

LATVIA'S INFORMATIVE INVENTORY REPORT 2018

Submitted under the Convention on Long-Range
Transboundary Air Pollution



Data sheet

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Abbreviations

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 Emissions in Europe

EMEP/EEA 2013 – EMEP/EEA air pollutant emission inventory guidebook 2013

EMEP/EEA 2016 – EMEP/EEA air pollutant emission inventory guidebook 2016

GHG – Greenhouse gases

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

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

UN – United Nations

UNFCCC – United Nations Framework Convention on Climate Change

Pollutants

Main pollutants (from 1990)

NO_x – nitrogen oxides, expressed as NO₂

NM VOC – non-methane volatile organic compounds

NH₃ – ammonia

SO₂ – sulphur dioxide

Other (from 1990)

CO – carbon monoxide

POPs - persistent organic pollutants (from 1990)

PCDD/PCDF – polychlorinated dibenzodioxins/furans

HCB – hexachlorobenzene

PCB – polychlorinated biphenyls

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

PM₁₀ – 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 2016 for anthropogenic emissions of NO_x, NMVOC, SO₂, NH₃ (Main pollutants); CO (Other); TSP, PM₁₀, 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.

Latvia's IIR 2018 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 database "2-Air", "2-Water", "3-Waste", other different databases and from enterprises and institutions.

Most emissions during 1990-2016 have decreased, with exception of TSP (36.3%) and HCB (42.1%) which have increased. Detailed information about emission trends and pollutants produced in each sector can be found under appropriate sectors and subsectors.

Comparing emissions between Submission 2017 and Submission 2018, some changes in reported national totals and calculations can be detected. The recalculations are done due to switching from EMEP/EEA 2013 Guidebook to EMEP/EEA 2016 Guidebook, hence the changes in methodology in several subsectors, as well as due to updated activity data and emission factors. Detailed information about recalculations done in IIR Submission 2018 can be found in Chapter 8.1. Implementation status of 2017 Comprehensive Technical Review of National Emission Inventories results can be found in Chapter 8.3.

1 Introduction

1.1 Background information on emission inventories

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. Directive¹ sets out new emission reduction commitments for Latvia regarding sulphur dioxide (-8% in 2020; -46% in 2030), nitrogen oxides (-32% in 2020; -34% in 2030), non-methane volatile organic compounds (-27% in 2020; -38% in 2030), ammonia (-1% in 2020, -1% in 2030) and fine particulate matter (-16% in 2020; -43% in 2030). 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. 419 of Cabinet on Ministers (31.05.2011) - Regulations Regarding the Maximum Permissible Emission into the Air in the State;
- 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](https://www.ece.org/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 2018 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 2016 for anthropogenic emissions of:

Main pollutants: NO_x, NMVOC, SO₂, NH₃ (kt)

Other: CO (kt)

Particulate matter: TSP, PM₁₀, 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)

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 2015. They were done because of the change of activity data in all sectors, as well as changes in emission factors due to implementation of EMEP/EEA 2016 and 2006 IPCC Guidelines and recommendations received after 2017 Comprehensive Technical Review of National Emission Inventories.

¹ http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_2016.344.01.0001.01.ENG

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 (MEPRD);
- Central Statistical Bureau (CSB);
- Institute of Physical Energetics;
- Latvian State Forest Research Institute "Silava";
- Latvia University of Life Sciences and Technologies;
- Ministry of Agriculture (MoA);
- Ministry of Transport (MoT);
- Ministry of Economics (MoE).

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 1990–2016. 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), 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 2016 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 2016 are shown in Table 1.1 and Table 1.2.

Table 1.1 Level assessment key categories in 1990²

	Key categories (Sorted from high to low from left to right)													Total (%)
NO_x	1A3biii 11.6%	1A1a 11.5%	1A3bi 11.2%	1A3c 10.0%	1A4ai 8.6%	1A2e 6.6%	1A2gviii 6.5%	3Da1 5.9%	1A4cii 4.3%	1A4ciii 3.7%	1A4bi 3.3%			83.2%
NMVOC	1A3bi 20.3%	1A4bi 11.5%	3B1a 10.3%	2D3d 8.1%	1A3biii 4.4%	2H2 4.1%	1A4ai 3.9%	3B1b 3.6%	1A4cii 3.5%	2D3a 3.0%	1B2b 2.6%	2D3g 2.5%	1A3bii 2.4%	80.2%
SO₂	1A1a 35.8%	1A4ai 23.1%	1A4bi 8.6%	1A2e 8.3%	1A2gviii 7.8%									83.5%
NH₃	3B1a 24.7%	3B3 18.8%	3Da1 18.0%	3Da2a 17.2%	3B1b 5.8%									84.5%
PM_{2.5}	1A4bi 56.7%	1A4ai 12.3%	6A 9.1%	1A1a 3.6%										81.7%
PM₁₀	1A4bi 48.7%	1A4ai 10.9%	6A 9.3%	3Dc 5.2%	1A1a 3.9%	2A2 3.0%								80.9%
TSP	1A4bi 38.9%	6A 10.8%	1A4ai 8.6%	3Dc 7.6%	2A2 5.8%	1A1a 4.1%	3B3 4.1%	3B4gi 2.9%						82.8%
CO	1A3bi 49.1%	1A4bi 24.5%	1A4cii 6.1%	1A3bii 5.0%										84.8%
Pb	2C1 70.3%	1A3bi 16.5%												86.8%
Cd	2C1 46.8%	1A4bi 29.9%	1A4ai 11.1%											87.7%
Hg	1A4ai 47.4%	1A4bi 18.7%	1A1a 12.0%	1A4ci 6.2%										84.3%
PCDD/ PCDF	1A4bi 55.0%	1A4ai 14.2%	5C1biii 12.6%											81.8%
PAHs	1A4bi 61.9%	6A 18.4%												80.3%
HCB	1A4bi 53.3%	1A4ai 18.3%	1A1a 13.7%											85.3%
PCBs	1A4ai 62.0%	1A4bi 27.2%												89.2%

In 1990, Energy sector was a key source for the largest part of pollutants. For SO₂, PM_{2.5}, PM₁₀, 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 NH₃ emissions in 1990 was Agriculture sector (NFR 3), and for Pb, Cd emissions the main contributors were IPPU (NFR 2C).

Table 1.2 Level assessment key categories in 2016

	Key categories (Sorted from high to low from left to right)												Total (%)
NO_x	1A3biii 16.9%	1A1a 12.4%	1A3bi 10.7%	1A4cii 9.3%	3Da1 9.0%	1A3c 8.5%	1A2gviii 5.7%	1A4bi 5.2%	1A3bii 4.4%				82.1%
NMVOC	1A4bi 17.6%	2D3d 11.5%	1A2gviii 10.4%	3B1a 9.7%	2D3a 6.5%	2D3i 5.4%	2D3g 4.4%	1A3bi 4.2%	1A4ai 3.8%	1B2b 3.6%	2H2 3.2%		80.3%
SO₂	1A4bi 31.1%	1A1a 22.1%	1A2gviii 19.9%	1A4ai 10.8%									83.9%
NH₃	3Da1 24.1%	3B1a 22.9%	3Da2a 16.5%	1A4bi 7.1%	3B3 6.1%	3B1b 4.4%							81.0%
PM_{2.5}	1A4bi 53.1%	1A1a 12.9%	1A2gviii 11.8%	1A4ai 4.1%									82.0%
PM₁₀	1A4bi 36.9%	2D3b 18.8%	1A1a 10.2%	1A2gviii 8.2%	3Dc 5.0%	2A5b 4.0%							83.1%
TSP	2D3b 45.2%	1A4bi 19.9%	2A5b 6.8%	1A1a 5.8%	1A2gviii 4.4%								82.2%
CO	1A4bi 61.9%	1A3bi 9.9%	1A2gviii 6.9%	1A4bii 3.2%									81.9%

² Full list of NFR codes can be seen on Annex III.

	Key categories (Sorted from high to low from left to right)										Total (%)
Pb	1A3bi 33.8%	1A4bi 23.4%	1A2gviii 14.0%	1A1a 12.1%							83.4%
Cd	1A4bi 45.9%	1A2gviii 31.8%	1A4ai 10.7%								88.3%
Hg	1A1a 27.4%	2A1 24.4%	1A4bi 14.7%	1A2gviii 9.2%	1A4ai 8.2%						83.9%
PCDD/ PCDF	1A4bi 61.8%	5E 13.3%	1A2gviii 8.8%								83.9%
PAHs	1A4bi 74.3%	6A 9.2%									83.5%
HCB	1A4bi 35.2%	1A1a 28.5%	1A2gviii 24.4%								88.2%
PCBs	1A4bi 39.5%	1A1a 25.3%	1A4ai 23.0%								87.9%

Tables 1.1. and 1.2. show that the key sources have slightly changed in 2016 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 NH₃ emissions. In comparison with key categories from 1990 main contributor for NMVOC emissions in 2016 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 2016 can be seen in Table 1.3.

Table 1.3 Trend assessment key categories in 2016

	Key categories (Sorted from high to low from left to right)													Total (%)
NO_x	1A3bi 11.2%	1A1a 11.1%	1A3c 10.2%	1A4ai 10.1%	1A3biii 9.7%	1A2e 8.3%	1A2gviii 6.6%	3Da1 4.8%	1A4cii 4.3%	1A2f 3.1%	1A2c 2.7%			82.1%
NMVOC	1A3bi 24.9%	3B1a 9.4%	1A4bi 7.8%	2D3d 5.9%	1A3biii 5.5%	1A4cii 4.2%	1A2gviii 4.0%	2H2 4.0%	3B1b 3.7%	1A4ai 3.6%	1A3bii 3.0%	1A3bv 2.7%	1A2gvii 2.2%	81.0%
SO₂	1A1a 36.0%	1A4ai 23.3%	1A2e 8.4%	1A4bi 8.2%	1A2gviii 7.6%									83.5%
NH₃	3B1a 24.5%	3B3 23.0%	3Da2a 16.8%	3Da1 14.9%	3B1b 6.1%									85.4%
PM_{2.5}	1A4bi 33.2%	1A4ai 14.4%	6A 11.2%	1A2gviii 10.1%	1A1a 9.0%	2D3b 3.5%								81.4%
PM₁₀	2D3b 22.6%	1A4bi 19.1%	1A4ai 10.9%	6A 9.7%	1A2gviii 8.6%	1A1a 7.7%	2A2 4.0%							82.4%
TSP	2D3b 65.6%	1A2gviii 5.3%	1A4bi 5.2%	6A 4.3%										80.4%
CO	1A3bi 54.0%	1A4bi 17.8%	1A4cii 6.6%	1A3bii 5.5%										83.9%
Pb	2C1 70.6%	1A3bi 16.3%												86.9%
Cd	2C1 55.3%	1A2gviii 15.5%	1A4bi 12.5%											83.3%
Hg	1A4ai 53.8%	1A4bi 18.3%	1A1a 7.3%	1A4ci 7.0%										86.3%
PCDD/ PCDF	1A4bi 42.0%	1A4ai 18.6%	5C1biii 16.7%	1A2gviii 5.2%										82.5%
PAHs	1A4bi 54.4%	6A 20.9%	1A4ai 16.3%											91.6%
HCB	1A2gviii 42.2%	1A1a 26.7%	1A4bi 24.3%											93.2%
PCBs	1A4ai 62.2%	1A4bi 26.5%												88.7%

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 PM₁₀, TSP, Pb and Cd main contributor is Industrial Processes and Product Use sector (NFR 2) with road paving with asphalt (2D3b) and iron and steel production (2C1) accordingly. Agriculture (NFR 3) is main contributor for NH₃ 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 1.4).

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, SO₂, NH₃ and CO, as well as for particulate matter (PM_{2.5}, PM₁₀, TSP, BC), priority heavy metals (Pb, Cd, Hg) and POPs (PCDD/F, PAHs, HCB, PCBs).

Table 1.4 Uncertainty assessment results in 2016

	Overall uncertainty, %	Trend uncertainty, %
NO_x	11.29%	2.22%
NMVOC	12.81%	4.41%
SO₂	6.23%	0.21%
NH₃	19.57%	3.45%
CO	32.20%	5.72%
PM_{2.5}	30.77%	50.32%
PM₁₀	23.96%	56.95%
TSP	27.66%	78.30%
BC	26.67%	13.80%
Pb	11.29%	2.22%
Cd	28.90%	12.37%
Hg	17.07%	7.65%
PCDD/F	32.19%	8.37%
PAHs	43.19%	11.35%
HCB	33.77%	38.69%
PCBs	26.65%	1.25%

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 1.5).

Table 1.5 Sources not estimated in 2016 (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
1A3c Railways	Pb, Hg, As	no methodology available, NE according to EMEP/EEA 2016
1A3di(ii) International inland waterways	NO _x , 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

NFR14 code	Substance(s)	Reason for not estimated
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
2A2 Lime production	NO _x , NMVOC, SO ₂ , CO, Pb, Cd, Hg,	no methodology available, NE according to EMEP/EEA 2016
2A3 Glass production	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	no data available
2B10a Chemical industry: Other (please specify in the IIR)	PM _{2.5} , PM ₁₀ , TSP, BC	no methodology available, NE according to EMEP/EEA 2016
2D3b Road paving with asphalt	NO _x , SO ₂ , CO, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB	no methodology available, NE according to EMEP/EEA 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	TSP	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	NO _x , 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	NO _x , 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
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)	NO _x , NMVOC, SO ₂ , BC, CO, Ni, Se, Zn, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAHs, HCB, PCBs	no methodology available, NE according to EMEP/EEA 2016

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 1.6).

Table 1.6 Sources included elsewhere in 2016 (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
5D1 Domestic wastewater handling	NMVOC	5D3 Other wastewater handling
5D2 Industrial wastewater handling	NMVOC	5D3 Other wastewater handling

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, PM₁₀, PM_{2.5}), heavy metals (lead, cadmium, mercury, arsenic, chromium, copper, nickel, vanadium, zinc), PAHs, PCBs and PCDD/F.

2.2 Main pollutants (NO_x, NMVOC, SO₂, NH₃, 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.

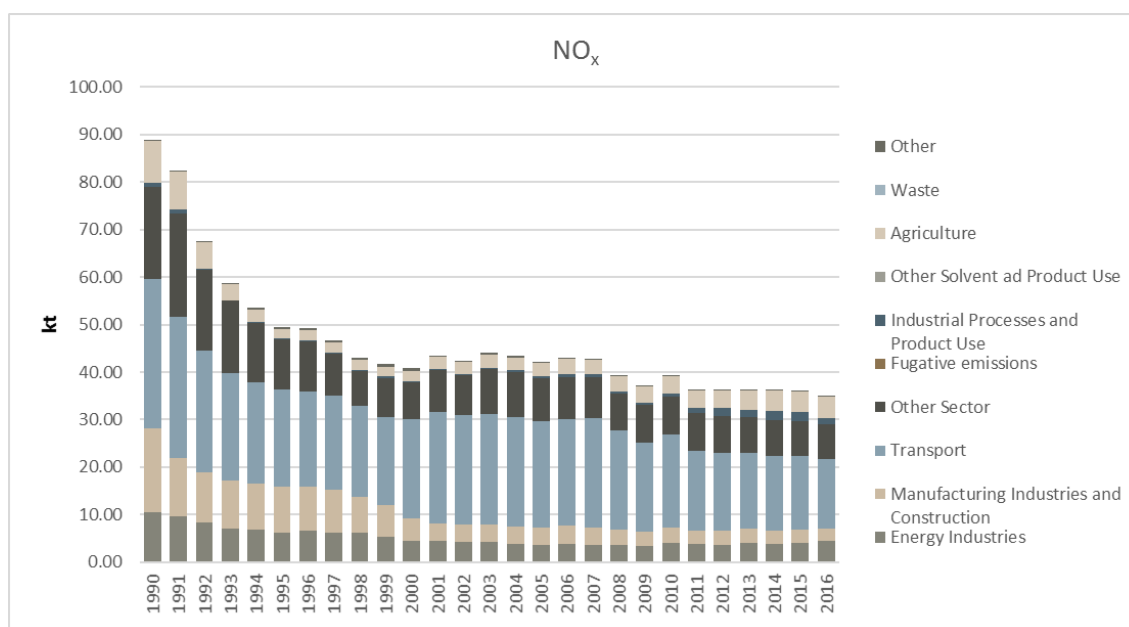


Figure 2.1 Total NO_x emissions (kt)

The total NO_x emissions have decreased by 60.8% from 1990 to 2016 (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 energy efficiency, especially for Transport sector, and also with replacement of solid fuels and heavy liquid fuels with natural gas and biomass fuels. In 2016, the total NO_x emissions were 34.85 kt, generated mainly in the Energy sector, including Transport (83.2% of total emissions).

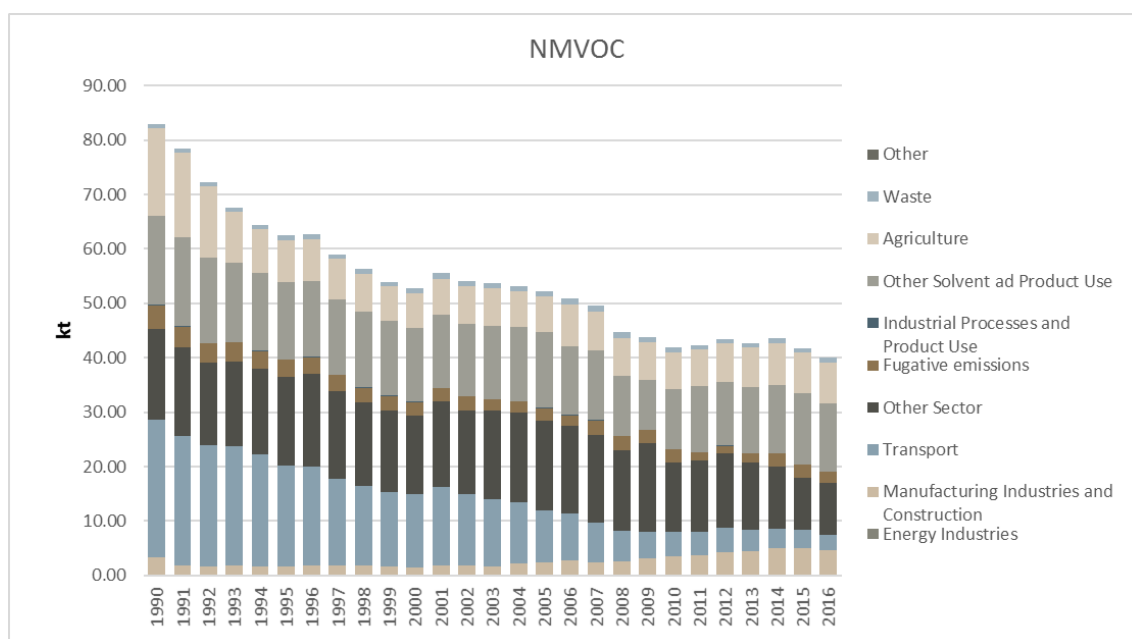


Figure 2.2 Total NMVOC emissions (kt)

The total NMVOC emissions in 2016 were 39.95 kt and since 1990 they have decreased by 51.8% (Figure 2.2). The decrease in total NMVOC emissions has happened mainly due to the Transport sector and can be explained with better technologies used in cars and gas stations which can prevent gasoline from unnecessary evaporation. NMVOC emissions in Transport sector have reduced by 87.9% since 1990. In recent years, largest NMVOC emission producer is Energy sector (38.6% of total emissions) and IPPU sector (31.5%). Approximately 18.8% of all NMVOCs are generated in Agriculture sector from manure management.

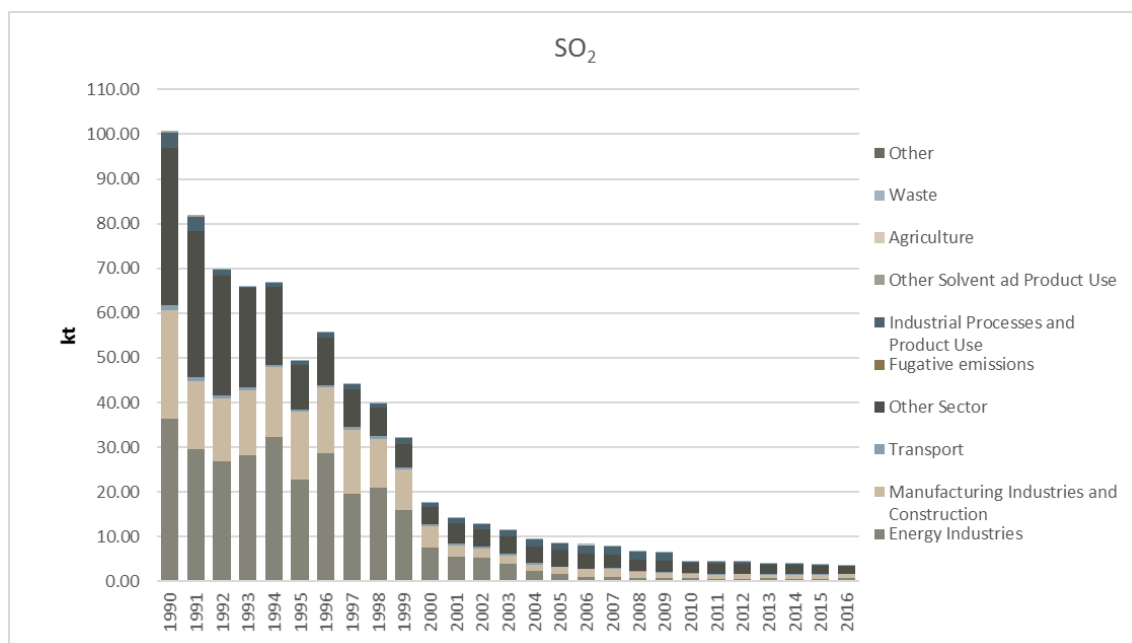


Figure 2.3 Total SO₂ emissions (kt)

Since 1990, total SO₂ emissions have decreased from approximately 100.46 kt to 3.48 kt (-96.5%). 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, SO₂ emissions are mainly produced in the Energy sector, including Transport, with 3.36 kt or 96.7% of total emissions (Figure 2.3).

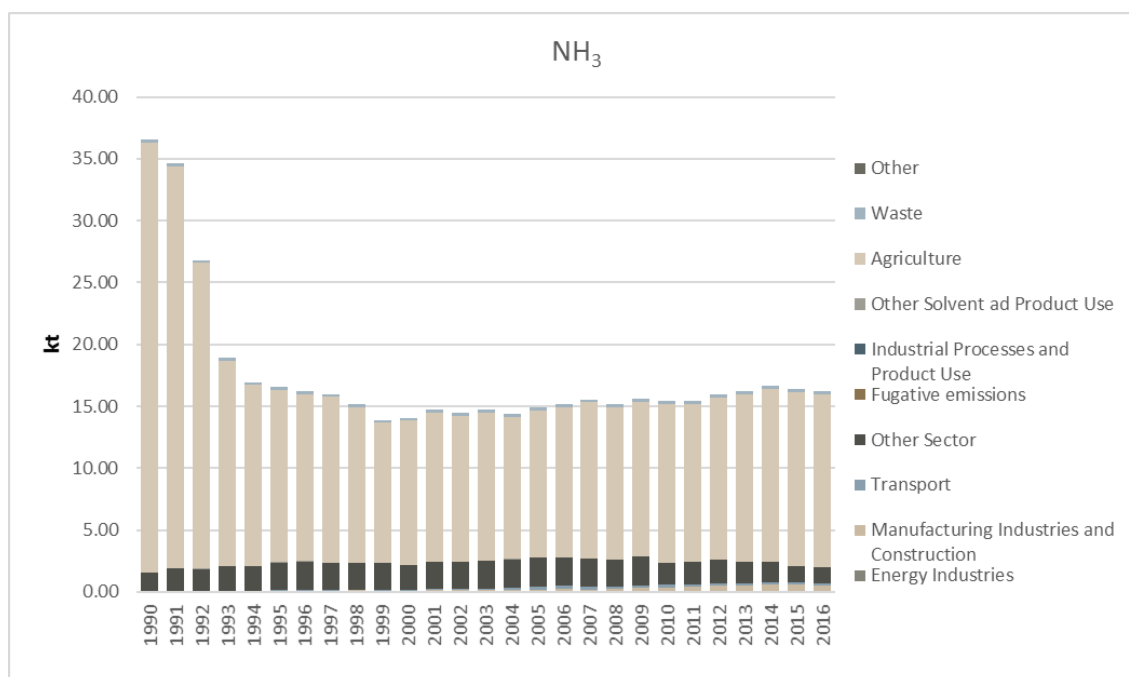


Figure 2.4 Total NH₃ emissions (kt)

The total ammonia emissions have decreased by 55.6% from 1990 to 2016 (Figure 2.4). In 2016, the amount of total NH₃ emissions produced was 16.25 kt. 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 2016, the largest part – 85.8% of NH₃ emissions are produced from agricultural activities, and the remaining producers of ammonia are Energy (NFR 1) and Waste (NFR 5) sectors. Insignificant NH₃ amounts are also produced in IPPU (NFR 2) sector.

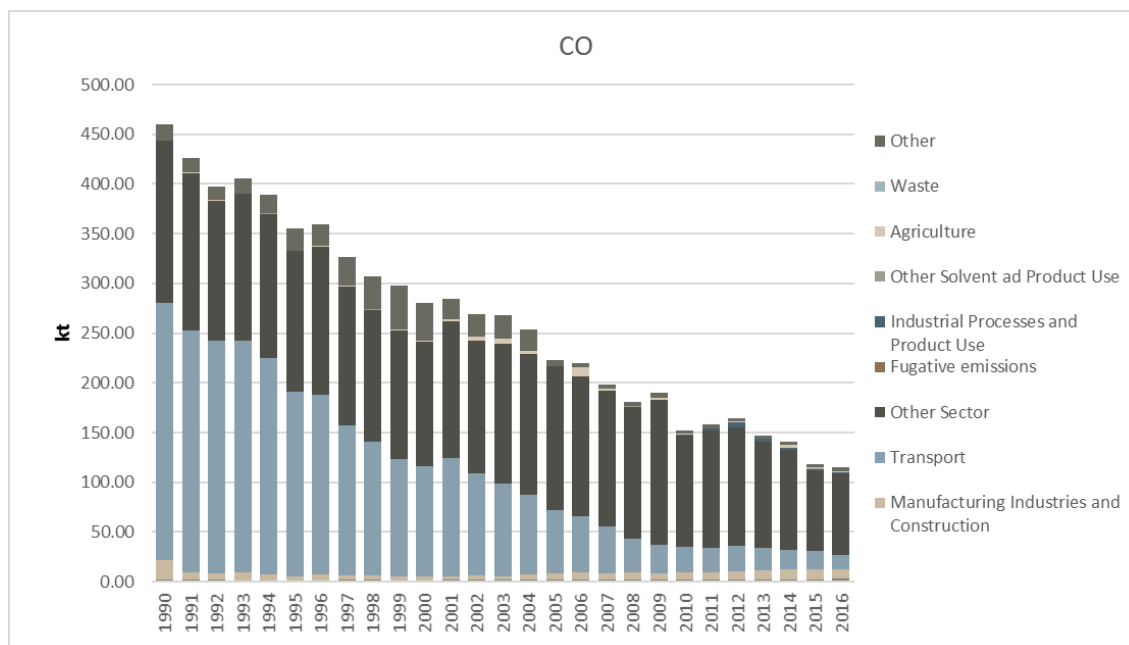


Figure 2.5 Total CO emissions (kt)

Carbon monoxide emission trend shows a decrease in emissions for period 1990 – 2016 by 75.0% (Figure 2.5). CO emissions, total 114.76 kt (2016), originates generally from the Energy (74.7%) and Transport

(20.4% of total emissions) sectors. The decrease in CO emissions can be mainly explained with better technologies used in cars that prevents gasoline from incomplete combustion.

2.3 Particulate matter (PM_{2.5}, PM₁₀, TSP, BC)

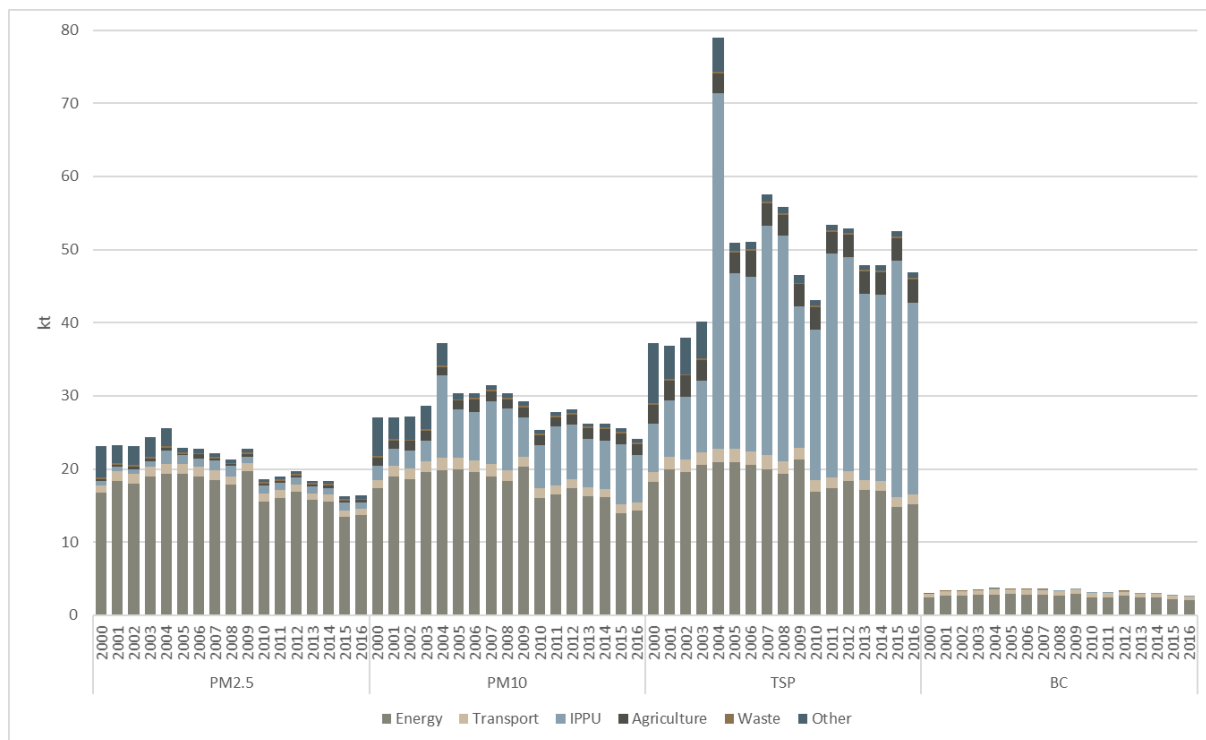


Figure 2.6 Total PM emissions (kt)

PM_{2.5} emissions in 2016 have decreased by 29.3%, and PM₁₀ emissions have decreased by 10.9%, TSP emissions have had significant increase by 26.1% since 2000 (Figure 2.6), due to increased activity in Industrial Processes and Product Use sector (NFR 2). The largest part of PM emissions are produced in Energy sector (including Transport) – PM_{2.5} is 89.2%, PM₁₀ – 64.0% with exception of TSP emissions where 56.0% was produced in IPPU from total emissions in 2016 and 35.2% in Energy sector (including Transport). PM emissions from Energy sector is connected with intensive combustion of wood, especially in Residential sector (NFR 1A4b). Peak in PM 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 2015-2016 PM_{2.5} emissions increased by 0.3% but PM₁₀ decreased by 5.6% as well as TSP decreased by 10.7%.

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

Emissions of heavy metals are shown in the Figure 2.7-Figure 2.9. In IIR, only priority HMs are described, but emissions for additional heavy metals can be found in NFR tables.

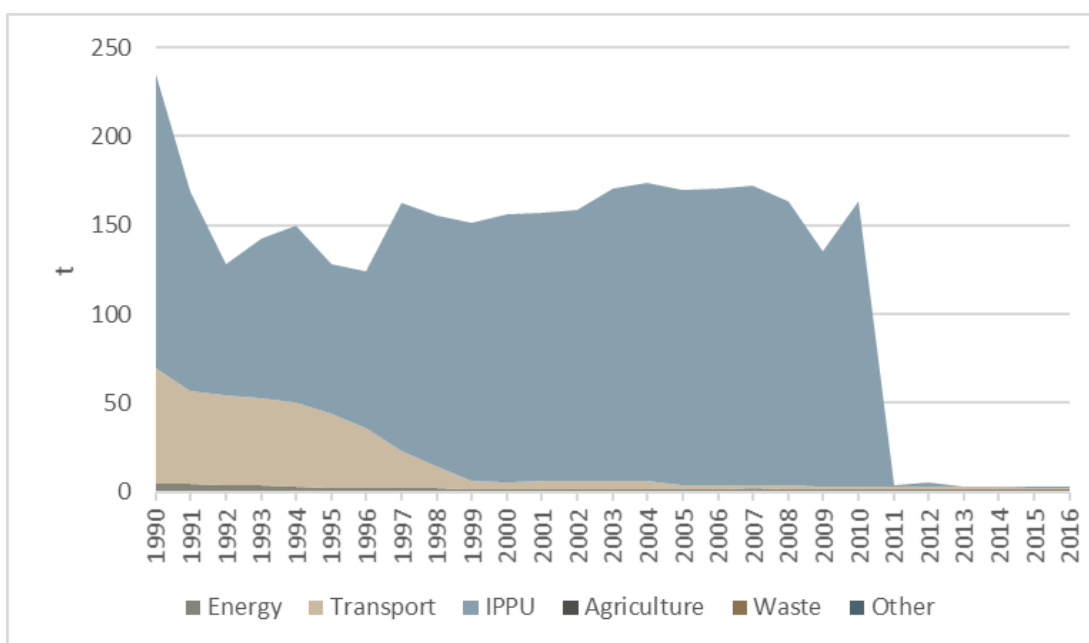


Figure 2.7 Total Pb emissions (t)

The most relevant changes can be seen in lead emissions (Figure 2.7). In comparison with 1990, Pb emissions have decreased by 98.9% in 2016. The amount of Pb emitted in 2016 is 2.67 tonnes. Largest Pb emitter in 2016 is Energy sector including Transport (94.7%). 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 97.8% 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.

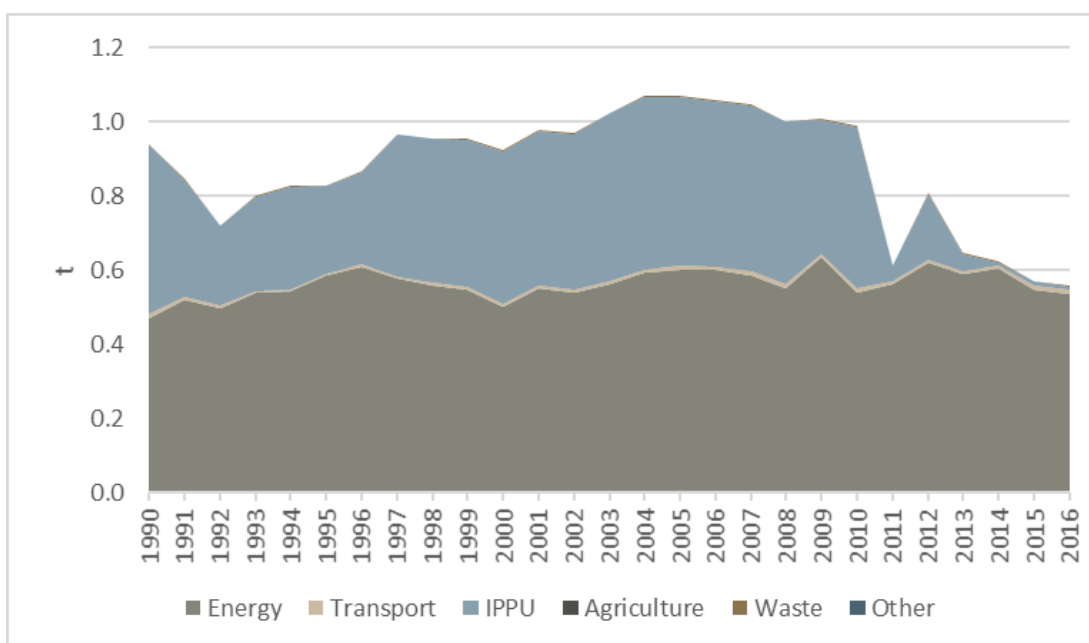


Figure 2.8 Total Cd emissions (t)

In 1990-2016, Cd emissions have decreased by 40.8%, and in 2016 total amounts of Cd emitted are 0.56 tonnes (Figure 2.8). Energy sector (including Transport) contributes to 98.0% of total Cd emissions in 2016. Significant decrease of emissions can be seen in IPPU (97.8%) 1990-2016 due to the bankruptcy of the local metal production company.

