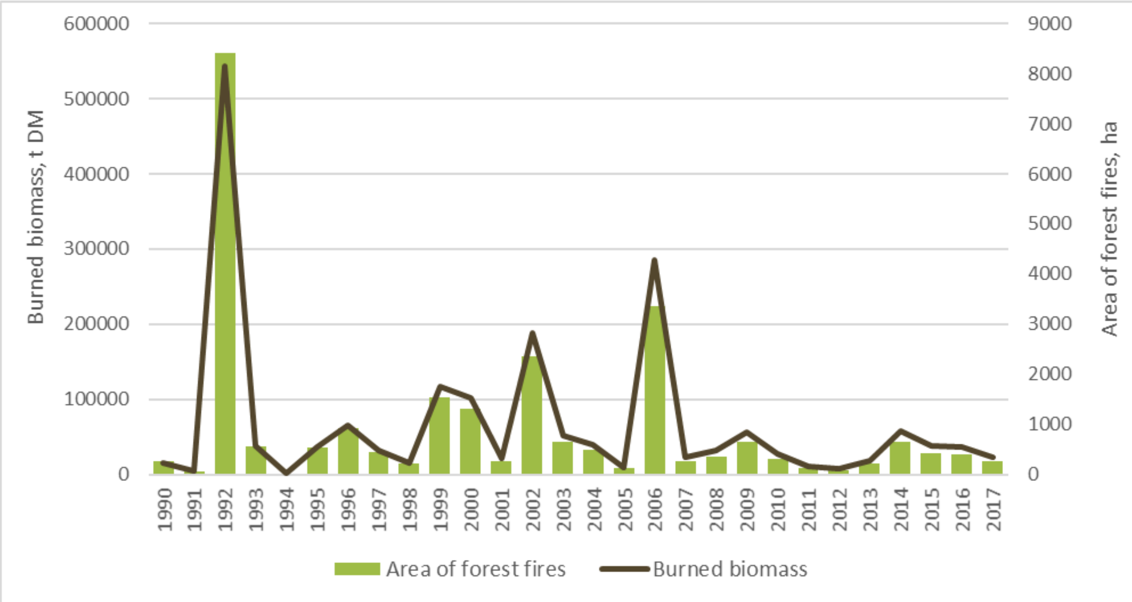

Figure 7.2 Area of forest fires and biomass in burned area

7.2.5 Uncertainties

Combined activity data uncertainty is ± 37.4%. Uncertainties of emission factors are based on the EMEP/EEA 2016 default values.

7.2.6 Recalculations

Recalculations are introduced due to improvement of activity data.

7.2.7 Planned improvements

No improvements are planned

8 Recalculations, improvements and recommendations from the TERT

8.1 Recalculations

Recalculations made in Submission 2019 can be seen in Figure 8.1.

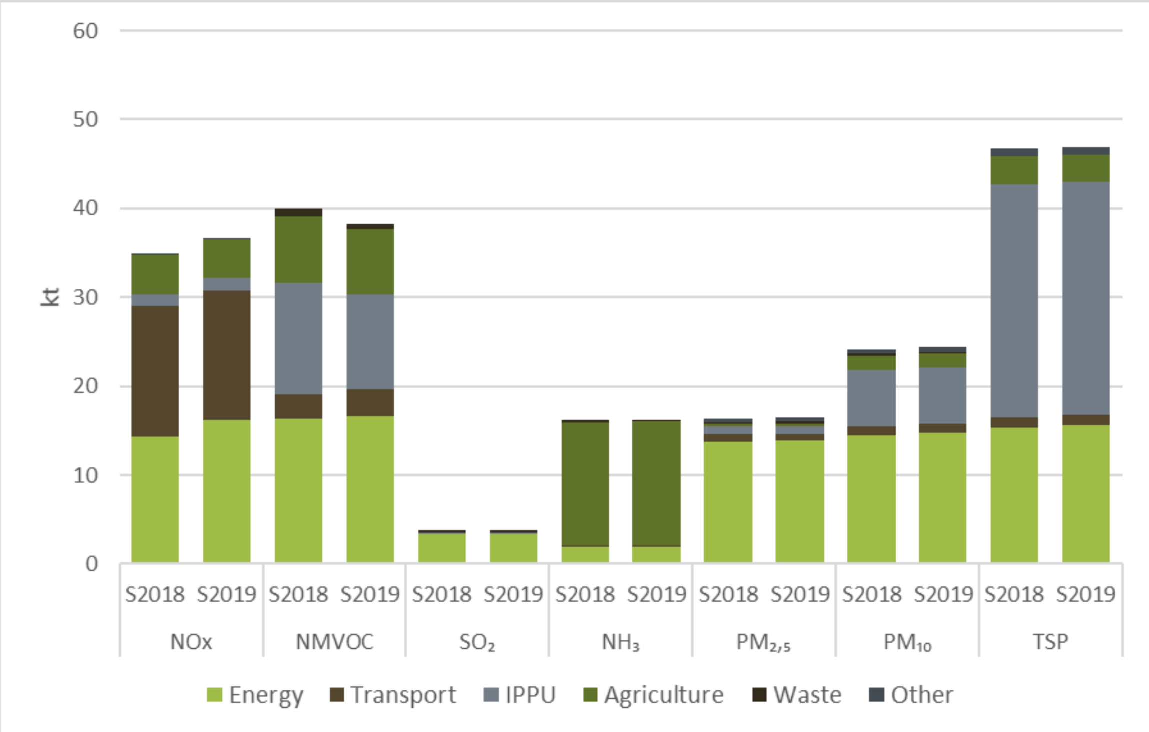

Figure 8.1 Emission comparison for 2016 between Submission 2018 and Submission 2019

Comparing reported emissions of 2016 in Submission 2018 and Submission 2019, NO_x emissions have increased by 4.99% mainly due to the diesel oil split from stationary combustion to stationary combustion and off-road. NMVOC emissions have decreased by 4.3% mainly due to the recalculations in Transport sector and Solvent use (IPPU). NH_3 emissions have increased by 0.3%, due to Transport sector. SO_2 emissions have decreased by 0.2% due to Agriculture sector. Total $PM_{2.5}$ emissions have increased by 0.4% due to recalculations in Energy sector. Total PM_{10} emissions have increased by 1.0% and TSP by 0.4% mainly due to the recalculations in Energy sector.

Detailed information about recalculations done in each sector is described in appropriate chapter.

8.2 Planned improvements

Planned improvements are:

Energy sector

- No improvements planned.

IPPU sector

- Planned to review submitted data for year 2017 in CR to get more precise data considering that some enterprises have submitted their notifications with delay

Agriculture sector

- Planned to continue to quantify and prepare detailed documentations of abatement strategies for ammonia emissions to provide implementation of them in the inventory;
- Reporting will include final data of emissions from use of pesticides. Research activities regarding to evaluation of pesticide use in Latvia will be finished in 2019.

Waste sector

- No improvements planned.

8.3 Recommendations from the TERT

Table 1. Recommendations from the NECD Review 2017, considering revised estimates (RE), technical corrections (TC) and their status of implementation in the inventory submission 2018

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
LV-1A1a-2018-0002	No	For category 1A1a Public Electricity and Heat Production and pollutants NO_X and $PM_{2.5}$ the TERT noted that Latvia uses a Tier 1 methodology. The TERT asked Latvia if any verification with large combustion plant data has been undertaken. In response to a question raised during the review, Latvia responded that "because of statistical sampling and confidentiality issues it is impossible to separate individual data from companies from Central statistical bureau's data." The TERT recommends that Latvia improves its national inventory system by getting access to company specific data in order to validate or improve its emissions estimates from energy production and manufacturing industry.	The TERT reiterates recommendation [LV-1A1a-2017-0002] from the 2017 NECD Review: "For category 1A1a and pollutants NO_X and $PM_{2.5}$ the TERT noted that Latvia uses a Tier 1 methodology. The TERT asked Latvia if any verification with large combustion plant data has been undertaken. In response to a question raised during the review, Latvia responded that "because of statistical sampling and confidentiality issues it is impossible to separate individual data from companies from Central statistical bureau's data. The TERT recommends that Latvia improves its national inventory system by getting access to company specific data in order to validate or improve its emissions estimates from energy production and manufacturing industry." In response to a question raised during the review, Latvia explained that data from national database 2-Air is used to validate calculated NO_X and CO emissions but due to the lack of good quality data to create a consistent time series a switch to higher Tier calculation methods is not planned yet. Nevertheless, the TERT recommends that Latvia continue to explore the possibility of obtaining data that would allow emissions from this key source to be calculated with a Tier 2 method.	Information added.	3.2.4.7
LV-1A2-2018-0001	No	For category 1A2 Stationary Combustion in Manufacturing Industries and Construction and	The TERT reiterates recommendation [LV-1A2-2017-0001] from the 2017 NECD Review: "For category	Work in progress.	

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
		pollutants NO_X, SO_2 and $PM_{2.5}$ the TERT asked Latvia a question about the use of data reported by large combustion plants. In response, Latvia explained that it uses a Tier 1 methodology from the 2016 EMEP/EEA Guidebook for estimation of 1A2 emissions. The TERT recommends that Latvia makes an effort to consider also data from large operators in their estimations of 1A2 emissions because using a Tier 1 methodology is not appropriate for this key source for NO_X, SO_2 and $PM_{2.5}$.	1A2 and pollutants NO_X, SO_2 and $PM_{2.5}$ the TERT asked Latvia a question about the use of data reported by large combustion plants. In response, Latvia explained that it uses a Tier 1 methodology from the EMEP 2016 Guidebook for estimation of 1A2 emissions. The TERT recommends that Latvia makes an effort to also consider data from large operators in their estimations of 1A2 emissions because using a Tier 1 methodology is not appropriate for this key source for NO_X, SO_2 and $PM_{2.5}$." In response to a question raised during the review, Latvia explained that there is no plan to move to a higher Tier methodology for 1A2 sub categories due to lack of necessary data. Nevertheless, the TERT recommends that Latvia continue to investigate opportunities to obtain data that will allow a Tier 2 method to be used for estimating emissions from this key source.		
LV-1A2f-2018-0001	No	For category 1A2f Stationary Combustion in Manufacturing Industries and Construction: Non-Metallic Minerals the TERT noted that cement industry is included until 2009 and that cement industry from 2010 onwards is included in 2A1 Cement Production (also refer to issue LV-2A1-2017-0001). The TERT recommends that Latvia reports fuel related emissions from cement industry under category 1A2f or alternatively under 2A1 for the whole time series in a consistent way and that it investigates if there is any double counting of emissions from cement industries within these two categories.	The TERT reiterates recommendation [LV-1A2f-2017-0001] from the 2017 NECD Review: "For category 1A2f the TERT noted that cement industry is included until 2009 and that cement industry from 2010 onwards is included in 2A1 (also refer to issue LV-2A1-2017-0001). The TERT recommends that Latvia reports fuel related emissions from cement industry under category 1A2f or alternatively under 2A1 for the whole time series in a consistent way and that it investigates if there is any double counting of emissions from cement industries within these two categories." In response to a question raised during the review, Latvia explained that additional information on the calculation carried out in category 1A2f will be included in the next	Additional information added.	3.2.5.3

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
			submission. The TERT recommends that Latvia review and improve the consistency of the current calculation methods and includes explanatory information in the IIR of the next submission.		
LV-1A3b-2018-0001	No	For category 1A3b Road Transport, all pollutants and years, the TERT noted that in response to a question raised during the review, Latvia explained its treatment of lubricant consumption in vehicles with 2-stroke engines but has not confirmed whether the consumption of lubricants was accounted for in the energy balance for road transport used in the inventory. The TERT notes that this issue does not relate to an over or under-estimate but recommends that for completion the contribution of lubricants to the energy consumption assigned to 1A3b is taken into account in the future submissions and correct assignment is applied to 2-stroke engines in 1A3b and 4-stroke engines in IPPU sectors NFR 2D3 Solvent Use/2G Other Product Use, also avoiding a double-count for the IPPU sector.	Following a recommendation from the previous 2017 NECD Review, LV-1A3b-2017-0005, related to providing more information on lubricant consumption, the TERT asked for further clarifications in addition to what is provided in the IIR. After exchanging Q/As with Latvia, the following points were clarified: 1) Latvia reports lubricant consumption and emissions from 2-stroke engines (e.g. motorcycles) under 1A3b. 2) Latvia does not report lubricant consumption and emissions from 4-stroke engines from road transport under 2D/2G in the NFR tables submitted in 2018; emissions from lubricants in sectors 2D/2G are not calculated and not included in IIR and NFR due to lack of emission calculation methodology in EMEP/EEA 2016 Guidebook. The TERT confirms that lubricant consumption and emissions from 2-stroke engines are correctly reported under 1A3b. However, regarding 4-stroke engines from road transport, lubricant consumption and emissions should be reported under 2D/2G according to recent (2018) TFEIP/EIONET guidelines. Hence, the TERT recommends that Latvia estimates these emissions and correctly allocates them in future submissions.	Latvia reports lubricant consumption and emissions from 2-stroke engines (e.g. motorcycles) under 1A3b. A residue of lubricant consumption in transport sector (non energy use) have been reported to 2D/2G sector.	3.2.6.3.4.
LV-1A3c-2018-0001	No	For category 1A3c Railways (gasoil fuel usage), the pollutant SO_2 and the year 2015, the TERT noted that Directive 2009/30/EC which limits the sulphur content of fuel used in the railway sector was not taken into account. In response	Following a recommendation from the previous 2017 NECD Review, LV-1A3c-2017-0001, related to implementing a revised estimate for sector 1A3c, pollutant SO_2, year 2015, the TERT noted that this issue is claimed to have been addressed in the IIR,	Value for SO_2 emissions in 2015 corrected in a current submission of NFR tables.	