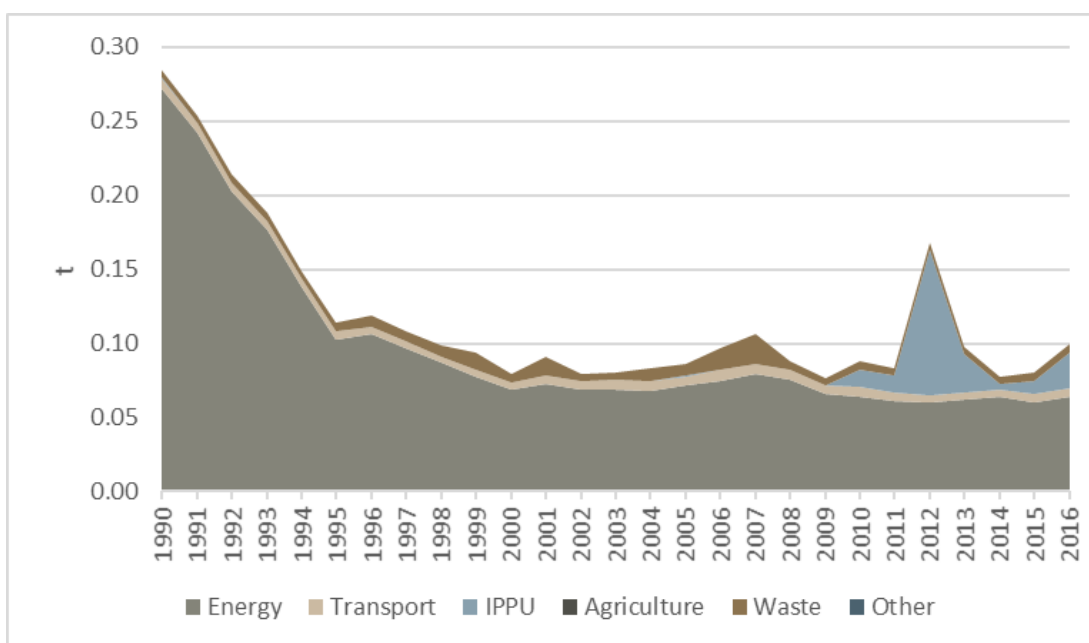


Figure 2.9 Total Hg emissions (t)

Mercury emission trend shows a decrease by 65.0% in emissions for period 1990 – 2016 (Figure 2.9). Hg emissions, total - 0.10 t (2016), originates generally from the Energy sector (64.7%). The decrease in Hg emissions can be mainly explained with decreasing amounts of fossil fuels used in combustion. Spike of Hg emission in 2012 in IPPU sector as well as increase of mercury emissions in later years is mainly related with the increased activity in the local Cement production (NFR 2A1).

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

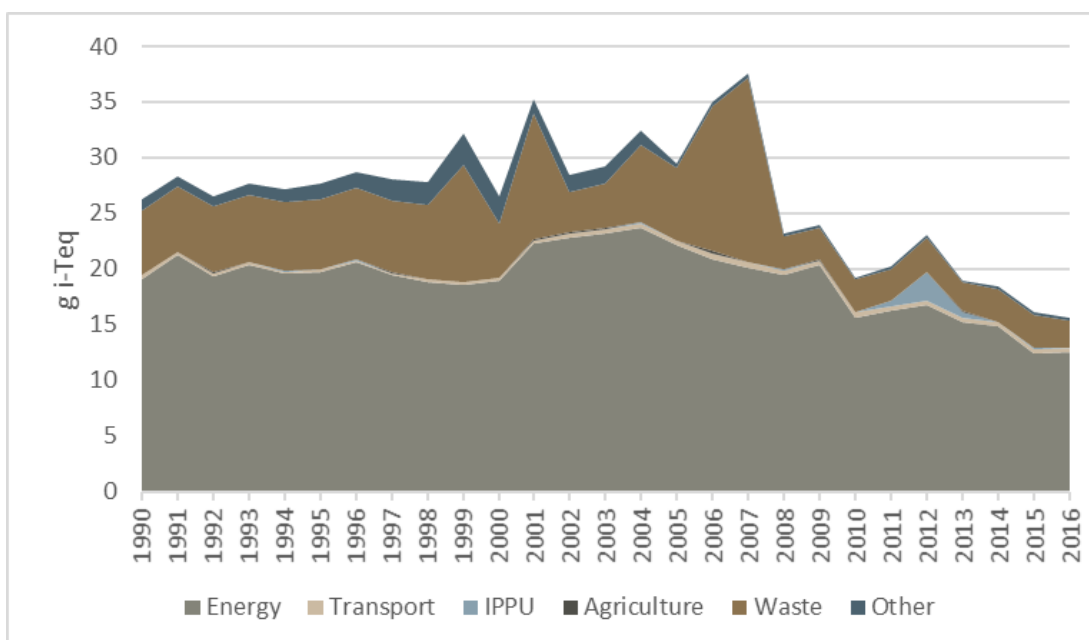


Figure 2.10 Total PCDD/F emissions (g i-Teq)

PCDD/F emissions have decreased by 40.6% in 1990-2016 and have a fluctuating trend (Figure 2.10). It is connected with waste incineration processes, as well as biomass combustion. In 2016, approximately 82.4% 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. In Latvia wood is a local fuel, therefore it is widely used. Also the seasonal changes in temperature can be seen and are analysed in comparison with fuel consumption in relevant subchapters of stationary combustion.

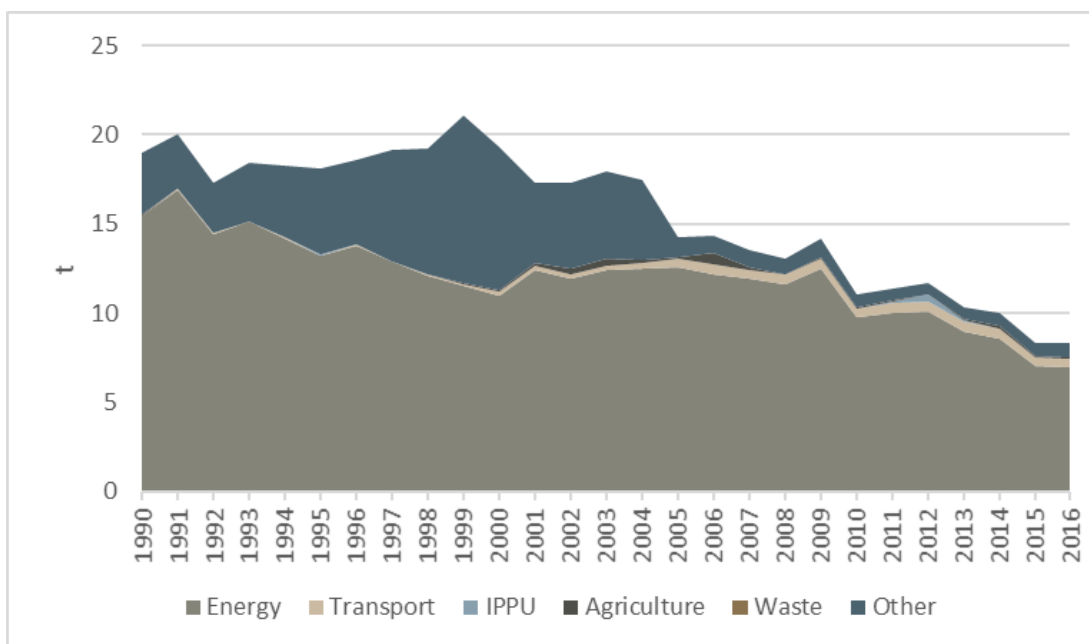


Figure 2.11 Total PAH emissions (t)

PAH emissions in 1990–2016 have decreased by 56.3%, reaching 8.29 tonnes in 2016 (Figure 2.11). 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 2016 89.8% 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 for industrial waste incineration (combusted in NFR 1A2 Manufacturing and Construction Industries for energy purposes), where emission factor only for total PAH emissions can be found.

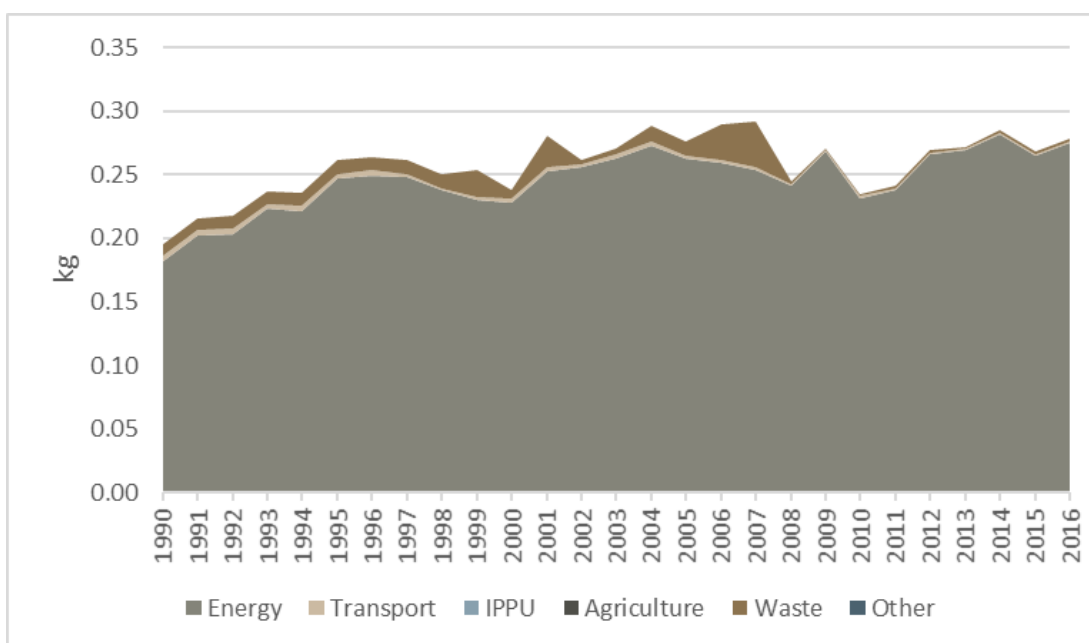


Figure 2.12 Total HCB emissions (kg)

HCB emissions have increased by 42.1% from 1990-2016, reaching 0.28 kg in 2016 (Figure 2.12). Emissions have increased 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. 99.5% from HCB emissions in 2016 are generated in Energy (including Transport) and mainly in solid biomass combustion processes.

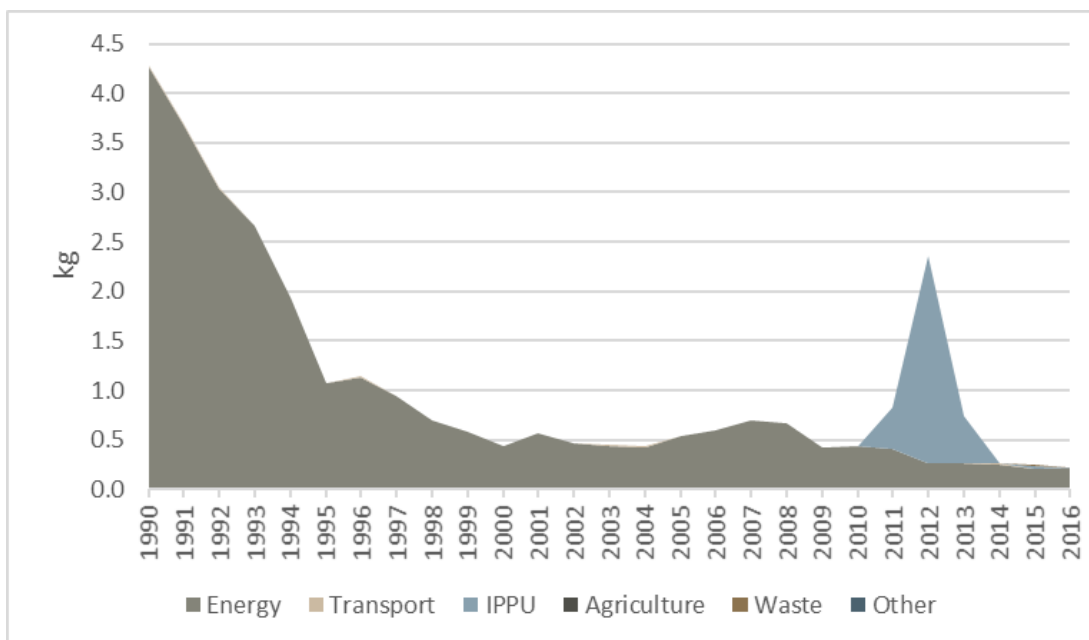


Figure 2.13 Total PCB emissions (kg)

PCB emission trend shows a decrease by 94.9% in emissions for period 1990 – 2016 (Figure 2.13). PCB emissions, total 0.22 kg (2016), originates generally from the Energy sector (including Transport), contributing 99.5% from all emissions. The decrease in PCB 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

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Energy consumption	318553	176157	143522	178811	186840	174020	176586	176896	175993	176748	181013
Liquid fuels, total	161191	81672	53516	68197	73227	65318	65194	65456	66429	69604	72541
RFO	76326	41290	9462	10231	8661	6535	6942	6852	6821	5467	6258
Gasoline	26754	18132	14837	15137	13016	12243	10424	9548	9278	9242	8771
Jet Kerosene	3068	1171	1142	2525	4946	4943	5033	5209	4646	4530	5204
Other Kerosene	647	432	43	NO	NO	NO	NO	NO	NO	NO	6
Shale Oil	NO	78	2440	157	39	79	39	NO	NO	NO	7
Diesel Oil	48023	18273	20907	36898	42765	39046	39421	39906	41352	46195	47928
LPG	3691	1548	2095	2552	2103	2414	3279	3840	4235	4103	4174
Petroleum Coke	NO	NO	NO	429	627	NO	NO	NO	NO	NO	124
Other Oil Products	2681	747	2591	268	1070	59	56	99	97	67	68
Solid fuels, total	26249	7225	2785	3199	4378	4509	3645	2905	2473	1950	1678
Anthracite	NO	NO	NO	NO	NO	NO	82	27	NO	NO	27
Oil Shale	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	237	53	26	54	NO	NO	NO	NO	NO	NO	NO
Coal	25984	7172	2759	3145	4378	4509	3563	2878	2473	1950	1651
Peat products, total	3217	3836	2392	80	46	43	34	64	35	11	34
Peat briquettes	867	401	31	NO	6	3	4	4	5	1	NO
Peat	2350	3435	2361	80	40	40	30	60	30	10	34
Natural gas	99517	41304	44962	56685	61044	53528	50301	49994	44798	45758	46751
Biomass, total	27501	42120	39774	49678	47647	49871	56535	57362	60979	58177	59093
Wood	27501	42102	39695	49120	45376	46594	52169	52676	55531	52231	53905
Straws	NO	NO	NO	NO	60	43	38	58	99	135	161
Charcoal	NO	NO	NO	60	60	60	59	90	90	60	65
Biofuel	NO	NO	NO	107	1158	1067	938	895	998	1047	500
Landfill Gas CH4	NO	NO	NO	251	331	349	347	371	369	420	409
Sludge Gas CH4	NO	18	41	90	114	100	105	97	91	99	107
Other Biogas CH4	NO	NO	NO	NO	37	465	1629	2140	2535	3053	3137
Municipal waste (biomass fraction)	NO	NO	37	49	510	1193	1250	1035	1266	1130	808
Other fuels, total	879	NO	94	972	499	752	877	1115	1279	1248	917
Municipal Waste (non-biomass fraction)	NO	NO	NO	NO	327	343	579	707	915	946	743
Industrial Waste	NO	NO	94	125	77	321	240	379	335	273	148
Waste Oil	879	NO	NO	847	95	88	58	29	29	29	25

Liquid fossil fuels have an important place in the Latvian energy resource market. Its market share was about 40.1% in 2016. The essential decrease of heavy oil share in CSB 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 66.1% from total liquid fuel consumption in 2016; diesel oil is mostly used in Transport sector. The total consumption of liquid fuels in 2016 has decreased by 55.0% since 1990. Reason for such drastic decrease can be explained with changes in technology, with exception of Transport sector and Other (1A5), that, technology that uses liquid fuel, is replaced with one that uses biomass.

Total share of *solid fuels* in national market is quite low – approximately 0.9% in 2016. The solid fuel consumption in recent years is stable, although, it is constantly decreasing with 13.9% decrease 2015-2016 (1990-2016 total decrease by 93.6%). A decrease (19.3%) in solid fuel consumption can be seen in 2008-

³ Excluding electricity.

2009 due to the global economic crisis. In 2010-2016 due to decrease in use of coal there was a 61.7% decrease in solid fuel consumption.

Peat and *peat briquettes* are local fuels that are quite widely 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 0.02% of total share in 2016. The reason for decrease in amount of this fuel used is the same as for the solid and liquid fuel - changes in technology. 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 25.8% in 2016. Natural gas consumption has decreased by 53.0% in 1990-2016. In recent years (2010-2014) natural gas consumption had a decreasing trend, but in last two years (2014-2016) approximate 2% increase can be seen from year to year.

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 - 29.8% of total energy consumption in 2016, while in 1990 all biomass fuels in total made up only 8.6% from total energy consumption. In 2010-2016 use of wood and wood products have increased by 18.8%. Such fuels as straws are used more often and have an increasing trend in the past few years.

*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 2015 consumption decreased by 2.4%. In 2016 decrease was even bigger - 26.6% - in comparison with 2015. 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 of electricity from Russia, Estonia and Lithuania has a quite substantial role in the electricity supply.

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
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

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
2015	25459	4358	1450	19651	21101
2016	28967	4635	2506	21826	24332

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

Types of fuels used for combustion in Latvia:

Liquid fuels are mainly imported from Latvia's neighbouring countries – Lithuania, Belarus, Russian Federation, Norway 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 are mainly produced inside of the country;

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

Biomass fuels:

- solid biomass – wood and other wood products, charcoal, straw, is mainly produced inside of the country,
- methane obtained from biogas that is produced inside of the country – landfill gas that is used since 2002 when first landfill started to collect and combust biogas with energy recovery, and sludge gas that is combusted with energy recovery since 1993 in one sewage purification plant, and also other biogases 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 ecofuel collected by and combusted in cement production plant in Latvia, as well as waste oils.

3.1.2 Description

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

- NFR 1A1 – Energy Industries;
- NFR 1A2 – Manufacturing Industries and Construction;
- NFR 1A3 – Transport;
- NFR 1A4 – Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/ Fisheries);
- NFR 1A5 – Other (Not elsewhere specified);
- NFR 1B – Fugitive emissions from solid fuels, natural gas and oil.

3.2 Stationary fuel combustion (NFR 1A1, 1A2, 1A4)

3.2.1 Sector overview

3.2.1.1 Source category description

This chapter includes stationary combustion plants and autoproducer plants (undertakings that generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity).

NFR 1A1 Energy Industries sectors include emissions from fuel combustion in point sources in energy production. NFR 1A1 sector includes the emissions from on-site use of fuel in the energy production facilities and emissions from manufacturing of solid fuels (peat briquettes, charcoal plant) – these emissions are reported under 1A1c Manufacture of solid fuels and other energy industries sector. There is no petroleum refining in Latvia, therefore there are no emissions in NFR 1A1b sector.

NFR 1A2 and 1A4 sectors also include emissions from autoproducers in the industrial production and commercial facilities – according to 2006 IPCC Guidelines, emissions from autoproducers are assigned to the sector where they were generated and not under NFR 1A1.

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

- Manufacturing of Machinery;
- Manufacturing of Transport equipment;
- Mining and Quarrying;
- Wood and Wood Products;
- Construction;
- Textile and leather;
- Non-specified (Industry).

Table 3.4 Source categories and methods for Stationary fuel combustion sectors

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
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Tier 1	NS	D
1A4ai	Commercial/Institutional	Tier 1	NS	D
1A4bi	Residential	Tier 1, Tier 2	NS	D
1A4ci	Agriculture/Forestry/Fishing	Tier 1	NS	D

Table 3.5 Reported emissions in Stationary fuel combustion sectors in 2016

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
1A2gviii	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
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
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
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

3.2.1.2 Key sources

In 2016, in stationary combustion the Energy Industries (NFR 1A1) was the most important source for NO_x, Hg, As, Cu, Ni and Se, and Other Sectors (commercial/institutional, households and agriculture/forestry/fishery; NFR 1A4) for NMVOCs, SO₂, NH₃, CO, PMs, Pb, Cd, Cr, Se, Zn, PCDD/F, PAHs, HCB and PCBs emissions Figure 3.1.

⁵ National statistics

⁶ Default EF from EMEP/EEA 2016

⁷ Plant specific (AD – data obtained from plant)

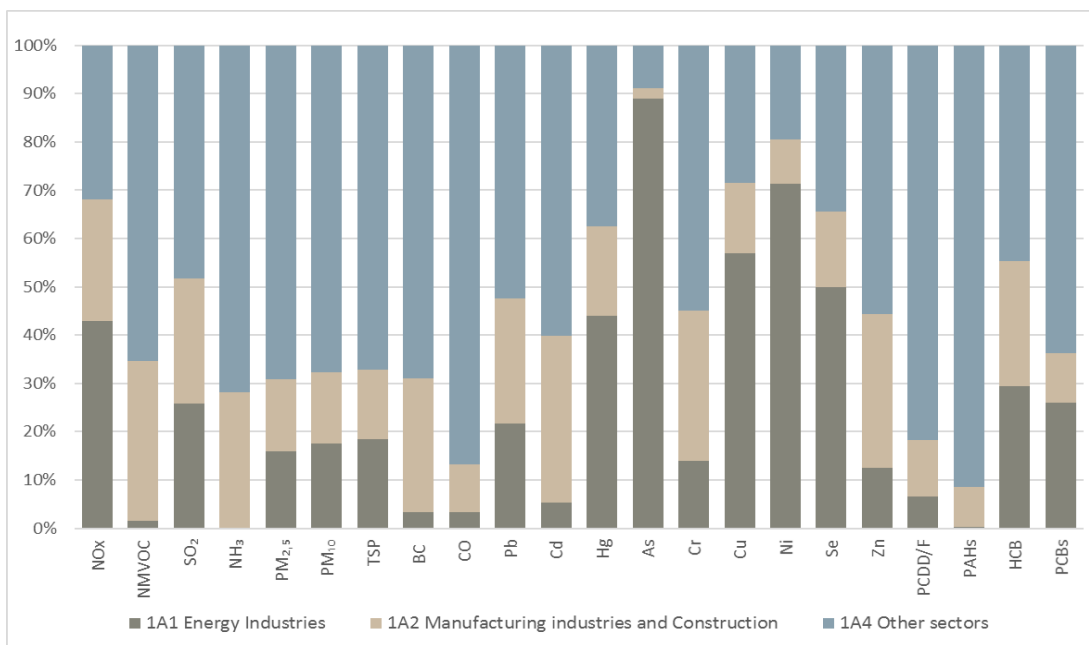


Figure 3.1 Distribution of emissions in Stationary combustion by subsectors in 2016 (%)

Main pollutants

NO_x emissions generated in stationary fuel combustion sectors made up 35.5% from total emissions generated in Energy sector or 29.5% from total emission generated in Latvia in 2016. The largest part in Stationary combustion were produced in 1A1 Energy Industries (42.9%). **SO₂** emissions from stationary fuel combustion were 88.6% from total SO₂ emissions in 2016, and 1A4 Other Sector was the most important with 48.4% (within Stationary combustion). **NMVOC** emissions from Energy sector contributed to 33.5% of the total Latvia's NMVOC emissions in 2016. 1A4 Other Sector contributed to the largest part with 65.3% from Stationary combustion emissions. The most important source for NMVOC emissions from stationary fuel combustion is solid biomass combustion in Residential sector. The largest part of **NH₃** emissions in stationary fuel combustion are produced in 1A4 Other Sector – in 2016 8.3% of total NH₃ emissions or 71.8% from stationary fuel combustion were produced there. In EMEP/EEA 2016, there are no emission factors for NH₃ emission estimation in 1A1 sector, therefore notation key NE in the particular sector was used.

In 2016, stationary fuel combustion sectors accounted for 74.7% of the total **CO** emissions in Latvia. 1A4 Other Sector was the largest emission source accounting for 86.9% of stationary combustion emissions.

Particulate matter

Stationary fuel combustion generated 83.5% of **PM_{2.5}** emissions, 59.2% of **PM₁₀** emissions, 32.3% of **TSP** emissions and 80.1% of total **black carbon** emissions in Latvia in 2016. The largest part of PM emissions in stationary combustion are generated in 1A4 Other Sectors (around 67-69%; for BC – 68.9%). Mainly particulate matter emissions are produced in biomass combustion process.

Heavy metals

Lead emissions from stationary fuel combustion were 57.5% from total Pb emissions in 2016, and 1A4 Other Sector was the one with the highest contribution 52.4% (within stationary combustion). **Cadmium** emissions from stationary fuel combustion account for 96.3% from total emissions, and 1A4 Other Sector is the biggest producer of cadmium emissions in stationary fuel combustion sector with 60.1% from total Cd emissions in the energy sector. In 2016 stationary fuel combustion accounted for 64.7% of the total mercury emissions in Latvia. **Mercury** emissions from stationary fuel combustion are mainly emitted in solid fuels and biomass combustion, and the largest part of emissions are produced in 1A1 Energy Industries (43.9% from stationary combustion).

POPs

Stationary fuel combustion is the main producer of POPs emissions in Latvia – **PCDD/F** (80.0%), **PAHs** (84.2%), **HCB** (99.1%) and **PCB** (99.3%). 1A4 Other Sector is the largest sector of HCB emissions with 44.7% of total stationary fuel combustion emissions. Solid biomass combustion is the main source of PAHs emissions in 2016, and 1A4 Other Sector is the largest contributor to PAH emissions with 91.4% from stationary combustion respectively. In stationary fuel combustion, 1A4 Other Sectors is 81.8% for the PCDD/F emissions where solid biomass and solid fuels are the main emitters for the particular emissions.

3.2.1.3 Trends in emissions

Table 3.6 Reported emissions in Stationary fuel combustion sectors in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	40.35	21.09	13.12	11.71	11.30	10.39	10.79	10.81	10.45	10.22	10.29	-74.5
NM_{VOC}		15.50	17.45	15.16	18.10	15.46	15.93	16.99	15.81	15.59	13.78	13.38	-13.6
SO_x		94.78	47.13	15.77	6.33	3.75	3.47	3.55	3.30	3.29	3.07	3.08	-96.7
NH₃		1.55	2.35	2.13	2.54	2.14	2.24	2.41	2.22	2.20	1.92	1.87	20.0
PM_{2.5}		16.28	18.96	16.81	19.31	15.50	16.06	16.86	15.73	15.52	13.40	13.65	-16.1
PM₁₀		17.14	19.63	17.34	19.90	16.01	16.56	17.39	16.30	16.11	13.96	14.28	-16.6
TSP		18.45	20.81	18.27	20.93	16.85	17.42	18.29	17.18	17.00	14.75	15.13	-18.0
BC		2.38	2.86	2.47	2.86	2.39	2.48	2.66	2.47	2.43	2.13	2.09	-12.3
CO	t	140.39	143.22	124.16	143.67	114.22	118.37	121.15	108.48	104.18	86.22	85.76	-38.9
Pb		4.81	2.26	1.50	1.79	1.60	1.61	1.62	1.59	1.65	1.51	1.54	-68.0
Cd		0.47	0.58	0.50	0.60	0.54	0.56	0.62	0.59	0.60	0.55	0.54	13.8
Hg		0.272	0.103	0.069	0.071	0.064	0.061	0.060	0.062	0.064	0.060	0.064	-76.4
PCDD/F		19.12	19.70	18.92	22.13	15.62	16.22	16.80	15.24	14.85	12.45	12.48	-34.7
PAHs		15.42	13.21	10.94	12.58	9.72	10.02	10.10	8.96	8.59	7.03	6.98	-54.7
HCB		0.18	0.25	0.23	0.26	0.23	0.24	0.27	0.27	0.28	0.26	0.28	50.9
PCBs		4.27	1.07	0.43	0.53	0.44	0.40	0.27	0.26	0.26	0.21	0.22	-95.0

The majority of total emissions from stationary fuel combustion have decreased in 1990-2016, with exception of NH₃, Cd and HCB emissions (Table 3.6). An increase in particular emissions is directly related with the increased use of biomass in 1990-2016.

SO₂ emissions have the biggest decrease (96.7%) in 1990–2016 (Table 3.6). In 2010-2016 SO₂ emissions have decreased by 17.3%. 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 (74.5%) 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.

NH₃ emissions have increased by 20.0% in 1990-2016, mainly because of increased use of biomass. NH₃ 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 16% in 2000-2016. 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 60-80% in 1990-2016, except Cd, which has increased by 13.8%. 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 2016 PAH emissions have decreased by 54.7%, HCB emissions increased by 50.9% and PCDD/F emissions decreased by 34.7%, which can be explained with sharp increase of solid biomass consumption

and decrease of fossil fuel consumption. The decrease of PCB emissions by 95.0% 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.

3.2.2 Energy Industries (NFR 1A1)

3.2.2.1 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.

3.2.2.2 Trends in emissions

Table 3.7 Trends in emissions from 1A1 Energy Industries sector in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	10.543	6.249	4.404	3.698	4.097	3.806	3.618	4.075	3.818	4.057	4.418	-58.1
NM_{VOC}		0.217	0.123	0.116	0.124	0.142	0.132	0.132	0.163	0.168	0.180	0.207	-4.7
SO₂		36.393	22.828	7.635	1.612	0.685	0.632	0.633	0.651	0.605	0.635	0.798	-97.8
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	187.6
PM₁₀		0.993	0.728	0.683	0.764	0.886	0.820	0.977	1.511	1.825	1.994	2.518	153.6
TSP		1.375	0.970	0.810	0.861	0.987	0.913	1.086	1.676	2.024	2.211	2.792	103.0
BC	t	0.041	0.027	0.021	0.022	0.025	0.023	0.028	0.043	0.052	0.056	0.071	75.7
CO		2.612	1.387	1.558	1.735	2.016	1.872	1.850	2.254	2.286	2.455	2.793	6.9
Pb		0.238	0.177	0.138	0.103	0.118	0.109	0.131	0.201	0.241	0.263	0.333	40.0
Cd		0.056	0.034	0.020	0.011	0.011	0.010	0.012	0.018	0.021	0.023	0.029	-48.9
Hg		0.037	0.023	0.020	0.011	0.013	0.012	0.014	0.019	0.021	0.023	0.028	-22.7
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	366.7
PAHs	t	0.002	0.002	0.004	0.005	0.007	0.006	0.007	0.012	0.014	0.016	0.020	1160.3
HCb	kg	0.032	0.038	0.034	0.023	0.030	0.028	0.034	0.051	0.059	0.064	0.081	156.7
PCB		0.002	0.004	0.011	0.015	0.019	0.017	0.021	0.033	0.041	0.044	0.056	3542.0

Part of emissions from NFR 1A1 Energy Industries sector have decreased in 1990-2016 with an exception 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.

3.2.2.3 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)

3.2.2.4 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).

SO₂ 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 SO₂ 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 – SO₂ / S (kg/kg)

s – sulphur content in fuel (%)

r – retention of sulphur in ash (%)

Q – net calorific value (TJ/kt)

10⁶ – (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.

3.2.2.5 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 m³) 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 enterprises with turnovers equal or more than 4 mln euro, 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 1990-2016 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.

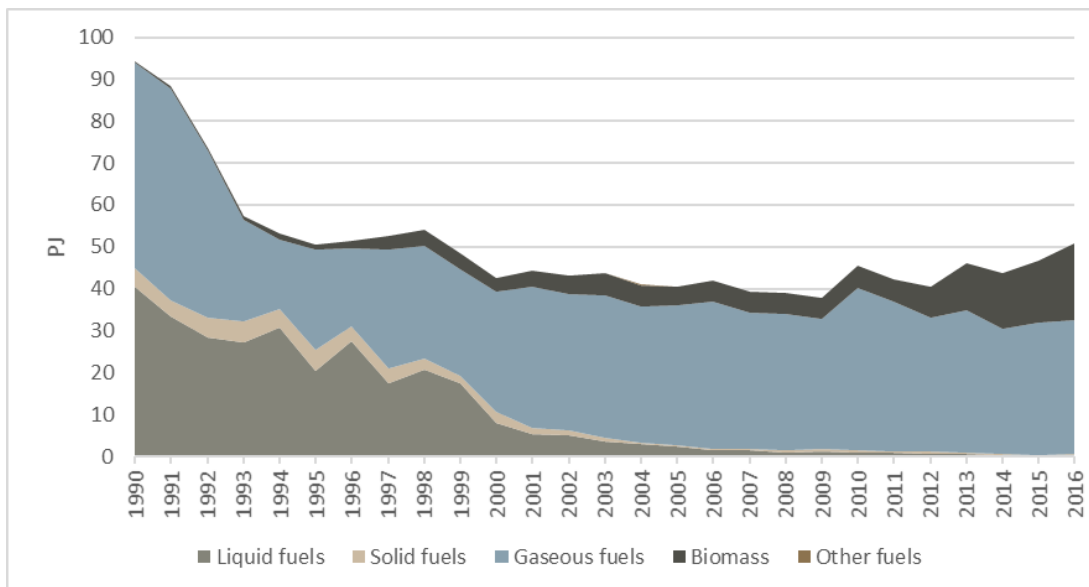


Figure 3.2 Fuel consumption in NFR 1A1 Energy Industries in 1990-2016 (PJ)

The largest decrease in 1990–2016 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 1A1.a 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 2015-2016 increase in fuel consumption can be seen for liquid fuels (4.2%), solid fuels (44.8%) and gaseous fuels (2.3%). Consumption of biomass fuel has significantly increased in 1990–2016 almost 40 times. 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 its CO₂ neutrality, enterprises switched from fossil fuels to biomass. As biomass keeps replacing fossil fuels, consumption of biomass in 2016 increased by 23.7% in comparison with 2015.

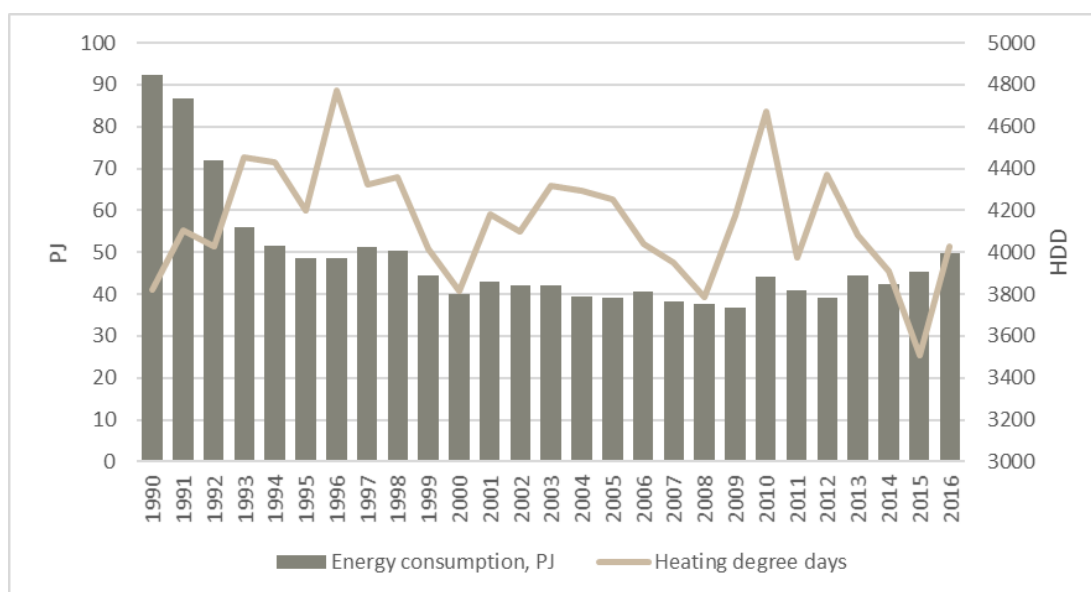


Figure 3.3 Fuel consumption in NFR 1A1a Public electricity and heat production and heating degree days in Latvia

As it can be seen in Figure 3.3 the fuel consumption in 1A1a Public electricity and heat production sector can be related with the heating degree days 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 2016 number of HDD and fuel consumption increased.

3.2.2.6 Uncertainties

Uncertainty of activity data for fuel combustion in 1A1 sector is $\pm 2\%$ in 2016. 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.

3.2.2.7 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.

3.2.2.8 Recalculations

In Submission 2018, the following recalculations were done:

- Correction of activity data.

3.2.2.9 Planned improvements

No improvements planned.

3.2.3 Manufacturing Industries and Construction (NFR 1A2)

3.2.3.1 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).

3.2.3.2 Trends in emissions

Table 3.8 Trends in emissions from NFR 1A2 Manufacturing Industries and Construction sector in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	17.46	9.60	4.87	3.48	3.20	2.73	3.05	2.87	2.81	2.68	2.58	-85.2
NM_{VOC}		1.66	1.43	1.28	2.20	3.28	3.62	4.17	4.29	4.81	4.85	4.44	167.1
SO₂		24.32	15.08	4.70	1.56	0.99	0.81	0.94	0.83	0.90	0.84	0.79	-96.7
NH₃		0.02	0.09	0.10	0.20	0.36	0.41	0.48	0.50	0.57	0.58	0.53	2201.5
PM_{2.5}		0.87	0.75	0.56	0.96	1.47	1.65	1.91	1.97	2.22	2.23	2.04	135.4
PM₁₀		0.88	0.76	0.57	0.99	1.51	1.69	1.95	2.01	2.27	2.28	2.08	136.1
BC		0.90	0.78	0.59	1.03	1.58	1.77	2.04	2.11	2.38	2.39	2.18	143.3
TSP		0.37	0.29	0.19	0.26	0.42	0.46	0.54	0.56	0.62	0.63	0.58	56.8
CO	t	4.50	3.38	2.55	4.69	6.39	7.08	8.16	8.27	9.31	9.26	8.48	88.4
Pb		0.23	0.16	0.11	0.29	0.31	0.35	0.41	0.40	0.45	0.44	0.40	76.8
Cd		0.011	0.033	0.036	0.074	0.128	0.146	0.169	0.176	0.200	0.202	0.185	1579.8

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
Hg		0.030	0.014	0.010	0.019	0.014	0.014	0.015	0.013	0.014	0.013	0.012	-60.2
PCDD/F	g I-Teq	0.43	0.40	2.09	3.09	1.06	1.20	1.39	1.41	1.60	1.59	1.45	237.0
PAHs	t	0.99	0.57	0.44	0.62	0.51	0.53	0.61	0.59	0.65	0.63	0.58	-41.7
HCB	kg	0.004	0.012	0.024	0.042	0.049	0.056	0.065	0.068	0.077	0.078	0.071	1658.0
PCB		0.26	0.11	0.04	0.17	0.06	0.06	0.07	0.04	0.05	0.02	0.02	-91.6

As it can be seen in Table 3.8, the largest part of emissions with an exception of NO_x, SO₂, Hg, PAHs and PCB have increased in 1990-2016, 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, NH₃, 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 2016 all emissions have decreased compared with 2015 due to reduced fuel consumption in sector.

3.2.3.3 Methods

Tier 1 method was used to calculate emissions from the stationary 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)

3.2.3.4 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).

SO₂ emission factors are calculated using the same methodology as for NFR 1A1 sector, using Tier 2 (see chapter 3.2.2.4).

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.

3.2.3.5 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.

Only gasoline combustion is reported as off-roads in NFR 1A2 sector. All reported diesel oil is estimated as combusted stationary because it is not possible to divide the consumption between fuel combusted stationary and filled in technological vehicles (off-roads).

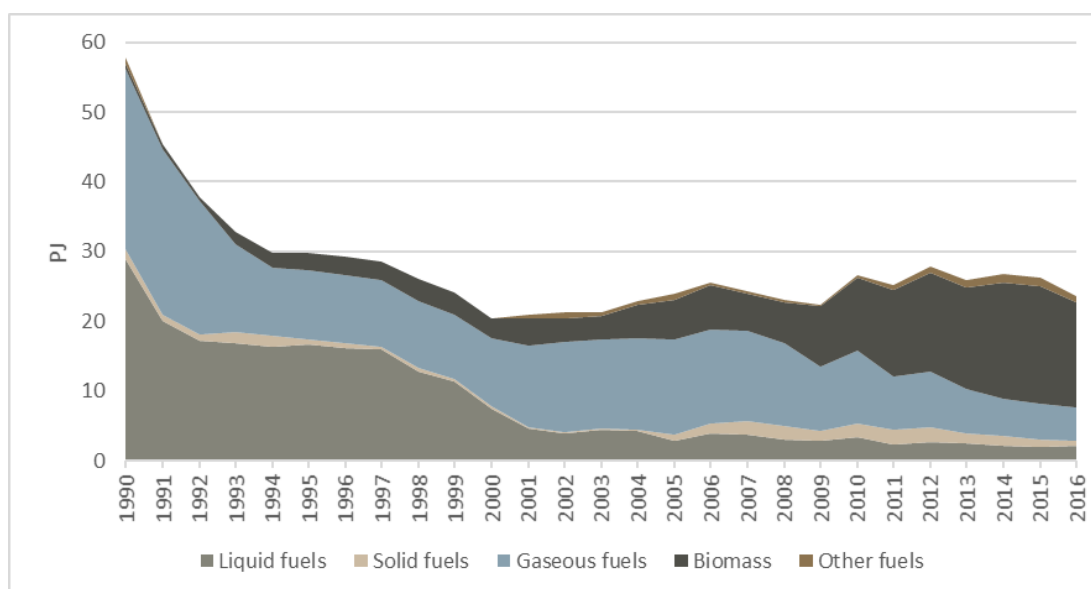


Figure 3.4 Fuel consumption in NFR 1A2 Manufacturing Industries and Construction in 1990-2016 (PJ)

Most of the fuel types with an exception of biomass and other fossil fuels have decreased in 1990-2016 (Figure 3.4). Liquid fuels have the biggest decrease 92.6%. 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 comparing 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 rapidly 7.1 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.

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 1990-2016 natural gas consumption have decreased by 81.6% and by 9.6% in 2015-2016.

Consumption of biomass fuel have increased significantly it is 24 times bigger than it was in 1990 with some fluctuations in 2000-2008. Lower costs of solid and liquid biomass, 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 taken from „CEMEX”, the only company which combusts used tires and municipal waste for energy purposes) reported as other fossil fuels have increased 34 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 used oils are also reported, and the amounts of this

fuel are fluctuating over the years with a decreasing trend in recent years. Decrease can be seen in 2015-2016 by 26.9%, it can be explained with changes in demand of cement.

3.2.3.6 Uncertainties

Uncertainty for activity data of fuel combustion in 1A2 sector is $\pm 2\%$ in 2016. 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.

3.2.3.7 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.

3.2.3.8 Recalculations

In Submission 2018, following recalculations were done:

- Correction of emission factors;
- Correction of activity data.

3.2.3.9 Planned improvements

No improvements planned.

3.2.4 Other Sectors (NFR 1A4)

3.2.4.1 Overview

NFR 1A4 Other Sectors include emissions from the small combustion plants used in Commercial/Institutional Residential sectors and Agriculture/Forestry/Fisheries. Also 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.

Emissions from mobile machinery used in Commercial (NFR 1A4aⁱⁱ), Residential (NFR 1A4bⁱⁱ) and Agriculture/Forestry (1A4cⁱⁱ) and Fishery (1A4cⁱⁱⁱ) sectors are reported as off-road under Transport chapter.

3.2.4.2 Trends in emissions

Table 3.9 Trends in emissions from NFR 1A4 Other Sectors in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	12.35	5.24	3.85	4.53	4.00	3.85	4.12	3.86	3.82	3.48	3.29	-73.4
NMVOC		13.62	15.90	13.76	15.78	12.04	12.18	12.70	11.35	10.61	8.75	8.74	-35.8
SO_x		34.06	9.23	3.43	3.16	2.07	2.02	1.98	1.82	1.78	1.59	1.49	-95.6
NH₃		1.53	2.26	2.03	2.33	1.78	1.83	1.93	1.72	1.63	1.34	1.34	-12.5
PM_{2.5}		14.66	17.64	15.69	17.70	13.27	13.70	14.11	12.47	11.73	9.45	9.45	-35.6
PM₁₀		15.26	18.13	16.09	18.15	13.62	14.05	14.46	12.78	12.02	9.69	9.68	-36.6
BC		16.18	19.06	16.87	19.04	14.29	14.74	15.16	13.39	12.60	10.16	10.15	-37.3
TSP		1.97	2.55	2.25	2.57	1.95	2.00	2.09	1.87	1.76	1.44	1.44	-27.0
CO		133.28	138.44	120.05	137.24	105.82	109.42	111.14	97.95	92.59	74.51	74.49	-44.1
Pb	t	4.35	1.93	1.25	1.40	1.18	1.15	1.08	0.99	0.95	0.81	0.81	-81.5
Cd		0.40	0.52	0.45	0.52	0.40	0.40	0.44	0.39	0.38	0.32	0.32	-20.1
Hg		0.205	0.065	0.038	0.041	0.037	0.035	0.031	0.029	0.028	0.024	0.024	-88.3
PCDD/F	g I-Teq	18.52	19.13	16.62	18.80	14.27	14.75	15.09	13.33	12.65	10.21	10.21	-44.9
PAHs	t	14.43	12.64	10.49	11.96	9.21	9.48	9.48	8.36	7.92	6.38	6.38	-55.8
HCB	kg	0.15	0.20	0.17	0.20	0.15	0.15	0.17	0.15	0.15	0.12	0.12	-16.1
PCBs		4.00	0.95	0.38	0.35	0.36	0.32	0.17	0.18	0.17	0.14	0.14	-96.6

All emissions have decreased in 1990-2016 NFR 1A4 Other Sectors (Table 3.9). 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 SO₂ 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.

3.2.4.3 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)

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.

3.2.4.4 Emission factors

The main source for emission factors is EMEP/EEA 2016. Emission factors used for Energy sector are presented in Annex I, Table 3.

SO₂ emission factors are calculated using the same methodology as for NFR 1A1 and 1A2 sectors, using Tier 2 (see chapter 3.2.2.4), 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.

3.2.4.5 Activity data

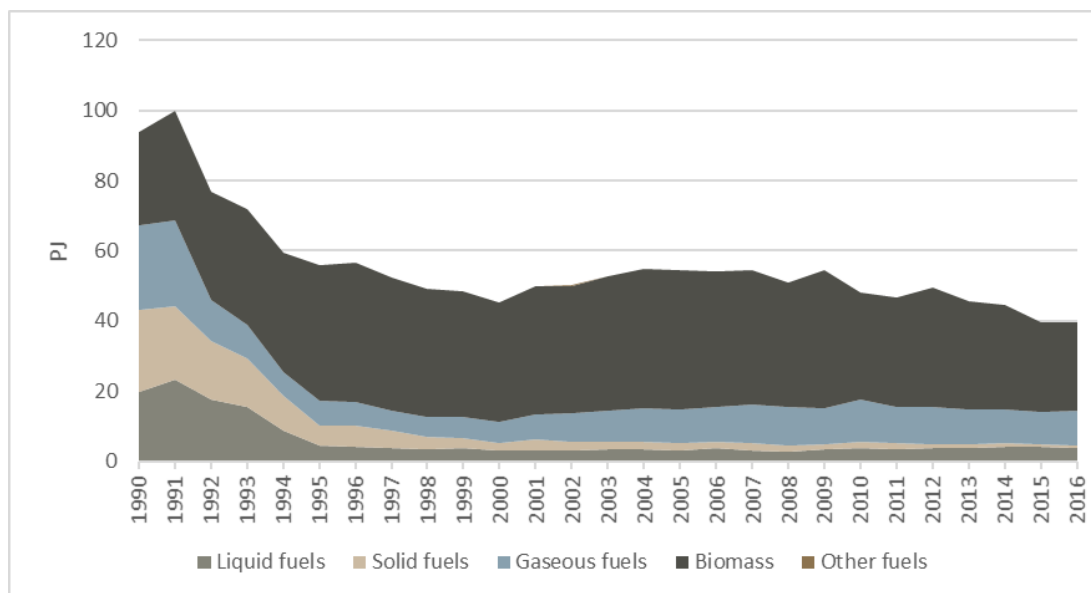


Figure 3.5 Fuel consumption in NFR 1A4 Other Sectors in 1990–2016 (PJ)

The biggest decrease in 1990–2016 was for solid fuel consumption – 96.4%, liquid fuels consumption – 68.9% (Figure 3.5) and gaseous fuels by 59.3%. 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 56.6% in 1990–2016 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 2016 it was by 1.5% lower than in 2015, in comparison with 1990 consumption have decreased by 4.7%.

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 strongly 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.

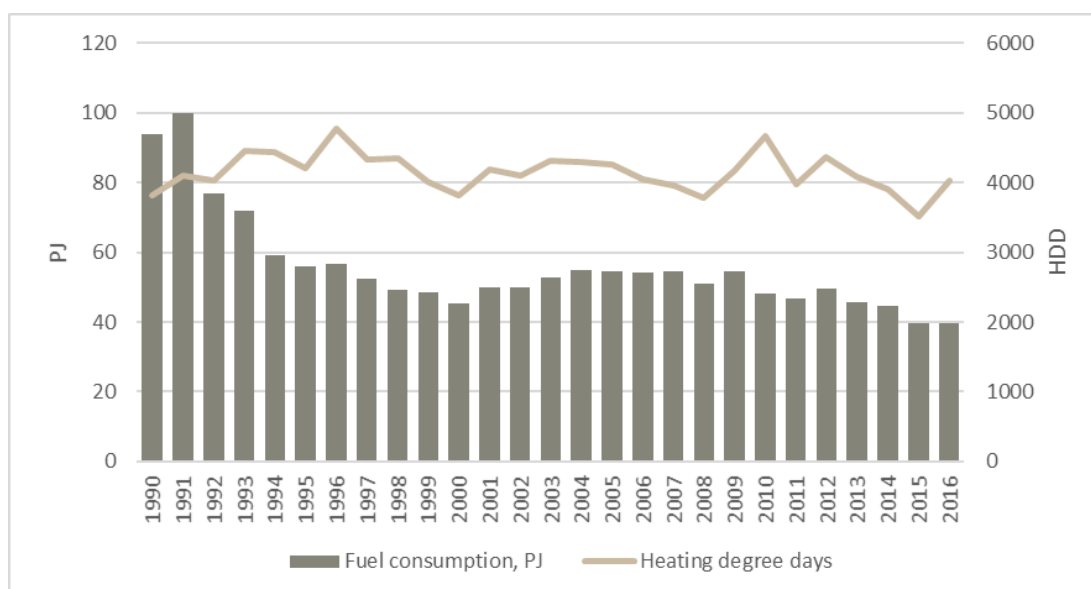


Figure 3.6 Fuel consumption in NFR 1A4 Other Sectors and heating degree days in Latvia

As it can be seen in Figure 3.6, fuel consumption in 1A4.b sector is related with changes in temperature – in years where heating degree days 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 2016 number of HDDs was higher than in 2015 and amount of fuel used have increased as well. Difference in trend could be explained with changes in heating devices that impact the amount of fuel used. Higher efficiently boiler will use less fuel to produce the same amount of heat.

3.2.4.6 Uncertainties

Uncertainty for activity data of fuel combustion in 1A4 sector is $\pm 2\%$ in 2016. 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 1.A.4 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%.

3.2.4.7 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.

3.2.4.8 Recalculations

In Submission 2018, the following recalculations were done:

- Correction of activity data mistakes;
- Correction of NO_x emission factor;
- Recalculation of all emissions 2010-2015 in NFR 1A4b.

3.2.4.9 Planned improvements

No improvements planned.

3.3 Transport (NFR 1A3)

3.3.1 Sector overview

3.3.1.1 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 2016. The sector includes civil aviation, road transport, railways, domestic 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. Civil Aviation includes helicopters, airplanes with turbojet engine and airplanes with piston engines. Aircrafts that are not included in Civil Aviation are included in Other (NFR 1A5b). Domestic Navigation comprises for miscellaneous vessels (tugs, barges, towboats, icebreakers), recreational crafts and personal boats. Emissions from fishing boats are included in NFR 1A4ciii sector.

Table 3.10 shows the methods and source for activity data and emission factors used for emission calculating in Transport sector. Table 3.11 shows list of pollutants, which are produced in Transport sector.

Table 3.10 Source categories and methods for Transport sector

NFR code	Description	Method	AD	EF
1A3a	Domestic and international Civil aviation	Tier 1, 2	NS ⁸	D ⁹
1A3b	Road transport	Tier 2	NS	D
1A3c	Railways	Tier 1	NS	D
1A3d	National navigation and international maritime navigation	Tier 1	NS	D

Table 3.11 Reported emissions in Transport sector in 2016

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

⁸ National Statistics

⁹ Default emission factor from guidelines

NFR code	Emissions
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

3.3.1.2 Key sources

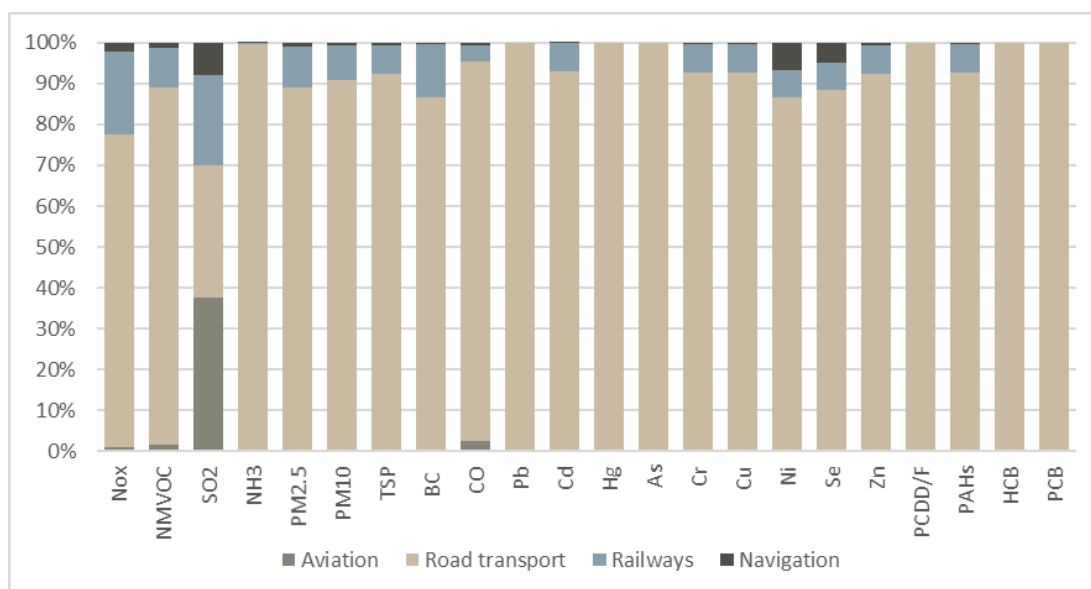


Figure 3.7 Distribution of emissions in Transport sector by subsectors in 2016 (%)

Road transport takes up the biggest part of Transport sector emissions followed by Railways (Figure 3.7). Civil aviation and domestic navigation contribute just a small part of transport emissions. Exception is SO₂ emissions where railway, aviation and navigation, in addition to road transport, are significant sources of emissions in transport sector.

3.3.1.3 Trends in emissions

Table 3.12 Fuel consumption in Transport sector in 2015 and 2016 (TJ)

	Liquid fuel		Change in 2015-2016, %	Biomass		Change in 2015-2016, %
	2015	2016		2015	2016	
Aviation	556.00	559.26	0.6	NO	NO	NO
Road transport	40209.41	40377.74	0.4	880.00	365.00	-58.5
Railways	2765.00	2335.00	-15.6	74.00	67.00	-9.5
Navigation	132.00	181.00	37.1	NO	NO	NO

In 2016, total fuel consumption in the Transport sector (excluded off-road), compared to 2015, has decreased by 0.5% (Table 3.12). In different subsectors various changes have taken place in 2016. The main impact to changes was in total fuel consumption related to railway where the fuel consumption has decreased by around 15%. Fuel consumption in road transport has increased by around 0.4% in 2016 compared to 2015.

In total, Road transport consumes around 92.8%, railway – around 5.5%, civil aviation – around 1.1% (including international LTO), domestic navigation – the remaining share of fuel.

Diesel oil is the main fuel type in the transport sector and it constitutes 73.4 %. It is followed by gasoline – 19.5%, LPG constitutes to 6.0% and biofuels (biodiesel and bioethanol) to 1.0% of the total fuel consumption in the transport sector.

Table 3.13 Trends in emissions from Transport sector in 1990 and 2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	31.37	20.56	20.73	22.40	19.65	16.89	16.34	16.09	15.80	15.65	14.59	-53.5
NM VOC		25.32	18.52	13.52	9.41	4.48	4.12	4.41	3.85	3.57	3.29	2.69	-89.4
SO_x		1.05	0.59	0.36	0.15	0.18	0.20	0.20	0.19	0.18	0.17	0.05	-94.9
NH₃		0.02	0.03	0.07	0.22	0.21	0.20	0.20	0.20	0.21	0.20	0.15	892.6
PM_{2.5}		0.90	0.62	0.81	1.21	1.01	0.85	0.85	0.79	0.79	0.78	0.76	-15.4
PM₁₀		1.08	0.75	0.96	1.42	1.24	1.05	1.03	0.98	0.99	1.00	0.99	-8.9
TSP		1.28	0.90	1.11	1.64	1.49	1.26	1.23	1.19	1.21	1.24	1.22	-4.3
BC		0.40	0.27	0.37	0.61	0.52	0.45	0.45	0.41	0.41	0.40	0.39	-4.0
CO		258.85	185.89	111.53	64.25	25.34	23.82	25.31	22.34	19.87	18.42	15.14	-94.2
Pb	t	55.93	41.57	4.27	1.67	1.40	1.30	1.10	1.00	0.98	0.97	0.95	-98.3
Cd		0.00665	0.00464	0.00486	0.00724	0.00780	0.00723	0.00700	0.00705	0.00751	0.00805	0.00808	21.6
Hg		0.00581	0.00440	0.00429	0.00569	0.00608	0.00530	0.00487	0.00483	0.00504	0.00537	0.00533	-8.3
As		0.00018	0.00014	0.00013	0.00015	0.00015	0.00014	0.00012	0.00012	0.00012	0.00013	0.00013	-31.3
Cr		0.03	0.02	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	22.1
Cu		1.12	0.78	0.82	1.22	1.32	1.22	1.18	1.20	1.28	1.37	1.37	23.1
Ni		0.05	0.03	0.03	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	29.3
Se		0.00663	0.00464	0.00486	0.00723	0.00780	0.00723	0.00700	0.00785	0.00791	0.00835	0.00849	28.0
Zn		0.67	0.47	0.49	0.73	0.78	0.73	0.70	0.72	0.76	0.81	0.81	21.9
PCDD/F	g I- Teq	0.27	0.21	0.25	0.40	0.44	0.38	0.38	0.37	0.39	0.39	0.37	37.8
PAHs	t	0.049	0.032	0.036	0.056	0.065	0.056	0.054	0.057	0.060	0.065	0.066	35.4
HCB	kg	0.00017	0.00015	0.00017	0.00031	0.00041	0.00035	0.00035	0.00034	0.00036	0.00037	0.00035	104.8
PCBs		0.021	0.013	0.014	0.021	0.023	0.020	0.020	0.020	0.021	0.023	0.022	5.7

Generally, most of emissions have decreased in 1990-2016 (Table 3.13) with an exception of NH₃, Cr, Cu and PAHs and some other metal emissions. Emissions from heavy metal species have increased due to increase in fuel consumption. NH₃ 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 NH₃ 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 SO₂ and Pb emissions.

3.3.2 Civil aviation (NFR 1A3a)

3.3.2.1 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.

3.3.2.2 Trends in emissions

Table 3.14 Trends and emissions in Civil aviation in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
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	18.12
NM VOC		0.07	0.03	0.03	0.02	0.04	0.05	0.04	0.04	0.04	0.04	0.04	-42.24
SO_x		0.01	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	58.82

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
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	48.06
PM₁₀		0.0016	0.0006	0.0006	0.0012	0.0024	0.0025	0.0024	0.0024	0.0023	0.0024	0.0024	48.06
TSP		0.0016	0.0006	0.0006	0.0012	0.0024	0.0025	0.0024	0.0024	0.0023	0.0024	0.0024	48.06
BC		0.0008	0.0003	0.0003	0.0006	0.0011	0.0012	0.0012	0.0012	0.0011	0.0011	0.0011	48.06
CO		0.24	0.09	0.09	0.19	0.38	0.41	0.38	0.38	0.37	0.38	0.38	55.96

Different trend tendencies during the time span 1990 - 2016 have to be noted for emissions in civil aviation (Table 3.14). 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.

3.3.2.3 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 2004-2016. Tier 1 approach has been applied for aviation gasoline emission calculation.

3.3.2.4 Emission factors

Default emission factors for Civil aviation are taken from EMEP/EEA 2016 methodology and are presented in Table 3.15.

Table 3.15 Emission factors used in the calculation of emissions from Civil aviation (kt/PJ)

	NO _x	CO	NM VOC	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.

3.3.2.5 Activity data

The data about fuel consumption in aviation is derived from the CSB. CSB has started to collect data as of year 2004 (Figure 3.8). For the time period 1990 – 2003 and for aviation gasoline consumption the data is used from the study (IPE, 2004¹⁰). For 2004 onwards, air flight statistics are provided by Riga International Airport.

¹⁰ "Research on fuel consumption by domestic aviation and private boats in domestic navigation"

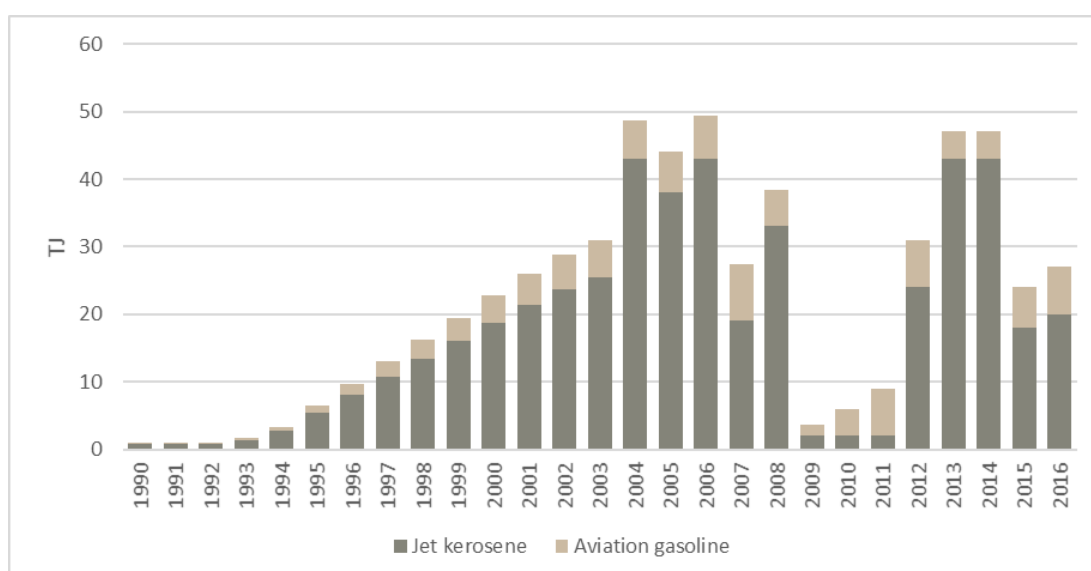


Figure 3.8 Fuel consumption in Civil aviation (TJ)

3.3.2.6 Uncertainties

CSB gives approximately 2% statistical sample error for statistical data. Considering this uncertainty in total fuel consumption for 2004 – 2016 is $\pm 2\%$. As fuel consumption for LTO and cruise cycle was calculated based on assumptions concerning representative aircraft model, assumed uncertainty for fuel consumption in LTO and cruise cycle is $\pm 10\%$. For the rest of time period uncertainty in activity data of fuel consumption is $\pm 20\%$. Taking into account that it is used representative emission factors for LTO and cruise activities the uncertainty of EF lies between 20-45%.

3.3.2.7 QA/QC and verification

Assessment of trends were performed.

3.3.2.8 Recalculations

No recalculations were carried out for this submission.

3.3.2.9 Planned improvements

No improvements are planned for the next submission.

3.3.3 Road transport (NFR 1A3b)

3.3.3.1 Overview

Road transport is producing the greatest part of emissions in Transport sector (Figure 3.7). The main source of emissions are passenger cars, light (LDV) and heavy duty vehicles (HDV) 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.

3.3.3.2 Trends in emissions

Table 3.16 Trends and emissions in Road transport in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO _x	kt	22.380	16.527	17.269	18.019	15.621	12.357	11.665	11.540	11.689	11.775	11.169	-50
NM _{VOC}		24.452	18.132	13.176	8.992	4.101	3.687	3.973	3.432	3.172	2.920	2.351	-90
SO _x		0.360	0.284	0.288	0.086	0.019	0.016	0.015	0.015	0.016	0.017	0.017	-95
NH ₃		0.014	0.030	0.067	0.219	0.210	0.202	0.199	0.196	0.205	0.200	0.150	974
PM _{2.5}		0.668	0.516	0.721	1.097	0.914	0.735	0.730	0.679	0.682	0.683	0.677	1
PM ₁₀		0.837	0.641	0.861	1.296	1.139	0.924	0.909	0.866	0.881	0.898	0.895	7

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
TSP		1.020	0.779	1.012	1.514	1.381	1.127	1.101	1.066	1.094	1.129	1.129	11
BC		0.253	0.202	0.316	0.537	0.462	0.373	0.379	0.344	0.344	0.337	0.335	32
CO		256.77	184.95	110.70	63.128	24.179	22.513	23.999	21.081	18.659	17.266	14.063	-95
Pb	t	55.932	41.568	4.272	1.671	1.398	1.298	1.101	0.999	0.979	0.974	0.950	-98
Cd	t	0.005	0.004	0.004	0.006	0.007	0.006	0.006	0.006	0.007	0.007	0.008	52
PCDD/F	g I-Teq	0.272	0.209	0.249	0.397	0.445	0.380	0.378	0.367	0.386	0.393	0.375	38
PAHs	t	0.035	0.026	0.031	0.050	0.059	0.050	0.048	0.050	0.054	0.060	0.061	73

In the road transport all main emissions have decreased in 1990 – 2016 with an exception of NH₃ and PM (Table 3.16). NH₃ emission increase is likely due to the increasing number of vehicles equipped with catalytic systems for combustion gas treatment. Development of PM_{2.5} during the time span 1990 – 2016 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. The main reason for decrease of emissions is a steady improvement of car technologies and introduction of stronger requirements for fuel quality.

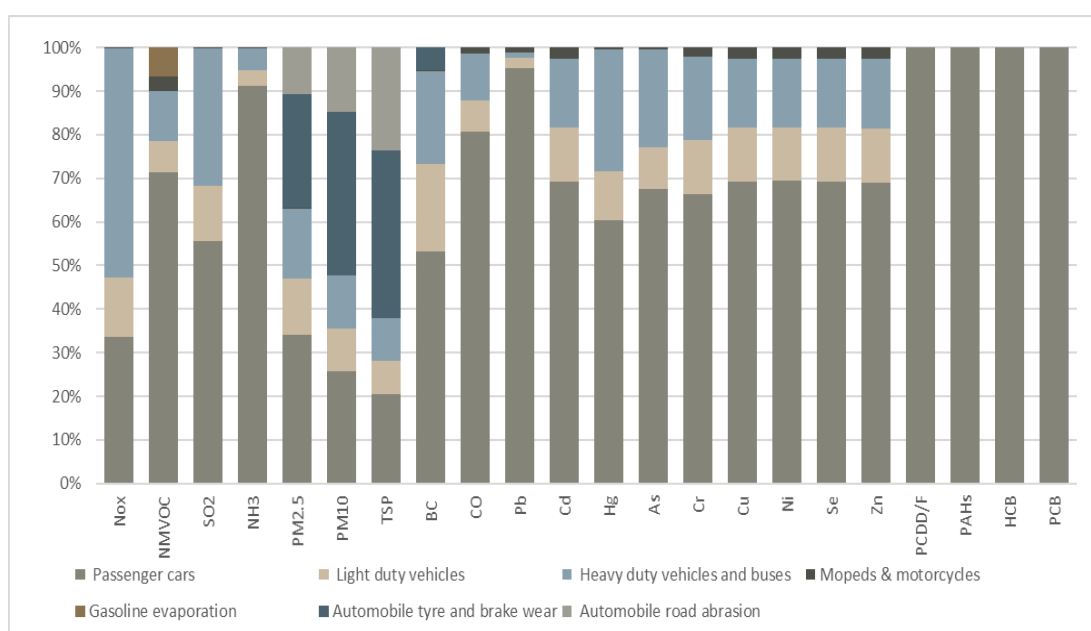


Figure 3.9 Emissions in Road transport, 2016

When analysing the development of emissions in road transport in 2016 following trends could be mentioned:

- Compared to 2015, NO_x and CO emissions have decreased in 2016 by 5.1% and 18% 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. Detailed analysis of the vehicle fleet's structure is provided below.
- Compared to 2015, in 2016 PM emissions in road transport have decreased by 1%. 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 emissions of passenger cars fleet has increased by 3.6%, the total PM emissions of HDV vehicles fleet has decreased by 11% due to increase of share of new HDV vehicles.
- NMVOC emissions in 2016 have decreased by around 19% in comparison with 2015, which is mainly due to decrease in gasoline consumption;
- The main sources of NO_x emissions are HDV (57.7%) followed by passenger cars (32%) and LDV (10%);

- The main sources of NMVOC emissions are passenger cars - around 75%;
- The main sources of SO₂ emissions are passenger cars - around 55% and HDV - around 34%.

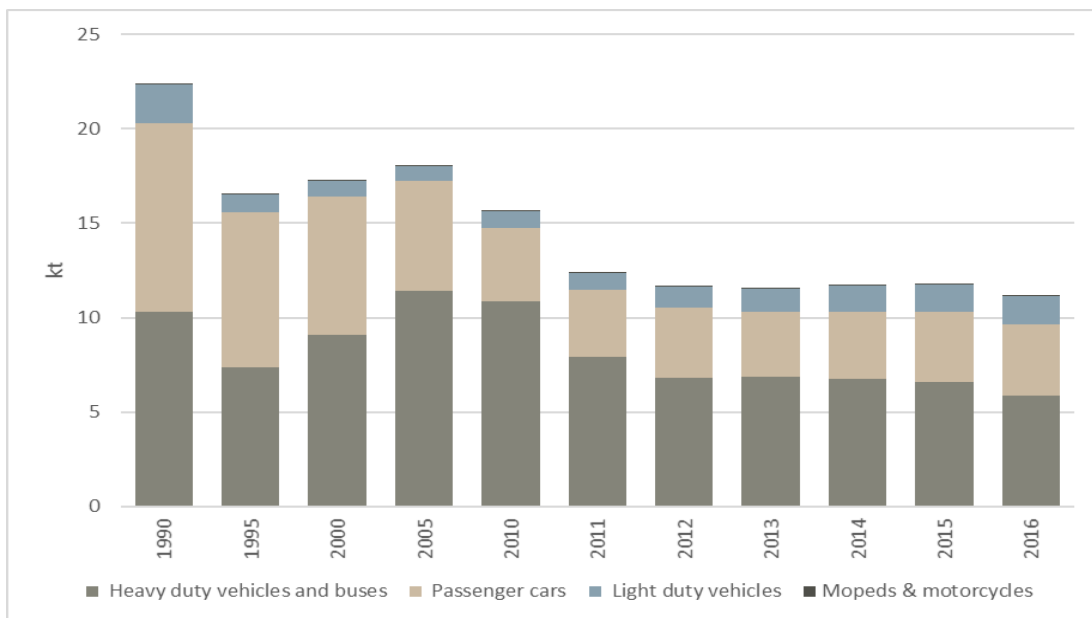


Figure 3.10 Development of NO_x emissions in Road transport (kt)

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

- The main sources of NO_x emissions are heavy duty vehicles (HDV) 52.7% followed by passenger cars 33.5% and LDV 13.7%;
- The main sources of NMVOC emissions are passenger cars - around 71%, gasoline evaporation is responsible for 6.7% no total NMVOC emissions;
- The main sources of SO₂ emissions are passenger cars - around 55% and HDV - around 34%;
- The major part of CO emissions in road transport are created by passenger cars, - 81%, followed by HDV - 11%;

In total PM 2.5 emissions passenger cars contributed to 34.2%, automobile tyre and brake wear to 26.2%, HDV to 16.2%, LDV to 12.7% and automobile road abrasion to 10.6% of emissions

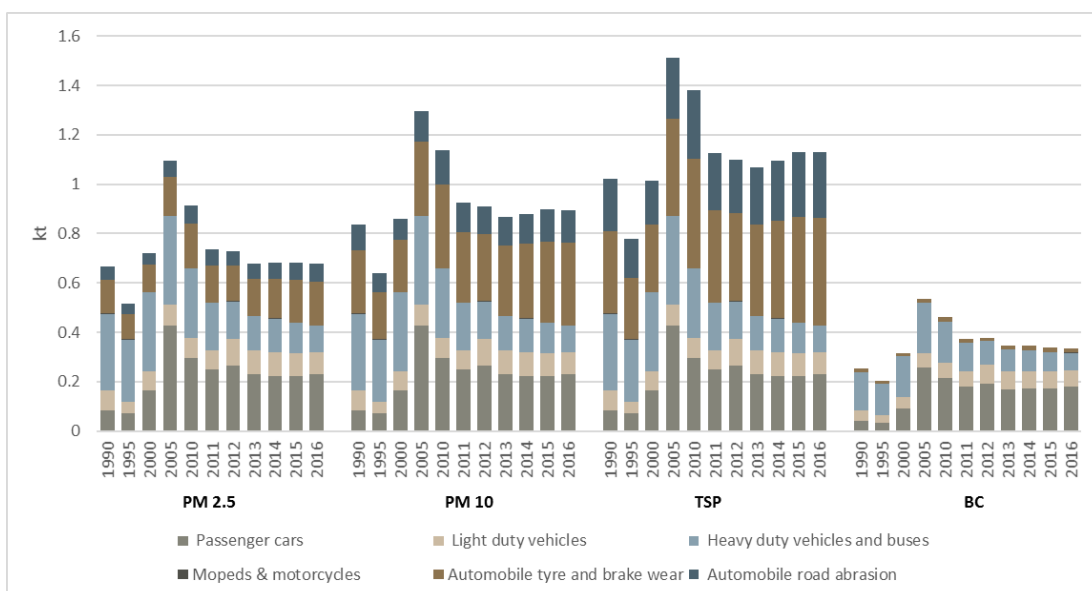


Figure 3.11 Distribution of solid particle emissions by sources in Road transport (kt)

3.3.3.3 *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.