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
		to a question raised during the review, Latvia explained that this had been an oversight and that it should have been taken into account in the 2015 emission estimate. Latvia provided a revised estimate for 2015 and stated that it will be included in the next submission. The TERT agreed with the revised estimate provided by Latvia. The TERT recommends that Latvia includes the revised estimate in its next submission.	but in the NFR tables the value is the same as in previous 2017 submission. In response to a question raised during the review, Latvia answered that this was due to a misprint in the 2018 NFR tables and that the recalculation has indeed been implemented. The TERT accepted this explanation and recommended that the recalculated value is included in the NFR table by the next submission 2019.		
LV-2A1-2018-0001	Yes	For category 2A1 Cement Production and pollutants SO_2 and NO_X the TERT noted that there is a time series inconsistency. The impact of this inconsistency could be above the threshold of significance for SO_2. The TERT noted in the IIR it was described that a new facility was opened and the old one was closed, which implied a change from wet to dry process kiln technology. The new facility reports emissions to the 2-AIR database but no activity data is available due to confidentiality, while for the old plant an emission factor combined with clinker production was used to estimate emissions. In response to a question raised during the review, Latvia explained that technology changes and specific changes to fuel and raw materials (using low-sulphur) explain the change in SO_2 emissions, while the NO_X changes can also be explained by the change in technology. Given that company specific data are not available prior to 2010 and production data are not available after 2010, Latvia cannot make a consistent time series based on one	The TERT reiterates recommendation LT-2A1-2017-0001 from the 2017 NECD Review. For category 2A1 and pollutants SO_2 and NO_X the TERT noted that there is a time series inconsistency. The TERT noted that the issue is clearly described in the IIR, as a new facility reports emissions to the 2-AIR database but no activity data is available due to confidentiality, while for the older (now closed) plant an emission factor combined with clinker production was used to estimate emissions. In response to a question raised during the 2017 review, Latvia explained that technology changes and specific changes to fuel and raw materials (using low-sulphur) explain the change in SO_2 emissions, while the NO_X changes can also be explained by the change in technology. Given that company specific data are not available prior to 2010 and production data are not available after 2010, Latvia cannot make a consistent time series based on one approach. The TERT partially accepted this explanation. The differences between wet and dry kiln in terms of emission factors are not confirmed by literature (e.g. US EPA AP42). However, the TERT recognises that from one plant to the other	Based on this suggestion explanation is included in the IIR. After contacting with representative of the company, it is approved that there is 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.	4.2.2.3.

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
		approach. The TERT partially accepted this explanation. The differences between wet and dry kiln in terms of emission factors are not confirmed by literature (e.g. US EPA AP42). However, the TERT recognises that from one plant to the other differences may exist. For SO_2, using low sulphur fuels and raw materials could explain the large decrease in emissions reported by Latvia. The TERT recommends that Latvia verifies the reported emissions for NO_X and SO_2 in the current plant and looks for ways to create a consistent time series for at least 2005-present.	differences may exist. For SO_2, using low sulphur fuels and raw materials could explain the large decrease in emissions reported by Latvia. The TERT recommends that Latvia verifies the reported emissions for NO_X and SO_2 in the current plant and looks for ways to create a consistent time series for at least 2005-present.		
LV-2A3-2018-0002	No	For category 2A3 Glass Production for all pollutants there is an apparent time series inconsistency. The possible over- or under-estimation associated with this time series inconsistency is likely to be below the threshold of significance. The reason is a change of methodology in 2007, since from that time company reported data became available, while at the same time due to the closure of one of the two plants activity data were no longer available (confidentiality), and the 2016 EMEP/EEA Guidebook methodology could no longer be applied. In response to a question raised during the review, Latvia explained that it is not possible to solve this now, but this inconsistency issue will be included in the inventory improvement plan. The TERT agreed with the explanation and recommends Latvia to develop a consistent time series using the data available and report emissions according to this	For category 2A3, the TERT notes that there is a possible time series inconsistency. Company reported data are used from 2005 onwards, while for earlier years this was not available. The TERT welcomes the improvements made by Latvia compared to the 2017 review (recommendation LV-2A3-2017-0001), creating consistent time series from 2005 onwards. However, the TERT notes that CO, NO_X and SO_2 are 'NE' before 2005, and HM emissions are 'NE' from 2007 onwards. The TERT notes the issue is below the threshold of significance and recommends Latvia to report complete time series for the next submission to the extent possible (by gap filling using best prctice techniques if needed), and to document clearly the methodology used to fill the gaps in the IIR.	Calculations for heavy metals have been made (2007-2017) and description is included in the IIR. The explanation why before 2005 is 'NE' is described in the IIR.	4.2.4.1.

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
		consistent methodology in the next submission. Additionally, Latvia should ensure that the allocation of emissions between combustion and process is made properly and consistent over time.			
LV-2A5c-2018-0001	No	For category 2A5c Storage, Handling and Transport of Mineral Products and the pollutant $PM_{2.5}$ the TERT noted that emissions from this source were not estimated ('NE' notation key). In response to a question raised during the review, Latvia acknowledged the issue and agreed to use the Tier 1 methodology in the Guidebook, which assumes all emissions from this source to be included in the sectoral chapters (notation key 'IE'). The TERT agreed with this approach by the Member State. The TERT recommends that Latvia puts the notation key 'IE' in its next submission, for all years in the time series.	For category 2A5c and pollutant $PM_{2.5}$, the TERT notes a possible time series inconsistency due to the use of a mix of Tier 1 (until 2010) and Tier 3 (from 2011 onwards). While the TERT welcomes the improvements compared to the 2017 submission (recommendation LV-2A5c-2017-0001), the TERT has some concerns regarding time series consistency due to the use of different Tiers in different years. In addition, the TERT noted a strong decrease in reported $PM_{2.5}$ emissions (more than 80 %) in 2015-2016 compared to the years before. In the IIR this is explained by decreasing amounts of cement production, however this decrease was found to be only 16 %. The TERT recommends that Latvia investigate and clearly explain the reason for the sharp decrease in the next submission of the IIR. In addition, the TERT recommends that Latvia uses best practice techniques to improve the consistency of the time series, and clearly describes this in the IIR for the next submission.	The explanation for sharp decrease in category 2A5c Storage, Handling and Transport of Mineral Products is made by exploring the cause. In the Cement production from 2011 is used Tier 3, therefore emssions from storage, handling and transport of mineral products cannot be in 2A1 and are reported in 2A5c sector. Thereby it is not possible to use notation key 'IE' for all time series.	4.2.7.2.
LV-2D3d-2018-0001	Yes	For the key category 2D3d Coating Applications and the pollutant NMVOC the TERT noted that EFs for some sub-categories were Tier 1. In response to a question raised during the review, Latvia explained that the member state used the wrong EF for Other industrial paint application, and that the correct EF is the Tier 1 EF 400 g NMVOC/kg paint. Latvia provided revised	For category 2D3d and pollutant NMVOC, the TERT noted that the revised estimate provided by Latvia during the 2017 review (LV-2D3d-2017-0002) is different from the reported NMVOC emissions in the 2018 submission. In response to a question raised during the review, Latvia explained that some errors were found after the 2017 review and the whole time series was recalculated. In addition, Latvia	NMVOC emissions from Solvent use sector were recalculated for all time series and all subsectors including 2D3D taking into account that estimation of exported NMVOC containing products from the country for the period 2006-	4.5.3.2. 4.5.3.4.

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
		estimates for the years 1990-2015. The change in NMVOC emissions for 2010 was 2.3 % of the national total and thus exceeds the threshold of significance. The TERT agreed with the revised estimate provided by Latvia. The TERT recommends that Latvia includes the revised estimate in its next submission.	provided full time series of activity data and emission factors for the TERT to check the calculations. The TERT agreed to the calculations, although it seems NMVOC emissions from paint use in car manufacturing are not included in the calculation. The TERT recommends that Latvia checks the calculation again for this issue and documents the findings in the IIR for the next submission.	2017 was carried out. As well as activity data for year 2016 was specified and therefore emissions were recalculated for this year under all subsectors including 2D3D. The NMVOC emission factors for Paint application (2D3d) are taken from the EMEP/EEA 2016 and found in IIR. In Latvia car manufacturing (Coating applications: manufacture of automobiles, SNAP 060101) is not occuring thefore NMVOC emissions from paint use in car manufacturing are not included in the calculation.	
LV-2D3i-2018-0001	Yes	For key category 2D3i Other Solvent Use, the pollutant NMVOC and the years 2013 and 2015 the TERT noted a significant dip in the time series in 2013 and jump in the time series in 2015 that may be above the threshold of significance. In response to a question raised during the review, Latvia explained that "We would like to inform that last year LEGMC introduced electronic reporting system of the Register of Chemical Substances and Chemical Mixtures for the first time (previously the annual reports by enterprises were submitted in paper form) so there could be some unnoticed mistakes made by enterprises. In order to check this we are going to review submitted data for	For category 2D3i and pollutant NMVOC, the TERT noted that the time series of reported emissions show several dips and jumps, despite a recommendation made in the 2017 review (LV-2D3i-2017-0001) to verify reported emissions by companies. In response to a question raised during the review, Latvia explained that this verification had been done which is confirmed by the changed numbers. The TERT notes, however, that some of these outliers have become stronger. The TERT recommends that Latvia improves the verification process of reported emissions by companies as much as possible, using independent datasets where available, in order to create consistent time series of emissions. The TERT also recommends that Latvia	NMVOC emissions from Solvent use sector were recalculated for all time series and all subsectors including 2D3i taking into account that estimation of exported NMVOC containing products from the country for the period 2006-2017 was carried out. As well as activity data for year 2016 was specified and therefore emissions were recalculated for this year under all subsectors including 2D3i. Dips and jumps	4.5.3.2.

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
		year 2015 in CR once again before the next submission. Related to the year 2013, we do not see any particular explanation why the decline occurred. Probably part of the enterprises did not submit their report." The TERT notes that at present it is not possible to estimate whether the potential errors in the data register exceed the level of significance. The TERT recommends that Latvia reviews the submitted data for 2015 and includes potential revised estimates in the next submission.	explains strong dips and jumps in the time series in the IIR.	are explained in chapter 4.5.3.2. in the IIR.	
LV-3B-2018-0001	Yes	For category 3B Manure Management and pollutant NH_3 for years 2005, 2010 and 2015 the TERT noted that there is a lack of transparency regarding the implementation of NH_3 emission abatement measures for cattle and swine in the national inventory. In response to a question raised during the review, Latvia explained that abatement measures are defined according to country legislation Regulations No 834 and the ECE Guidance Document on Control Techniques for Preventing and Abating Emissions of NH_3 (2007), which indicate that the reduction potential is 35 – 50 % if natural crust is as cover and 30 – 60 % if lagoons are replaced with covered tanks. The reason for the decrease in swine NH_3 IEFs from 2000 is the implementation of abatement measures set in country legislation and the UNECE guidance document. Following the 2016 EMEP/EEA Guidebook chapter 3, the expert judgement has to be documented in detail. The TERT recommends that Latvia includes a detailed documentation of	The TERT reiterates recommendation LV-3B-2017-0002 from the 2017 NECD Review. The TERT recommends that Latvia includes detailed documentation of assumptions, technologies, reduction factors and underlying N amounts per animal category in its next IIR to provide a sufficient level of transparency. During the 2018 NECD Review, Latvia provided further information on assumptions and methods for abatement techniques estimates. The TERT recommends that Latvia includes the table "Estimated NH_3 reduction from storage of slurry" provided during the review in its next submission.	More information is provided of assumptions for reduction measures from statistical data which affect estimated reduction based on relatable national legal acts.	5.2.4.