3.3.3.4 *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 1996-2016 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.

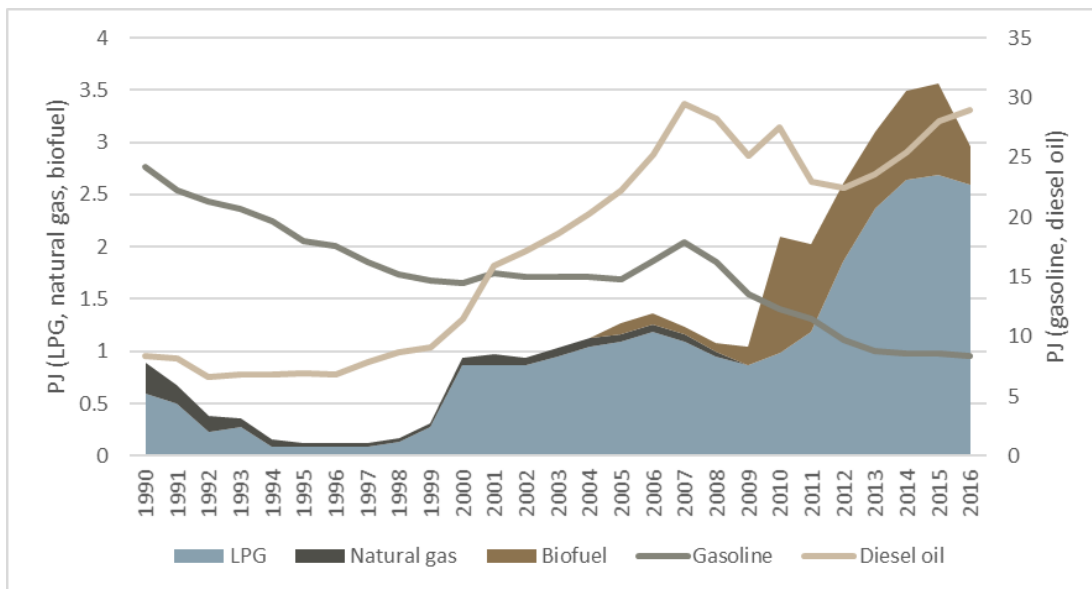


Figure 3.12 Development of fuel consumption in Road transport (TJ)

As seen in Figure 3.12 the fuel consumption has changed essentially in 1990 – 2016. 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 2.5% in 2016 compared to 2015. 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 3.5% in 2016 compared to 2015. Substantial LPG consumption increase in road transport was observed starting from 2011. In 2016 LPG consumption compared to the last 6 years' trend was not visible and LPG consumption had decreased by 3.6% in 2016 compared to 2015.

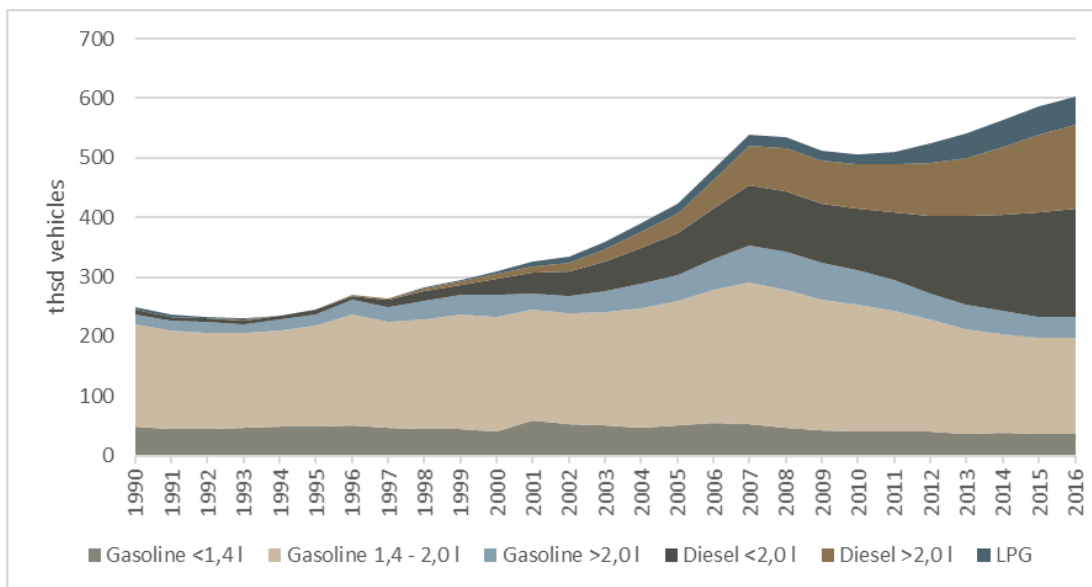


Figure 3.13 Distribution of passenger cars fleet by sub-classes

Analysing the development of the passenger car fleet in 1990 – 2016, following features can be noted (Figure 3.13, Figure 3.14, Figure 3.15):

- Cars with a diesel engine of a capacity < 2.0l constitute a 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% in 2016 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 53.5% from the total number of passenger cars in 2016;
- As of 2005, in the car fleet with a gasoline engine, the number of EURO 4 and EURO 5 cars grow rapidly. In 2016 a share of EURO4, EURO5 and EURO6 cars constitute to 42%;
- As of 2005, in the car fleet with a diesel engine, the number of EURO 4 and EURO 5 cars grow rapidly. In 2016 a share of EURO4, EURO5 and EURO6 cars constitute to 38%.

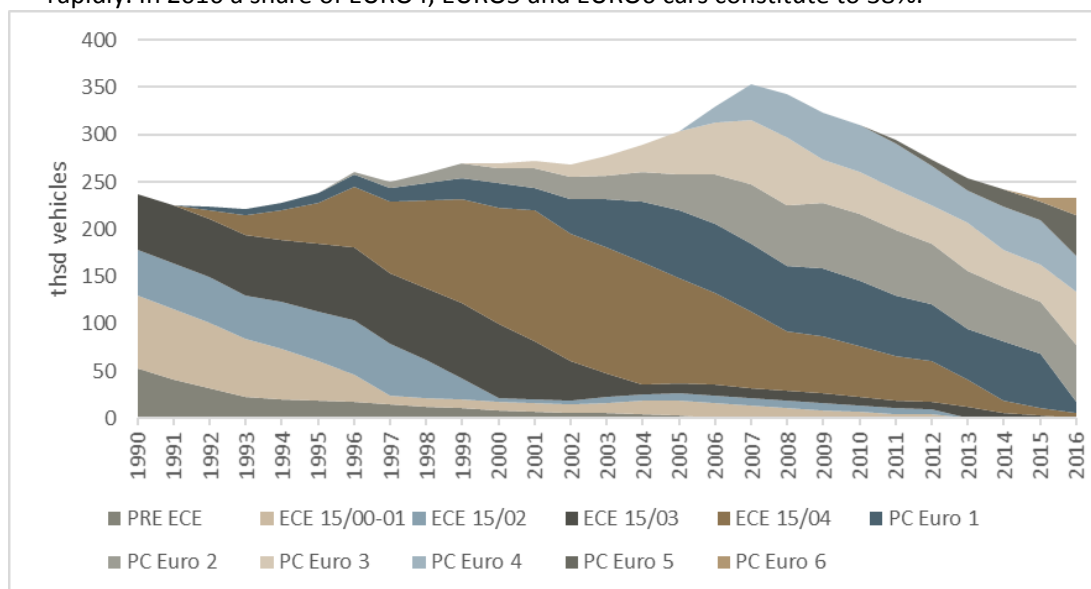


Figure 3.14 Distribution of gasoline passenger cars fleet by layers

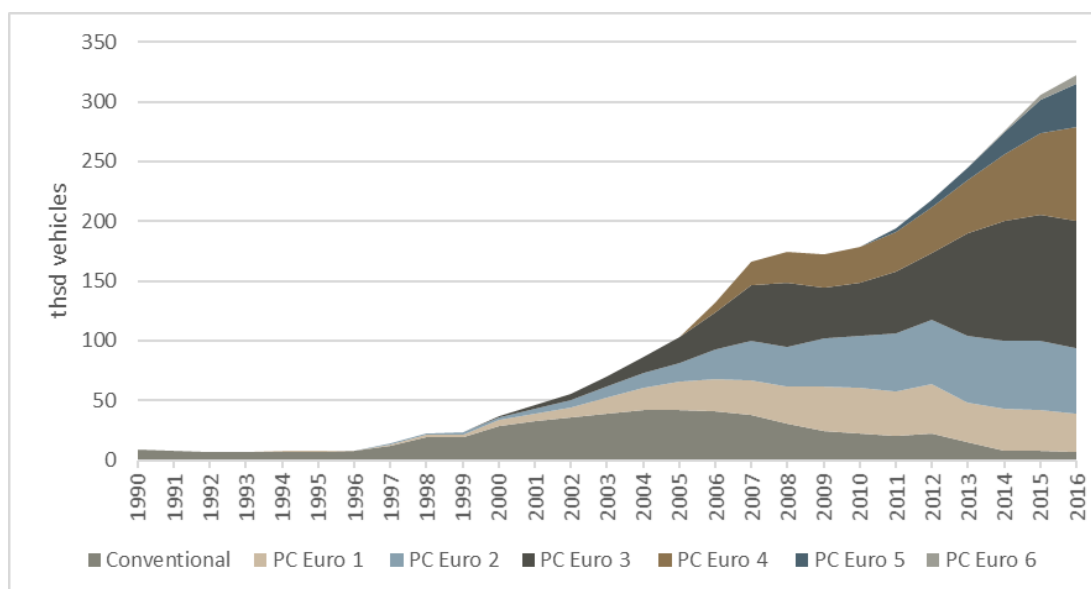


Figure 3.15 Distribution of diesel oil passenger cars fleet by layers

Analysing the development of LDV fleet (Figure 3.16, Figure 3.17) 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 2016 the share of diesel cars is 92%;
- As of 2005, the number of EURO4, EURO5 and EURO6 cars have increased. In 2016 the share of EURO4, EURO5 and EURO6 cars constitute to 52.0%;

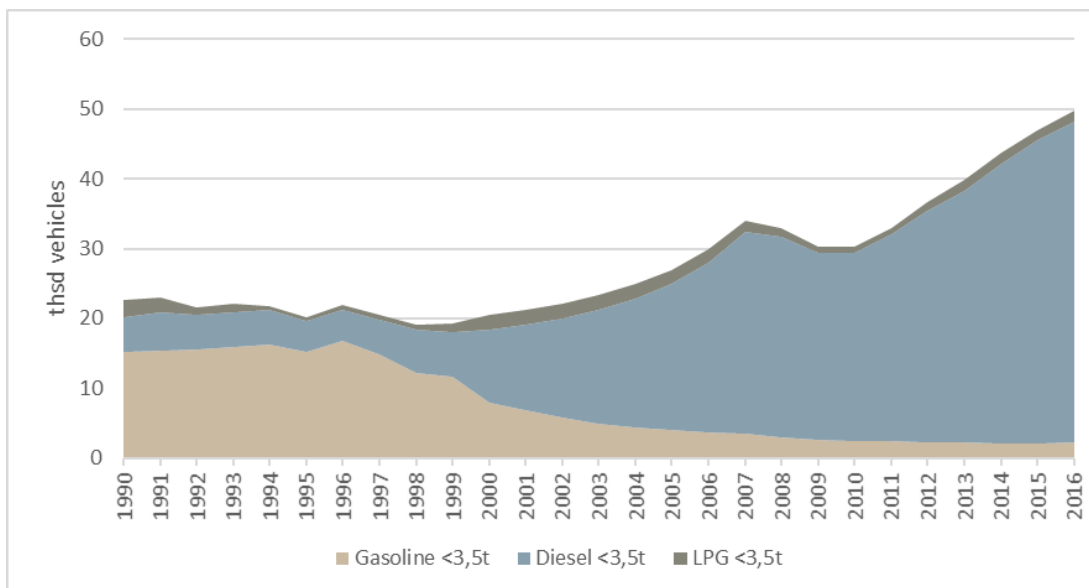


Figure 3.16 Distribution of light duty vehicles fleet by sub-classes

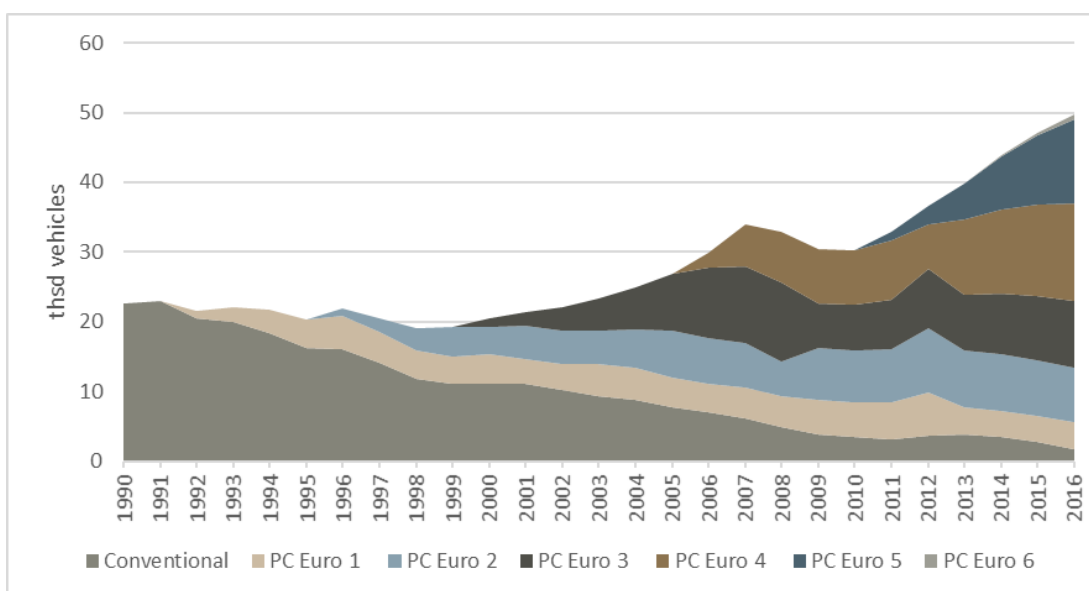


Figure 3.17 Distribution of light duty vehicles fleet by layers

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 have decreased from 33% to 3.5 % corresponding years 2000 and 2016;
- 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 2015 the share of EURO IV, EURO V and EURO VI cars constituted 48%.

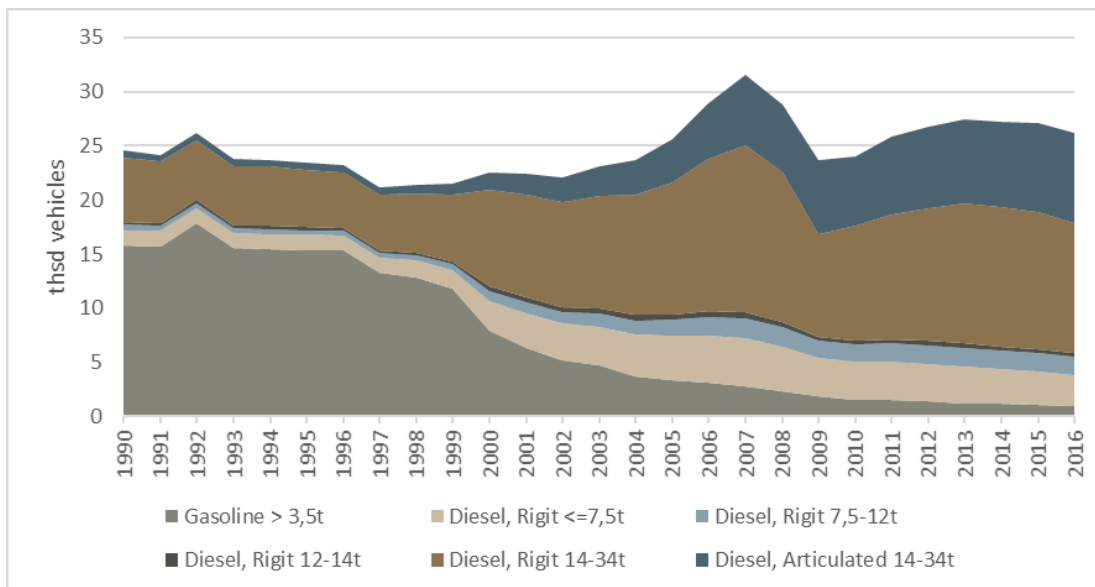


Figure 3.18 Distribution of heavy duty vehicles fleet by sub-classes

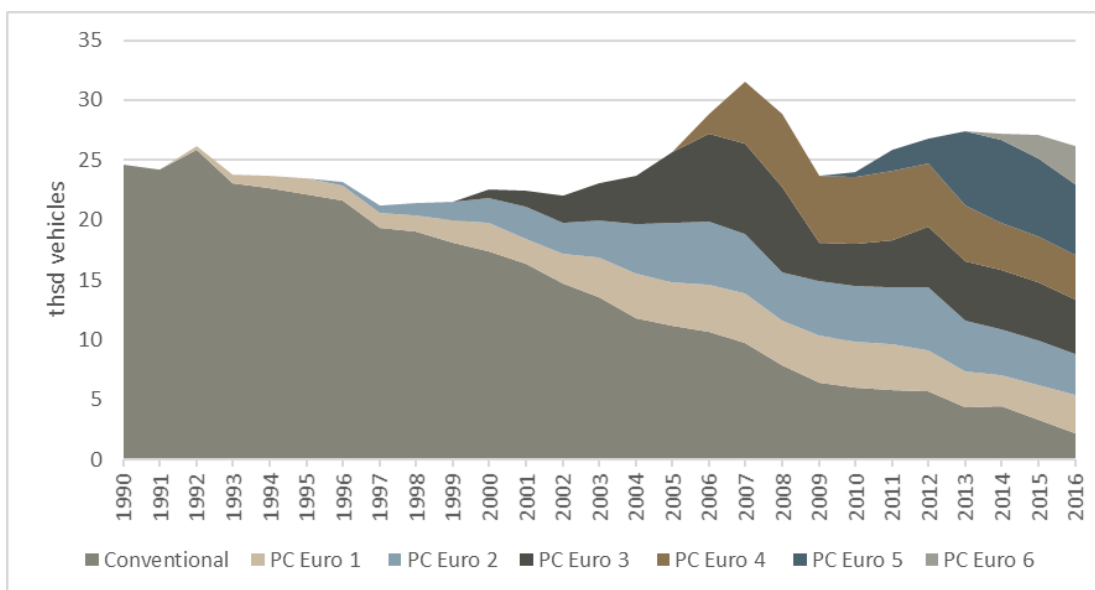


Figure 3.19 Distribution of heavy duty vehicles fleet by layers

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.

3.3.3.5 Uncertainties

Taking into account that CSB gives approximately 2% statistical sample error for statistical data, uncertainty in activity data of fuel consumption is $\pm 2\%$. 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.

3.3.3.6 QA/QC and verification

Assessment of trends were performed.

3.3.3.7 Recalculations

All emissions for 1990 – 2015 were recalculated. Recalculations were done due to switch from COPERT IV model version to COPERT 5 model version.

3.3.3.8 Planned improvements

No improvements are planned for the next submission.

3.3.4 Railway (NFR 1A3c)

3.3.4.1 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 52.7% (2016) of the total freight transport in Latvia (traffic of goods in ton-km) and the transit transport traffic is dominant. In 2009 and 2010 transported freight along the railway and therefore diesel consumption has slightly decreased compared to 2008 level. Due to dependence on transit transport of goods from Russia and other neighbouring countries fuel consumption has decreased by approximately 15.4% in 2016 compared to 2015.

3.3.4.2 Trends in emissions

When analysing the development of emissions trends in railway (Table 3.17), following features could be noted:

- Due to the decrease of diesel oil consumption by around 67% in railway in time period 1990 – 2016 all emissions decreased by 67–98%;

In 2000 – 2016 diesel fuel consumption decreased in railway by around 13%. It is a reason for PM and TSP emission decrease by around 13%. However, SO₂ emissions decreased by about 95% at the same time due to implementation of stronger fuel quality requirements;

Table 3.17 Trends and emissions in Railway in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO _x	kt	8.86	3.98	3.41	4.30	3.50	3.99	4.22	3.78	3.67	3.50	2.96	-66.5
NM VOC		0.79	0.35	0.30	0.38	0.31	0.36	0.37	0.34	0.33	0.31	0.26	-66.5
SO ₂		0.68	0.30	0.06	0.06	0.13	0.16	0.16	0.14	0.14	0.13	0.01	-98.2
NH ₃		0.00118	0.00053	0.00045	0.00057	0.00047	0.00053	0.00056	0.00050	0.00049	0.00047	0.00040	-66.5
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	-66.5
PM ₁₀		0.243	0.109	0.094	0.118	0.095	0.112	0.114	0.104	0.101	0.096	0.081	-66.5
TSP		0.257	0.116	0.099	0.125	0.100	0.118	0.120	0.110	0.106	0.102	0.086	-66.5
BC		0.150	0.068	0.058	0.073	0.059	0.069	0.070	0.064	0.062	0.059	0.050	-66.5
CO	t	1.808	0.813	0.696	0.877	0.706	0.830	0.845	0.772	0.748	0.715	0.605	-66.5
Cd		0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-66.5
PAHs		0.014	0.006	0.005	0.007	0.005	0.006	0.005	0.006	0.006	0.005	0.005	-66.5

Due to the decrease of fuel consumption in railway all emissions decreased by approximately 15.4% in 2016 compared to 2015.

3.3.4.3 Methods

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

3.3.4.4 Emission factors

Default emission factors for Railway (Table 3.18, Table 3.19) are taken from EMEP/EEA 2016. The emission factors for Particulate Matters are taken from CEPMEIP/TNO database (Table 3.10). The SO₂ emissions factors are used consistent with sulphur content in diesel oil by years (Table 3.20).

Table 3.18 Emission factors used for emissions calculation from Railway

Pollutant	Unit	Diesel oil
NO _x	kt/PJ	1.233
CO		0.252

Pollutant	Unit	Diesel oil
NM VOC		0.109
NH ₃		0.000165
Cd		0.00024
Cr		0.00118
Cu		0.04001
Ni	t/PJ	0.00165
Se		0.00024
Zn		0.02353
benzo(a)pyrene		0.000706
benzo(b)fluoranthene		0.0011767

Table 3.19 Emission factors used in the calculation of Particulate Matters emissions from Railway

	PM _{2.5}	PM ₁₀	TSP
	kt/PJ		
Diesel oil	0.03224	0.03389	0.03577

Table 3.20 SO₂ emission factors for Diesel oil used in the calculation of SO₂ emissions from Railway

	Sulphur content (%)	NCV (TJ/kt)	EF (kt/PJ)
1990-2002; 2005-2007	0.2	42.49	0.0941
2003-2004	0.05	42.49	0.0235
2008-2014	0.1	42.49	0.0471
2015-2016	0.001	42.49	0.005

3.3.4.5 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 3.20). Fuel consumption decreased by around 15.4% in 2016 compared to 2015.

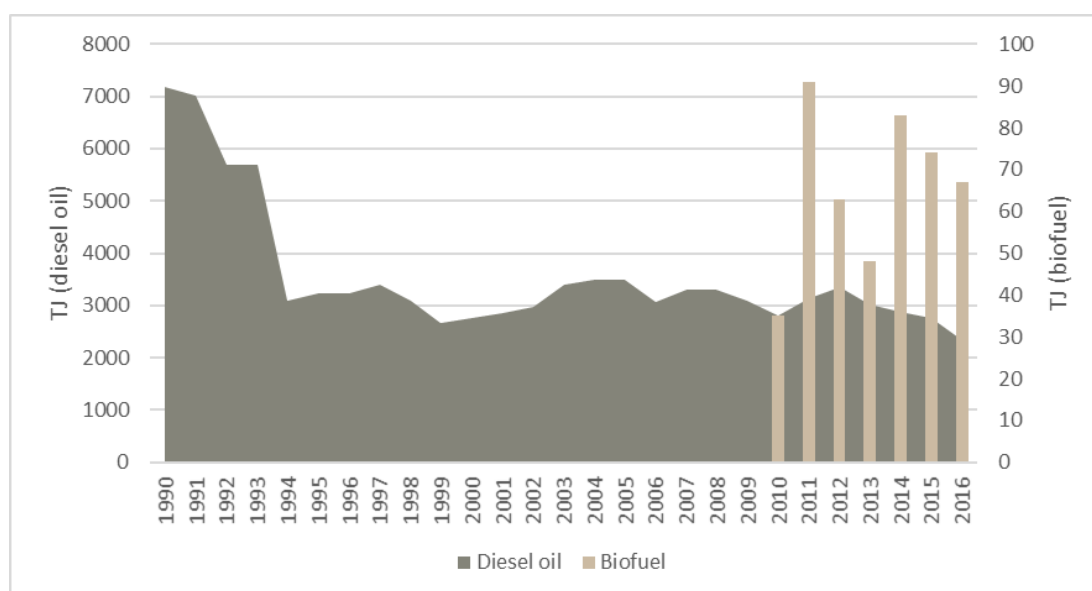


Figure 3.20 Fuel consumption in Railway transport (TJ)

3.3.4.6 Uncertainties

Uncertainty in activity data of fuel consumption is $\pm 2\%$ in 2016. CSB gives approximately 2% statistical sample error for statistical data. The uncertainty of EF lies between 20-45%.

3.3.4.7 QA/QC and verification

Assessment of trends was performed.

3.3.4.8 Recalculations

SO₂ 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.

3.3.4.9 Planned improvements

No improvements are planned for the next submission.

3.3.5 Navigation (NFR 1A3d)

3.3.5.1 Overview

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

Fuel consumption for domestic navigation has variations. For example, in 2014 diesel oil consumption decreased approximately 2 times compared to 2013. Number of services for international freight in harbours mostly affects the changes in fuel consumption, however, dramatic fuel consumption decrease in 2014 was due to completion of the harbour deepening (a project that was carried out during 2013). Diesel oil consumption increased by approximately 37% in 2016 compared to 2015.

3.3.5.2 Trends in emissions

Table 3.21 Trends and emissions in Navigation in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	0.021	0.011	0.012	0.011	0.392	0.392	0.315	0.629	0.315	0.239	0.326	1429
NM VOC		0.011	0.012	0.014	0.017	0.026	0.026	0.030	0.039	0.032	0.021	0.032	192
SO_x		0.00028	0.00016	0.00017	0.00015	0.00510	0.00510	0.00410	0.00818	0.00411	0.00311	0.0042	1403
NH₃		1.80E-06	9.41E-07	9.95E-07	8.50E-07	3.39E-05	3.39E-05	2.72E-05	5.44E-05	2.72E-05	2.06E-05	2.82E-05	1463
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	656
PM₁₀		0.0009	0.0008	0.0009	0.0010	0.0081	0.0083	0.0070	0.0129	0.0071	0.0052	0.0073	679
TSP		0.0009	0.0008	0.0009	0.0010	0.0081	0.0083	0.0070	0.0129	0.0071	0.0052	0.0073	679
BC		0.00014	0.00009	0.00010	0.00010	0.00220	0.00220	0.00177	0.00352	0.00179	0.00135	0.00185	1205
CO	t	0.035	0.039	0.045	0.052	0.076	0.076	0.088	0.111	0.095	0.0616	0.0959	178
Cd		3.22E-09	2.04E-09	2.23E-09	2.14E-09	7.06E-08	5.06E-08	4.00E-08	9.90E-07	1.18E-06	7.13E-07	1.18E-06	36535
PAHs		2.57E-05	1.64E-05	1.79E-05	1.72E-05	0.0006	0.0004	0.0003	0.0006	0.0003	0.0002	0.0003	1223

Analysing the development of the emission trends in domestic navigation (Table 3.21), following features can be noted:

- Due to remarkable increase (more than 10 times) in fuel consumption in 1990 – 2016 all emissions increased several times;
- In 2016 NO_x and SO₂ emissions increased by around 36.5% compared to 2015 due to fuel consumption increase. NMVOC emissions increased by around 54% but PM_{2.5} and PM₁₀ emissions by 40.4% and 40.2% correspondingly.

3.3.5.3 Methods

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

3.3.5.4 Emission factors

Default EFs (Table 3.22) for navigation is used (EMEP/EEA 2016):

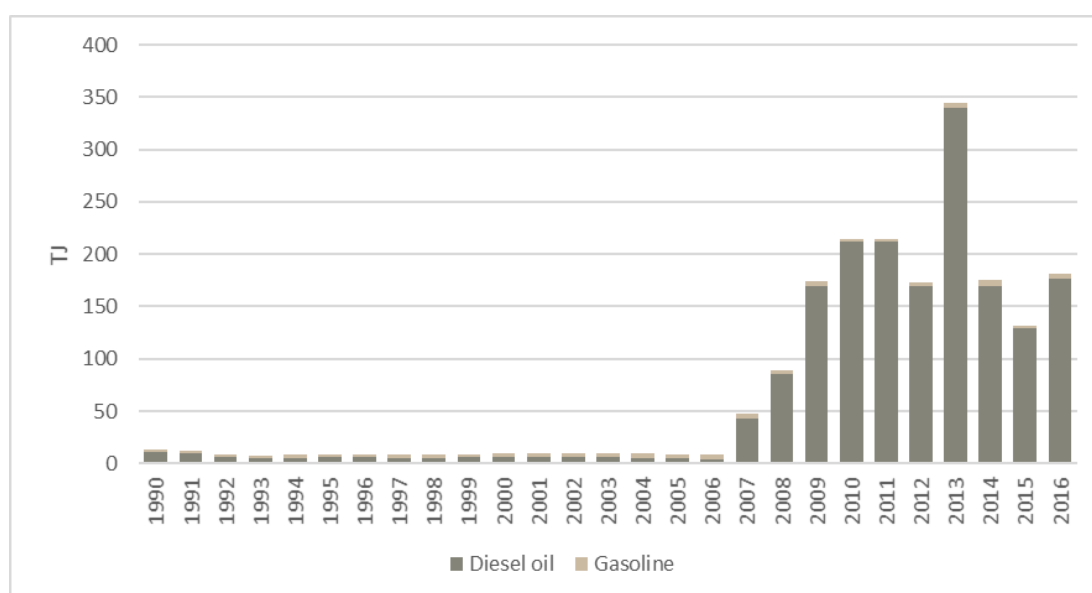
Table 3.22 Emission factors used in the calculation of emissions from navigation

	NO _x	CO	NM VOC	NH ₃	PM _{2.5}	PM ₁₀	TSP
	kt/PJ						
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 SO₂ emission factors are used consistent with sulphur content in diesel oil and gasoline.

3.3.5.5 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 3.21 below.

**Figure 3.21 Development of gasoline and diesel oil fuel consumption in Navigation**

3.3.5.6 Uncertainties

Uncertainty in activity data of fuel consumption for time period 2006 – 2016 is $\pm 2\%$. 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 $\pm 20\%$. The uncertainty of EF lies between 20-40%.

3.3.5.7 QA/QC and verification

Assessment of trends were performed.

3.3.5.8 Recalculations

No recalculations were carried out.

3.3.5.9 Planned improvements

No improvements are planned for the next submission.

3.4 Off-road mobile machinery (NFR 1A2gvii, 1A4aii, 1A4bii, 1A4cii, 1A4ciii, 1A5b)

3.4.1 Overview

Under the NFR 1A2gvii, 1A4aii, 1A4bii, 1A4cii emissions from gasoline use are reported. It is assumed that all gasoline is consumed for off-road purposes in Manufacturing industries and Construction, Commercial, Residential and Agriculture and Forestry sectors. It is assumed that 90% of diesel that is reported under Agriculture/Forestry/Fishing (1A4c) is consumed in off-road vehicles and machinery (1A4cii).

Under the NFR 1A4c iii Fishing sector it is assumed that all diesel and residual fuel oil is consumed for fishing boats.

Under the NFR 1A5b Other Mobile sources emissions from liquid fuels – aviation gasoline, diesel oil and jet kerosene, used in aircrafts and ships are reported. These emissions appear since 1996.

3.4.2 Trends in emissions

Table 3.23 Trends and emissions in off-roads in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Changes in 1990-2016, %
NO_x	kt	7.24	5.19	4.08	4.56	3.95	4.10	3.56	3.57	3.70	3.77	4.10	-47.9
NM_{VOC}		4.55	0.49	0.74	0.94	0.87	1.09	0.99	1.07	0.93	0.85	0.93	-81.4
SO_x		1.06	0.72	0.50	0.52	0.21	0.22	0.20	0.20	0.20	0.21	0.23	-79.8
NH₃		0.0011	0.0005	0.0005	0.0006	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0009	-27.1
PM_{2.5}		0.33	0.18	0.16	0.17	0.16	0.17	0.15	0.15	0.15	0.16	0.17	-51.8
PM₁₀		0.34	0.19	0.16	0.18	0.16	0.17	0.15	0.15	0.16	0.16	0.17	-53.0
TSP		0.34	0.19	0.16	0.18	0.16	0.17	0.15	0.15	0.16	0.16	0.17	-53.0
BC		0.12	0.07	0.07	0.08	0.09	0.09	0.08	0.08	0.08	0.09	0.09	-27.4
CO	t	43.91	3.08	5.95	8.27	7.42	9.58	8.82	9.67	8.20	7.13	8.26	-83.8
Pb		8.80	0.46	0.04	0.05	0.04	0.06	0.05	0.06	0.05	0.04	0.04	-99.5
Cd		0.00226	0.00113	0.00099	0.00116	0.00114	0.00120	0.00108	0.00110	0.00111	0.00115	0.00122	-49.3
Hg		0.00114	0.00117	0.00078	0.00076	0.00036	0.00039	0.00027	0.00025	0.00028	0.00023	0.00031	-79.8
PCDD/PCDF	g I- Teq	0.0095	0.0085	0.0057	0.0048	0.0016	0.0017	0.0011	0.0011	0.0012	0.0010	0.0013	-89.6
PAHs	t	0.005	0.000	0.240	0.401	0.480	0.481	0.479	0.481	0.481	0.400	0.401	8531.2
HCB	kg	0.00408	0.00390	0.00260	0.00238	0.00096	0.00103	0.00071	0.00068	0.00076	0.00061	0.00083	-85.0
PCBs		0.00798	0.00638	0.00426	0.00314	0.00046	0.00049	0.00034	0.00032	0.00036	0.00029	0.00039	-96.3

As it can be seen from Table 3.23 above, most of the emissions have decreased in 1990-2016 due to decrease in fuel consumption.

3.4.3 Methods

When calculating emissions from off-roads, Tier 1 method was applied.

3.4.4 Emission factors

Emission factors are taken from EMEP/EEA 2016. A complete table with all emission factors and references is presented in Annex I.

3.4.5 Activity data

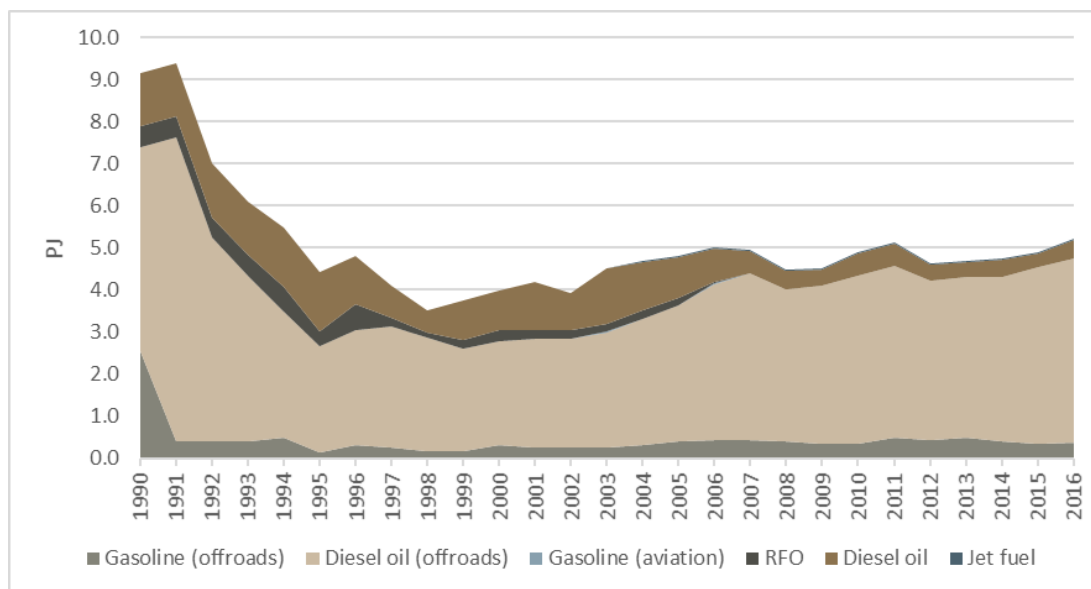


Figure 3.22 Fuel consumption in off-roads (PJ)

The data about consumption in off-roads is derived from the CSB (Figure 3.22).

3.4.6 Uncertainties

Uncertainty in activity data of fuel combustion is assumed $\pm 2\%$ in 2016. 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 are imported and import and export statistics are fairly accurate.

Emission factor uncertainty is assumed as 50%.

3.4.7 QA/QC and verification

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

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 was 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.

3.4.8 Recalculations

No recalculations done.

3.4.9 Planned improvements

No improvements planned.

3.5 Fugitive emissions (NFR 1B)

3.5.1 Overview

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 1990–2016.

Fugitive particulate matters emissions in 1990-2016 from the operations of solid fuels – coal and coke, transportation via railways and storage and handling, are estimated.

3.5.2 Trends in emissions

Table 3.24 Fugitive emissions in 1990-2016

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NMVOC	4.18	3.19	2.48	2.28	2.35	1.40	1.44	1.71	2.34	2.40	2.06	-50.8
PM_{2.5}	0.000278	0.000078	0.000032	0.000038	0.000051	0.000053	0.000044	0.000037	0.000031	0.000024	0.000021	-92.3
PM₁₀	0.002784	0.000780	0.000324	0.000381	0.000510	0.000525	0.000435	0.000369	0.000306	0.000243	0.000213	-92.3
TSP	0.006960	0.001950	0.000810	0.000953	0.001275	0.001313	0.001088	0.000923	0.000765	0.000608	0.000533	-92.3

NMVOC emissions are decreasing due to decrease in use of gasoline (Table 3.24). Also, particulate matter emissions have decreased if compared to 1990.

3.5.3 Methods

LEGMC receives data about emissions from gas leakage directly from the natural gas holding company “Latvijas Gāze” for the time period 1990–2016. Consequently “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 2 method, using country-specific data and calculations.

EMEP/EEA 2016 Tier 1 methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in 1990–2016. 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.

3.5.4 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).

Table 3.25 PM emission factors (g/t)

	Coal
TSP	7.5
PM₁₀	3

	Coal
PM_{2.5}	0.3

3.5.5 Activity data

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

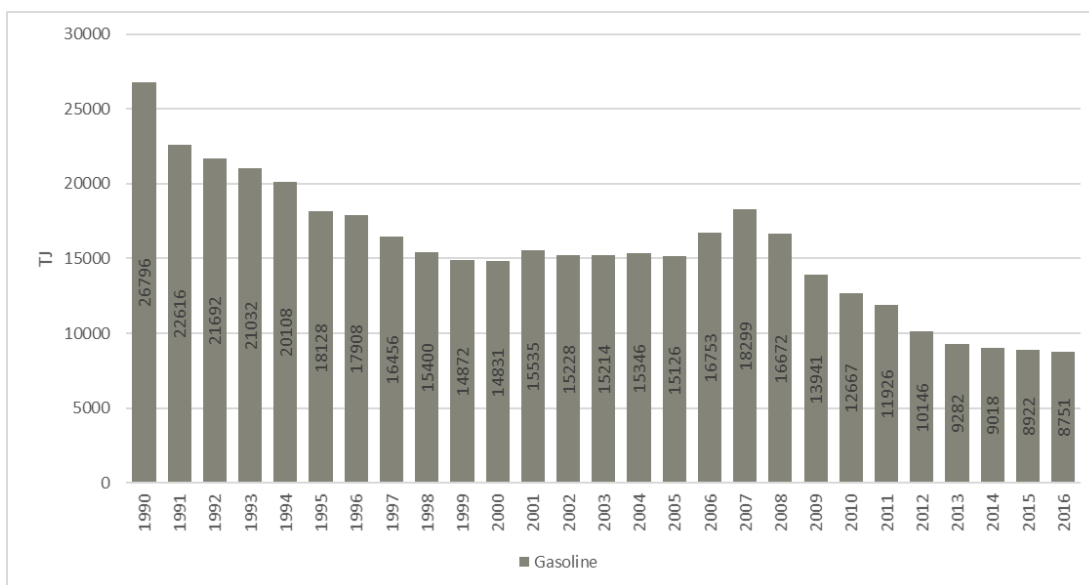


Figure 3.23 Gasoline consumption in Latvia in 1990-2016 (TJ)

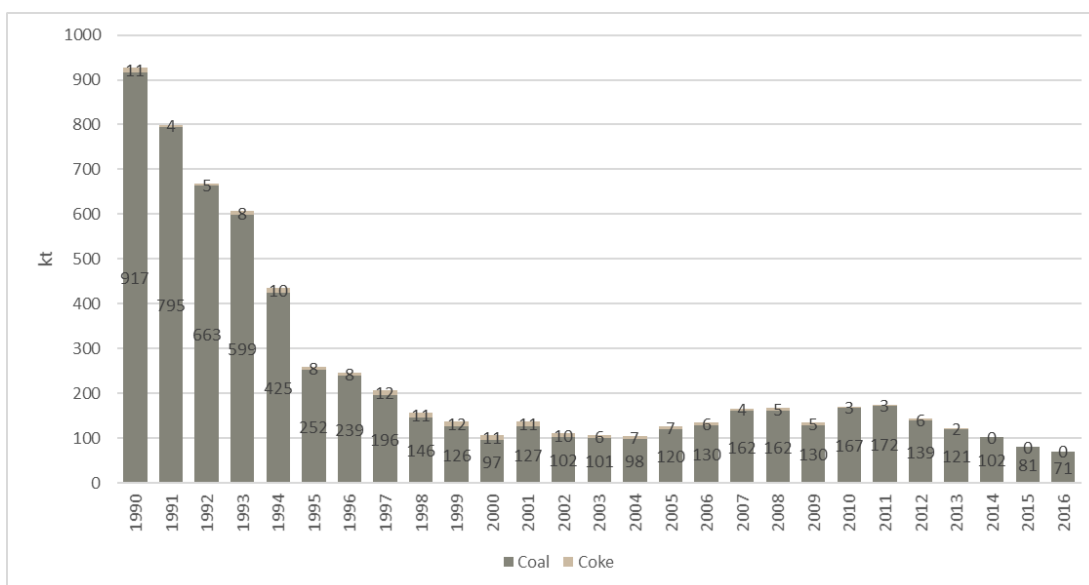


Figure 3.24 Activity data used for particulate matters emissions calculation in 2000–2016 (kt)

Table 3.26 Amounts of natural gas leaked in 1990-2016 (10⁶ m³)

	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

	Venting	Transmission and storage	Distribution	Other	Total
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

3.5.6 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.

3.5.7 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.

3.5.8 Recalculations

No recalculations were performed in Submission 2018.

3.5.9 Planned improvements

No improvements are planned.

3.6 International bunkers

3.6.1 Overview

International bunkers cover International 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.

3.6.2 Trends in emissions

International maritime navigation contributed around 96%, 86% and 98% in total international emissions correspondingly for NO_x and SO₂ and PM emissions in 2016.

3.6.3 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

	Emissions factors, kt/PJ			
	NO _x	CO	NM VOC	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	NM VOC	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

	Emissions factors, kt/PJ		
	PM ₁₀	PM _{2.5}	TSP
Diesel oil	0.035	0.033	0.035
RFO	0.1527	0.1379	0.1527

The SO₂ emissions factors are used consistent with sulphur content in diesel oil (Table 3.30, Table 3.31).

Table 3.30 SO₂ emission factors used for Diesel oil in the SO₂ calculation of emissions for International Bunkers

	Fuel content (%)	NCV (TJ/kt)	EF (kt/PJ)
1990-2007	0.2	42.49	0.094
2008-2016	0.1	42.49	0.0471

Table 3.31 SO₂ Emission factors used for RFO in the SO₂ calculation of emissions for International Bunkers

RFO	Fuel content (%)	NCV (TJ/kt)	EF (kt/PJ)
1990-2006	2.8	40.6	1.352
2007-2016	1.5	40.6	0.7241

3.6.4 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.

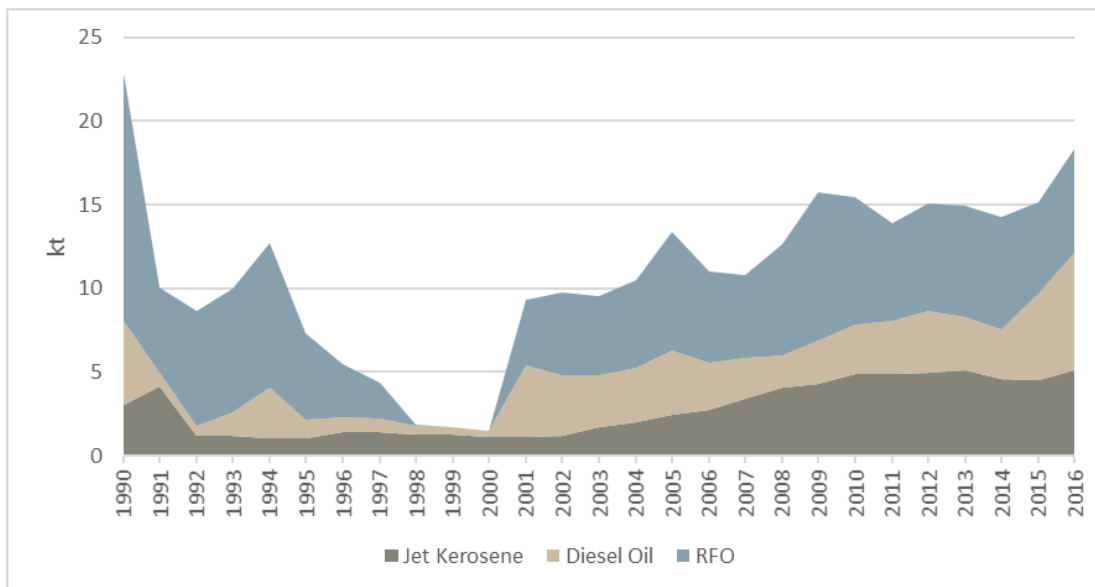


Figure 3.25 Fuel consumption in International Transport (PJ)

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 more (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 2	NS	Tier 2
2D3b	Road paving with asphalt	Tier1	NS	D
2D3c	Asphalt roofing	Tier1	NS	D
2D3d	Coating applications	Tier 1	NS	Tier 1
2D3e	Degreasing	Tier 1	NS	Tier 1
2D3f	Dry cleaning	CS	NS	CS
2D3g	Chemical products	Tier 1, Tier 2	NS	Tier 1, Tier 2
2D3h	Printing	Tier 1	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 2016

NFR code	Emissions
2A1	NO _x , NMVOC, SO ₂ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Hg
2A3	NO _x , NMVOC, SO ₂ , PM _{2.5} , PM ₁₀ , TSP, BC, CO
2A5a	PM _{2.5} , PM ₁₀ , TSP
2A5b	PM _{2.5} , PM ₁₀ , TSP
2A5c	PM _{2.5} , PM ₁₀ , TSP
2D3a	NMVOC
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	NO _x , 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

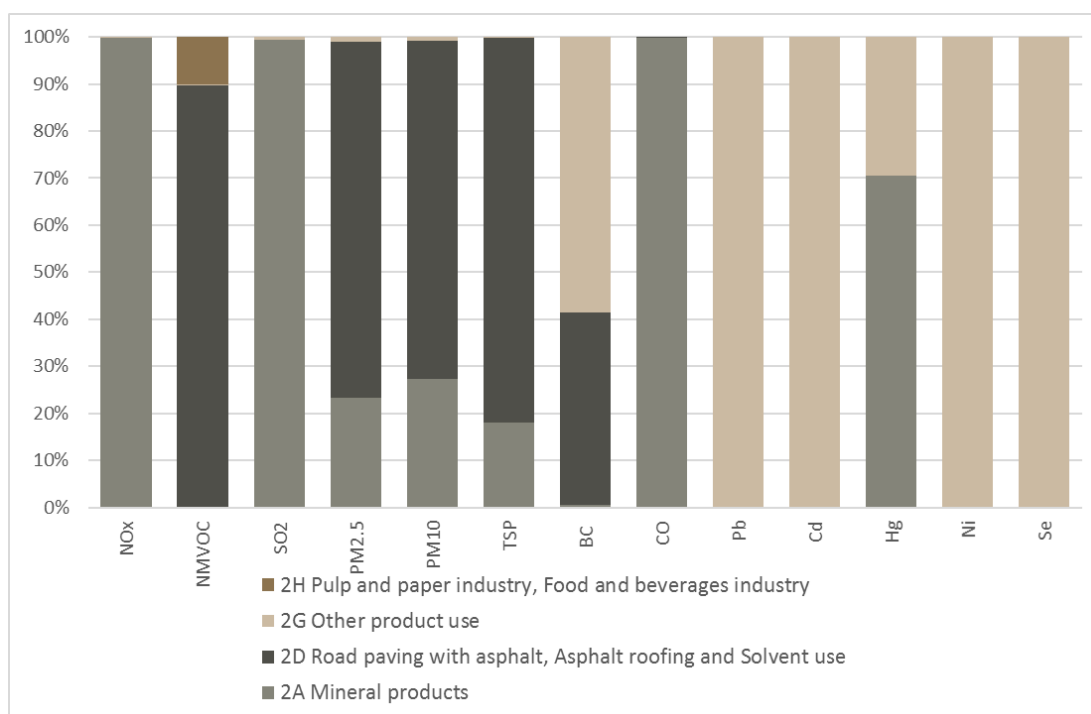


Figure 4.1 Emissions from Industrial processes and product use sector by subsectors in 2016

There are three main categories in IPPU sector – mineral production dominates in NO_x, SO₂, CO; Other solvent and product use dominates in NMVOC and particulate matter emissions and Other product use dominates in heavy metal emissions. Coating application sector (NFR 2D3d) dominates in NMVOC, particulate matter and BC emissions (Figure 4.1). Division of emission most likely could be different because several emissions are not estimated due to lack of official methodology and default or country specific emission factors.

Cement production sector is a key source category for Hg emissions with 24.4% from total Hg emissions in 2016.

The main share of total NMVOC emissions was contributed by Coating (2D3d) –11.53% or 4.61 kt and Domestic solvent use (2D3a) – 6.48% or 2.59 kt.

4.1.3 Trends in emissions

Table 4.3 Change in emissions from Industrial processes and product use sector in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	0.910	0.243	0.232	0.470	0.597	1.137	1.714	1.672	1.901	1.970	1.410	117
NMVOC		16.579	14.155	13.673	13.900	11.092	12.183	11.769	12.185	12.627	13.165	12.569	-21
SO₂		3.571	0.944	0.933	1.482	0.205	0.425	0.495	0.240	0.215	0.255	0.104	-93
NH₃		0.010	0.009	0.009	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	-30
PM_{2.5}		0.688	0.386	0.576	1.144	1.018	1.016	0.996	0.879	0.880	1.053	0.857	53
PM₁₀		1.704	1.449	1.984	6.621	5.796	7.986	7.492	6.687	6.616	8.213	6.402	382
TSP		3.406	3.429	6.648	24.034	20.585	30.614	29.345	25.421	25.401	32.334	26.248	849
BC		0.013	0.007	0.017	0.034	0.027	0.031	0.033	0.026	0.027	0.036	0.035	178
CO		0.132	0.124	0.119	0.111	0.954	2.153	5.089	3.042	2.362	1.794	0.815	1259
Pb	t	165.08	83.82	150.27	166.60	160.70	0.563	2.347	0.656	0.159	0.139	0.140	-100
Cd		0.459	0.237	0.413	0.456	0.438	0.042	0.177	0.048	0.009	0.012	0.010	-97
Hg		0.0001	0.00003	0.00003	0.0001	0.012	0.012	0.098	0.026	0.004	0.008	0.024	6207
As		16.508	8.382	15.010	16.635	16.059	0.003	0.013	0.003	0.0003	0.0004	0.0002	-100
Cr		1.275	0.645	1.156	1.285	1.233	0.019	0.087	0.022	0.003	0.003	0.003	-100
Cu		0.182	0.099	0.255	0.323	0.233	0.084	0.124	0.100	0.099	0.070	0.089	-62
Ni		5.528	2.805	5.019	5.569	5.362	0.127	0.597	0.145	0.011	0.017	0.010	-100
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	-
Zn		4.480	2.274	4.115	4.589	4.377	0.650	3.073	0.751	0.057	0.085	0.051	-98
PCDD/PCDF	g I-teq	0.037	0.019	0.034	0.037	0.036	0.503	2.509	0.580	0.0004	0.038	0.0002	1
PAHs	kg	0.006	0.003	0.006	0.006	0.006	0.081	0.402	0.093	0.0005	0.006	0.0004	5
PCBs		NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.419	2.091	0.483	0.000	0.031	NO,NA	-100

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 SO₂ 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 SO₂ 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 SO₂ 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 2016 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 2010-2016 CO emissions are fluctuating but since 2014 the downward trend can be observed due to decrease in cement and glass production. CO emissions are automatically measured at cement and glass fibre plants and available from the national database "2-Air".

In Solvent use the fluctuation of NMVOC emissions in the period 1990-2016 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 2016 NMVOC emissions were increasing.

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, SO₂, CO, particulate matter, BC and Hg emissions;
- NFR 2A2 Lime production - particulate matter, BC;
- NFR 2A3 Glass and glass fibre production – NO_x, NMVOC, SO₂, CO, particulate matter and BC emissions;
- NFR 2A5a Quarrying and mining of minerals other than coal - particulate matter emissions;
- NFR 2A5b Construction and demolition - particulate matter emissions;
- NFR 2A5c Storage, handling and transport of mineral products - particulate matter emissions.

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

4.2.1.2 Trends in emissions

Table 4.4 Change in emissions from Mineral products in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO _x	kt	0.9025	0.2372	0.2257	0.4635	0.5912	1.1126	1.6023	1.6444	1.8980	1.9658	1.4062	56%
NMVOC		0.1550	0.0420	0.0412	0.0724	0.0291	0.0333	0.0135	0.0145	0.0210	0.0170	0.0165	-89%
SO _x		3.4094	0.8960	0.8526	1.3919	0.1186	0.4140	0.4439	0.2273	0.2140	0.2538	0.1033	-97%
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	-33%
PM ₁₀		1.1025	0.8752	0.3653	2.9386	2.7514	3.8793	3.0802	3.2001	3.0361	3.4443	1.7466	58%
TSP		2.3422	1.7412	0.6845	8.5676	8.0431	11.662	9.0472	9.3558	8.8952	10.291	4.7494	103%
BC		0.0043	0.0010	0.0009	0.0016	0.0005	0.0006	0.0007	0.0004	0.0006	0.0005	0.0004	-90%
CO	t	NA/NE	NA/NE	NA/NE	NA/NE	0.8525	3.5645	3.5645	2.6223	2.2661	1.6784	0.7120	-
Pb		0.0741	0.0173	0.0125	0.0385	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	-
Cd		0.0057	0.0013	0.0010	0.0029	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	-
Hg		0.0001	0.0000	0.0000	0.0001	0.0120	0.0034	0.0560	0.0160	0.0036	0.0076	0.0242	18423%
As		0.0083	0.0019	0.0014	0.0043	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	-
Cr		0.0100	0.0023	0.0017	0.0052	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	-
Cu		0.0003	0.0001	0.0001	0.0002	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	-
Ni		0.0213	0.0050	0.0036	0.0111	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	-
Se		0.0349	0.0082	0.0059	0.0181	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	-

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
Zn		0.0161	0.0038	0.0027	0.0084	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	NA/NE	–

During the time period 1990-2016 NO_x, PM₁₀, TSP and Hg emissions from Mineral products were increasing. At the same time NMVOC, SO₂, 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 2016 NO_x emissions have increased by 145% compared to 1990 due to the change of cement production technology. At the same time CO emissions decreased by 16% in 2016 compared to 2010. In cement plant NO_x, SO₂ and CO emissions, as well as particulate matter and Hg emissions are measured automatically by plant itself. Compared to 1990 emissions of particulate matter PM₁₀ and TSP increased by 58% and 103% accordingly but PM_{2.5} emissions decreased by 33%. To reduce particulate matter emissions, all mineral producing plants are equipped with filters.

NMVOC emissions decreased by 89% in 2016 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, SO₂, PM_{2.5}, PM₁₀, 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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	0.902	0.237	0.226	0.358	0.492	1.017	1.517	1.539	1.795	1.864	1.305	45
NMVOC		0.154	0.040	0.038	0.061	0.008	0.011	0.011	0.011	0.011	0.009	0.007	-96
SO₂		3.409	0.896	0.853	1.354	0.075	0.374	0.388	0.171	0.153	0.191	0.064	-98
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	-92
PM₁₀		0.341	0.090	0.085	0.135	0.029	0.002	0.004	0.034	0.038	0.029	0.014	-96
TSP		0.401	0.105	0.100	0.159	0.030	0.005	0.004	0.035	0.039	0.030	0.015	-96
BC		0.004	0.001	0.001	0.001	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002	-95
CO	NE	NE	NE	NE	NE	0.812	1.738	3.532	2.584	2.230	1.644	0.685	-16
Hg	t	NE	NE	NE	NE	0.012	0.003	0.056	0.016	0.004	0.008	0.024	103

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 SO₂, 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 SO₂ and NO_x emissions in 2010 decreased by 95.7% and 10.4% accordingly compared to 2009. Rapid decrease of SO₂ 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 SO₂ 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.

SO₂ 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 SO₂ and NO_x as Tier 3 method is applied since 2010 and plant specific data is not available prior to 2010.

In 2016 NMVOC, SO₂, 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 in 2014 increased by 3.6%. In 2015 compared to 2014 produced amount of clinker decreased by 16% but in 2016 compared to 2015 decrease was even larger - 26% due to decrease of amounts exported and reduced activity in building sector which caused lower demand for cement. 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.

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, SO₂ (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).

According to Industrial emissions directive (IED) permit there are 36 dedusting filters installed in the cement plant with total efficiency approximately 99%¹¹. These filters mainly are designed to collect large coarse particles. Therefore, total TSP emissions decreased by 99% due to installation of filters. TSP emissions are measured automatically in plant and available from the national database “2-Air”.

For 2010-2016 additionally Hg emissions are reported which also were taken from the database mentioned above.

¹¹ http://old.vpvpb.gov.lv/ippc/atlauja/Aatl/Cemex_meiri.pdf (page 15)

4.2.2.4 Emission factors

As the EFs for NO_x, NMVOC and SO₂ are not available in EMEP/EEA 2016¹² (marked as “Not Estimated”) the EFs from EMEP/CORINAIR 2007¹³ 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 report¹⁴ under EU ETS (Figure 4.2).

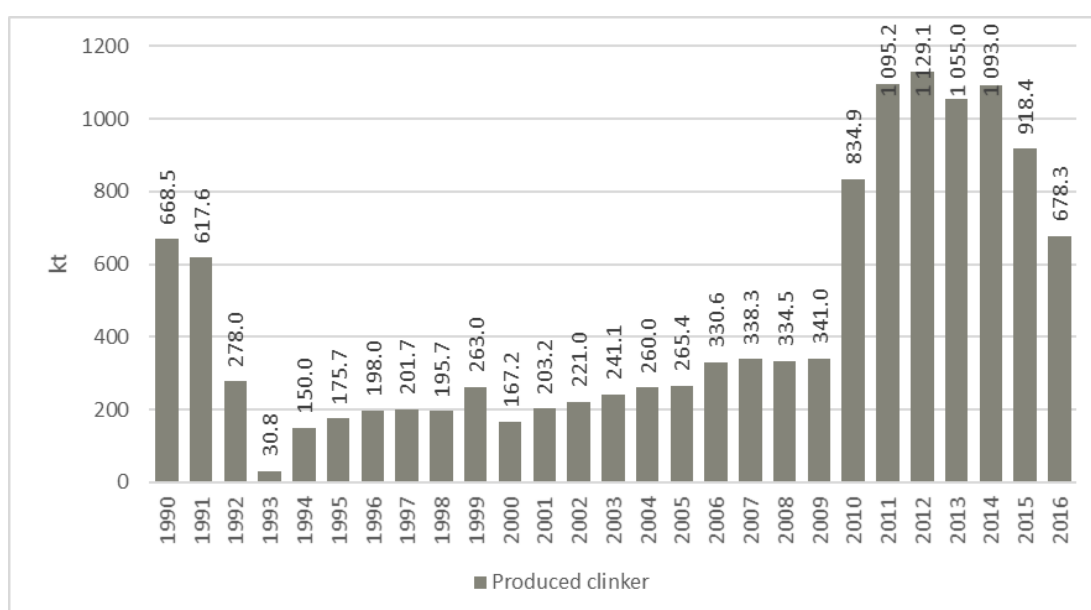


Figure 4.2 Cement production activity data in 1990–2016 (kt)

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:

$$U_{total} = \sqrt{U_1^2 + U_2^2 + \dots + U_n^2}$$

where:

U_{total} = the percentage uncertainty in the product of the quantities

¹²<https://www.eea.europa.eu/publications/emep-eea-guidebook-2016> (pages 11-12)

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

¹⁴http://www.vvd.gov.lv/izsniegtas-atlajas-un-licences/seg-atlajas/?company_name=cemex&org_id=&perm_date_from=&perm_date_to=&s=1

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, SO₂, 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 2018 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}, PM₁₀, 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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
PM _{2.5}	kt	0.150	0.013	0.006	9.49E-05	2.58E-05	5.88E-06	1.64E-05	1.41E-05	2.36E-05	2.60E-05	NO	-100
PM ₁₀		0.750	0.067	0.028	0.001	1.72E-04	3.92E-05	1.09E-04	9.40E-05	1.57E-04	1.73E-04	NO	-100
TSP		1.928	0.173	0.071	0.001	3.44E-04	7.84E-05	2.19E-04	1.88E-04	3.15E-04	3.46E-04	NO	-100
BC		0.001	6.18E-05	2.54E-05	4.37E-07	1.19E-07	2.70E-08	7.56E-08	6.48E-08	1.09E-07	1.19E-07	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 2015 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
Lime (total production) 1990-2004	0.0007	0.0035	0.009
Lime (total production) 2005-2015	0.00003	0.0002	0.0004

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

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;

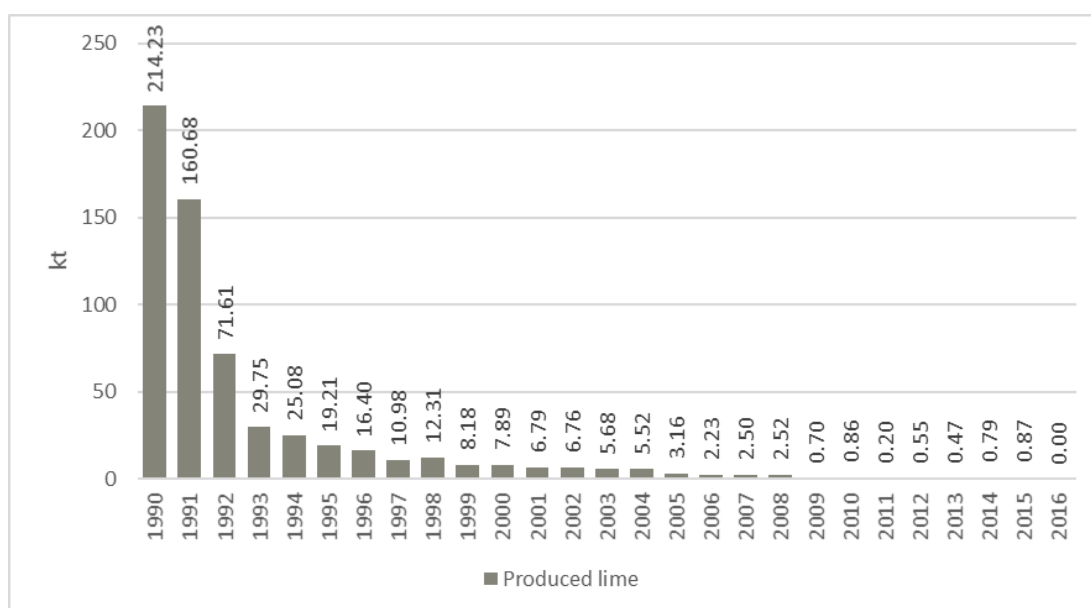


Figure 4.3 Lime production activity data in 1990–2016 (kt)

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 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 (MRG¹⁵) 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 2018 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, SO₂, PM_{2.5}, PM₁₀, TSP, BC and CO emissions from glass and glass fibre production are reported for 1990-2016.

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. Since 2005 PM_{2.5}, PM₁₀, TSP, BC, CO, NO_x and SO₂ emissions are available from the national database "2-Air". Heavy metal emissions were reported 1990-2006 when the total produced glass amount was available. Since 2007 only one glass production plant remained therefore activity data became confidential "C" hence heavy metal emissions are reported as "NE" due to lack of activity data for those emission calculations.

4.2.4.2 Trends in emissions

Table 4.10 Emissions from Glass production in 1990-2016

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NMVOC	0.0013	0.0016	0.0027	0.0114	0.0207	0.0224	0.0022	0.0040	0.0101	0.0078	0.0097	656
CO	NE	NE	NE	0.0119	0.0410	0.0388	0.0323	0.0381	0.0361	0.0339	0.0275	131
NOx	NE	NE	NE	0.1052	0.0994	0.0953	0.0849	0.1053	0.1025	0.1021	0.1015	-4
SO₂	NE	NE	NE	0.0384	0.0441	0.0403	0.0558	0.0568	0.0615	0.0632	0.0390	2
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	7
PM₁₀	0.0118	0.0028	0.0020	0.0256	0.0396	0.0374	0.0439	0.0189	0.0338	0.0360	0.0283	141
TSP	0.0131	0.0031	0.0022	0.0532	0.0825	0.0779	0.0915	0.0393	0.0704	0.0750	0.0590	351
BC	0.0000	0.0000	0.0000	0.0002	0.0003	0.0003	0.0003	0.0001	0.0003	0.0003	0.0002	3358
Pb	0.0741	0.0173	0.0125	0.0385	NE	NE	NE	NE	NE	NE	NE	-
Cd	0.0057	0.0013	0.0010	0.0029	NE	NE	NE	NE	NE	NE	NE	-
Hg	0.0001	0.0000	0.0000	0.0001	NE	NE	NE	NE	NE	NE	NE	-
As	0.0083	0.0019	0.0014	0.0043	NE	NE	NE	NE	NE	NE	NE	-
Cr	0.0100	0.0023	0.0017	0.0052	NE	NE	NE	NE	NE	NE	NE	-
Cu	0.0003	0.0001	0.0001	0.0002	NE	NE	NE	NE	NE	NE	NE	-

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

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
Ni	0.0213	0.0050	0.0036	0.0111	NE	NE	NE	NE	NE	NE	NE	–
Se	0.0349	0.0082	0.0059	0.0181	NE	NE	NE	NE	NE	NE	NE	–
Zn	0.0161	0.0038	0.0027	0.0084	NE	NE	NE	NE	NE	NE	NE	–

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.

All emissions from glass production have increased if compared to 1990 (with exception of NO_x) due to increase in the volume of production especially since 2007 till 2011.

Heavy metal emissions are comparably low and calculated till 2006 while total produced glass amount was known.

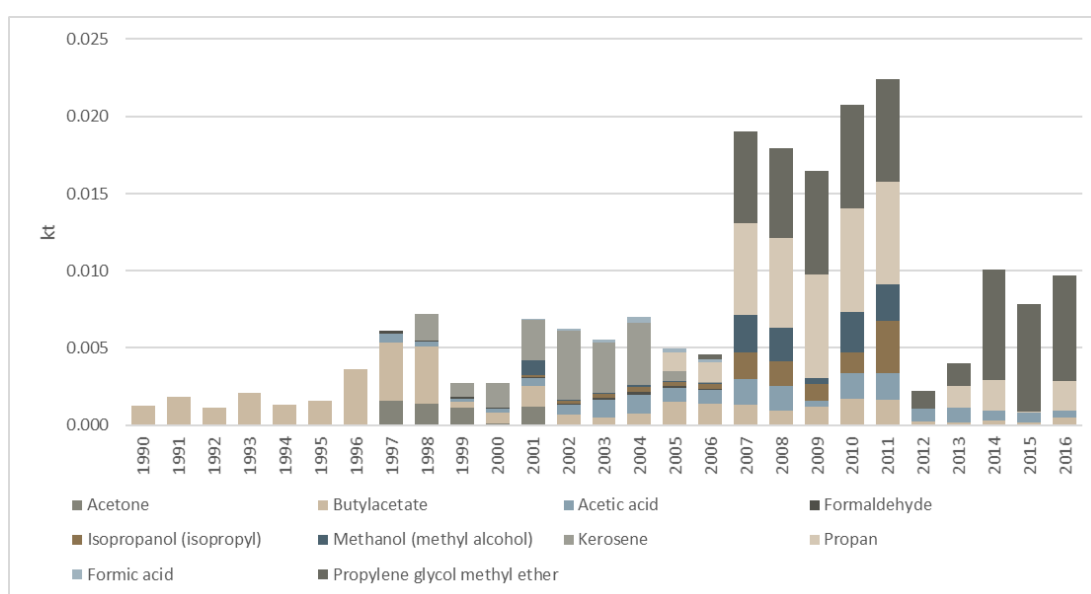


Figure 4.4 NMVOC emissions from glass fibre production in 1990–2016 (kt)

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 2016 only butylacetate, acetic acid, propan (propyl alcohol) and propylene glycol methyl ether was used in glass fibre production in small amounts (Figure 4.4). It resulted in NMVOC emission increase by 23.5% compared to 2015.

4.2.4.3 Methods

EFs of particulate matter (1990-2004) and heavy metals (1990-2007) were taken from EMEP/EEA 2016 for Tier 1 approach.

CO, NO_x, SO₂, 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, EF from EMEP/EEA 2016 are used (Table 4.11).

Table 4.11 Emission factors for glass production 1990-2016 (g/Mg)

	PM _{2.5}	PM ₁₀	TSP	BC	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	g/Mg												
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 SO₂ emissions are taken from the data source mentioned above.

NMVOC emissions from 1997 to 2016 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 2018 are made based on final completed NFR data table.

4.2.4.8 Recalculations

Activity data on used NMVOCs was slightly updated from 2006 till 2015 due to more precise information given by glass/glass fibre producing company on emitted amounts by NMVOC sub-type. Differences were negligible (below 1%). Also due to suggestion by TERT during 2017 NECD Comprehensive Review to develop a consistent time series using the data available and report emissions according to this consistent methodology since 2005 CO, NO_x, SO₂, particulate matter and BC emissions were taken from the national database “2-Air”.

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}, PM₁₀ 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 1990-2016

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1995-2016, %
PM_{2.5}	NA	0.07	0.03	0.06	0.07	0.08	0.08	0.08	0.08	0.08	0.07	-2.4
PM₁₀	NA	0.72	0.25	0.65	0.73	0.84	0.79	0.83	0.76	0.77	0.70	-2.4
TSP	NA	1.46	0.51	1.32	1.50	1.72	1.61	1.70	1.56	1.56	1.42	-2.4

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 2016 compared to 2015 emissions from 2A5a sector have decreased by 8.7% (Figure 4.5).

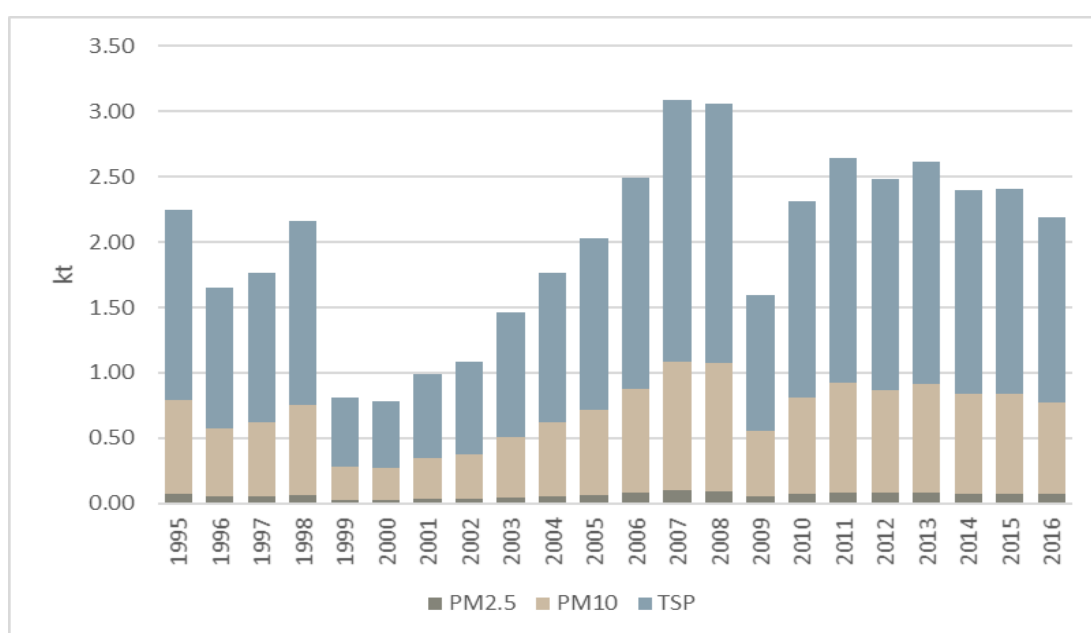


Figure 4.5 Particulate matter emissions from quarrying of minerals in 1995–2016 (kt)

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 1995-2016 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 1990–2016 (g/Mg mineral)

	PM _{2.5}	PM ₁₀	TSP
Quarrying of minerals other than coal	5	50	102

4.2.5.5 Activity data

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

4.2.5.6 Uncertainties

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

4.2.5.7 QA/QC and verification

Assessment of trends was performed. All data was checked on input mistakes by comparing calculation data base with input data in NFR tables in all time series. All figures and tables represented in IIR 2018 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}, PM₁₀ 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.