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
		assumptions, technologies, reduction factors and underlying N amounts per animal category in its next IIR.			
LV-3B-2018-0003	No	For category 3B4h Manure Management - Other Animals and pollutants NO_X, NH_3, NMVOC and $PM_{2.5}$ for year 2005, 2010, 2015 the TERT noted that animal numbers reported under NEC are much smaller than those reported under MMR. In response to a question raised during the review, Latvia explained that according to the 2016 EMEP/EEA Guidebook, EFs for other poultry refers to geese and duck and that the numbers of other poultry in NRF include the total number of geese and ducks. For UNFCCC Submission, other poultry includes all other poultry except hens, broilers, turkeys, ducks and geese. Latvia notes that the lack of EF for other poultry (except hens, broilers, turkeys, ducks and geese) in the 2016 EMEP/EEA Guidebook denies the possibility of emission calculation without large uncertainty for this poultry group. However, estimates should be provided for all poultry. EFs are provided in the 2016 EMEP/EEA Guidebook. The TERT recommends that Latvia uses expert judgement to decide which of those EFs provided by the Guidebook are most appropriate for the other types of poultry raised in Latvia. For example, the default 2016 EMEP/EEA Guidebook EF for broilers may be used for small poultry such as quail, while the default 2016 EMEP/EEA Guidebook EF for male turkeys could be used to calculate emissions from larger poultry such as ostriches.	For 3B4giv Other poultry and $PM_{2.5}$, NO_X and NH_3 for the period 1990-2016 the TERT noted that there was an under-estimate due to missing emissions from other poultry. In response to a question raised during the review, Latvia provided a revised estimate for the whole time series. The TERT agreed with the revised estimate provided by Latvia and attached it to the annex of the review report. The TERT recommends that Latvia includes the revised estimate in its next submission.	Revised estimate of 3B4giv Other poultry is done and reported in the submission.	5.2.

Observation	Key Category	Recommendation made in previous review report	Assessment of Implementation	LV Response (status on implementation)	Chapter in the IIR
LV-5D-2018-0001	No	For category 5D Wastewater Handling the TERT noted that the considered activity data is the "waste water discharge in Latvia" whereas only domestic and industrial waste water treated in Waste Water Treatment (WWTP) has to be taken into account. In response to a question raised during the review, Latvia confirmed that all waste water is included. The TERT noted that the issue is below the threshold of significance for a technical correction but recommends that Latvia only includes waste water handled in WWTP.	For sector 5D the TERT noted that Latvia partially implemented recommendation LV-5D-2017-0001. The TERT also noted that there is a lack of transparency and consistency of the reporting in the IIR, NFR emissions and NFR activity data for 5D1, 5D2 and 5D3. In response to the question from the TERT, Latvia replied that activity data to calculate NMVOC emissions the total amount of treated wastewater was used (including both domestic, commercial and industrial wastewater). The TERT recommends that Latvia reports in the NFR the emission estimates separately for sectors 5D1, 5D2 and 5D3 to the extent possible, and methodology descriptions in the IIR.	Implemented	6.5.3., 6.5.5.

Table 2. Recommendations from the NECD Review 2018 concerning the first phase of the in-depth review of national emission inventories of POPs and heavy metals

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
LV-2C1-2018-0003	Yes	2C1 Iron and Steel Production, Hg, 1990, 2005	For category 2C1 Iron and Steel Production and pollutant Hg, the TERT noted that emissions were not estimated only from 2011-2015 while for other years 'NE' is reported. In response to a question raised during the review, Latvia acknowledged there was an error in the calculations and Hg emissions should have been estimated for 1990-2015 (for the years where the electric arc furnace was operational). Latvia also provided an estimate for Hg emissions from 2C1 for the full time series. The TERT agrees with the explanation and recommends that Latvia includes Hg emissions for 2C1 and the full time series in the next submission, and clearly documents the methodology in the IIR.	Calculations for Hg have been made for all time series and description is included in the IIR.	4.4.2.
LV-2D3g-2018-0001	Yes	2D3g Chemical Products, PAHs, 1990, 2005, 2016	For category 2D3g Chemical Products and pollutant PAHs the TERT noted that emissions are not estimated (NA) for all years in the time series, despite the availability of emission factors for asphalt blowing in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review, Latvia explained that asphalt blowing does not occur in Latvia. The TERT notes that category 2D3g includes multiple activities and that	Asphalt blowing in Latvia is not occurring, therefore notation key NA is used.	4.5.3.2.

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
			'NO' would not be the appropriate notation key in this case. Therefore, the TERT recommends that Latvia includes an explanation stating that asphalt blowing is not occurring in the country in the next IIR.		
LV-2A3-2018-0001	No	2A3 Glass Production, Cd, Pb, 2016	For category 2A3 Glass Production and pollutants Cd and Pb, the TERT noted that after 2007 emissions are reported as 'NE' (Not Estimated) while for earlier years in the time series emissions have been reported. In response to a question raised during the review, Latvia explained that this was due to confidentiality since only one glass producer remained operational after 2007. The TERT suggested to use an alternative methodology to complete the time series, for instance estimating heavy metals as a fraction of PM based on Guidebook emission factors and apply that to the company reported PM emissions. Latvia welcomed this offer and provided a first estimate of the emissions for the full time series using this methodology. The TERT recommends that Latvia includes emissions for the full time series in the next submission using the suggested methodology and clearly documents the methodology used for gap-filling the missing years in the IIR.	Calculations for Cd and Pb have been made (2007-2017) and description is included in the IIR	4.2.4.2.
LV-2D3a-2018-0001	No	2D3a Domestic Solvent use including Fungicides, Hg, 1990, 2005, 2016	For category 2D3a Domestic Solvent use including Fungicides and pollutant Hg the TERT noted that emissions are not reported by Latvia, despite the availability of a Hg emission factor from fluorescent tubes in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review, Latvia acknowledged that these emissions are missing, provided an estimate of these emissions and agreed to include them for the next submission. The TERT recommends that Latvia includes these emissions for the next submission (based on the Guidebook or using an alternative methodology), along with an explanation of the methodology in the IIR. In case emissions are not estimated, the TERT recommends changing the notation key to 'NE' (Not Estimated).	Hg emissions from 2D3a Domestic Solvent use including Fungicides are estimated and reported.	4.5.3.2. 4.5.3.8.
LV-3Df-2018-0001	No	3Df Use of Pesticides, HCB, 1990-2016	For category 3Df Use of Pesticides and pollutant HCB the TERT noted there may be an under-estimate, since emissions are reported as 'NE'. In response to a question raised during the review, Latvia indicated that these emissions will be included in 2019 submission and that a description of the use of HCB as pesticide will be included in IIR. The TERT recommend that if HCB is used as pesticides Latvia reports these emissions in its next IIR.	Reporting will include final data of emissions from use of pesticides. Research activities regarding to evaluation of pesticide use in Latvia are in progress.	5.3.9

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	LV Response (status of implementation)	Chapter in the IIR
LV-3I-2018-0001	No	3I Agriculture other, PAHs, 1990-2016	For category 3I Agriculture other and PAH emissions the TERT noted dips and jumps in the trend and that emissions are high enough to make this source a key category in some years. The emissions reported by Latvia result from grassland burning. In a response to a question raised during the review, Latvia provided further information on the activity data that explains the trends in emissions. Latvia also provided further clarification on emission factors used. The TERT noted that emissions factor for PAH are those from an outdated version of the EMEP/CORINAIR Guidebook and that the 2016 EMEP/EEA Guidebook does not include a methodology for PAH estimates from grassland burning. The TERT recommends Latvia assesses the appropriateness of the currently used EF and makes sure that these actually reflect the national circumstances.	Currently used country specific data on grassland fires (provided by the State Fire and Rescue Service) and default emissions factors (EMEP/CORINAIR Emission Inventory Guidebook) are the best available information. National researches on emission factors for grassland burning are not conducted. Due to the considerable reduction of this source of emissions in comparison to situation 10-20 years ago, there are no plans to elaborate country specific method.	5.4.4.

9 Projections

Information about projections will be added with National Air Pollution Control Program under the National Emissions Ceilings Directive.

10 Submission of Latvia's gridded emissions data

The latest data were reported on 28.04.2017. Submitted date is available:

- NECD - https://cdr.eionet.europa.eu/lv/eu/nec_revised/gridded/envwqndwq/
- CLRTAP - https://cdr.eionet.europa.eu/lv/un/clrtap/gridded/envwqneqq/

No information is provided in this submission.

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- EMEP/EEA air pollutant emission inventory guidebook - 2013
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Annex I: Detailed methodological descriptions

Table 1 Emission factors and assumptions for Energy sector

	NOx	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	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
Unit	*g/GJ*							*mg/GJ*									*ng I-TEQ/GJ*	*mg/GJ*				*µg/GJ*	*µg/WHO-TEG/GJ*	
1.A.1																								
Diesel oil	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
RFO	142	2.3	NE	19.3	25.2	35.6	15.1	4.56	1.2	0.341	3.98	2.55	5.31	255	2.06	87.8	2.5	NE	0.005	0.005	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-5
LPG	89	2.6	NE	0.89	0.89	0.89	39	0.0015	0.00025	0.1	0.12	0.00076	0.000076	5E-04	0.011	0.002	0.5	6E-04	8E-04	8E-04	8E-04	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-4
Jet fuel	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
Other kerosene	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
Other liquid	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
Petroleum coke	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
Waste oils	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
Shale oil	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
Coal	209	1	NE	3.4	7.7	11.4	8.7	7.3	0.9	1.4	7.1	4.5	7.8	4.9	23	19	10	7E-04	0.037	0.029	0.001	6.7	0.0033	EMEP/EEA 2016 - 1A1 - Table 3-2
Coke	209	1	NE	3.4	7.7	11.4	8.7	7.3	0.9	1.4	7.1	4.5	7.8	4.9	23	19	10	7E-04	0.037	0.029	0.001	6.7	0.0033	EMEP/EEA 2016 - 1A1 - Table 3-2
Peat briquettes	247	1.4	NE	3.2	7.9	11.7	8.7	15	1.8	2.9	14.3	9.1	1	9.7	45	8.8	10	0.001	0.037	0.029	0.002	6.7	0.0033	EMEP/EEA 2016 - 1A1 - Table 3-3
Peat	247	1.4	NE	3.2	7.9	11.7	8.7	15	1.8	2.9	14.3	9.1	1	9.7	45	8.8	10	0.001	0.037	0.029	0.002	6.7	0.0033	EMEP/EEA 2016 - 1A1 - Table 3-3
Natural gas	89	2.6	NE	0.89	0.89	0.89	39	0.0015	0.00025	0.1	0.12	0.00076	0.000076	5E-04	0.011	0.002	0.5	6E-04	8E-04	8E-04	8E-04			EMEP/EEA 2016 - 1A1 - Table 3-4
Wood	81	7.31	NE	133	155	172	90	20.6	1.76	1.51	9.46	9.03	21.1	14.2	1.2	181	50	1.12	0.043	0.016	0.037	5	3.5	EMEP/EEA 2016 - 1A1 - table 3-7
CH4 from Sludge Gas	89	2.6	NE	0.89	0.89	0.89	39	0.0015	0.00025	0.1	0.12	0.00076	0.000076	5E-04	0.011	0.002	0.5	6E-04	8E-04	8E-04	8E-04	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-4
Landfill gas	89	2.6	NE	0.89	0.89	0.89	39	0.0015	0.00025	0.1	0.12	0.00076	0.000076	5E-04	0.011	0.002	0.5	6E-04	8E-04	8E-04	8E-04	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-4