¹⁶ http://data.csb.gov.lv/pxweb/en/vide/vide__ikgad__vide/VI0080.px/?rxid=cdbc978c-22b0-416a-aacc-aa650d3e2ce0

Table 4.14 Emissions from building and road construction in 1990-2016

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 2005-2016, %
PM_{2.5}	NA	NA	NE	0.21	0.19	0.30	0.22	0.23	0.22	0.26	0.10	-54.4
PM₁₀	NA	NA	NE	2.13	1.95	2.96	2.20	2.27	2.16	2.58	0.97	-54.4
TSP	NA	NA	NE	7.03	6.43	9.79	7.27	7.51	7.16	8.58	3.21	-54.4

Particulate matter emissions from building construction are estimated in 2005-2016. Emission fluctuations can be associated with development of construction and building sectors in Latvia. Biggest share of these sector emissions come from road construction.

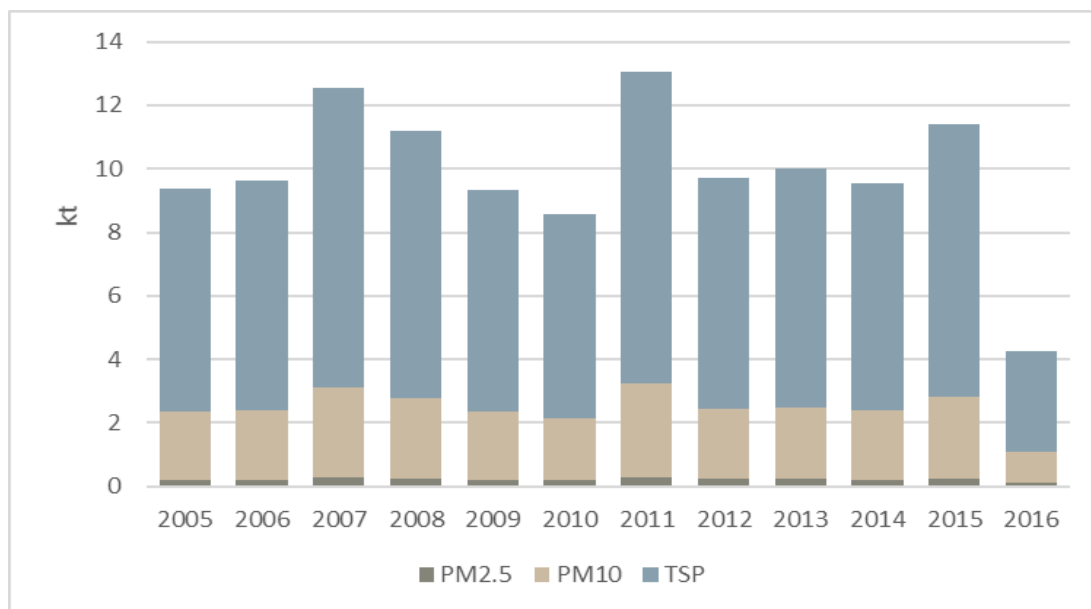


Figure 4.6 Particulate matter emissions from building and road construction in 2005–2016 (kt)

In 2016 compared to 2015 emissions from 2A5b sector decreased by 62.3% because no new roads were constructed in 2016 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 2005-2016 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 1990–2016 (kg/[m² year])

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

4.2.6.5 Activity data

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

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 2018 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}, PM₁₀ 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 1990-2016. 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 sectoral 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 1990-2016

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 2011-2016, %
PM_{2.5}	IE	IE	IE	IE	IE	0.03	0.03	0.03	0.03	0.01	0.00	-94
PM₁₀	IE	IE	IE	IE	IE	0.04	0.04	0.04	0.04	0.04	0.03	-11
TSP	IE	IE	IE	IE	IE	0.07	0.07	0.07	0.07	0.04	0.04	-36

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

¹⁷ http://data.csb.gov.lv/pxweb/en/rupnbuvn/rupnbuvn__ikgad__buvn/BU0040.px/?rxid=cddb978c-22b0-416a-aacc-aa650d3e2ce0

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. Since 2015 emissions start to decrease due to decrease of produced cement clinker amount (Figure 4.7).

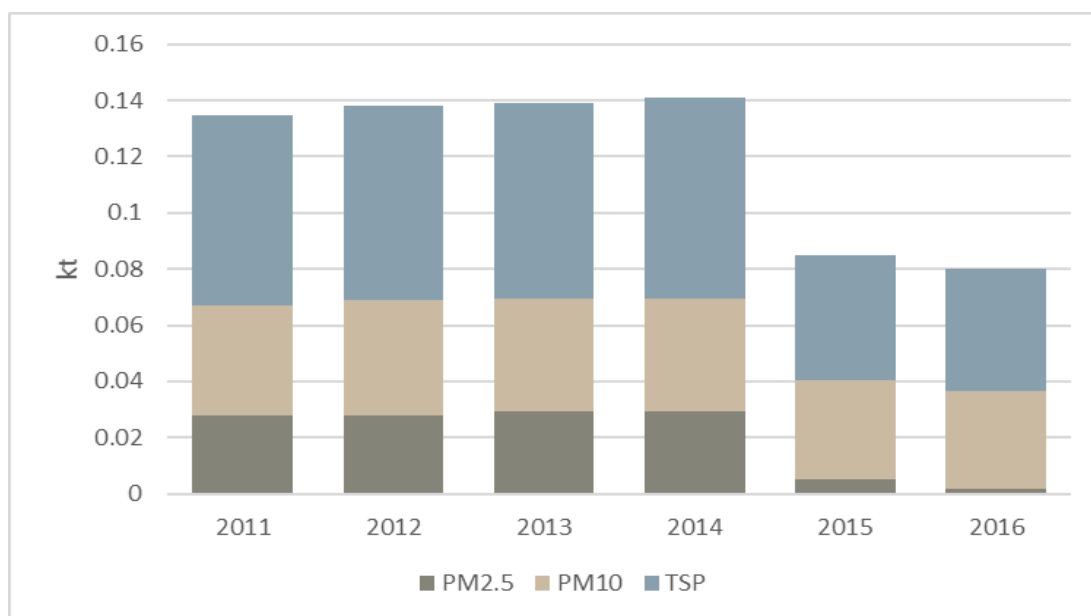


Figure 4.7 Particulate matter emissions from storage, handling and transport of mineral products 2011–2016 (kt)

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 sectoral 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 2018 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, SO₂, PM_{2.5}, PM₁₀, 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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change from 1990 to 2016, %
NO _x	kt	0.0028	0.0014	0.0026	0.0028	0.0027	0.0218	0.1087	0.0251	1.20E-05	0.0016	NO	-100%
NMVOC		0.0110	0.0056	0.0100	0.0111	0.0107	0.0077	0.0385	0.0089	4.26E-06	0.0006	NO	-100%
SO _x		0.0880	0.0447	0.0800	0.0887	0.0856	0.0101	0.0502	0.0116	5.55E-06	0.0007	NO	-100%
PM _{2.5}		0.3300	0.1676	0.3002	0.3326	0.3212	0.0035	0.0176	0.0041	1.94E-06	0.0003	NO	-100%
PM ₁₀		0.4400	0.2235	0.4002	0.4435	0.4282	0.0040	0.0201	0.0046	2.22E-06	0.0003	NO	-100%
TSP		0.5500	0.2793	0.5003	0.5543	0.5353	0.0050	0.0251	0.0058	2.78E-06	0.0004	NO	-100%
BC		0.0079	0.0040	0.0072	0.0080	0.0077	0.00001	0.0001	0.00001	6.99E-09	0.000001	NO	-100%
CO	t	0.0006	0.0003	0.0005	0.0006	0.0005	0.2850	1.4219	0.3284	1.57E-04	0.0212	NO	-100%
Pb		165.000	83.798	150.09	166.304	160.59	0.436	2.175	0.502	2.41E-04	0.0324	NO	-100%
Cd		0.0004	0.223	0.400	0.443	0.428	0.034	0.167	0.039	1.85E-05	0.0025	NO	-100%
As		16.500	8.380	15.009	16.630	16.059	0.003	0.013	0.003	1.39E-06	0.0002	NO	-100%
Cr		0.001	0.642	1.151	1.275	1.231	0.017	0.084	0.019	9.25E-06	0.0012	NO	-100%
Cu		0.0002	0.084	0.150	0.166	0.161	0.003	0.017	0.004	1.85E-06	0.0002	NO	-100%
Ni		5.500	2.793	5.003	5.543	5.353	0.117	0.586	0.135	6.48E-05	0.0087	NO	-100%
Zn		4.455	2.263	4.052	4.490	4.336	0.603	3.011	0.695	3.33E-04	0.0449	NO	-100%
PCDD/PCDF	g i- Teq	0.037	0.019	0.034	0.037	0.036	0.503	2.509	0.580	2.78E-04	0.0374	NO	-100%
PAHs	t	0.006	0.003	0.005	0.006	0.005	0.080	0.401	0.093	4.44E-05	0.0060	NO	-100%
PCBs	kg	NA	NA	NA	NA	NA	0.419	2.091	0.483	2.31E-04	0.0312	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 SO₂ 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.

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
SO₂		0.00016	0.00006
PM_{2.5}		0.0006	0.000021
PM₁₀		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
As		0.00003	0.000000015
Cr		0.0000023	0.0000001
Cu		0.0000003	0.00000002
Ni		0.00001	0.0000007

	Unit	EF for 1990-2010	EF for 2011-2015
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 ETS¹⁸ (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 1990–2016 (kt)

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

4.4.6 Uncertainties

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

¹⁸http://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

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 2018 are made based on final completed NFR data table.

4.4.8 Recalculations

Recalculations were done for NO_x (1990-2010), CO (2011-2015), PCDD/F (dioxins/ furans) and Total 4 PAHs (all time series) as well as PCBs (2011-2015) due to mistake in use of units.

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;
- 2 G 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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NMVOC	kt	16.413	14.108	13.622	13.817	11.052	12.142	11.717	12.162	12.606	13.117	12.517	-23.7
SO₂		0.073	0.003	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.000	0.001	-99.3
PM_{2.5}		0.077	0.100	0.213	0.475	0.394	0.589	0.632	0.505	0.520	0.588	0.625	707.7
PM₁₀		0.161	0.350	1.218	3.239	2.617	4.103	4.392	3.483	3.580	4.086	4.340	2594.9
TSP		0.514	1.408	5.463	14.912	12.007	18.947	20.273	16.059	16.506	18.862	20.032	3800.2
BC		0.001	0.002	0.009	0.024	0.019	0.030	0.033	0.026	0.026	0.030	0.032	4417.2
CO		0.131	0.123	0.119	0.099	0.101	0.092	0.103	0.091	0.096	0.094	0.103	-21.6

Solvent Use sector was the largest pollution source of NMVOC emissions in Latvia in 2016 and it covered 31.31% (12.52 kt) from the total Latvia's NMVOC emissions. In general, the NMVOC emissions from Solvent Use sector are constantly decreasing since the beginning of 1990s till 2016 mostly due to the economic situation in the country. A slight decrease in emissions occurred between 1991 and 1997, when industry was affected by the crisis. In subsequent years NMVOC emission increase was observed till 2006 which resulted in import growth of NMVOC containing products. At the end of 2008 the world was struck by the economic crisis which also affected the Solvent Use sector in Latvia till 2009. As shown there is a slight increase of NMVOC emissions of Solvent Use sector during the later period of 2010 till 2016. For instance,

emissions of NMVOC increased by 13.26 % from 11.05 kt NMVOC in 2010 to 12.52 kt NMVOC in 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 lead 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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Trend in 1990-2016, %
NMVOC	kt	0.0015	0.0045	0.0116	0.0319	0.0257	0.0406	0.0434	0.0344	0.0353	0.0472	0.0461	2944
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	1474
PM₁₀		0.0967	0.2901	1.1608	3.1921	2.5679	4.0593	4.3428	3.4391	3.5345	4.7238	4.6059	4662
TSP		0.4493	1.3477	5.4057	14.866	11.958	18.904	20.224	16.016	16.460	21.998	21.450	4674
BC		0.0007	0.0021	0.0087	0.0239	0.0192	0.0304	0.0325	0.0258	0.0265	0.0354	0.0345	4749
CO		0.0001	0.0002	0.0004	0.0011	0.0009	0.0014	0.0015	0.0012	0.0012	0.0016	0.0016	2055

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 2016 emissions from road paving and asphalt roofing decreased by 2.5% compared to 2015.

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).

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.¹⁹ Before the beginning of 1990s Latvia was part of former USSR and was going through the economic transition phase, so it was assumed that 80% was used for road paving and remaining was used for asphalt roofing till 2000. After 2000 it is assumed that 90% was used for road paving.

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

	Amount of bitumen mixtures used (kt)	% of asphalt used for road paving	% of asphalt used for roofing	Road paving with asphalt (kt)	Asphalt roofing (kt)
1990	39.00	80%	20%	31.20	7.80
1991	12.60	80%	20%	10.08	2.52
1992	2.10	80%	20%	1.68	0.42
1993	58.93	80%	20%	47.14	11.79
1994	125.63	80%	20%	100.50	25.13
1995	116.99	80%	20%	93.59	23.40
1996	214.81	80%	20%	171.85	42.96
1997	225.00	80%	20%	180.00	45.00
1998	225.53	80%	20%	180.43	45.11
1999	334.81	80%	20%	267.85	66.96
2000	423.64	90%	10%	381.28	42.36
2001	495.70	90%	10%	446.13	49.57
2002	558.42	90%	10%	502.58	55.84
2003	625.67	90%	10%	563.11	62.57
2004	3651.96	90%	10%	3286.76	365.20
2005	1165.02	90%	10%	1048.51	116.50
2006	1116.70	90%	10%	1005.03	111.67
2007	1492.52	90%	10%	1343.27	149.25
2008	1536.66	90%	10%	1382.99	153.67
2009	838.45	90%	10%	754.60	83.84

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

	Amount of bitumen mixtures used (kt)	% of asphalt used for road paving	% of asphalt used for roofing	Road paving with asphalt (kt)	Asphalt roofing (kt)
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

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 2018 are made based of final completed NFR data table.

4.5.2.8 *Recalculations*

All emissions from Road paving with asphalt and Asphalt roofing were recalculated for 2015 due to activity data precising from CSB.

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 was the largest pollution source of NMVOC emissions in Latvia in 2016 and it covered over 28.0 % (11.22 kt) from the total Latvia's NMVOC emissions. From Solvent use sector the main share of total NMVOC emissions contributed Coating applications – 41.12% or 4.61 kt and Domestic solvent use including fungicides – 23.07% or 2.59 kt (Figure 4.9).

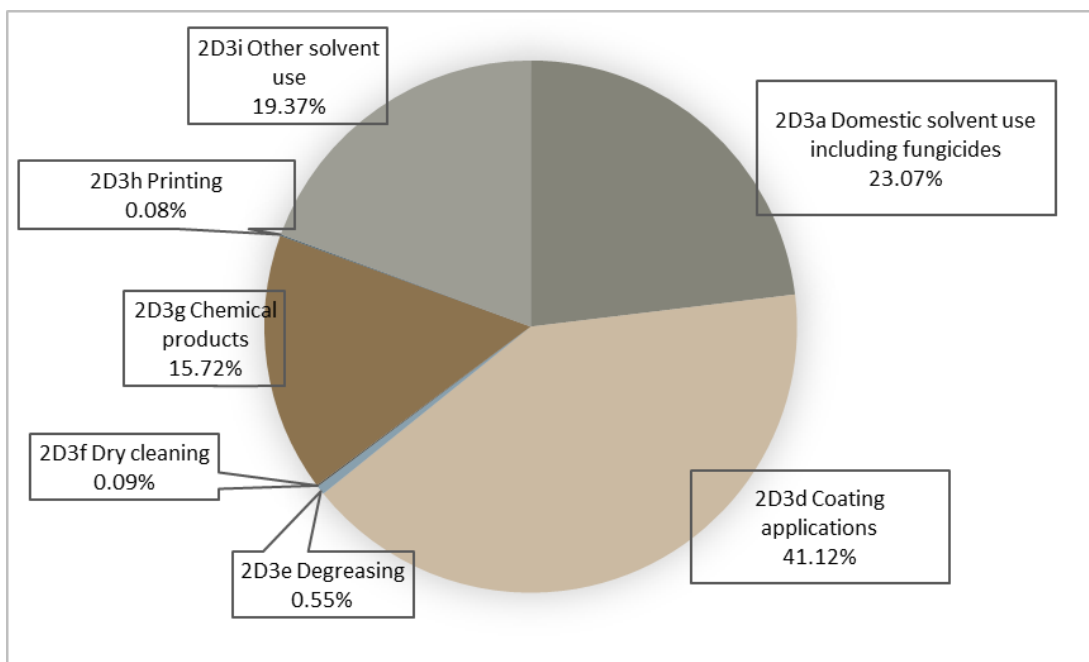


Figure 4.9 Distribution of NMVOC emissions in Solvent use sector in 2016 (kt)

Domestic solvent use including fungicides (NRF 2D3a) comprises NMVOC emissions from a number of product categories, for instance, cosmetics & toiletries, household products, construction and car care products. *Coating applications* (NRF 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* (NRF 2D3e) includes cleaning products from water-insoluble substances such as grease, fats, oils waxes and tars. *Dry Cleaning* (NRF 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* (NRF 2D3h) involved the use of inks, cleaning solvents and organic dampeners. *Other product use* (NRF 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 was the largest pollution source of NMVOC emissions in Latvia in 2016 and it covered over 28.0% (11.22 kt) from the total Latvia's NMVOC emissions. Since 1990, NMVOC emissions have decreased in the solvent sector by 13.82% (Table 4.23). Three major categories where a decrease in NMVOC emissions has occurred in recent years include Coating applications (2D3d), Dry cleaning (2D3f) and Chemical products (2D3g). The fluctuation of NMVOC emissions in the period 1990-2016 mostly occurred due to the welfare of the economic state of the country considering that Latvia is a small country. A slight decrease in emissions occurred between years 1990 and 2002. From 2002 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 2009 NMVOC emissions decreased by 30.11% in comparison with 2007 (Table 4.23). As shown there is an increase of NMVOC emissions during the later period of 2010 till 2016. For instance, emissions of NMVOC of Solvent sector increased by 44.49% in comparison with 2007 (Table 4.23).

Table 4.23 NMVOC emissions from Solvent use in 1990-2016, kt

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
Domestic solvent use including fungicides	2.479	2.324	2.209	2.091	1.277	1.636	1.647	1.743	1.952	2.160	2.588	4
Coating applications	6.746	6.322	6.010	5.688	5.580	4.530	4.815	5.737	5.182	4.627	4.612	-32
Degreasing	0.067	0.063	0.060	0.080	0.034	0.084	0.082	0.074	0.063	0.052	0.062	-8
Dry cleaning	0.035	0.033	0.031	0.051	0.007	0.009	0.012	0.019	0.014	0.009	0.010	-71
Chemical products	2.112	1.979	1.882	2.395	1.522	3.021	2.225	2.064	1.946	1.828	1.763	-17
Printing	0.192	0.180	0.171	0.111	0.006	0.008	0.009	0.011	0.010	0.009	0.009	-95
Other solvent use	1.387	1.300	1.236	1.170	1.218	1.488	1.547	1.119	2.099	3.080	2.172	57

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 2006-2016 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 2006-2016. 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; it is approximately 3000 enterprises in total every year. From these approximately 3000 enterprises data is used only from the enterprises that produces NMVOC emissions according to the EMEP/EEA 2016. The enterprises are reporting their produced NMVOC emissions dividing in a particular NMVOC.

To obtain a comparable data in time series for 1990-2001 where statistics were not kept, NMVOC emissions were extrapolated considering the number of inhabitants 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

	Number of inhabitants
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) are taken from the EMEP/EEA 2016.

Table 4.25 Approaches and emission factors for Solvent Use sector

NRF	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, shoe 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
	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

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 2006-2016 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.

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 $\pm 20\%$ 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

Recalculations were done for the all time series considering recommendations concluded during the 2017 NECD Comprehensive Review. For instance, now correct Tier 1 EF 400 gNMVOC/kg paint is used for Other industrial paint application (2D3d_8) for all time series (previously it was wrong - Tier 1 EF – 200 gNMVOC/kg). Similarly, for subcategory Application of glues and adhesives (2D3i_3) now Tier 2 EF 562 gNMVOC/kg solvent is used (previously it was Tier 1 EF 2 kgNMVOC/Mg product used). Related to the Other Solvent Use (2D3i) Latvia has reviewed submitted data for 2015 in CR once again and completed missing data gaps.

4.5.3.9 Planned improvements

It is planned to again review submitted data for year 2016 in CR to get more precise data considering that some enterprises have submitted their notifications with delay. Research about export impact to Solvent Use emissions is also planned.

4.5.4 Other product use (NFR 2G)

4.5.4.1 Overview

Other Product Use sub-sector includes emissions from Use of fireworks and Tobacco combustion. This sub-sector contains SO₂, CO, NMVOC, NH₃, NO_x, TSP, PM₁₀, PM_{2.5}, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, PCDD/PCDF, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, indeno (1,2,3-cd) pyrene emissions.

4.5.4.2 Trends in emissions

The emissions from Other product use subsector have constantly decreased since the beginning of 90ties although emissions from Use of fireworks have increased. Emissions of heavy metals mostly occur from Use

of fireworks and their increase in the latest years is linked with the economic situation of the country (Table 4.26).

Table 4.26 Emissions from Other product use sector in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	0.0043	0.0040	0.0039	0.0032	0.0033	0.0030	0.0033	0.0029	0.0031	0.0030	0.0033	-22.54
NM VOC		0.0115	0.0108	0.0103	0.0083	0.0087	0.0078	0.0087	0.0078	0.0082	0.0081	0.0088	-23.58
SO₂		0.0000	0.0000	0.0006	0.0010	0.0004	0.0005	0.0007	0.0006	0.0006	0.0004	0.0005	2175.99
NH₃		0.0099	0.0093	0.0088	0.0072	0.0075	0.0067	0.0075	0.0067	0.0070	0.0069	0.0076	-23.58
PM_{2.5}		0.0643	0.0603	0.0573	0.0466	0.0487	0.0437	0.0487	0.0434	0.0456	0.0450	0.0492	-23.57
PM₁₀		0.0643	0.0603	0.0573	0.0466	0.0487	0.0437	0.0488	0.0434	0.0456	0.0450	0.0492	-23.56
TSP		0.0643	0.0603	0.0573	0.0466	0.0487	0.0437	0.0488	0.0434	0.0456	0.0450	0.0492	-23.55
CO		0.1313	0.1231	0.1185	0.0974	0.1003	0.0902	0.1010	0.0900	0.0944	0.0927	0.1016	-22.64
Pb	t	0.0062	0.0058	0.1646	0.2595	0.1102	0.1270	0.1721	0.1537	0.1583	0.1065	0.1401	2175.99
Cd		0.0129	0.0121	0.0118	0.0098	0.0099	0.0090	0.0101	0.0090	0.0094	0.0092	0.0101	-21.60
Hg		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2175.99
As		0.0000	0.0000	0.0003	0.0004	0.0002	0.0002	0.0003	0.0003	0.0003	0.0002	0.0002	2175.99
Cr		0.0001	0.0001	0.0033	0.0052	0.0022	0.0025	0.0034	0.0031	0.0032	0.0021	0.0028	2175.99
Cu		0.0164	0.0153	0.1047	0.1563	0.0722	0.0806	0.1072	0.0957	0.0988	0.0693	0.0892	445.41
Ni		0.0067	0.0062	0.0120	0.0146	0.0091	0.0092	0.0115	0.0102	0.0106	0.0086	0.0103	54.12
Zn		0.0085	0.0079	0.0603	0.0907	0.0414	0.0465	0.0619	0.0553	0.0571	0.0398	0.0514	506.35
PCDD/F	g I-Teq	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	-23.58
PAH	t	0.0006	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	-23.55

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 1995-2016 and from Tobacco combustion for the time series 2003-2016 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.

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 1995-2016 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 1995-2016 and 2003-2016, 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 $\pm 20\%$ 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 SO₂ emissions are reported 1990-1996 and under NFR 2H2 NMVOC emissions are reported 1990-2016.

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 is 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 4.27 Emissions from Pulp and paper industry (NFR 2H1) and Food and beverages industry (NFR 2H2) production sectors in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NMVOC	kt	3.38	1.89	2.00	2.19	1.37	1.32	1.33	1.35	1.30	1.33	1.28	-63
SO ₂		0.07	0.003	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 4.27). 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 2016 the NMVOC emissions constitute 1.28 kt which is 3.4% lower than in 2015.

SO₂ 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 4.28) 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 4.28 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 (SO₂)	
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 4.29). 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 2007-2016. The same situation with spirits since 2012.

Table 4.29 Activity data for 2.H 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

	Pulp and Paper	Wine	Beer	Spirits	Meat, fish, poultry	Sugar	Cakes, biscuits, breakfast cereals	Bread	Animal feed
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

4.5.5.6 Uncertainties

Uncertainty of activity data was assumed as $\pm 2\%$ for 1990-2006 because statistical data from the CSB was used. For 2007-2016 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 2018 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 (3I), which include emissions from last year's grass burning (Table 5.1).

Table 5.1 Source categories and methods for agriculture sector

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

NO_x (nitrous oxides), NMVOC (volatile organic compounds), NH₃ (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 2018 report (Table 5.2).

Table 5.2 Reported emissions in agriculture sector in 2016

NFR code	Emissions
3B1a	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP

20 Default value from EMEP/EEA 2016 or 2006 IPCC Guidelines

21 Country specific value

22 National statistics

NFR code	Emissions
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	NO _x , 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 NH₃ emissions (85.84%) in 2016. 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 12.59%, but for NMVOC emission – 18.73%.

NH₃ 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 2016, emissions from crop production and agricultural soils constituted 50.66% (7.07 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 2016 reached 49.27% (6.87 kt). 95.24% (4.19 kt) of NO_x emissions were reported from crop production and agricultural soils and 3.80% of emissions were linked to manure management.

In 2016, the largest part of NMVOC emissions were related to manure management – 84.37% (6.32 kt). Crop production and agricultural soils accounted for 14.17% (1.06 kt) of NMVOC. 51.95% (0.15 kt) of PM_{2.5}, 76.30% (1.21 kt) of PM₁₀ and 61.48% (1.92 kt) of TSP emissions originated from crop production and agricultural soils, while 32.80% (0.10 kt) of PM_{2.5}, 20.22% (0.32 kt) of PM₁₀ and 35.80% (1.12 kt) of TSP were related to manure management (Figure 5.1).

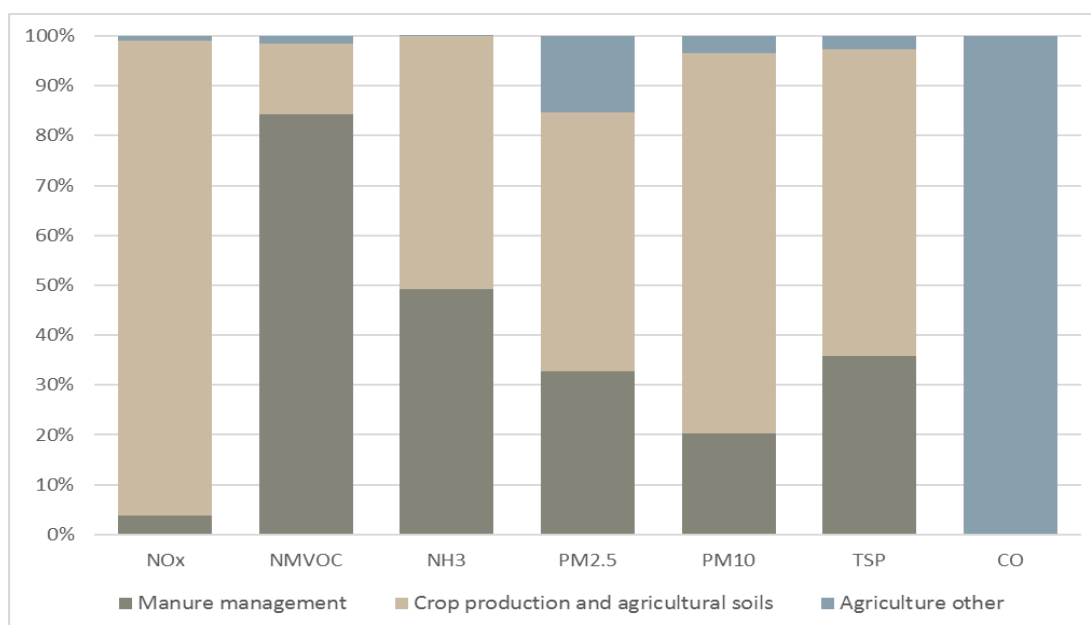


Figure 5.1 Distribution of emissions in agriculture sector by subsectors in 2016 (%)

5.1.3 Trends in emissions

The NH₃ emissions from agriculture have decreased by 59.84% over the period of 1990 – 2016 (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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Changes in 1990-2016, %
NO _x	kt	8.78	2.05	2.10	2.81	3.56	3.55	3.82	4.06	4.31	4.33	4.40	-49.86
NMVOC		16.07	7.84	6.20	6.62	6.81	6.78	7.06	7.24	7.68	7.47	7.49	-53.39
NH ₃		34.73	13.92	11.63	11.91	12.84	12.74	13.12	13.53	13.95	14.00	13.95	-59.84
PM _{2.5}		0.46	0.24	0.22	0.23	0.25	0.24	0.25	0.25	0.34	0.29	0.30	-35.77
PM ₁₀		2.25	1.20	1.10	1.20	1.36	1.30	1.38	1.40	1.56	1.53	1.59	-29.64
TSP		6.03	2.93	2.54	2.80	3.00	2.89	2.97	3.03	3.15	3.06	3.13	-48.07
BC		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	g i-Teq	0.21	0.20	0.84	0.76	0.93	0.60	0.70	0.70	2.54	1.21	1.21	482.21
PCDD/ PCDF		0.00	0.00	0.02	0.02	0.02	0.01	0.01	0.01	0.05	0.03	0.03	482.20
PAHs		0.01	0.01	0.06	0.05	0.06	0.04	0.05	0.05	0.18	0.08	0.08	482.20

The amount of PM, NMVOC and NO_x emissions depend on the number of produced animals and crops. In the time period 1990-2016, PM emissions have decreased by 35 - 48 %. Similarly, emissions of NO_x and NMVOC have decreased by 49.86% and 53.39%, 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 NH₃ emissions from manure management are included. In 2016, the majority of NH₃ emissions from manure management in different livestock categories were related to production of the dairy cattle (54.20%), swine (14.32%), non-dairy cattle (10.31%) and laying hens (6.96%) (Figure 5.2).

TSP, PM₁₀ 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.

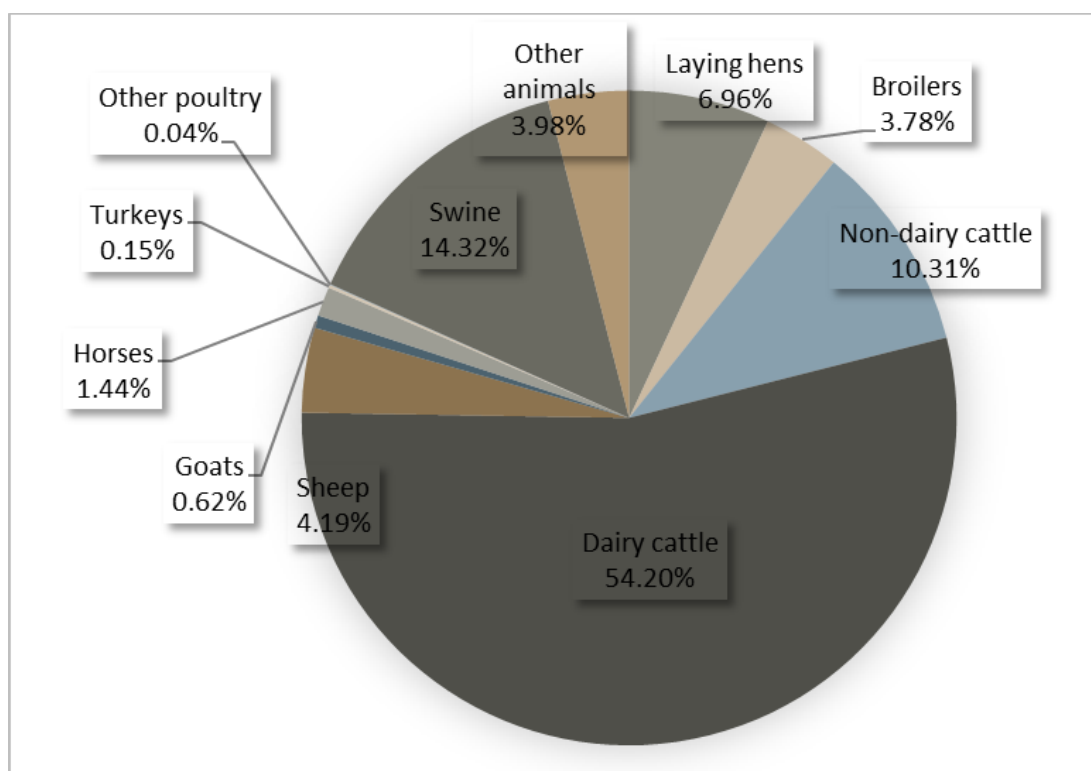


Figure 5.2 NH₃ emissions from manure management in 2016

5.2.2 Trends in emissions

Latvian livestock industry has been influenced by historical events and the changing economic situation²³. 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 NH₃ emissions from manure management have decreased by 67.1%, NO_x -

²³ Aina Dobeļe, Irina Pilvere, Edgars Ozols, Lasma Dobeļe 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

74.0%, NMVOC – 56.9%, PM_{2.5} – 68.4%, PM₁₀ – 66.1%, TSP – 67.8% over the period of 1990 – 2016 (Table 5.4).

Table 5.4 Trends in emissions from Manure management in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Changes in 1990-2016, %
NO _x	kt	0.64	0.30	0.22	0.21	0.19	0.18	0.19	0.18	0.19	0.17	0.17	-74.0
NM _{VOC}		14.65	7.02	5.36	5.69	5.77	5.79	6.03	6.19	6.46	6.35	6.32	-56.9
NH ₃		20.91	9.78	7.40	7.26	6.97	6.87	6.95	7.02	7.16	7.01	6.87	-67.1
PM _{2.5}		0.31	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-68.4
PM ₁₀		0.94	0.42	0.30	0.32	0.32	0.31	0.32	0.33	0.32	0.32	0.32	-66.1
TSP		3.48	1.47	1.11	1.18	1.21	1.15	1.17	1.19	1.18	1.15	1.12	-67.8

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).

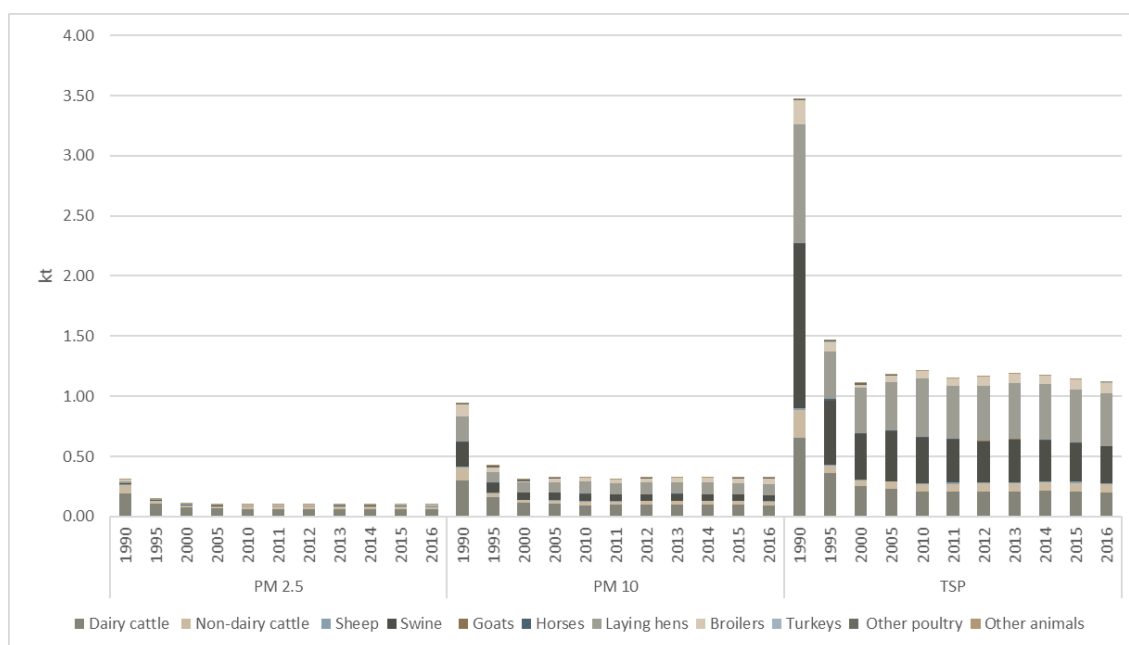


Figure 5.3 PM emissions from housing 1990-2016

In 2016, 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 – 60.79% (0.06 kt), non-dairy cattle – 20.51% (0.02 kt) and laying hens 7.13% (0.01 kt)). The biggest contributors for PM₁₀ emissions were laying hens – 28.84% (0.09 kt), dairy cattle – 28.34% (0.09 kt), swine – 15.74% (0.05 kt) and broilers– 13.55% (0.04 kt). Laying hens – 39.16% (0.44 kt), swine – 27.25% (0.31 kt) and dairy cattle – 17.75% (0.20 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 2016, agricultural holdings were breeding 412.3 thousand cattle, which were by 6.8 thousand less than the year before, according to the information from Central Statistical Bureau (CSB)²⁴ of Latvia. The number of dairy cows fell by 8.4 thousand or 5.17%. African swine fever is one of reasons of decreased fattening pig's and young breeding sow's numbers by 13.3 thousand or 8.82% over the year, however numbers of pigs in age below 4 months increased by 13.7 thousand overall number of pigs increased by 2,2, thousand or 0.7%.