	NOx	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	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
Unit	*g/GJ*							*mg/GJ*									*ng I-TEQ/GJ*	*mg/GJ*				*µg/GJ*	*µg/WHO-TEG/GJ*	
Other Biogass	89	2.6	NE	0.89	0.89	0.89	39	0.0015	0.00025	0.1	0.12	0.00076	0.000076	5E-04	0.011	0.002	0.5	6E-04	8E-04	8E-04	8E-04	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-4
Biodiesel	65	0.8	NE	0.8	3.2	6.5	16.2	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81	0.5	NE	NE	NE	0.007	NE	NE	EMEP/EEA 2016 - 1A1 - Table 3-6
1.A.2																								
Diesel oil	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
RFO	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
LPG	74	23	NE	0.78	0.78	0.78	29	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	0.52	7E-04	0.003	0.001	0.001	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-3
Jet fuel	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Other kerosene	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Other liquid	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Petroleum coke	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Waste oils	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Shale oil	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Coal	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A2 - Table 3-2
Coke	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A2 - Table 3-2
Peat briquettes	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A2 - Table 3-2
Peat	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A2 - Table 3-2
Anthracite	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A2 - Table 3-2
Oil shale	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A2 - Table 3-2
Natural gas	74	23	NE	0.78	0.78	0.78	29	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	0.52	7E-04	0.003	0.001	0.001	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-3
Wood	91	300	NE	140	143	150	570	27	13	0.56	0.19	23	6	2	0.5	512	100	10	16	5	4	5	0.06	EMEP/EEA 2016 - 1A2 - Table 3-5

	NOx	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	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
Unit	*g/GJ*							*mg/GJ*									*ng I-TEQ/GJ*	*mg/GJ*				*µg/GJ*	*µg/WHO-TEG/GJ*	
BIodiesel	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Landfill gas	74	23	NE	0.78	0.78	0.78	29	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	0.52	7E-04	0.003	0.001	0.001	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-3
Unit	*kg/Mg waste*							*g/Mg waste*									*µg I-TEQ/Mg waste*					*g/Mg waste*		
Industrial waste (used tires)	0.87	7.4	NE	0.004	0.007	0.01	0.07	1.3	0.1	0.056	0.016	NE	NE	0.14	NE	NE	350	NE	NE	NE	NE	0.002	NE	EMEP/EEA 2016 - 5.C.1.b - Table 3-1
Unit	*g/Mg*							*mg/Mg*									*ng/Mg*	*µg/Mg*					*ng/Mg*	
Municipal waste	1071	5.9	3	3	3	3	41	58	4.6	18.8	6.2	16.4	13.7	21.6	11.7	24.7	52.5	8.4	17.9	9.5	11.6	45.2	3.4	EMEP/EEA 2016 - 5.C.1.a - Table 3-1
1.A.4.a i, 1.A.4.c i																								
Unit	*g/GJ*							*mg/GJ*									*ng I-TEQ/GJ*	*mg/GJ*				*µg/GJ*		
Diesel oil	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A4 - Table 3-9
RFO	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A4 - Table 3-9
LPG	74	23	NE	0.78	0.78	0.78	29	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	0.52	7E-04	0.003	0.001	0.001	NE	NE	EMEP/EEA 2016 - 1A4 - Table 3-8
Jet fuel	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A4 - Table 3-9
Other kerosene	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A4 - Table 3-9
Other liquid	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A4 - Table 3-9
Petroleum coke	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Waste oils	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A2 - Table 3-4
Shale oil	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002	NE	NE	EMEP/EEA 2016 - 1A4 - Table 3-9
Coal	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A4 - Table 3-7
Coke	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A4 - Table 3-7
Oil shale	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A4 - Table 3-7
Peat briquettes	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A4 - Table 3-7

	NOx	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	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
Unit	*g/GJ*							*mg/GJ*									*ng I-TEQ/GJ*	*mg/GJ*				*µg/GJ*	*µg/WHO-TEG/GJ*	
Peat	173	88.8	NE	108	117	124	931	134	1.8	7.9	4	13.5	17.5	13	1.8	200	203	45.5	58.9	23.7	18.5	0.62	170	EMEP/EEA 2016 - 1A4 - Table 3-7
Natural gas	74	23	NE	0.78	0.78	0.78	29	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	0.52	7E-04	0.003	0.001	0.001			EMEP/EEA 2016 - 1A4 - Table 3-8
Wood	91	300	37	140	143	150	570	27	13	0.56	0.19	23	6	2	0.5	512	100	10	16	5	4	5	0.06	EMEP/EEA 2016 - 1A4 - Table 3-10
Landfill gas	74	23	NE	0.78	0.78	0.78	29	0.011	0.0009	0.54	0.1	0.013	0.0026	0.013	0.058	0.73	0.52	7E-04	0.003	0.001	0.001			EMEP/EEA 2016 - 1A4 - Table 3-8
Straws	91	300	37	140	143	150	570	27	13	0.56	0.19	23	6	2	0.5	512	100	10	16	5	4	5	0.06	EMEP/EEA 2016 - 1A4 - Table 3-10
Biodiesel	513	25	NE	20	20	20	66	0.08	0.006	0.12	0.03	0.2	0.22	0.008	0.11	29	1.4	0.002	0.015	0.002	0.002			EMEP/EEA 2016 - 1A4 - Table 3-9
Off road (1.A.2.gvii, 1.A.4.a ii, 1.A.4.b ii, 1.A.4.c ii, 1.A.4.c iii, 1.A.5.b ii)																								
Unit	*g/tonnes fuel*							*mg/kg*									*µg/kg*							
Gasoline: 2-stroke	2765	227289	3	3762	3762	3762	620793	1990-1998 - 0.00015	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	40	40	NE	NE	NE	NE	EMEP/EEA 2016 - 1A4 Other mobile - Table 3-1
Gasoline: 4-stroke	7117	18893	4	157	157	157	770368	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 2016 - 1A4 Other mobile - Table 3-1
Diesel	34457	3542	8	1913	1913	1913	7673	NE	0.01	NE	NE	0.05	1.7	0.07	0.01	1	NE	80	50	NE	NE	NE	NE	EMEP/EEA 2016 - 1A4 Other mobile - Table 3-1
Unit	*kg/Mg*							*g/Mg*									*µg/Mg*					*mg/Mg*		
Aviation gasoline	4	19	NE	NE	NE	NE	1200	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	EMEP/EEA 2016 - 1A3d Navigation-shipping - Table 3-2
Diesel oil (in Fisheries)	78.5	2.8	NE	1.4	1.5	1.5	7.4	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 2016 - 1A3a Aviation - Table 3-4

Table 2 Emission factors in Residential wood burning appliances

		Conventional boilers	Energy efficient stoves	Advanced/ecolabelled stoves	Conventional stoves	Pellet stoves
NOx	**g/GJ**	80	80	95	50	80
CO		4000	4000	2000	4000	300
NMVOC		350	350	250	600	10
NH_3		74	37	37	70	12

		Conventional boilers	Energy efficient stoves	Advanced/ecolabelled stoves	Conventional stoves	Pellet stoves
TSP		500	400	100	800	31
PM_{10}		480	380	95	760	29
$PM_{2.5}$		470	370	93	740	29
BC		75.2	59.2	26.04	74	4.35
Pb	**mg/GJ**	27	27	27	27	27
Cd		13	13	13	13	13
Hg		0.56	0.56	0.56	0.56	0.56
As		0.19	0.19	0.19	0.19	0.19
Cr		23	23	23	23	23
Cu		6	6	6	6	6
Ni		2	2	2	2	2
Se		0.5	0.5	0.5	0.5	0.5
Zn		512	512	512	512	512
PCBs	**µg/GJ**	0.06	0.03	0.007	0.06	0.01
PCDD/F	**ng/GJ**	550	250	100	800	100
benzo(a)pyrene	**mg/GJ**	121	121	10	121	10
benzo(b)fluoranthene		111	111	16	111	16
benzo(k(fluoranthene		42	42	5	42	5
indeno(1,2,3-cd)pyrene		71	71	4	71	4
HCB	**µg/GJ**	5	5	5	5	5
Reference		*EMEP/EEA 2016 - 1A1 - Table 3-18*	*EMEP/EEA 2016 - 1A1 - Table 3-23*	*EMEP/EEA 2016 - 1A1 - Table 3-24*	*EMEP/EEA 2016 - 1A1 - Table 3-17*	*EMEP/EEA 2016 - 1A1 - Table 3-25*

Table 3 Sulphur content and SO_2 emission factors used in Energy sector

Fuel	NCV	Sulphur content (%)																		
		1990-95	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Diesel	*42.49*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
RFO	*40.60*	*2.00*	*2.00*	*2.12*	*2.10*	*2.00*	*2.08*	*1.98*	*1.96*	*2.02*	*1.38*	*1.23*	*0.99*	*1.21*	*0.91*	*0.79*	*0.91*	*0.97*	*0.94*	*0.80*
Gasoline	*43.97*	*0.015*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.01*	*0.01*	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
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*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
Other liquid fuel	*41.86*	*0.65*	*0.61*	*0.59*	*0.58*	*0.57*	*0.56*	*0.55*	*0.53*	*0.52*	*0.51*	*0.50*	*0.48*	*0.47*	*0.46*	*0.45*	*0.44*	*0.42*	*0.41*	*0.40*
LPG	*45.54*	*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*	*0.00*	*0.00*
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*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*	*0.80*
Coal	*23.91*	*1.80*	*1.80*	*1.47*	*1.37*	*1.06*	*0.90*	*0.87*	*0.78*	*0.66*	*0.67*	*0.72*	*0.66*	*0.52*	*0.45*	*0.46*	*0.39*	*0.41*	*0.50*	*0.44*
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*	*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*	*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*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*
RFO (marine)	*40.60*	*2.00*	*2.00*	*2.00*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.50*	*1.00*	*1.00*	*1.00*	*1.00*
Wood	*6.70*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*
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*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*	*0.00029*
		EF (kt/PJ)																		
Diesel		*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.094*	*0.047*	*0.047*	*0.047*	*0.047*	*0.047*	*0.047*
RFO		*0.966*	*0.966*	*1.024*	*1.012*	*0.968*	*1.003*	*0.957*	*0.948*	*0.976*	*0.665*	*0.596*	*0.479*	*0.583*	*0.441*	*0.382*	*0.442*	*0.467*	*0.456*	*0.389*
Gasoline		*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0068*	*0.0023*	*0.0023*	*0.0023*	*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*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*	*0.046*
Other liquid fuel		*0.311*	*0.290*	*0.284*	*0.278*	*0.272*	*0.267*	*0.261*	*0.255*	*0.249*	*0.243*	*0.237*	*0.231*	*0.225*	*0.220*	*0.214*	*0.208*	*0.202*	*0.196*	*0.190*
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*	*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*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*	*0.407*
Coal		*1.138*	*1.138*	*0.928*	*0.865*	*0.673*	*0.567*	*0.551*	*0.493*	*0.451*	*0.459*	*0.498*	*0.454*	*0.357*	*0.308*	*0.318*	*0.266*	*0.280*	*0.342*	*0.328*
Coke		*0.410*	*0.410*	*0.410*	*0.410*	*0.410*	*0.410*	*0.410*	*0.403*	*0.403*	*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*	*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*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*	*0.507*
RFO (marine)		*0.966*	*0.966*	*0.966*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*0.724*	*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*	*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*	*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 4 Distribution of road transport fleet by subsectors and layers, year 2017

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
Passenger Cars	Petrol	Small	Euro 1	2 569	3 640
Passenger Cars	Petrol	Small	Euro 2	4 169	6 118
Passenger Cars	Petrol	Small	Euro 3	8 034	10 011
Passenger Cars	Petrol	Small	Euro 4	10 909	12 135
Passenger Cars	Petrol	Small	Euro 5	7 077	15 573
Passenger Cars	Petrol	Small	Euro 6 up to 2016	4 443	21 134
Passenger Cars	Petrol	Small	Euro 6 2017-2019	3 402	21 134
Passenger Cars	Petrol	Medium	Euro 1	49 530	4 368
Passenger Cars	Petrol	Medium	Euro 2	29 962	8 676
Passenger Cars	Petrol	Medium	Euro 3	24 677	12 135
Passenger Cars	Petrol	Medium	Euro 4	25 688	15 237
Passenger Cars	Petrol	Medium	Euro 5	10 739	17 191
Passenger Cars	Petrol	Medium	Euro 6 up to 2016	4 408	20 224
Passenger Cars	Petrol	Medium	Euro 6 2017-2019	3 522	22 247
Passenger Cars	Petrol	Large-SUV-Executive	Euro 1	4 060	5 131
Passenger Cars	Petrol	Large-SUV-Executive	Euro 2	4 262	11 014
Passenger Cars	Petrol	Large-SUV-Executive	Euro 3	8 961	14 936
Passenger Cars	Petrol	Large-SUV-Executive	Euro 4	7 057	15 168
Passenger Cars	Petrol	Large-SUV-Executive	Euro 5	2 178	19 213
Passenger Cars	Petrol	Large-SUV-Executive	Euro 6 up to 2016	997	21 236
Passenger Cars	Petrol	Large-SUV-Executive	Euro 6 2017-2019	675	21 741
Passenger Cars	Diesel	Small	Euro 1	16	9 809
Passenger Cars	Diesel	Small	Euro 2	48	10 701
Passenger Cars	Diesel	Small	Euro 3	2 402	11 593
Passenger Cars	Diesel	Small	Euro 4	1 922	15 159
Passenger Cars	Diesel	Small	Euro 5	1 369	21 924
Passenger Cars	Diesel	Small	Euro 6 up to 2016	339	22 060
Passenger Cars	Diesel	Small	Euro 6 2017-2019	274	24 266
Passenger Cars	Diesel	Medium	Euro 1	24 406	9 809
Passenger Cars	Diesel	Medium	Euro 2	32 673	10 701
Passenger Cars	Diesel	Medium	Euro 3	77 782	11 593
Passenger Cars	Diesel	Medium	Euro 4	39 924	15 159
Passenger Cars	Diesel	Medium	Euro 5	26 486	21 924
Passenger Cars	Diesel	Medium	Euro 6 up to 2016	7 826	22 060
Passenger Cars	Diesel	Medium	Euro 6 2017-2019	5 268	24 266
Passenger Cars	Diesel	Large-SUV-Executive	Euro 1	11 636	10 701
Passenger Cars	Diesel	Large-SUV-Executive	Euro 2	13 625	11 949
Passenger Cars	Diesel	Large-SUV-Executive	Euro 3	70 777	12 484
Passenger Cars	Diesel	Large-SUV-Executive	Euro 4	28 939	16 100
Passenger Cars	Diesel	Large-SUV-Executive	Euro 5	12 133	21 134
Passenger Cars	Diesel	Large-SUV-Executive	Euro 6 up to 2016	3 425	22 301
Passenger Cars	Diesel	Large-SUV-Executive	Euro 6 2017-2019	1 097	24 532
Passenger Cars	LPG Bifuel	Small	Conventional	1 963	12 503
Passenger Cars	LPG Bifuel	Small	Euro 1	11 682	14 420
Passenger Cars	LPG Bifuel	Small	Euro 2	10 156	16 670
Passenger Cars	LPG Bifuel	Small	Euro 3	11 892	17 504
Passenger Cars	LPG Bifuel	Small	Euro 4	7 952	18 337
Passenger Cars	LPG Bifuel	Small	Euro 5	1 841	19 554
Passenger Cars	LPG Bifuel	Small	Euro 6	335	20 522
Light Commercial Vehicles	Petrol	N1-II	Euro 1	260	17 838
Light Commercial Vehicles	Petrol	N1-II	Euro 2	205	18 829
Light Commercial Vehicles	Petrol	N1-II	Euro 3	378	21 306
Light Commercial Vehicles	Petrol	N1-II	Euro 4	452	27 182

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
Light Commercial Vehicles	Petrol	N1-II	Euro 5	359	31 348
Light Commercial Vehicles	Petrol	N1-II	Euro 6 up to 2017	155	31 661
Light Commercial Vehicles	Diesel	N1-II	Euro 1	3 737	21 847
Light Commercial Vehicles	Diesel	N1-II	Euro 2	4 526	22 721
Light Commercial Vehicles	Diesel	N1-II	Euro 3	10 411	24 294
Light Commercial Vehicles	Diesel	N1-II	Euro 4	14 151	27 788
Light Commercial Vehicles	Diesel	N1-II	Euro 5	11 393	35 125
Light Commercial Vehicles	Diesel	N1-II	Euro 6 up to 2017	2 802	35 125
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 1	601	22 505
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 2	180	33 316
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 3	230	34 310
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 4	249	35 841
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 5	154	39 175
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 6	16	39 175
Heavy Duty Trucks	Petrol	>3,5 t	Conventional	852	20 224
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro I	1 170	18 281
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro II	400	18 548
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro III	705	24 969
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro IV	253	36 561
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro V	200	37 453
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro VI	48	38 345
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro I	649	18 281
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro II	200	18 548
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro III	510	24 969
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro IV	174	36 561
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro V	94	37 453
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro VI	58	38 345
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro I	190	18 281
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro II	45	18 548
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro III	66	24 969
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro IV	21	36 561
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro V	15	37 453
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro VI	15	38 345
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro I	1 464	26 752
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro II	517	27 198
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro III	658	33 886
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro IV	488	49 045
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro V	311	57 963
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro VI	218	59 746
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro I	880	34 332
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro II	524	34 778
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro III	572	47 262
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro IV	590	53 504
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro V	473	57 963
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro VI	126	62 421
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro I	127	34 332

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro II	76	34 778
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro III	189	47 262
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro IV	52	53 504
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro V	98	57 963
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro VI	109	62 421
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro I	103	34 332
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro II	111	34 778
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro III	251	47 262
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro IV	74	53 504
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro V	146	57 963
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro VI	177	62 421
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro I	87	34 332
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro II	72	34 778
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro III	170	47 262
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro IV	139	53 504
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro V	73	57 963
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro VI	47	62 421
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro I	281	26 752
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro II	653	27 198
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro III	1 790	33 886
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro IV	1 704	49 045
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro V	3 538	57 963
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro VI	2 266	59 746
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro I	47	34 332
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro II	77	34 778
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro III	295	47 262
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro IV	259	53 504
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro V	770	57 963
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro VI	1 730	62 421
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro I	2	34 332
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro II	8	34 778
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro III	25	47 262
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro IV	9	53 504
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro V	14	57 963
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro VI	9	62 421
Buses	Petrol	N1-III	Euro 2	17	31 399
Buses	Diesel	Urban Buses Midi <=15 t	Euro I	300	29 041
Buses	Diesel	Urban Buses Midi <=15 t	Euro II	172	29 041
Buses	Diesel	Urban Buses Midi <=15 t	Euro III	401	39 139
Buses	Diesel	Urban Buses Midi <=15 t	Euro IV	292	53 504
Buses	Diesel	Urban Buses Midi <=15 t	Euro V	652	57 963
Buses	Diesel	Urban Buses Midi <=15 t	Euro VI	390	57 963
Buses	Diesel	Coaches Standard <=18 t	Euro I	222	42 803
Buses	Diesel	Coaches Standard <=18 t	Euro II	117	43 249
Buses	Diesel	Coaches Standard <=18 t	Euro III	286	53 504
Buses	Diesel	Coaches Standard <=18 t	Euro IV	58	65 097
Buses	Diesel	Coaches Standard <=18 t	Euro V	197	71 339
Buses	Diesel	Coaches Standard <=18 t	Euro VI	40	73 122
Buses	Diesel	Coaches Articulated >18 t	Euro I	89	42 803
Buses	Diesel	Coaches Articulated >18 t	Euro II	97	43 249
Buses	Diesel	Coaches Articulated >18 t	Euro III	403	53 504
Buses	Diesel	Coaches Articulated >18 t	Euro IV	28	65 097
Buses	Diesel	Coaches Articulated >18 t	Euro V	26	71 339
Buses	Diesel	Coaches Articulated >18 t	Euro VI	164	73 122
L-Category	Petrol	Mopeds 2-stroke <50 cm^3	Euro 1	2 226	1 112
L-Category	Petrol	Mopeds 2-stroke <50 cm^3	Euro 2	4 006	2 402
L-Category	Petrol	Mopeds 2-stroke <50 cm^3	Euro 3	8 600	2 629
L-Category	Petrol	Mopeds 2-stroke <50 cm^3	Euro 4	428	2 629
L-Category	Petrol	Motorcycles 2-stroke >50 cm^3	Conventional	311	1 112

Category	Fuel	Segment	Euro Standard	Population	Average mileage per car
L-Category	Petrol	Motorcycles 2-stroke >50 cm³	Euro 1	660	1 112
L-Category	Petrol	Motorcycles 2-stroke >50 cm³	Euro 2	868	1 618
L-Category	Petrol	Motorcycles 2-stroke >50 cm³	Euro 3	1 492	2 996
L-Category	Petrol	Motorcycles 2-stroke >50 cm³	Euro 4	206	3 135
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm³	Conventional	1 903	1 416
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm³	Euro 1	1 409	1 416
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm³	Euro 2	1 065	2 090
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm³	Euro 3	2 054	5 056
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm³	Euro 4	173	5 192
L-Category	Petrol	Motorcycles 4-stroke >750 cm³	Conventional	1 617	1 820
L-Category	Petrol	Motorcycles 4-stroke >750 cm³	Euro 1	1 856	1 820
L-Category	Petrol	Motorcycles 4-stroke >750 cm³	Euro 2	1 342	2 090
L-Category	Petrol	Motorcycles 4-stroke >750 cm³	Euro 3	1 547	5 056
L-Category	Petrol	Motorcycles 4-stroke >750 cm³	Euro 4	197	5 192
L-Category	Petrol	Quad & ATVs	Euro 4	869	418

Annex II: National energy balance

Table 1 National Energy Balance in 2017, TJ

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil (oven fuel inclusive)	Residual (heavy) fuel oils	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	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
NCV		39	46	44	43	43	43	42	41	40	40	40	40	33	42	29	24	10	15	27		34	8	3	3	17	18	26	22	30	27	37	19	20	19	14
Production of primary energy resources	518										518							19	11				23496	7319	27564	1027	25718				233	1987	337	101	3463	234
Recycled products	27															27												97	362							
Imports	96885	18	10884	9372		5919	4	66114	28	46	1826	2317	232	2	123		1634			3		42499	163	434	1005	304	3285	95	1454	279	266	183				
Imported for bunkering	10895							5779	5116																											
Exports	32271	17	6582	1615				22435	51	5	1440		3		123		142	14					831	247	5884	608	28169			628	176	2195				
Bunkering	10895							5779	5116																											
Stock changes	-641		-76	159		5		-902	61	1	-32	81	20	42			194	24	-3			-829	1403	1337	619	-35	1595		-19	38	8	147				-11
Statistical differences	1296			446				850																												
Gross energy consumption	65814	1	4226	8362		5924	4	43627	38	42	872	2398	249	44		27	1686	29	11	3		41670	24231	8843	23304	688	2429	192	1797	311	331	122	337	101	3463	223
Transformation	47		5					20	22								154	29				26988	1599	440	18184	10	149			377			217	101	3252	33
Electricity plants																																				
Public CHP	7							7									88					24333	1	367	11751								25	101	2478	18
Autoproducer CHP	3		3																			303			309								192		774	
Public Heat Plants	30		1					7	22								19					1783	278	39	5467	1	99									
Autoproducer Heat Plants	7		1					6									47					569	387	34	657	9	50									15
Production of peat briquettes																		29																		
Charcoal Production																							933							377						
Energy sector	244							244														440														