²⁴ The collection of statistics "Agriculture in Latvia" (2017). Available at <http://www.csb.gov.lv/dati/e-publikacijas/latvijas-lauksaimnieciba-2017-45757.html>

In 2016, the number of sheep and poultry continued to grow – by 4.20% and 4.00%, respectively, while the number of fur animals reduced by 28.9 thousand or 10.62%.

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.

5.2.3 Methods

Emissions calculations are based on EMEP/EEA 2016. Estimation Tier 2 (mass flow approach) is used for NH₃ and NO_x emissions, which is described in the EMEP/EEA methodology. Calculations were done using MS Office Excel. Due to the N-flow calculation process, NH₃ 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 3.B.1.a, b; 3.B.2; 3.B.4.d, e, f, h and 3.B.gi,ii,iii,iv). Emissions from manure spreading are not calculated for fur animals (3.B.4.h Other animals) due to emission factor not available. Calculated NO emissions were converted to NO₂ 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 NH₃ 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 NH₃-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

Animal type	Manure type	EF housing	EF storage	EF spreading	EF grazing
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
Fur animals	solid	0.27	0.09	NA	-

Emission factors used to estimate NO_x emissions from manure management are the default values from EMEP/EEA 2016 (Table 5.6). Emission factors for pigs of age till 4 months are estimated as weighted mean based on share of piglets of 8 kg²⁵ 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
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

The NH₃ emission calculations also include evaluation of emission reduction measures influence. The estimation of emission reduction is based on ammonia emission abatement measures for dairy cattle and swine slurry storage. According to Regulations No 829²⁶ of the Cabinet of Ministers of Latvia, all animal housings must have slurry storages with at least natural coverage. Therefore, NH₃ 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%²⁷ 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 operators²⁸. 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

²⁵ Lauksaimniecības datu centrs Publiskā datu bāze http://pub.ldc.gov.lv/pub_stat.php?lang=lv

²⁶ 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>

²⁷ United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions, 24 March 2015 <https://undocs.org/ECE/EB.AIR/129>

²⁸ Law On Pollution <https://likumi.lv/ta/id/6075-par-piesarnojumu>

of solid manure to slurry takes place is close to 100²⁹. The influence of techniques on emissions is estimated by statistical data of animal distribution in different scale farms³⁰. Estimated reduction potential for dairy cattle and swine is summarized in Table 5.8.

Table 5.8 NH₃ reduction from storage of slurry (%)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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
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

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, therefore, in this category reduction of emissions is set to be 30% for cattle and swine. Solid manure has to be incorporated within 24 h, and reduction rate by this activity is set to be 30 %²³. 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 legislation³¹.

The calculation of PM and TSP emissions is based on EMEP/EEA 2016 methodology. Emission factors by type are shown in the Table 5.9.

Table 5.9 PM and TSP emission factors (kg AAP⁻¹a⁻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
Turkeys	0.110	0.110	0.020
Ducks	0.140	0.140	0.020
Geese	0.240	0.240	0.030
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 Database³² of CSB of Latvia and statistical yearbooks³³. 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 Technologies³⁴.

Statistical information about the livestock number in Latvia is included in Table 5.10. The number of fur-bearing animals is not available for 1990-1992 and 1995 therefore interpolation and extrapolation are used

²⁹ Laurs A., Priekulis J., Markovics Z., Aboltins A. (2016) Research in farms animal breeding technological parameters. Engineering for rural development, Jelgava, 25. 27.05. 2016, pp 1054 -1058

³⁰ Agriculture, Forestry and Fishery. <http://data.csb.gov.lv/pxweb/en/lauks/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8>

³¹ 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>

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

³³ The collection of statistics "Agriculture in Latvia" (2017). Available at <http://www.csb.gov.lv/dati/e-publikacijas/latvijas-lauksaimnieciba-2017-45757.html>

³⁴ 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

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.

Table 5.10 Number of livestock (thousand heads), 1990–2016

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Dairy cows	535.1	291.9	204.5	185.2	164.1	164.1	164.6	165.0	165.9	162.4	154.0
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
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
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
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
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
Fattening pigs and young breeding sows	759.2	287.7	191.7	175.7	156.3	144.8	141.5	142.6	151.7	155.4	141.7
Sows, boars	146.5	75.8	35.3	37.7	36.0	34.3	28.6	29.8	27.7	25.0	27.1
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
Sheep	164.6	72.2	28.6	41.6	76.8	79.7	83.6	84.8	92.5	102.3	106.6
Goats	5.4	8.9	10.4	14.9	13.5	13.4	13.3	12.6	12.3	12.7	13.2
Horses	30.9	27.2	19.9	13.9	12.0	11.5	10.9	10.7	10.1	9.6	9.3
Layers	5160.6	2071.2	1980.5	2121.8	2549.5	2315.9	2395.0	2430.5	2443.8	2335.3	2310.3
Broilers	5089.3	2055.8	570.2	1365.0	1638.3	1417.7	1898.3	1906.4	1796.6	2035.9	2170.8
Turkeys	10.1	10.1	12.5	15.1	1.0	1.1	1.4	1.7	2.0	3.1	18.1
Ducks	48.6	48.6	51.0	38.4	2.9	2.9	3.1	3.8	5.5	6.6	6.2
Geese	12.6	12.6	14.4	16.2	1.6	1.8	1.9	2.1	2.7	3.3	3.3
Fur animals	260.2	213.5	97.2	141.7	167.0	183.7	231.6	231.6	313.9	272.2	243.3

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 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 5.11 and Table 5.12. Detailed description of country specific Nex is available at Latvia Inventory Report 2018 and in previous submissions³⁵.

Table 5.11 Average N excretions (N, kg year⁻¹) per head of animal

	Livestock category		N, kg year ⁻¹	Source
Non-dairy cattle sub-groups	Young cattle under 1 year	dairy cattle calves	15.7	National studies
		beef cattle calves	18.5	National studies
	Young cattle aged from 1 to 2 years	dairy cattle	24.7	National studies
		beef cattle	26.4	National studies
	Cattle after 2 years old	bulls	93.9	National studies
		heifers	49.4	National studies
		other cows	65.9	National studies
	Fattening pigs		14	National studies
	Sows, boars		27.6	National studies
	Pigs till 4 months		5.1	National studies
Sheep			15.3	National studies
Goats			15.8	National studies
Horses			44.0	National studies
Layers			0.55	National studies

³⁵ Latvia Inventory Report submissions <https://www.meteo.lv/lapas/sagatavotie-un-iesniegtie-zinojumi?&id=1153&nid=393>

	Livestock category	N, kg year ⁻¹	Source
	Broilers	0.35	National studies
	Turkeys	1.64	EMEP/EEA 2016
	Ducks	0.58	National studies
	Geese	1.12	National studies
	Fur animals	4.60	EMEP/EEA 2016

Average N excretion data during the year for dairy cattle vary in all emission reporting period depending on productivity indicators (Table 5.12).

Table 5.12 Average N excretions for cattle (N, kg year⁻¹) per head of cattle

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

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 5.13 represents the share of each manure management system in 2016.

Table 5.13 Share of each manure management system per animal type (%), 2016

	Pasture	Solid storage	Slurry	Anaerobic digester
Dairy cows	6.4	45.9	34.6	13.1
Beef cattle under 1 year old	78.7	21.3	0.0	0.0
Dairy cattle under 1 year old	7.1	82.7	0.0	10.2
Beef cattle 1- 2 years old	78.7	21.3	0.0	0.0
Dairy cattle 1 - 2 years old	7.1	82.7	0.0	10.2
Cattle after 2 years old	78.7	21.3	0.0	0.0
Fattening pigs	0.0	7.8	60.4	31.8
Sows, boars	0.0	8.6	59.8	31.6
Pigs till 4 months	0.0	8.8	59.7	31.5
Sheep	26.0	74.0	0.0	0.0
Goats	11.3	88.7	0.0	0.0
Horses	17.6	82.4	0.0	0.0
Layers	3.2	55.1	0.0	41.7
Broilers	0.0	100.0	0.0	0.0
Turkeys	19.5	80.5	0.0	0.0
Ducks	20.8	79.2	0.0	0.0
Geese	19.1	80.9	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 5.14).

Table 5.14 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

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 NH₃ 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 result from:

- emissions calculations for swine are done from 3 groups, the new group includes pigs below 4 months of age, this is done for calculation improvement;
- Nex of fur animals (Other animals) is changed from IPCC 2006 default to provided value by EMEP/EEA 2016 due to lack of country specific value;
- abatement strategies are evaluated for dairy cattle and swine according to statistical data of farms structure and national legislations, to provide more transparency;
- PM emissions are calculated only from housing, grazing periods are taken into account, as this deficiency was detected during review;
- numbers of poultry are corrected for period of 1990 – 1998.

5.2.9 Planned improvements

It is planned to continue to quantify abatement strategies for ammonia emissions to provide implementation of them in the inventory for next submission.

Estimates should be provided for all poultry. For this moment estimations are done only for in EMEP/EEA 2016 mentioned poultry groups. Starting from 1999 when more detailed statistical data is available and there is not specified poultry group, emissions from them are not calculated as more research activities are needed for this moment of time. It is planned to implement calculations in next submission. For this moment to state that these emissions are below of threshold of significant see Table 5.15, were NH₃ emissions are calculated based on broilers EF.

Table 5.15 Assessment of NH₃ emission of not specified poultry

	Number of not specified poultry (thousand heads)	Total NH ₃ emissions (kt)	Threshold of significance (2% from total NH ₃ emissions) (kt)	NH ₃ emission from not specified poultry (kt)	Difference	
1999	436.20	13.89	0.28	0.05	0.23	0.38%
2000	476.00	14.06	0.28	0.06	0.22	0.41%
2001	715.70	14.73	0.29	0.09	0.21	0.58%
2002	583.10	14.44	0.29	0.07	0.22	0.48%

	Number of not specified poultry (thousand heads)	Total NH ₃ emissions (kt)	Threshold of significance (2% from total NH ₃ emissions) (kt)	NH ₃ emission from not specified poultry (kt)	Difference	
2003	967.90	14.70	0.29	0.12	0.18	0.79%
2004	773.00	14.36	0.29	0.09	0.19	0.64%
2005	535.80	14.90	0.30	0.06	0.23	0.43%
2006	563.10	15.17	0.30	0.07	0.24	0.44%
2007	705.90	15.55	0.31	0.08	0.23	0.54%
2008	868.10	15.15	0.30	0.10	0.20	0.69%
2009	823.00	15.58	0.31	0.10	0.21	0.63%
2010	755.40	15.45	0.31	0.09	0.22	0.59%
2011	678.50	15.40	0.31	0.08	0.23	0.53%
2012	611.20	15.97	0.32	0.07	0.25	0.46%
2013	641.30	16.21	0.32	0.08	0.25	0.47%
2014	163.25	16.64	0.33	0.02	0.31	0.12%
2015	147.80	16.39	0.33	0.02	0.31	0.11%
2016	203.00	16.25	0.32	0.02	0.30	0.15%

Conditions for estimations represented in Table 5.15 are based on broilers.

5.3 Agricultural soils (NFR 3D)

5.3.1 Overview

Under the category NFR 3D Latvia reports: ammonia (NH₃) and nitrous oxides (NO_x) emissions from inorganic N-fertilizers application, NH₃ and NO_x emissions from animal manure, sewage sludge and other organic fertilizers applied to soils, NH₃ 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}, PM₁₀, 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 5.16).

Table 5.16 Emissions from fertilizers, urine and dung deposited by grazing animals and crop production, 1990-2016 (kt)

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Changes in 1990-2016, %
NO _x	kt	8.13	1.75	1.84	2.58	3.34	3.34	3.61	3.85	4.04	4.12	4.19	-48.4
NMVOC		1.40	0.80	0.76	0.86	0.95	0.93	0.97	0.99	0.99	1.01	1.06	-24.2
NH ₃		13.82	4.14	4.22	4.64	5.86	5.87	6.17	6.50	6.77	6.98	7.07	-48.9
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	5.6
PM ₁₀		1.30	0.77	0.76	0.85	0.99	0.97	1.02	1.04	1.12	1.15	1.21	-6.9
TSP		2.54	1.45	1.37	1.56	1.72	1.70	1.75	1.79	1.79	1.82	1.92	-24.2

NH₃ emissions

In 2016, agricultural soils contributed 7.07 kt of NH₃. The main source of NH₃ emissions was application of inorganic N-fertilizers, contributing 55.4% or 3.92 kt of NH₃ emissions from agricultural soils. NH₃ emissions from application of inorganic N-fertilizers are reported in category 3.D.a.1. NH₃ emissions from pastures (3.D.a.3) had a share of 4.9% (0.35 kt). Application of manure (3.D.a.2.a), sludge (3.D.a.2.b) and other organic fertilizers (3.D.a.2.c) emitted 2.8 kt of NH₃ or 39.7% of total NH₃ emissions from agricultural soils. In 2016, the total emission of NH₃ from agricultural soils increased by 1.2%, compared to 2015. Emissions of NH₃ rose by 5% from pastures and by 3.3% from inorganic N-fertilizers application, however NH₃ emissions decreased from manure application by 0.9%, from sludge application by 9.7% and from other organic fertilizers application by 22.9%.

NO_x emissions

NO_x emissions from agricultural soils reached 4.19 kt in 2016. The main sources of NO_x emissions similarly to NH₃ emissions were application of inorganic N-fertilizers, manure, sludge and other organic fertilizers as well as pastures. 74.7% of NO_x emission formed from the use of inorganic N-fertilizers, 17.9% from manure application, 6.1% from pastures and 1.3% from sludge and other organic fertilizers application. Comparing to previous submission year, NO_x emissions increased by 1.9%. The most important source of emissions increase was pastures (+5.1%) and application of inorganic N-fertilizers (+3.3%).

NM VOC and PM emissions

In 2016, agricultural soils contributed 1.06 kt of NM VOC (by 5.6% more than in 2015) emission in Latvia. The only source for NM VOC was emissions from cultivated crops (3.D.e). Agricultural soils also contributed 1.92 kt, 1.21 kt and 0.15 kt of the total agricultural TSP, PM₁₀ and PM_{2.5} emissions, respectively. These emissions were reported in category 3.D.c (Farm-level agricultural operations including storage, handling and transport of agricultural products). Also these emissions rose by 5.2-5.8% 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. NH₃ emissions rapidly increased in relation to inorganic N-fertilizer application. In 2016, sown area in Latvia increased by 5.6% comparing to previous year and reached 1233.9 thousand hectares. 716.0 thousand hectares of land were covered with cereals, which is 43.6 thousand hectares or 6.5 % more than in 2015. Also the sown areas of pulses continued to grow. In 2016, the total area of pulses increased by 32.1%. The increase was encouraged by the introduction of a support payment for climate and environment-friendly farming practices or agricultural greening in 2015. In 2016, 134.2 thousand tons of mineral fertilizers (expressed as 100 % of nutrients) were used on the sown area of agricultural crops – 4.2% more than in 2015. Mineral fertilizers were applied on 58% of the total sown area. In 2016, the use of nitrogen per one hectare of sown area reduced slightly – from 65 kg in 2015 to 63 kg in 2016. In 2016, the share of straight nitrogen fertilizers in the total volume of mineral fertilizers applied (in physical weight) grew significantly, comprising 60.0% (49.8% in 2015). All statistical information is adopted from the collection of statistics “Agriculture in Latvia” (2017)³⁶ 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 3.B.

5.3.3 Methods

Emissions calculation of NH₃ 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. NM VOC and PM, including TSP emissions were calculated using the data of the total sown area and respective emission factors. NH₃ emissions from animal manure applied to soils and urine and dung deposited by grazing animals were calculated under the category 3.B.

NH₃, NO_x, NM VOC, PM and TSP emissions are calculated by methodology explained in EMEP/EEA 2016. NH₃ and NO_x emissions from crop production and agricultural soils are calculated using the following equation:

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

where:

E_{pollutant} = amount of pollutant emitted (kg a⁻¹),

³⁶ The collection of statistics “Agriculture in Latvia” (2017). Available at <http://www.csb.gov.lv/dati/e-publikacijas/latvijas-lauksaimnieciba-2017-45757.html>

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 NH₃ 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).

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 1990-2016:

- 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 NO₂.

NH₃ 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. NH₃ emissions from inorganic N-fertilizers application for the period of 1990-2016 was calculated by using EF 0.05 (kg NH₃ kg⁻¹ fertilizer N applied). NH₃ 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 NH₃ 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 NO₂ per kg applied fertilizer-N) is used. For 1990-2016, 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 5.17.

Table 5.17 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

NH₃ emissions from pasture grazed by livestock and animal manure applied to soils are derived by Tier 2 methodology that is implemented for NH₃ 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 1990-2016. The data about the use of N with inorganic fertilizers are included in Figure 5.4.

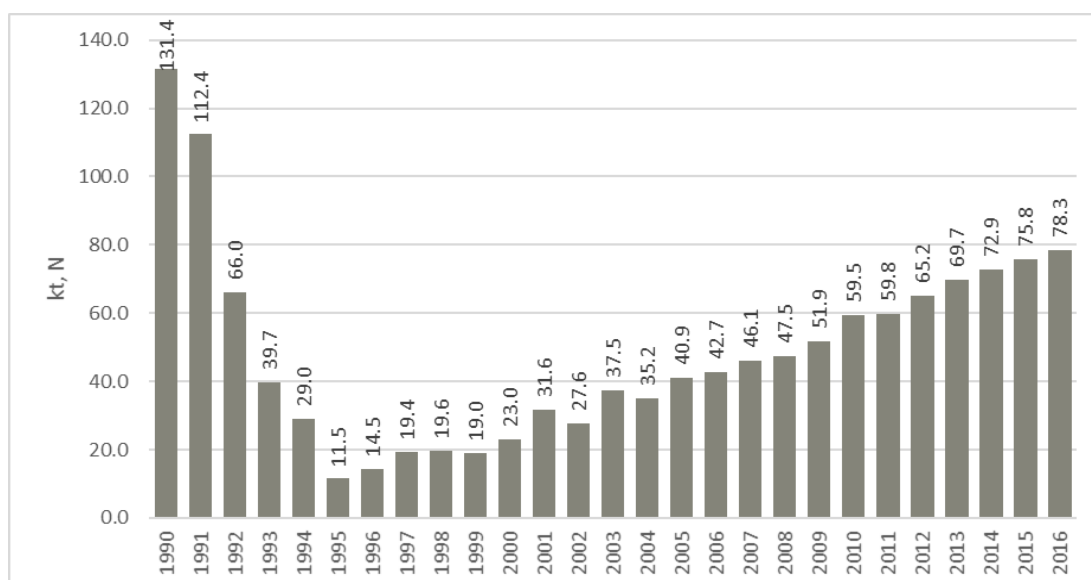


Figure 5.4 Used N with inorganic N-fertilizer (kt), 1990-2016

The data of detailed statistics of consumption of different types of N fertilizers is available for the period of 2007-2016. For 1990-2006 data on the use of urea was derived by interpolation or extrapolation of available statistical data. Same additional results of urea consumption were obtained from FAO statistics for 2002 and 2003 (Table 5.18).

Table 5.18 Consumption of fertilizer types (t), 2007-2016

Fertilizer type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Ammonium nitrate	89155	84006	103333	107953	113185	109837	112238	127237	124443	116068
Ammonium sulphate	4176	5728	11294	14931	17559	23524	32114	33135	36227	34273
Calcium ammonium nitrate	NA	19399	9084	4699	4891	4748	8738	4669	4243	3929
Urea	1946	4323	5930	5459	5798	7901	5558	6445	8468	10815
Urea and ammonium nitrate solutions	2091	1025	3356	NA	NA	NA	NA	NA	NA	10815
NPK complex	105896	92952	72195	107669	112652	131702	157503	147146	121114	124585

The area covered by crops for period 1990-2016 is represented in Figure 5.5.

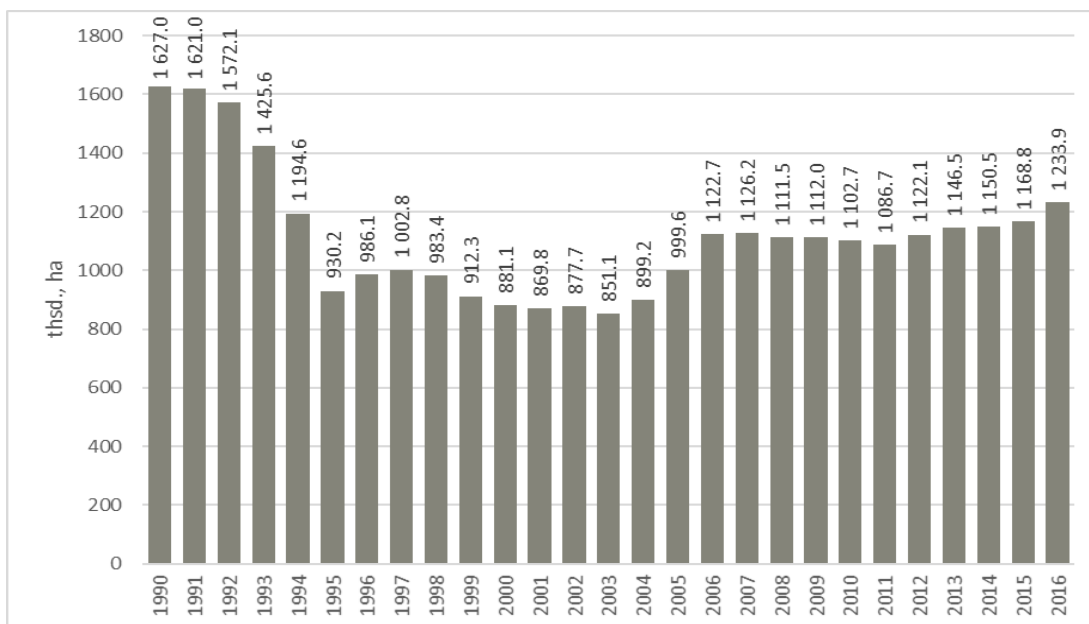


Figure 5.5 Area covered by crops (thsd. ha), 1990-2016

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^{37;38}. Available data are represented in Table 5.6.

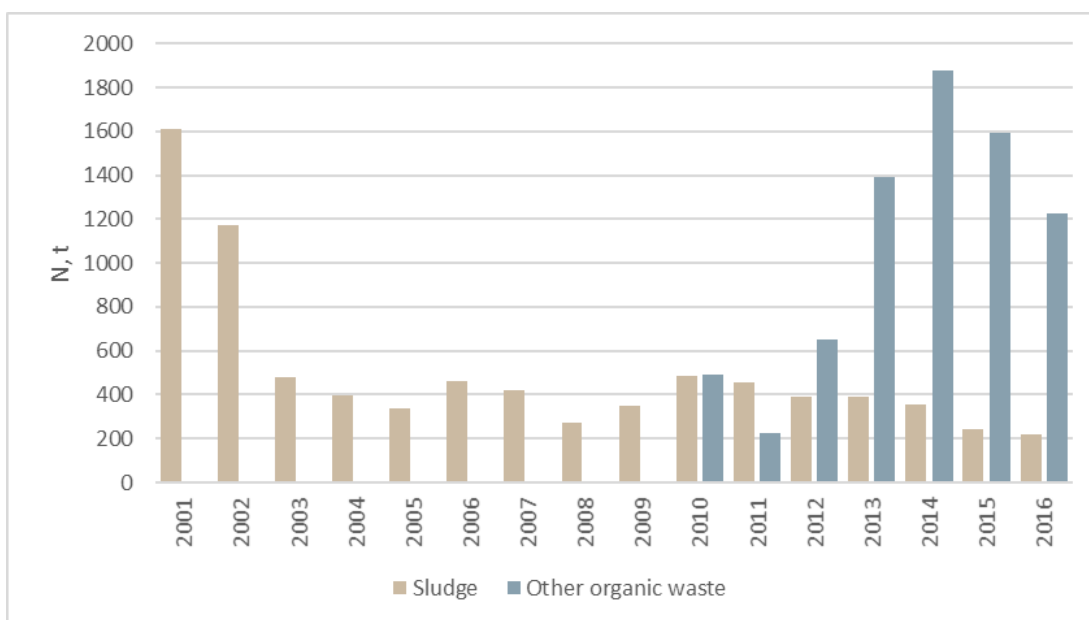


Figure 5.6 N in sewage sludge and other organic fertilizers applied to soils (t), 2001-2016

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 NH₃ emissions.

³⁷ Gemste I., Vucāns A. (2010) Notekūdeņu dūņas. Jelgava, LLU, 276 lpp.

³⁸ Litiņa I. (2013) Digestāta kā mēslošanas līdzekļa efektivitātes novērtējums kukurūzas sējumā. Zinātniski praktiskā konference LAUKSAIMNIECĪBAS ZINĀTNE VEIKSMĪGAI SAIMNIEKOŠANAI. Jelgava, LLU, 206-209 lpp.

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

Recalculations were done due to implementation of:

- 1) EF 0.05 (kg NH₃ kg⁻¹ fertilizer N applied) from inorganic N-fertilizer application according to EMEP/EEA 2016 guidelines;
- 2) updated Tier 2 methodology for sector 3B;
- 3) reporting emissions from sewage sludge.

5.3.9 Planned improvements

Reporting will include data of emissions from use of pesticides.

5.4 Other (NFR 3I)

5.4.1 Overview

Under category 3I Other NO_x, NMVOC, SO₂, NH₃, PM_{2.5}, PM₁₀, 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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO _x	kt	0.007	0.007	0.029	0.026	0.032	0.021	0.024	0.025	0.089	0.042	0.042	482
NMVOC		0.019	0.018	0.077	0.069	0.085	0.055	0.064	0.064	0.232	0.111	0.110	
SO ₂		0.002	0.002	0.007	0.006	0.007	0.005	0.006	0.006	0.020	0.010	0.010	
NH ₃		0.002	0.002	0.007	0.006	0.007	0.005	0.006	0.006	0.020	0.010	0.010	
PM _{2.5}		0.008	0.007	0.032	0.028	0.035	0.023	0.026	0.026	0.095	0.046	0.045	
PM ₁₀		0.009	0.009	0.039	0.035	0.043	0.028	0.032	0.032	0.117	0.056	0.055	
TSP		0.015	0.014	0.060	0.054	0.066	0.043	0.049	0.050	0.180	0.086	0.085	
CO		0.207	0.196	0.844	0.756	0.931	0.604	0.698	0.703	2.543	1.215	1.206	
PCDD/PCDF	g i-Teq	0.004	0.004	0.018	0.016	0.019	0.013	0.015	0.015	0.053	0.025	0.025	
PAHs	t	0.014	0.014	0.058	0.052	0.064	0.042	0.048	0.049	0.175	0.084	0.083	

Emission amount is directly dependent on the burned area of grassland (Table 5.19, Figure 5.6). 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, SO₂, NH₃, TSP, PM₁₀ 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).

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
NM VOC	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.

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.

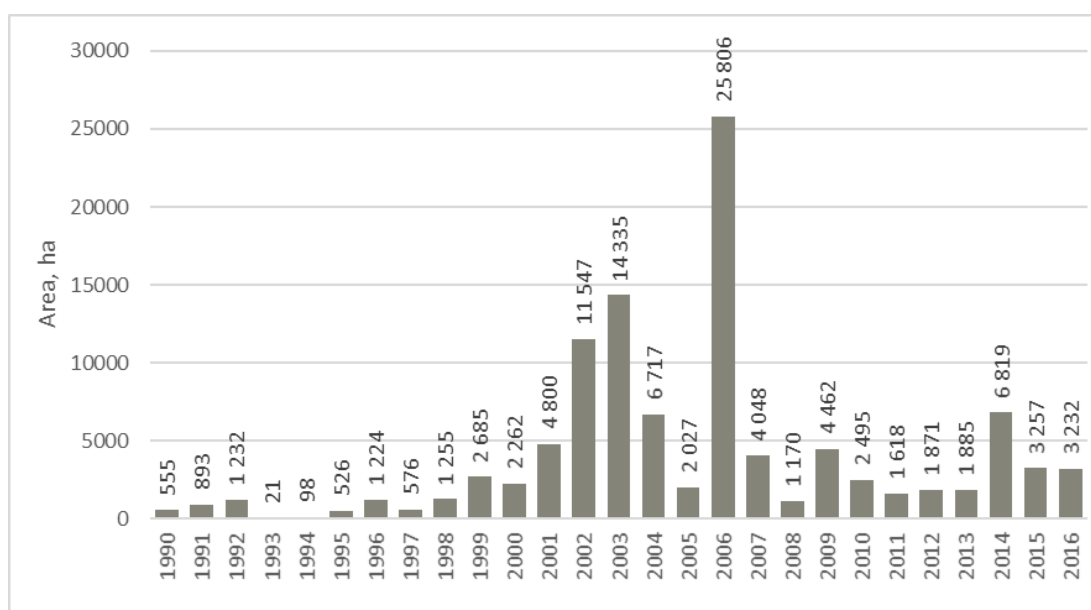


Figure 5.7 Area of last years grass burned (ha)

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

No recalculations were done.

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 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

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 2016

NFR code	Emissions
5A	NMVOC, PM _{2.5} , PM ₁₀ , TSP
5B1	NH ₃
5B2	NH ₃
5C1biii	NO _x , NMVOC, SO ₂ , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, PCDD/F, total PAHs, HCB

NFR code	Emissions
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

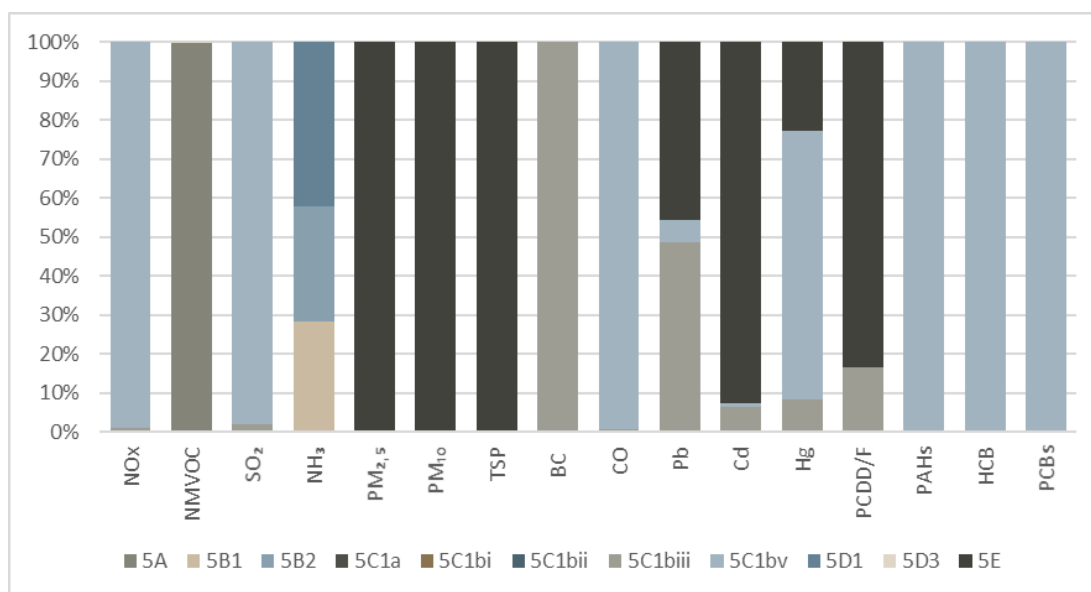


Figure 6.1 Distribution of emissions in Waste sector by subsectors in 2016 (%)

Only PCDD/F emissions are a key source in Waste water handling sector. Emissions of heavy metals, PAHs, HCB, PCBs and PCDD/PCDF occur only from waste incineration and cremation, relatively these are small amounts. NMVOC emissions mainly occur from solid waste disposal.

6.1.3 Trends in emissions

Emissions are increased since 1990 for NO_x and SO₂. 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 and 2016 (%)

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO _x	kt	0.00045	0.00100	0.00166	0.00168	0.00194	0.00182	0.00167	0.00179	0.00182	0.00202	0.00200	340
NMVOC		0.711	0.825	0.943	0.957	0.948	0.859	0.828	0.836	0.791	0.788	0.829	17
SO ₂		0.00006	0.00013	0.00019	0.00024	0.00025	0.00025	0.00023	0.00025	0.00024	0.00028	0.00028	368
NH ₃		0.244	0.230	0.222	0.227	0.250	0.206	0.234	0.251	0.268	0.265	0.276	13
PM _{2.5}		0.22891	0.22891	0.22895	0.22896	0.22898	0.23564	0.24052	0.23354	0.24350	0.21678	0.20494	-10
PM ₁₀		0.22899	0.22901	0.22907	0.22908	0.22910	0.23577	0.24065	0.23368	0.24363	0.21689	0.20506	-10
TSP		0.23051	0.23078	0.23018	0.23097	0.22947	0.23623	0.24119	0.23405	0.24402	0.21739	0.20542	-11
BC	t	0.22892	0.00004	0.00002	0.00004	0.00001	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000	-100
CO		0.00023	0.00035	0.00065	0.00038	0.00044	0.00031	0.00028	0.00030	0.00040	0.00034	0.00034	48
Pb		0.0055	0.0071	0.0051	0.0073	0.0018	0.0015	0.0019	0.0011	0.0016	0.0018	0.0013	-77
Cd		0.00136	0.00214	0.00186	0.00218	0.00146	0.00148	0.00155	0.00141	0.00152	0.00142	0.00128	-6
Hg		0.0049	0.0063	0.0055	0.0080	0.0050	0.0051	0.0051	0.0048	0.0052	0.0056	0.0052	6
PCDD/F	g I-Teq	3.416	6.297	4.814	6.476	2.900	2.890	3.150	2.595	2.934	2.933	2.482	-27
PAHs	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	768
HCB	kg	0.0089	0.0104	0.0072	0.0109	0.0020	0.0016	0.0021	0.0009	0.0017	0.0022	0.0014	-84

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
PCB		NA	0.00023	0.00046	0.00063	0.00086	0.00088	0.00081	0.00088	0.00091	0.00098	0.00098	100

Emission estimates from the waste sector include:

- NMVOC, PM_{2.5}, PM₁₀, TSP emissions from solid waste disposal and fires (5E);
- NH₃ emissions from composting and anaerobic digestion;
- NMVOC, NH₃ 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

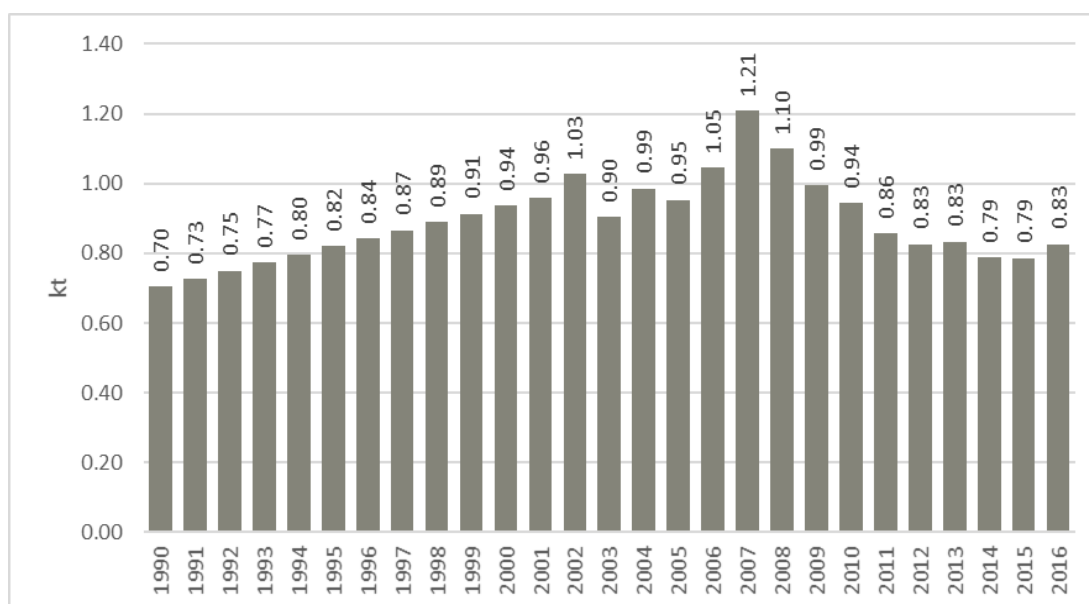


Figure 6.2 NMVOC emissions from Solid waste disposal (kt)

Emissions of NMVOC from solid waste disposal (Figure 6.2) correlate with CH₄ emissions, which are calculated according to UNFCCC requirements. These emissions mostly relate to disposed waste amount in landfills.