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil (oven fuel inclusive)	Residual (heavy) fuel oils	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	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Losses																						*477*														
Final consumption	*65523*	*1*	*4221*	*8362*		*5924*	*4*	*43363*	*16*	*42*	*872*	*2398*	*249*	*44*		*27*	*1532*		*11*	*3*		*13765*	*22632*	*8403*	*5120*	*678*	*2280*	*192*	*1797*	*66*	*331*	*122*	*120*		*211*	*190*
Transport	*51182*		*2440*	*8041*		*5914*		*33950*			*837*																				*331*	*57*				
International air transport	*5858*					*5858*																														
Domestic air transport	*62*			*6*		*56*																														
Road transport	*42842*		*2440*	*8030*				*31570*			*802*																				*331*	*28*				
Rail transport	*2228*							*2193*			*35*																					*29*				
Inland shipping	*192*			*5*				*187*																												
Pipeline transport																																				
Industry and construction	*4995*	*1*	*532*	*36*				*1657*	*12*	*42*		*2398*	*249*	*44*		*24*	*971*			*3*		*4513*	*1884*	*6990*	*4534*	*154*	*151*	*192*	*1797*			*8*			*23*	*45*
Manufacture of metals	*1*							*1*														*6*														
Manufacture of chemicals and chemical products	*192*		*142*	*4*				*4*		*42*												*447*	*33*	*9*	*144*		*1*					*6*			*22*	
Manufacture of other fabricated metal products																						*26*														
Manufacture of other non-metallic mineral products	*333*		*1*					*288*						*44*			*899*					*1285*	*5*				*1*	*192*	*1797*			*2*				
Manufacture of transport equipment	*29*		*5*					*24*												*3*		*42*	*2*				*2*									
Machinery	*34*		*18*	*2*				*14*									*9*					*212*	*25*	*23*	*47*		*39*									
Mining and quarrying	*182*			*1*				*181*														*32*	*11*				*3*									
Manufacture of food products, beverages and tobacco	*356*		*191*					*132*	*9*							*24*	*40*					*1240*	*87*		*192*	*17*	*31*								*1*	*45*
Manufacture of paper and paper products	*6*		*4*					*2*														*105*	*2*	*1*	*2*		*4*									

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil (oven fuel inclusive)	Residual (heavy) fuel oils	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	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Manufacture of wood and of products of wood and cork	605	1	26	15				408					155				3					630	1662	6882	4107	132	42									
Construction	3138		140	14				584	2			2398					7					253	31	5		5	15									
Manufacture of textiles	6		2					4									6					183	4				9									
Manufacture of other products	113		3					15	1				94				7					52	22	70	42		4									
Other Sectors	9346		1249	285		10	4	7756	4		35					3	561		11			9252	20748	1413	586	524	2129			66		57	120		188	145
Other consumers - commercial and public sector	1579		331	43		10	4	1184	4							3	150		11			4241	1875	588	451	49	479						120			
Households	2314		794	220				1300									410					4673	18704	323		470	1596			66						
Crop and animal production, hunting and related service activities; forestry and logging	5137		124	22				4957			34											334	165	502	135	5	54					57			188	145
Fishing	316							315			1						1					4	4													

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	*94338*	*88210*	*73651*	*57391*	*53160*	*50514*	*51326*	*52637*	*54187*	*48325*	*42657*	*44355*	*43268*	*43796*	*41000*	*40407*	*41916*	*39400*	*38929*	*37897*
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*	*3430*	*2974*	*3083*	*2157*	*1275*	*2351*	*1230*	*1005*	*663*	*70*	*60*	*30*	*29*	*20*	*10*
Gaseous Fuels	*49029*	*50288*	*39788*	*24246*	*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*	*5206*	*4464*	*5089*	*5028*	*4908*	*4956*
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*	*39348*	*39061*	*40483*	*38378*	*37639*	*36780*
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*	*4648*	*4222*	*4817*	*4755*	*4635*	*4499*
Other Fossil Fuels	*42*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*42*	*29*	*88*	*29*	*NO*	*NO*	*NO*	*29*
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*
LPG	*46*	*46*	*46*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*1967*	*1583*	*1137*	*1421*	*NO*	*126*	*84*	*42*	*126*	*NO*	*NO*	*126*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*39*	*NO*	*NO*	*NO*	*394*	*944*	*472*	*354*	*157*	*NO*	*NO*	*39*	*39*	*NO*	*NO*
Coal	*2305*	*1736*	*1935*	*2106*	*1366*	*1395*	*740*	*541*	*427*	*370*	*371*	*398*	*285*	*209*	*210*	*183*	*105*	*341*	*446*	*472*
Peat briquettes	*31*	*15*	*15*	*15*	*15*	*77*	*62*	*77*	*15*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*1347*	*1688*	*1930*	*2422*	*2231*	*2626*	*2341*	*2523*	*1749*	*1046*	*1970*	*1125*	*995*	*653*	*60*	*40*	*20*	*20*	*20*	*10*
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*	*4741*	*4675*	*4556*	*4390*
Sludge gas	*NO*	*NO*	*NO*	*31*	*24*	*18*	*39*	*23*	*17*	*38*	*41*	*51*	*67*	*43*	*78*	*90*	*76*	*80*	*79*	*100*
Landfill gas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*9*
Other biogas	*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*
Straws	*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	*1865.1*	*1521.3*	*1750.15*	*1444.85*	*1663.85*	*1924*	*2826.4*	*1404.7*	*3733.75*	*3996.35*	*2737.65*	*1424.25*	*1270*	*1613*	*1652*	*1346*	*1433*	*1022*	*1290*	*1117*
Liquid Fuels	*339.2*	*251.2*	*251.2*	*251.2*	*433.2*	*252.6*	*1223*	*329.6*	*2546*	*3005*	*1550*	*170*	*212*	*170*	*212*	*212*	*212*	*170*	*212*	*163*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solid Fuels	*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*	*727.4*	*571.4*	*483.1*	*392.75*	*229.35*	*380.65*	*105.25*	*10*	*10*	*10*	*20*	*10*	*9*	*NO*	*NO*
Gaseous Fuels	*815*	*630*	*630*	*624*	*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*
Diesel oil	*212*	*170*	*170*	*170*	*170*	*212*	*127*	*127*	*127*	*212*	*127*	*170*	*212*	*170*	*212*	*212*	*212*	*170*	*212*	*163*
RFO	*81*	*81*	*81*	*81*	*81*	*41*	*1096*	*203*	*487*	*731*	*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*
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	*711*	*640*	*869*	*570*	*595*	*727*	*571*	*483*	*393*	*229*	*381*	*105*	*10*	*10*	*10*	*20*	*10*	*9*	*NO*	*NO*
Natural gas	*815*	*630*	*630*	*624*	*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
1.A.1. Energy Industries								
Total	*45595*	*42380*	*40380*	*46021*	*43786*	*46642*	*50940*	*47993*
Liquid Fuels	*918*	*848*	*662*	*466*	*319*	*283*	*295*	*281*
Solid Fuels	*419*	*419*	*513*	*424*	*175*	*105*	*152*	*107*
Peat	*11*	*9*	*NO*	*40*	*NO*	*NO*	*NO*	*29*
Gaseous Fuels	*38687*	*35607*	*31872*	*33926*	*29870*	*31395*	*32108*	*26556*
Biomass	*5531*	*5494*	*7333*	*11165*	*13422*	*14859*	*18385*	*21034*
Other Fossil Fuels	*29*	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.1.a. Public Electricity and Heat Production								
Total	*44274*	*40852*	*39004*	*44541*	*42276*	*45330*	*49794*	*46738*
Liquid Fuels	*705*	*593*	*492*	*211*	*33*	*28*	*30*	*37*
Solid Fuels	*419*	*419*	*513*	*424*	*175*	*105*	*152*	*107*
Peat	*11*	*9*	*NO*	*40*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*37812*	*34664*	*30895*	*32997*	*29040*	*30712*	*31595*	*26116*
Biomass	*5298*	*5164*	*7104*	*10869*	*13028*	*14485*	*18017*	*20478*
Other Fossil Fuels	*29*	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*15*	*25*	*127*	*94*	*22*	*14*	*11*	*14*
RFO	*690*	*568*	*365*	*113*	*10*	*13*	*18*	*22*
LPG	*NO*	*NO*	*NO*	*4*	*1*	*1*	*1*	*1*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017
Coal	*419*	*419*	*513*	*424*	*175*	*105*	*152*	*107*
Peat briquettes	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*10*	*9*	*NO*	*40*	*NO*	*NO*	*NO*	*NO*
Natural gas	*37812*	*34664*	*30895*	*32997*	*29040*	*30712*	*31595*	*26116*
Wood	*5120*	*4635*	*5793*	*9198*	*11184*	*12286*	*15662*	*18003*
Sludge gas	*114*	*100*	*105*	*97*	*91*	*99*	*107*	*106*
Landfill gas	*18*	*22*	*22*	*14*	*16*	*13*	*13*	*14*
Other biogas	*37*	*355*	*1145*	*1560*	*1737*	*2086*	*2234*	*2337*
Biofuel	*8*	*52*	*39*	*NO*	*NO*	*NO*	*NO*	*NO*
Straws	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*18*
Waste oils	*29*	*3*	*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*	*1255*
Liquid Fuels	*213*	*255*	*170*	*255*	*286*	*255*	*265*	*244*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*29*
Gaseous Fuels	*875*	*943*	*977*	*929*	*830*	*683*	*513*	*440*
Biomass	*233*	*330*	*229*	*296*	*394*	*374*	*368*	*556*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*213*	*255*	*170*	*255*	*286*	*255*	*265*	*244*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*29*
Natural gas	*875*	*943*	*977*	*929*	*830*	*683*	*513*	*440*
Wood	*233*	*330*	*229*	*296*	*394*	*374*	*368*	*556*

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	24014	25616	24380	23176	22377
Liquid Fuels	29747	20311	17430	17082	16545	16745	16344	16010	12910	11400	7575	4681	3966	4417	4277	2866	4075	3847	3076	2946
Solid Fuels	1545	882	968	1639	1444	650	592	450	393	421	252	252	253	262	236	971	1394	1967	1997	1363
Peat	NO	20	10	NO	15	15	15	25	25	15	NO	NO	NO	NO	10	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
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	5584	6462	5415	5895	8674
Other Fossil Fuels	837	NO	NO	NO	NO	NO	NO	NO	NO	26	94	469	866	530	517	914	290	270	372	133
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
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	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
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	79	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
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	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
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
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																				

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	3943	2515	2013	3638	3935	5645	4160	3529	643	538	486	479	469	449	452	471	539	455	811	688
Liquid Fuels	3516	1932	1599	2963	3207	4547	3451	3207	325	122	122	164	162	122	NO	NO	NO	NO	81	41
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	29	59	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
RFO	3127	1543	1340	2963	3207	4547	3451	3207	325	122	122	122	162	122	NO	NO	NO	NO	81	41
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
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 briquettes	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
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	29	56	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
RFO	203	162	122	122	41	81	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
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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
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	5018	4876	4041	3139	2874
Liquid Fuels	7318	4471	3944	3578	3654	4141	4919	4398	4516	3581	2418	1184	1102	694	533	615	661	460	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	1034	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
RFO	7105	4425	3898	3532	3654	4060	4791	4223	4384	3492	1745	975	893	609	406	406	447	329	122	244
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
Other liquid	167	NO	NO	NO	NO	42	42	NO	NO	NO	NO	84	84	NO	42	84	84	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	39	NO	NO	NO	NO	630	79	79	39	39	79	39	40	40	39
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	916	1034	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	4084	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	169	165	175	100

	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	74
RFO	3289	1137	1259	1218	2842	2436	2477	2354	1827	2071	731	162	NO	NO	NO	41	NO	81	41	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
Other liquid	126	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	42	NO	251	NO	NO	42	NO	NO	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	198	956	1088	429	627	132	NO	165
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	118	748	236	118	118	79	39	39	39	39	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	135	139	77	67
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	33
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	209	586	234	205	175	117	88	117	29
Industrial wastes (used tires)	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	94	176	238	208	224	125	85	65	58	15
Municipal wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	80	30
										1.A.2.g. Other										
Total	24278	21798	16497	13910	10424	8992	9088	8814	9626	8599	6615	7269	6886	7148	8557	9274	10573	10028	9965	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	30	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	4350	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
Gasoline	880	220	220	220	132	44	132	88	88	44	44	44	69	44	88	88	88	88	88	44
Diesel oil	5549	5591	4019	3779	1597	1485	1315	1740	1655	1527	1469	1357	1231	1187	1357	1385	1527	1997	1657	1530

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
RFO	7632	5766	5563	4385	4099	3086	3085	2883	3411	2761	813	366	123	82	82	82	82	41	NO	NO
LPG	NO	NO	NO	NO	NO	91	137	91	NO	46	46	NO	NO	NO	46	46	46	46	45	NO
Other kerosene	NO	NO	NO	86	43	86	43	86	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	84	NO	NO	42	42	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	39	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	199	171	171	625	597	170	169	56	169	141	84	56	56	52	52	104	130	79	30	26
Coke	79	NO	NO	52	26	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	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
Peat	NO	20	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	10	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	4350	5442	4459	5132	7793
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	42	NO	NO	NO	NO	NO	NO	NO	29

	2010	2011	2012	2013	2014	2015	2016	2017
1.A.2 Manufacturing Industries and Construction								
Total	*26693*	*25255*	*27930*	*26004*	*26913*	*26320*	*23698*	*24281*
Liquid Fuels	*3500*	*2298*	*2649*	*2576*	*2254*	*2014*	*2193*	*2282*
Solid Fuels	*1861*	*2229*	*2149*	*1406*	*1336*	*1014*	*727*	*974*
Peat	*14*	*2*	*2*	*24*	*24*	*11*	*34*	*NO*
Gaseous Fuels	*10537*	*7578*	*7952*	*6259*	*5258*	*5262*	*4755*	*4689*
Biomass	*10319*	*12399*	*14301*	*14624*	*16762*	*16771*	*15077*	*15170*
Other Fossil Fuels	*462*	*749*	*877*	*1115*	*1279*	*1248*	*913*	*1166*
1.A.2.a. Iron and Steel								
Total	*4869*	*1207*	*1633*	*583*	*13*	*406*	*46*	*6*
Liquid Fuels	*1005*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0*
Solid Fuels	*26*	*27*	*184*	*32*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*3838*	*1180*	*1449*	*551*	*13*	*406*	*46*	*6*
Biomass	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Diesel oil	*0*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017
Other liquid	*1005*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*26*	*27*	*102*	*5*	*NO*	*NO*	*NO*	*NO*
Coke	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Anthracite	*NO*	*NO*	*82*	*27*	*NO*	*NO*	*NO*	*NO*
Natural gas	*3838*	*1180*	*1449*	*551*	*13*	*406*	*46*	*6*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.2.b. Non-Ferrous Metals								
Total	*135*	*170*	*170*	*138*	*72*	*61*	*37*	*26*
Liquid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Solid Fuels	*NO*	*2*	*1*	*NO*	*NO*	*1*	*1*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*135*	*168*	*168*	*138*	*72*	*60*	*36*	*26*
Biomass	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*2*	*1*	*NO*	*NO*	*1*	*1*	*NO*
Natural gas	*135*	*168*	*168*	*138*	*72*	*60*	*36*	*26*
Biofuel	*NO*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*
1.A.2.c. Chemicals								
Total	*803*	*639*	*790*	*804*	*865*	*761*	*754*	*850*
Liquid Fuels	*9*	*46*	*137*	*137*	*144*	*139*	*127*	*142*
Solid Fuels	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*20*	*11*	*NO*	*NO*	*NO*
Gaseous Fuels	*606*	*404*	*371*	*385*	*316*	*330*	*390*	*452*
Biomass	*188*	*188*	*282*	*262*	*394*	*292*	*237*	*256*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
RFO	*9*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*46*	*137*	*137*	*144*	*139*	*127*	*142*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*20*	*10*	*NO*	*NO*	*NO*
Natural gas	*606*	*404*	*371*	*385*	*316*	*330*	*390*	*452*
Wood	*187*	*169*	*210*	*208*	*278*	*221*	*179*	*188*
Biofuel	*1*	*1*	*NO*	*NO*	*1*	*1*	*NO*	*6*
Other biogas	*NO*	*18*	*72*	*54*	*115*	*70*	*58*	*62*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017
1.A.2.d. Pulp, Paper and Print								
Total	*257*	*209*	*170*	*200*	*104*	*104*	*102*	*118*
Liquid Fuels	*NO*	*NO*	*NO*	*NO*	*4*	*4*	*4*	*4*
Solid Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*101*	*101*	*68*	*103*	*97*	*95*	*86*	*105*
Biomass	*156*	*108*	*102*	*97*	*3*	*5*	*11*	*9*
Other Fossil Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*NO*	*NO*	*NO*	*4*	*4*	*4*	*4*
Coal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*
Natural gas	*101*	*101*	*68*	*103*	*97*	*95*	*86*	*105*
Wood	*156*	*108*	*102*	*97*	*3*	*5*	*11*	*9*
1.A.2.e. Food Processing, Beverages and Tobacco								
Total	*2738*	*2609*	*2790*	*2619*	*2484*	*2105*	*2151*	*1991*
Liquid Fuels	*396*	*291*	*379*	*305*	*226*	*156*	*197*	*200*
Solid Fuels	*52*	*16*	*27*	*25*	*24*	*24*	*46*	*40*
Peat	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*1919*	*1886*	*1819*	*1808*	*1729*	*1627*	*1476*	*1303*
Biomass	*339*	*360*	*536*	*452*	*476*	*269*	*411*	*424*
Other Fossil Fuels	*29*	*56*	*29*	*29*	*29*	*29*	*21*	*24*
RFO	*285*	*121*	*203*	*81*	*31*	*8*	*7*	*9*
LPG	*72*	*91*	*137*	*182*	*160*	*148*	*190*	*191*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*42*	*35*	*NO*	*NO*	*NO*
Shale oil	*39*	*79*	*39*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*52*	*16*	*27*	*25*	*24*	*24*	*46*	*40*
Coke	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat briquettes	*3*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*1919*	*1886*	*1819*	*1808*	*1729*	*1627*	*1476*	*1303*
Wood	*333*	*360*	*535*	*449*	*467*	*230*	*361*	*371*
Straws	*NO*	*NO*	*NO*	*NO*	*NO*	*29*	*41*	*45*
Biofuel	*6*	*NO*	*1*	*NO*	*NO*	*NO*	*NO*	*NO*
Other biogas	*NO*	*NO*	*NO*	*3*	*9*	*10*	*9*	*8*
Waste oils	*29*	*56*	*29*	*29*	*29*	*29*	*21*	*24*
1.A.2.f. Non-metallic minerals								
Total	*4318*	*4973*	*5282*	*4765*	*5125*	*4521*	*3686*	*4347*

	2010	2011	2012	2013	2014	2015	2016	2017
Liquid Fuels	*627*	*NO*	*NO*	*NO*	*NO*	*1*	*124*	*45*
Solid Fuels	*1757*	*2136*	*1910*	*1299*	*1254*	*957*	*650*	*899*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Gaseous Fuels	*1010*	*977*	*1280*	*1344*	*1353*	*1208*	*1186*	*1286*
Biomass	*520*	*1196*	*1273*	*1035*	*1269*	*1135*	*835*	*976*
Other Fossil Fuels	*404*	*664*	*819*	*1086*	*1250*	*1219*	*892*	*1142*
RFO	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
LPG	*NO*	*NO*	*NO*	*NO*	*NO*	*1*	*NO*	*1*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Petroleum coke	*627*	*NO*	*NO*	*NO*	*NO*	*NO*	*124*	*44*
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	*1757*	*2136*	*1910*	*1299*	*1254*	*957*	*650*	*899*
Oil shale	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Peat	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Natural gas	*1010*	*977*	*1280*	*1344*	*1353*	*1208*	*1186*	*1286*
Wood	*10*	*3*	*23*	*NO*	*NO*	*3*	*25*	*6*
Biofuel	*NO*	*NO*	*NO*	*NO*	*3*	*2*	*2*	*2*
Municipal wastes (biomass fraction)	*510*	*1193*	*1250*	*1035*	*1266*	*1130*	*808*	*968*
Waste oils	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Industrial wastes (used tires)	*84*	*331*	*242*	*379*	*335*	*273*	*148*	*180*
Municipal wastes	*320*	*332*	*577*	*707*	*915*	*946*	*743*	*962*
1.A.2.g. Other								
Total	*13573*	*15448*	*17095*	*16896*	*18249*	*18362*	*16922*	*16943*
Liquid Fuels	*1463*	*1961*	*2133*	*2134*	*1880*	*1714*	*1741*	*1891*
Solid Fuels	*26*	*47*	*27*	*50*	*58*	*32*	*29*	*35*
Peat	*11*	*2*	*2*	*4*	*13*	*11*	*34*	
Gaseous Fuels	*2928*	*2862*	*2797*	*1930*	*1678*	*1536*	*1535*	*1511*
Biomass	*9116*	*10547*	*12107*	*12778*	*14620*	*15069*	*13583*	*13506*
Other Fossil Fuels	*29*	*29*	*29*	*NO*	*NO*	*NO*	*NO*	*NO*
Gasoline	*44*	*44*	*44*	*44*	*43*	*48*	*41*	*36*
Diesel oil	*1359*	*1785*	*1997*	*1996*	*1722*	*1547*	*1560*	*1657*
RFO	*41*	*41*	*NO*	*NO*	*NO*	*5*	*3*	*3*
LPG	*19*	*91*	*92*	*94*	*115*	*114*	*137*	*194*
Other kerosene	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*

	2010	2011	2012	2013	2014	2015	2016	2017
Shale oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1*
Coal	*26*	*47*	*27*	*50*	*58*	*32*	*29*	*32*
Coke	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*3*
Peat briquettes	*1*	*NO*	*NO*	*4*	*3*	*1*	*NO*	*NO*
Peat	*10*	*2*	*2*	*NO*	*10*	*10*	*34*	*NO*
Natural gas	*2928*	*2862*	*2797*	*1930*	*1678*	*1536*	*1535*	*1511*
Wood	*9115*	*10547*	*12051*	*12776*	*14620*	*15069*	*13583*	*13506*
Biofuel	*1*	*NO*	*2*	*2*	*NO*	*NO*	*NO*	*NO*
Other biogas	*NO*	*NO*	*54*	*NO*	*NO*	*NO*	*NO*	*NO*
Waste oils	*29*	*29*	*29*	*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	*102092*	*108961*	*83730*	*77831*	*64625*	*60182*	*61263*	*56261*	*52470*	*52089*	*49117*	*54029*	*53828*	*57273*	*59428*	*59055*	*58857*	*59344*	*55403*	*57530*
Liquid Fuels	*27829*	*32499*	*24223*	*21319*	*14008*	*8817*	*8761*	*7849*	*6947*	*7439*	*6888*	*7363*	*6919*	*7887*	*7936*	*7807*	*8456*	*7888*	*7114*	*7778*
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*	*391*	*506*	*357*	*266*	*66*	*41*	*15*	*NO*	*10*	*NO*	*20*	*40*	*61*	*31*	*16*
Gaseous Fuels	*24289*	*24628*	*11751*	*9338*	*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*	*38380*	*38399*	*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	*40346*	*40142*	*34150*	*27786*	*17464*	*16517*	*16581*	*14795*	*12297*	*13125*	*11356*	*12366*	*13179*	*13856*	*15142*	*14292*	*14964*	*15997*	*13248*	*11285*
Liquid Fuels	*13453*	*16642*	*11910*	*10556*	*5308*	*2890*	*2758*	*2459*	*2017*	*2346*	*1715*	*1928*	*1818*	*2207*	*2167*	*1860*	*2289*	*1902*	*1596*	*1586*
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*	*114*	*250*	*163*	*71*	*15*	*31*	*15*	*NO*	*10*	*NO*	*20*	*40*	*61*	*31*	*16*
Gaseous Fuels	*6090*	*6408*	*5466*	*3579*	*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*	*6651*	*7253*	*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*
Gasoline	*44*	*44*	*44*	*44*	*220*	*NO*	*88*	*88*	*44*	*88*	*88*	*77*	*46*	*44*	*44*	*44*	*44*	*44*	*44*	*44*
Diesel oil	*8116*	*11515*	*7436*	*7478*	*1529*	*1189*	*1147*	*552*	*340*	*935*	*1020*	*1190*	*1317*	*1530*	*1657*	*1275*	*1700*	*1657*	*1360*	*1393*
RFO	*4953*	*4953*	*4344*	*2679*	*3248*	*1177*	*1300*	*1421*	*1137*	*974*	*528*	*528*	*325*	*284*	*244*	*365*	*365*	*40*	*80*	*41*
LPG	*46*	*NO*	*NO*	*182*	*137*	*91*	*137*	*182*	*410*	*91*	*NO*	*91*	*46*	*182*	*137*	*137*	*137*	*137*	*91*	*91*
Jet fuel	*NO*	*NO*	*NO*	*NO*	*NO*	*86*	*43*	*173*	*43*	*130*	*NO*	*NO*	*NO*	*NO*	*43*	*NO*	*43*	*24*	*21*	*17*
Other kerosene	*43*	*130*	*86*	*173*	*173*	*346*	*43*	*43*	*43*	*86*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Other liquid	*251*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*42*	*NO*	*42*	*84*	*167*	*42*	*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
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	79	NO	NO	NO	NO	39	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
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	511	356	449	248	155	62	139	93	31	15	31	15	NO	NO	NO	NO	NO	1	1	6
Peat	161	161	171	40	171	52	110	70	40	NO	NO	NO	NO	10	NO	20	40	60	30	10
Natural gas	6090	6408	5466	3579	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	6381	6966	4691	4482
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
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
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
Gasoline	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	132	132	132	132	132	220	264	264	264	264
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
LPG	2869	2823	2368	2140	1913	1275	1230	1321	1412	1321	1184	1139	1139	1139	1184	1230	1230	1047	1002	911
Other kerosene	86	86	43	43	43	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 briquettes	294	201	248	248	124	232	201	139	155	31	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	131	131	131	10	20	20	40	40	40	20	10	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	5938	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
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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Biomass	1220	1229	1271	1306	1307	358	365	617	648	665	590	546	508	506	607	552	534	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
Gasoline	1628	132	132	132	132	88	88	88	44	44	44	11	17	44	44	44	44	44	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
LPG	46	46	NO	91	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	46	45
Other kerosene	86	86	43	43	43	NO	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	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 briquettes	31	31	31	31	15	15	15	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	40	30	10	NO	NO	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	534	713	324	722
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NO	NO	NO	NO	NO	NO	NO	NO	NO

	2010	2011	2012	2013	2014	2015	2016	2017
1.A.4 Other Sectors								
Total	52940	51629	53939	50148	49268	44412	44549	47917
Liquid Fuels	8334	8351	8351	8476	8753	8887	8659	9318
Solid Fuels	2098	1861	983	1075	962	831	799	608
Peat	21	32	32	NO	11	NO	NO	11
Gaseous Fuels	11819	10343	10477	9809	9670	9101	9888	9948
Biomass	30659	31042	34097	30788	29872	25593	25199	28029
Other Fossil Fuels	8	NO	NO	NO	NO	NO	4	3
1.A.4.a. Commercial/Institutional								
Total	13329	11772	12743	12526	12038	11770	11348	11441
Liquid Fuels	1619	1397	1859	1939	2129	2243	1606	1583
Solid Fuels	1023	891	354	519	407	323	292	197
Peat	1	32	32	NO	11	NO	NO	11
Gaseous Fuels	5623	5055	4952	4477	4401	4166	4514	4651
Biomass	5054	4398	5546	5591	5090	5038	4934	4996
Other Fossil Fuels	8	NO	NO	NO	NO	NO	2	3

	2010	2011	2012	2013	2014	2015	2016	2017
Gasoline	44	88	44	88	44	44	33	43
Diesel oil	1418	1251	1713	1755	1924	2054	1273	1190
RFO	41	2	NO	NO	NO	1	4	4
LPG	99	54	98	96	161	144	249	332
Jet fuel	17	2	4	NO	NO	NO	34	10
Other kerosene	NO	NO	NO	NO	NO	NO	6	4
Other liquid	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	7	NO
Coal	1023	891	354	519	407	323	265	190
Anthracite	NO	NO	NO	NO	NO	NO	27	7
Peat briquettes	1	3	4	NO	1	NO	NO	11
Peat	NO	29	28	NO	10	NO	NO	NO
Natural gas	5623	5055	4952	4477	4401	4166	4514	4651
Wood	4680	3997	5163	5087	4603	4512	4455	4509
Landfill gas	314	327	325	357	353	407	396	408
Other biogas	NO	NO	NO	49	69	74	68	70
Straws	57	43	24	44	53	30	15	10
Biofuel	4	31	34	54	12	15	NO	NO
Waste oils	8	NO	NO	NO	NO	NO	2	3
1.A.4.b. Residential								
Total	33561	33797	35117	31228	30846	25862	26012	28556
Liquid Fuels	2237	2229	2236	2237	2283	2055	2140	2314
Solid Fuels	1049	944	577	530	531	501	498	410
Peat	20	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	5219	4480	4481	4266	4252	4116	4510	4673
Biomass	25036	26144	27823	24195	23780	19190	18864	21159
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	264	264	263	264	264	220	220	220
Diesel oil	1062	1062	1062	1062	1062	1062	1154	1300
RFO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	911	903	911	911	957	773	766	794
Other kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Coal	1049	944	577	530	531	501	498	410
Peat briquettes	NO	NO	NO	NO	NO	NO	NO	NO
Peat	20	NO	NO	NO	NO	NO	NO	NO
Natural gas	5219	4480	4481	4266	4252	4116	4510	4673
Wood	24974	26084	27764	24105	23690	19130	18799	21093
Charcoal	60	60	59	90	90	60	65	66

	2010	2011	2012	2013	2014	2015	2016	2017
Straws	2	NO	NO	NO	NO	NO	NO	NO
1.A.4.c. Agriculture/Forestry/Fisheries								
Total	6050	6059	6079	6394	6383	6781	7189	7919
Liquid Fuels	4478	4725	4255	4300	4341	4589	4913	5421
Solid Fuels	26	26	52	26	24	7	9	1
Peat	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	977	808	1044	1066	1017	819	864	624
Biomass	569	500	727	1002	1001	1366	1401	1873
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	2	NO
Gasoline	NO	88	88	88	46	25	82	22
Diesel oil	4462	4589	4121	4164	4248	4472	4722	5272
RFO	3	3	NO	NO	NO	NO	NO	NO
LPG	13	45	46	48	47	92	109	127
Other kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	NO	NO	NO	NO	NO	NO	NO	NO
Coal	26	26	52	26	24	7	9	1
Peat briquettes	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	977	808	1044	1066	1017	819	864	624
Wood	568	361	299	460	292	401	462	877
Other biogas	NO	91	358	474	604	814	768	789
Straws	NO	NO	14	14	46	76	105	150
Biofuel	1	48	56	54	59	75	66	57
Waste oils	NO	NO	NO	NO	NO	NO	2	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	NO	3	1	3	2	2	2	94	84	131	104	103	39	47	73
Liquid Fuels	NO	NO	NO	NO	NO	NO	3	1	3	2	2	2	94	84	131	104	103	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
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	2	2	3	2	6	1	5	1
Diesel oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	75	65	111	77	73	14	21	49

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Jet fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	17	17	17	24	24	24	21	23

	2010	2011	2012	2013	2014	2015	2016	2017
1.A.5 Other (Not elsewhere specified)								
Total	107	98	100	88	128	130	155	178
Liquid Fuels	107	98	100	88	128	130	155	178
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO	NO
Biomass	NO	NO	NO	NO	NO	NO	NO	NO
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	0	NO	NO	NO	NO	NO	NO	NO
Diesel oil	87	80	79	63	105	112	121	168
Jet fuel	20	18	21	24	23	18	34	10

Annex III: 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 included	PM emissions: the condensable component is excluded	EF references and comments
1A1a	*Public electricity and heat production*		*$PM_{2.5}$, PM_{10}*	*EMEP/EEA 2016 – 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 2016 – 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 2016 – 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 2016 – 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 2016 – 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 2016 – 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 2016 – 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 2016 – 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 2016 - 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 2016 - 1.A.4 Non road mobile machinery – Table 3-1*
1A2gviii	*Other*	No information		*EMEP/EEA 2016 – 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 2016 – 1.A.3.a Aviation - Table 3.4*
1A3aii(i)	*Domestic aviation LTO (civil)*	No information		*EMEP/EEA 2016 – 1.A.3.a Aviation - Table 3.4*
1A3bi	*Passenger cars*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 –COPERT 5.2 model*
1A3bii	*Light duty vehicles*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 –COPERT 5.2 model*
1A3biii	*Heavy duty vehicles and buses*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 –COPERT 5.2 model*
1A3biv	*Mopeds & motorcycles*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 –COPERT 5.2 model*
1A3bvi	*Automobile tyre and brake wear*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 –COPERT 5.2 model*
1A3bvii	*Automobile road abrasion*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 –COPERT 5.2 model*
1A3c	*Railways*	No information		*EMEP/EEA 2016 – 1.A.3.c Railways - Table 3.1*
1A3dii	*National navigation (shipping)*	*No information*		*EMEP/EEA 2016 - 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 2016 - 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 2016 - 1.A.4 Non road mobile machinery – Table 3-1*
1A4bi	*Residential - Stationary*	Information provided in reference column		*EMEP/EEA 2016 - 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 3-40 (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)*
1A4bii	*Residential - Off-road vehicles and other machinery*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 - 1.A.4 Non road mobile machinery – Table 3-1*
1A4ci	*Agriculture/Forestry/Fishing - Stationary*	No information		*EMEP/EEA 2016 - 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)*
1A4cii	*Agriculture/Forestry/Fishing - Off-road vehicles and other machinery*	$PM_{2.5}$, PM_{10}		*EMEP/EEA 2016 - 1.A.4 Non road mobile machinery – Table 3-1*

NFR	Source/sector name	PM emissions: the condensable component is		EF references and comments
		included	excluded	
1A4ciii	*Agriculture/Forestry/Fishing*	No information		*EMEP/EEA 2016 - 1.A.3.d Navigation (shipping) - Table 3-1, Table 3-2*
1A5b	*Other, Mobile*	No information		*EMEP/EEA 2016 - 1.A.3.d Navigation (shipping) - Table 3-2*
1B1a	*Coal mining and handling*	No information		EMEP/EEA 2016 - 1.B.1.a Fugitive emissions from solid fuels - Coal mining and handling – Table 3-6
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 2016 - 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 2016 - 2.A.5.a Quarrying and mining of minerals other than coal – Table 3-1*
2A5b	*Construction demolition*	No information		*EMEP/EEA 2016 - 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 2016 – 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 2016 – 2.D.3.b Road paving with asphalt – Table 3-1*
2D3c	*Asphalt roofing*	No information		*EMEP/EEA 2016 - 2.D.3.c Asphalt roofing – Table 3-1*
2G	*Other product use*	No information		*EMEP/EEA 2016 - 2.G Other solvent and product use – Table 3-13, Table 3-14*
3B1a	*Dairy cattle*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B1b	*Non-dairy cattle*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B2	*Sheep*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B3	*Swine*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B4d	*Goats*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B4e	*Horses*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B4gi	*Laying hens*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B4gii	*Broilers*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B4giii	*Turkeys*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B4giv	*Other poultry*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3B4h	*Other animals*	No information		*EMEP/EEA 2016 – 3B Manure Management – Table 3-5*
3Dc	*Farm-level agricultural operations including storage, handling and transport of agricultural products*	No information		*EMEP/EEA 2016 – 3D Crop production and agricultural soils – Table 3-1, Table 3-5, Table 3-7*

NFR	Source/sector name	PM emissions: the condensable component is		EF references and comments
		included	excluded	
3I	*Agriculture other*	No information		*EMEP/EEA 2016 – 11.B Forest fires - Table 3-8*
5A	*Biological treatment of waste - Solid waste disposal on land*	No information		*EMEP/EEA 2016 – 5.A Biological treatment of waste - Table 3-1*
5C1bii	*Hazardous waste incineration*	No information		*EMEP/EEA 2016 - 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 2016 - 5.C.1.b.v Cremation - Table 3-1*
5E	*Other waste (please specify in IIR)*	No information		*EMEP/EEA 2016 – 5.E Other waste - Table 3-2, Table 3-4, Table 3-6*
6A	*Other*	No information		*EMEP/EEA 2016 – 11.B Forest fires - Table 3-1*
11B	*Forest fires*	No information		*EMEP/EEA 2016 – 11.B Forest fires - Table 3-5*

Annex IV: 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)