6.2.3 Methods

NMVOC, PM_{2.5}, PM₁₀, TSP emissions from solid waste disposal are calculated. EMEP/EEA 2016 is used for emission calculations. To estimate NMVOC, PM_{2.5}, PM₁₀, 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}, PM₁₀, 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).

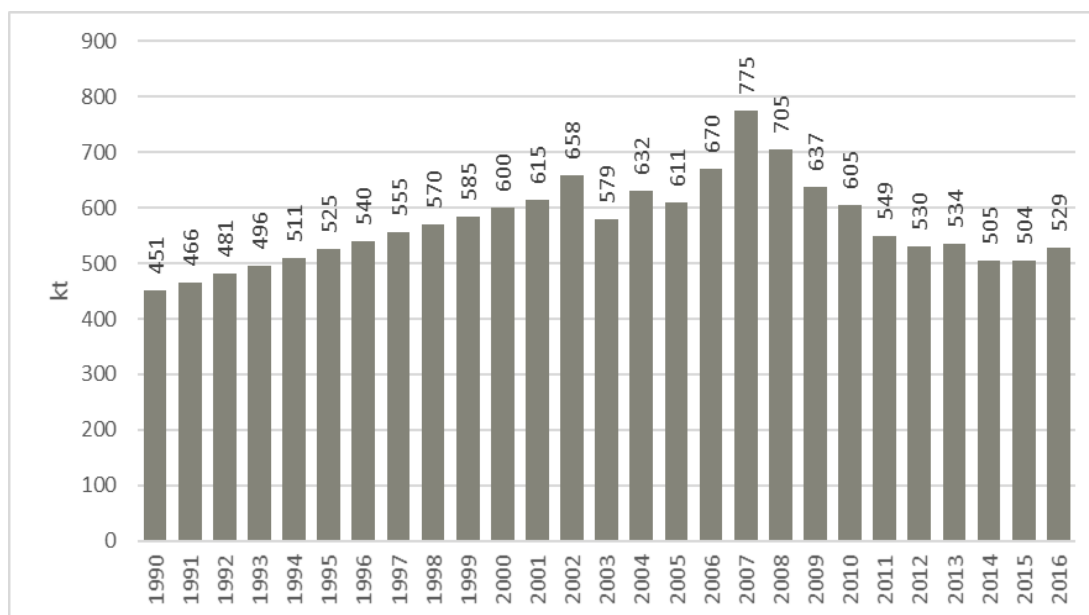


Figure 6.3 Disposed waste amounts in Latvia (kt)

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 - 2016 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 7%. 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

No recalculations

6.2.9 Planned improvements

No planned improvements.

6.3 Composting and anaerobic digestion (NFR 5B)

6.3.1 Overview

NH₃ 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

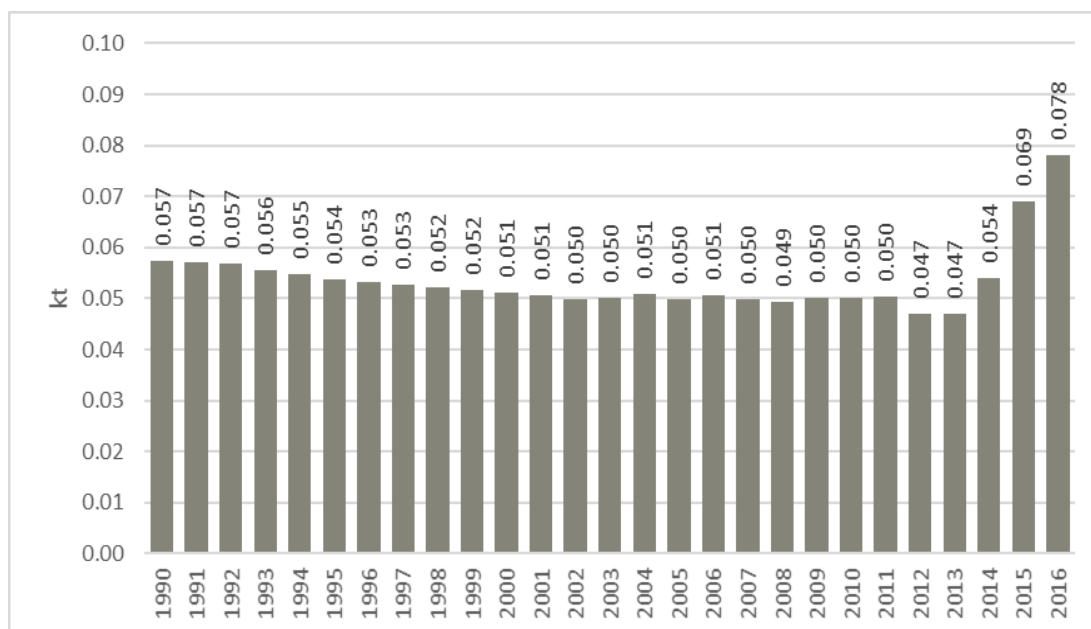


Figure 6.4 NH₃ emissions from composting (kt)

Composting NH₃ emissions increase in 2016 was due to increase of industrial composting amounts.

Manure anaerobic digestion in biogas facilities starts in 2009. NH₃ 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:

$$E_{NH_3} = AR_{feedstock} \cdot EF_{NH_3} \cdot 17/14$$

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

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 24%. 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

NH₃ from manure anaerobic digestion was calculated for the first time starting 2009.

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 PM₁₀, PM_{2.5}, NO_x and SO₂. 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}, PM₁₀, 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 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO_x	kt	0.00045	0.00100	0.00166	0.00168	0.00194	0.00182	0.00167	0.00179	0.00182	0.00202	0.00200	340
NMVOC		0.00231	0.00270	0.00516	0.00168	0.00152	0.00008	0.00004	0.00003	0.00127	0.00004	0.00004	-98
SO₂		0.00006	0.00013	0.00019	0.00024	0.00025	0.00025	0.00023	0.00025	0.00024	0.00028	0.00028	368
PM_{2.5}		0.00000	0.00000	0.00004	0.00005	0.00007	0.00027	0.00026	0.00033	0.00025	0.00018	0.00018	14983
PM₁₀		0.00000	0.00000	0.00004	0.00005	0.00007	0.00030	0.00029	0.00038	0.00028	0.00020	0.00020	9307
TSP		0.00141	0.00164	0.00101	0.00180	0.00030	0.00063	0.00070	0.00061	0.00055	0.00057	0.00043	-69
BC		0.00003	0.00004	0.00002	0.00004	0.00001	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000	-88
CO	t	0.00023	0.00035	0.00065	0.00038	0.00044	0.00031	0.00028	0.00030	0.00040	0.00034	0.00034	48
Pb		0.00553	0.00646	0.00443	0.00666	0.00112	0.00086	0.00118	0.00043	0.00092	0.00122	0.00070	-87
Cd		0.00069	0.00081	0.00053	0.00085	0.00013	0.00011	0.00015	0.00006	0.00011	0.00016	0.00009	-86
Hg		0.00357	0.00501	0.00414	0.00668	0.00370	0.00376	0.00371	0.00346	0.00376	0.00436	0.00401	12
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	0.40798	-88
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	768
HCb	kg	0.00888	0.01044	0.00719	0.01087	0.00200	0.00161	0.00210	0.00091	0.00170	0.00221	0.00138	-84
PCB		NA	0.00023	0.00046	0.00063	0.00086	0.00088	0.00081	0.00088	0.00091	0.00098	0.00098	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

Pollutant	Units EF	Industrial EF	Clinical EF	Animal EF
NO_x	kg/t	0.87	2.3	-
NMVOC	kg/t	7.4	0.7	-
SO₂	kg/t	0.047	0.54	-
CO	kg/t	0.07	0.19	-
PM_{2.5}	kg/t	0.004	NE	0.538
PM₁₀	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. PM_{2.5}, PM₁₀, Se and Zn are not calculated, because emission factors are not available.

Table 6.9 Emission factors from cremation

Pollutant	EF	Units EF
NO_x	0.825	kg/body
NMVOC	0.013	kg/body
SO₂	0.113	kg/body
CO	0.14	kg/body

Pollutant	EF	Units EF
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

Year	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
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

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 crematorium

	Burned bodies
1994	54

	Burned bodies
1995	564
1996	819
1997	817
1998	869
1999	982
2000	1127
2001	1297
2002	1293.00
2003	1389
2004	1391
2005	1529
2006	1630
2007	1959
2008	2227
2009	1977
2010	2102
2011	2158
2012	1970
2013	2150
2014	2222
2015	2395
2016	2396

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 46%. 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

No recalculations

6.4.9 Planned improvements

No planned improvements.

6.5 Waste water handling (NFR 5D)

6.5.1 Overview

Data of LEGMC shows there were 216 million m³ of waste water discharged in Latvia, including 138 million m³ of treated wastewater (2016). Most of national population (77%, 2016) 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	Change in 1990-2016, %
NMVOC	0.0050	0.0031	0.0023	0.0020	0.0020	0.0026	0.0023	0.0024	0.0019	0.0019	0.0021	-58.2
NH₃	0.187	0.176	0.171	0.177	0.180	0.129	0.131	0.127	0.127	0.118	0.116	-37.8

Both NMVOC and NH₃ 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.

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.

6.5.4 Emission factors

Table 6.13 Activity data and emission factors for calculation of NH₃ and NMVOC emission from Waste Water Handling sector

	Activity data	Emission factor value	Emission factor unit
NH₃	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 NH₃ 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 (2016)
NH₃	Population using latrines	73 (thousands of people)
NMVOC	Amount of waste water treated and discharged	138 (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 NH₃ 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.

Table 6.15 Activity data and result of emission (NH₃ and NMVOC) calculations from Waste Water Handling sector 1990-2016

	Population using latrines	Emission of NH ₃ , kt	Amount of waste water treated and discharged, mio m ³	Emission of NMVOC, kt
1990	116 677	0.187	330	0.00495
1991	116 116	0.186	317	0.00475
1992	115 787	0.185	295	0.00442
1993	114 275	0.183	241	0.00362
1994	111 525	0.178	229	0.00344
1995	110 136	0.176	205	0.00308
1996	108 987	0.174	192	0.00288
1997	108 060	0.173	191	0.00287
1998	107 052	0.171	189	0.00283
1999	106 560	0.170	168	0.00253
2000	106 820	0.171	153	0.00230
2001	123 355	0.197	150	0.00226
2002	115 184	0.184	151	0.00226

	Population using latrines	Emission of NH ₃ , kt	Amount of waste water treated and discharged, mio m ³	Emission of NMVOC, kt
2003	95 618	0.153	136	0.00204
2004	112 632	0.180	133	0.00199
2005	110 516	0.177	133	0.00199
2006	106 360	0.170	126	0.00189
2007	104 270	0.167	137	0.00205
2008	123 281	0.197	125	0.00187
2009	107 182	0.171	151	0.00227
2010	112 410	0.180	133	0.00200
2011	80 686	0.129	174	0.00260
2012	82 002	0.131	151	0.00226
2013	79 642	0.127	163	0.00245
2014	79 369	0.127	127	0.00191
2015	73 937	0.118	124	0.00186
2016	72 627	0.116	138	0.00207

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	8%	200%
NMVOC	8%	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

NH₃ emissions were recalculated for the entire reporting period (1990 – 2016) due to small adjustments of activity data. Changes in emissions for most years were insignificant.

NMVOC emissions were recalculated for the entire reporting period due to taking into account recommendation from the TERT during 2017 NECD Comprehensive Review to calculate NMVOC emissions only from treated 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 2016 are used as activity data.

6.6.2 Trends in emissions

Table 6.17 Emissions in Other waste in 1990-2016

	Unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
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	-10.6
PM₁₀		0.2289	0.2289	0.2289	0.2289	0.2289	0.2353	0.2402	0.2332	0.2432	0.2166	0.2047	-10.6
TSP		0.2289	0.2289	0.2289	0.2289	0.2289	0.2353	0.2402	0.2332	0.2432	0.2166	0.2047	-10.6
Pb	t	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0006	0.0006	-10.7
Cd		0.0013	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0013	0.0012	-10.7
Hg		0.0013	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0013	0.0012	-10.7
As		0.0021	0.0021	0.0021	0.0021	0.0021	0.0022	0.0022	0.0022	0.0023	0.0020	0.0019	-10.7
Cr		0.0020	0.0020	0.0020	0.0020	0.0020	0.0021	0.0021	0.0021	0.0022	0.0019	0.0018	-10.7
Cu		0.0047	0.0047	0.0047	0.0047	0.0047	0.0049	0.0050	0.0048	0.0050	0.0045	0.0042	-10.7
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	-10.4

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
PM₁₀	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

	Fires type	Number of fires
2011	Industrial	282
	Undetached	3678
	Car	449
2012	Industrial	252
	Undetached	3770
	Car	468
2013	Industrial	263
	Undetached	3647
	Car	566
2014	Industrial	271
	Undetached	3804
	Car	633
2015	Industrial	300
	Undetached	3359
	Car	621
2016	Industrial	269
	Undetached	3181

	Fires type	Number of fires
	Car	610

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}, PM₁₀, 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	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO _x	kt	0.232	0.320	0.531	0.076	0.048	0.047	0.043	0.042	0.048	0.050	0.051	-78
PM _{2.5}		1.899	2.616	4.342	0.619	0.390	0.388	0.349	0.348	0.394	0.405	0.414	
PM ₁₀		2.322	3.197	5.307	0.757	0.477	0.475	0.426	0.425	0.482	0.495	0.505	
TSP		3.588	4.941	8.201	1.170	0.738	0.734	0.659	0.657	0.745	0.765	0.781	
CO		16.462	22.670	37.629	5.368	3.384	3.366	3.023	3.012	3.418	3.512	3.584	
PCDD/F	g i-Teq	1.055	1.453	2.412	0.344	0.217	0.216	0.194	0.193	0.219	0.225	0.230	
PAHs	t	3.495	4.813	7.989	1.140	0.718	0.715	0.642	0.640	0.726	0.746	0.761	

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 forests³⁹. 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 studies⁴⁰ 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}, PM₁₀ 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.

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

³⁹ Lazdiņš, A., Zariņš, J., 2013. Meža ugunsgrēku un mežizstrādes atlieku dedzināšanas radītās siltumnicefeka 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.

⁴⁰ Līpiņš, L., 2004. Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resursu 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
Benzo [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).

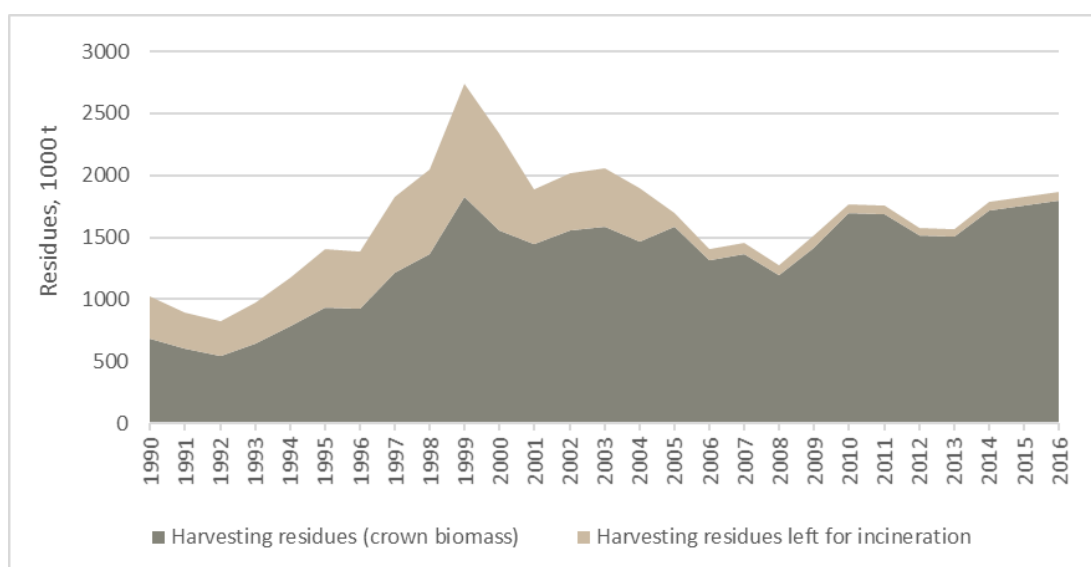


Figure 7.1 Harvesting residues and residues left for incineration (1000 tons)

7.1.5 Uncertainties

Combined activity data uncertainty is $\pm 92.6\%$. Uncertainties of emission factors are based on the 2006 IPCC Guidelines' and EMEP/EEA 2016 default values.

7.2 Forest wildfires (NFR 11B)

7.2.1 Sector overview

This source category (NFR 11B) includes NO_x, NMVOC, SO_x, NH₃, CO, PM_{2.5}, PM₁₀, 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	2011	2012	2013	2014	2015	2016	Change in 1990-2016, %
NO _x	kt	0.049	0.102	0.250	0.023	0.060	0.023	0.017	0.041	0.123	0.083	0.078	60
NMVOC		0.129	0.268	0.658	0.060	0.159	0.061	0.045	0.108	0.323	0.218	0.206	
SO _x		0.010	0.020	0.050	0.005	0.012	0.005	0.003	0.008	0.025	0.017	0.016	
NH ₃		0.011	0.023	0.057	0.005	0.014	0.005	0.004	0.009	0.028	0.019	0.018	
PM _{2.5}		0.141	0.330	0.906	0.090	0.250	0.097	0.072	0.174	0.517	0.351	0.332	136
PM ₁₀		0.172	0.404	1.108	0.110	0.305	0.118	0.088	0.212	0.631	0.429	0.406	
TSP		0.266	0.624	1.712	0.171	0.471	0.182	0.136	0.328	0.976	0.663	0.627	
CO		1.393	2.889	7.106	0.648	1.712	0.658	0.487	1.171	3.487	2.360	2.227	60
PCDD/F	g i-Teq	0.078	0.184	0.504	0.050	0.139	0.054	0.040	0.096	0.287	0.195	0.184	136
PAHs	t	0.259	0.608	1.668	0.166	0.459	0.178	0.132	0.319	0.950	0.646	0.611	

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 (dimensionless) was considered 0.45 according to Table 2.6 of 2006 IPCC Guidelines⁴¹.

7.2.3 Emission factors and other parameters

For NO_x, NMVOC, SO_x, NH₃, CO, PM_{2.5}, PM₁₀ 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).

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

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.

⁴¹ Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types.

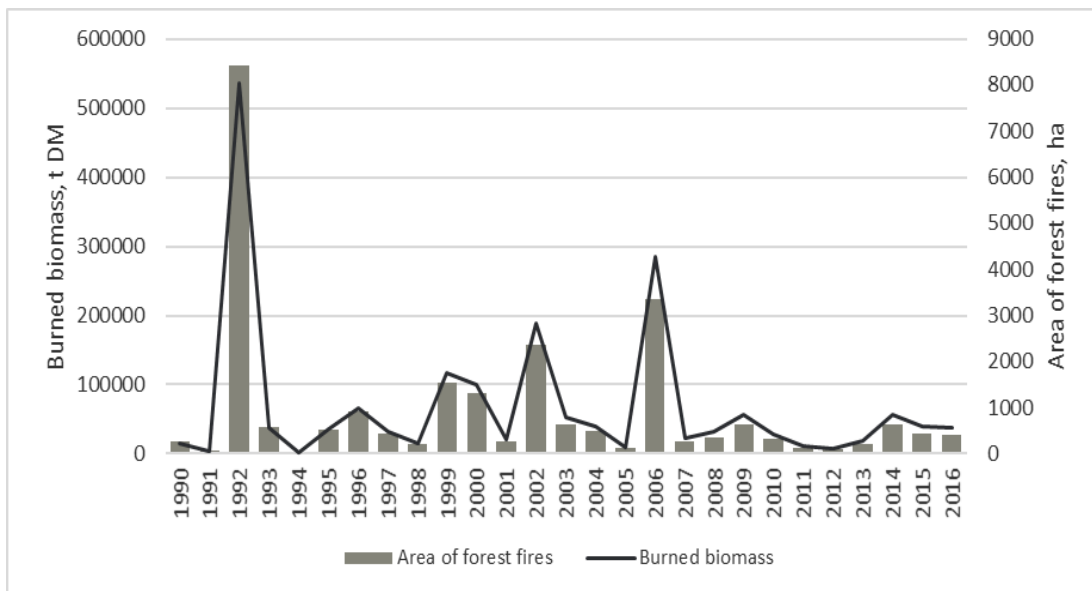


Figure 7.2 Area of forest fires and biomass in burned area

7.2.5 Uncertainties

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

8 Recalculations and improvements

8.1 Recalculations

In Submission 2018, large recalculations were made. That affected almost all main pollutant emissions, especially NMVOC (Figure 8.1).

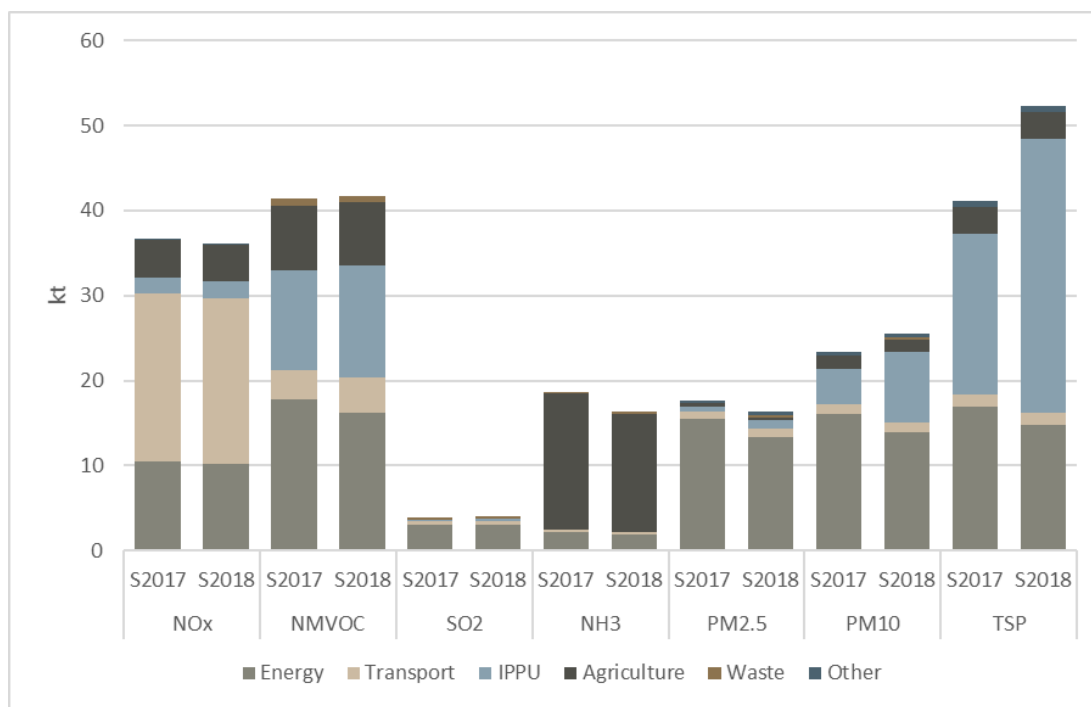


Figure 8.1 Emission comparison for 2015 between Submission 2017 and Submission 2018

Comparing reported emissions of 2015 in Submission 2017 and Submission 2018, NO_x emissions have decreased by 1.47% mainly due to the activity data corrections and emission factor corrections in Energy and IPPU sectors. NMVOC emissions have increased by 0.90% because of recalculations in Transport sector and Solvent use (IPPU). NH₃ emissions have decreased by 12.61%, due to Energy, Transport and Agriculture. SO₂ emissions have increased by 1.66% due to IPPU. Total PM_{2.5} emissions have decreased by 7.88% due to recalculations in all sectors. Total PM₁₀ emissions have increased by 9.4% and TSP by 27.68% mainly due to calculations in new sectors in IPPU and Waste.

List of main recalculations by sectors are listed below:

Energy sector

- Updated activity data for biogas in 2015 in sectors- NFR 1A1a and 1A4a;
- Corrected PAHs emission factors in NFR 1A2;
- Updated 1A4b calculations 2010-2015 for all pollutants;
- Corrected NO_x emission factor in 1A4;
- All emissions for 1990 – 2015 were recalculated. Recalculations were done due to switch from COPERT IV model version to COPERT 5 model version;
- SO₂ emissions were recalculated for 2015 in railway due to corrected EF as national regulation concerning stronger requirement to maximum allowed sulphur content for diesel oil (10mg/kg) used in railway is in force from 01.01.2015.

IPPU sector

- Activity data on used NMVOCs was slightly updated from 2006 till 2015 due to more precise information given by glass/glass fibre producing company on emitted amounts by NMVOC sub-

type. Differences were negligible (below 1%). Also due to suggestion by TERT during 2017 NECD Comprehensive Review to develop a consistent time series using the data available and report emissions according to this consistent methodology since 2005 CO, NO_x, SO₂, particulate matter and BC emissions were taken from the national database “2-Air”;

- Recalculations were done for NO_x (1990-2010), CO (2011-2015), PCDD/F (dioxins/ furans) and Total 4 PAHs (all time series) as well as PCBs (2011-2015) due to mistake in use of units;
- All emissions from Road paving with asphalt and Asphalt roofing were recalculated for 2015 due to activity data precising from CSB;
- Recalculations were done for the all time series considering recommendations concluded during the 2017 NECD Comprehensive Review. For instance, now correct Tier 1 EF 400 gNMVOC/kg paint is used for Other industrial paint application (2D3d_8) for all time series (previously it was wrong - Tier 1 EF – 200 gNMVOC/kg). Similarly, for subcategory Application of glues and adhesives (2D3i_3) now Tier 2 EF 562 gNMVOC/kg solvent is used (previously it was Tier 1 EF 2 kgNMVOC/Mg product used). Related to the Other Solvent Use (2D3i) Latvia has reviewed submitted data for 2015 in CR once again and completed missing data gaps.

Agriculture sector

- Emissions calculations for swine are done from 3 groups, the new group includes pigs below 4 months of age, this is done for calculation improvement;
- Nex of fur animals (Other animals) is changed from IPPCC 2006 default to provided value by EMEP/EEA 2016 due to lack of country specific value;
- Abatement strategies are evaluated for dairy cattle and swine according to statistical data of farms structure and national legislations, to provide more transparency;
- PM emissions are calculated only from housing, grazing periods are taken into account, as this deficiency was detected during review;
- Numbers of poultry are corrected for period of 1990 – 1998;
- EF 0.05 (kg NH₃ kg⁻¹ fertilizer N applied) from inorganic N-fertilizer application according to EMEP/EEA 2016 guidelines;
- Updated Tier 2 methodology for sector 3B;
- Reporting emissions from sewage sludge.

Waste sector

- NH₃ from manure anaerobic digestion was calculated for the first time starting 2009;
- NH₃ emissions were recalculated for the entire reporting period (1990 – 2016) due to small adjustments of activity data. Changes in emissions for most years were insignificant;
- NMVOC emissions were recalculated for the entire reporting period due to taking into account recommendation from the TERT during 2017 NECD Comprehensive Review to calculate NMVOC emissions only from treated waste water.

8.2 Planned improvements

Planned improvements are:

Energy sector

- No improvements planned.

IPPU sector

- It is planned to again review submitted data for year 2016 in CR to get more precise data considering that some enterprises have submitted their notifications with delay;
- Research about export impact to Solvent Use emissions.

Agriculture sector

- It is planned to continue to quantify abatement strategies for ammonia emissions to provide implementation of them in the inventory for next submission;
- Reporting will include data of emissions from use of pesticides.

Waste sector

- No improvements planned.

8.3 Recommendations from the TERT

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
LV-1A1a-2017-0002	Yes	1A1a Public Electricity and Heat Production, NO _x , PM _{2.5} , 2005,2010,2015	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.	no	Emissions calculated in NFR 1A1a for quality control purposes are compared with emissions from national database "2-Air", however it is not possible to recreate activity data reported by CSB due to confidentiality and statistical sampling.	Chapter 3.2.2
LV-1A2-2017-0001	Yes	1A2 Stationary Combustion in Manufacturing Industries and Construction, SO ₂ , NO _x , PM _{2.5} , 2005,2010,2015	For category 1A2 Stationary Combustion in Manufacturing Industries and Construction 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 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} .	no	In category 1A2f plant specific activity data (cement production) are used for emission calculation.	Chapter 3.2.3; 4.2.2
LV-1A2f-2017-0001	No	1A2f Stationary Combustion in Manufacturing Industries and Construction: Non-Metallic Minerals, SO ₂ , NO _x , NH ₃ ,	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	no	To avoid under or overestimation of emissions from cement production it is not possible to create consistent time series between Energy and IPPU sector. There is no information available about fuel used in specific cement production factory prior 2005. As well as since 2010 emissions	Chapter 3.2.3; 4.2.2

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
		NMVOC, PM _{2.5} , 2010, 2015	and that it investigates if there is any double counting of emissions from cement industries within these two categories.		are measured directly in cement production company providing plant specific data. These measurements are done in main chimney making it impossible to separate emissions from Energy and IPPU processes.	
LV-1A3b-2017-0005	No	1A3b Road transport, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 1990-2015	For 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 underestimate 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.	no	Additional information provided in the chapter Road transport.	Chapter 3.3.3.4
LV-1A3b-2017-0006	No	1A3b Road transport, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 1990-2015	For category 1A3b Road Transport, the TERT noted that there is a lack of transparency in the IIR on how the impact of biofuel use is being taken into account in the 1A3b emission calculations. In response to a question raised during the review, Latvia explained that emission calculations have been performed on the basis that all biofuels are used as 4.5-5% blends with fossil fuels (due to mandatory requirement introduced in Latvia from 2010). For transparency purposes, the TERT recommends that Latvia includes this information in the IIR, as the choice of emission factors are dependent on whether biofuels are assumed to be used as <10% blends with fossil fuels or a significant amount is being consumed as high strength blends (e.g. E85).	no	Additional information provided in the chapter Road transport.	Chapter 3.3.3.4

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
LV-1A3c-2017-0001	No	1A3c Railways, SO ₂ , 2012-2015	For 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 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.	RE	Recalculates emissions for 2015 have been included in a current submission.	Chapter 3.3.4.8
LV-1A4bi-2017-0001	Yes	1A4bi Residential: Stationary, NMVOC, PM _{2.5} , 2005,2010,2015	For 1A4bi Residential: Stationary and 2015 the TERT noted that that biomass consumption of the year 2015 is almost 19% below the 2014 value and that PM _{2.5} and NMVOC emissions drop by about 2% only. In response to a question raised during the review, Latvia provided a revised estimate for 2015. The TERT agreed with the revised estimate provided by Latvia. The TERT recommends that Latvia includes the revised estimate in its next submission.	RE	Values were recalculated and updated in alignment with TERT recommendations.	Chapter 3.2.4
LV-2A1-2017-0001	Yes	2A1 Cement Production, SO ₂ , NO _x , 2005-2015	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	no	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 are not available prior to 2010.	Chapter 4.2.2.2

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
			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 recognizes 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.			
LV-2A3-2017-0001	No	2A3 Glass Production, SO ₂ , NO _x , PM _{2.5} , 2005-2015	For category 2A3 Glass Production for all pollutants there is an apparent time series inconsistency. The possible over- or underestimation 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 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.	no	Since 2005 CO, NO _x , SO ₂ , particulate matter and BC emissions were taken from national database "2-Air" (Tier 3 method).	Chapter 4.2.4.5
LV-2A5a-2017-0001	No	2A5a Quarrying and mining of minerals other	For category 2A5a Quarrying and Mining of Minerals Other Than Coal and pollutant PM _{2.5} for all years the TERT noted that emissions from this source were not estimated. The TERT noted that the	RE	Revised estimate is included in Latvia's 2018 submission.	Chapter 4.2.5

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
		than coal, PM _{2.5} , 2005-2015	underestimate is below the threshold of significance. However, in response to a question raised during the review, Latvia provided a revised estimate for all the years from 1990 to 2015 for this source category. The TERT agreed with the revised estimate provided by the Member State. The TERT recommends that Latvia includes the revised estimate in its next submission.			
LV-2A5b-2017-0001	No	2A5b Construction and demolition, PM _{2.5} , 2005-2015	For category 2A5b Construction and Demolition and pollutants PM _{2.5} for all years the TERT noted that emissions from this source were not estimated. The TERT noted that the underestimate is below the threshold of significance. However, in response to a question raised during the review, Latvia provided a revised estimate for all the years from 2005 to 2015 for this source category. The TERT agreed with the revised estimate provided by the Member State. The TERT recommends that Latvia includes the revised estimate in its next submission. In addition, the TERT recommends Latvia to also provide an estimate for road construction which is currently missing in the revised estimate.	RE	Revised estimates are included in Latvia's 2018 submission. Emissions from road construction are also added since 2005.	Chapter 4.2.6
LV-2A5c-2017-0001	No	2A5c Storage, handling and transport of mineral products, PM _{2.5} , 2005-2015	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.	no	As the cement, lime and glass are being produced in Latvia emissions from storage, handling and transport of minerals shall be assessed 1990-2016. 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 sectoral source categories in the relevant mineral chapter therefore IE is reported (according to the Guidebook). Since	Chapter 4.2.7

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
					2011 data are available from national database "2-Air" and figures are reported.	
LV-2B7-2017-0001	No	2B7 Soda Ash Production, NH ₃ , 1990-2015	For category 2B7 Soda Ash Production the TERT noted that in response to a question raised during the review Latvia explained that soda ash production does not occur in Latvia and that the activity data reported under 2B7 in the NFR are actually use of soda ash in glass production. The TERT noted that the issue has no effect on the reported emissions. The TERT recommends that Latvia uses the proper notation key for 2B7 of 'NO' in the next submission. However, before the activity data for soda ash used in glass production is removed from 2B7 the TERT recommends that Latvia ensures that emissions from this use are included in the emissions reported under NFR category 2A3 Glass production.	no	Activity data reported under 2B7 in the NFR have been removed (notation key NO is used instead). From soda ash use in waste water neutralization in glass fibre production plant only CO ₂ emissions are accounted under UNFCCC. No air emissions are accounted under CLRTAP because no methodology is provided in EMEP/EEA 2016 Guidebook thus these emissions are not relevant.	NA
LV-2D3d-2017-0002	Yes	2D3d Coating Applications, NMVOC, 1990-2015	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 gNMVOC/kg paint. Latvia provided revised 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.	RE	For instance, now correct Tier 1 EF 400 gNMVOC/kg paint is used for Other industrial paint application (2D3d_8) for all time series (previously it was - Tier 1 EF – 200 gNMVOC/kg).	Chapter 4.4.3.4.
LV-2D3i-2017-0001	Yes	2D3i Other Solvent Use, NMVOC, 2013, 2015	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	no	Latvia has reviewed submitted data for year 2015 in CR once again and completed missing data gaps.	Chapter 4.4.3.2.

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
			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 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.			
LV-2D3i-2017-0002	Yes	2D3i Other Solvent, NMVOC, 1990-2015	For the key category 2D3i Other Solvent Use 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 an update for this source category is currently under way. The TERT concluded that it was not possible to make a revised estimate for the sub category Application of glues and adhesives, but recommended that a Tier 2 estimate will be included in the next submission.	no	Similarly, for subcategory Application of glues and adhesives (2D3i_3) now Tier 2 EF 562 gNMVOC/kg solvent is used (previously it was Tier 1 EF 2 kgNMVOC/Mg product used)	Chapter 4.4.3.4.
LV-3B-2017-0002	Yes	3B Manure management, NH ₃ , 2005, 2010, 2015	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.	no	Detailed information on storage of slurry for dairy cows and swine according to the statistical data and nation legislation is included in the IIR. It is planned to continue to quantify abatement strategies for ammonia emissions to provide implementation of them in the inventory for next submission. Detailed description of N amounts per	Chapter 5.2

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
			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 assumptions, technologies, reduction factors and underlying N amounts per animal category in its next IIR.		animal categories are available in NIR 2018 and previous NIR submissions.	
LV-3B-2017-0003	No	3B Manure Management, PM _{2.5} , 2005, 2010, 2015	For category 3B Manure Management and pollutant PM _{2.5} for years 2005, 2010 and 2015 the TERT noted that Latvia's PM _{2.5} IEFs except other cattle and swine are equal to the PM _{2.5} EFs provided in the 2016 EMEP/EEA Guidebook. However, the methodology in the 2016 EMEP/EEA Guidebook indicates that only housed animals should be considered as AD (except for poultry where total numbers should be taken) and Table 5.11 of Latvia's IIR 2017 shows that in most livestock categories part of animals is pastured. In response to a question raised during the review, Latvia explained that total livestock numbers were taken into account, but showed that the impact is below the threshold of significance. The TERT recommends that Latvia revises its estimates in its next submission.	no	Estimates were revised and implemented in the 2018 submission.	Chapter 5.2
LV-3B-2017-0004	No	3B Manure Management, NO _x , NH ₃ , NMVOC, PM _{2.5} , 2005, 2010, 2015	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	no	In progress. More discussions is needed for this moment of time to specify other poultry and emission factors related to them. It is planned to implement calculations in next submission.	Chapter 5.2

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
			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.			
LV-3Da2b-2017-0001	No	3Da2b Sewage sludge applied to soils, NO _x , NH ₃ , 2005, 2010, 2015	For category 3Da2b Sewage Sludge Applied to Soils and pollutants NO _x and NH ₃ for years 2005, 2010 and 2015 the TERT noted that Latvia reports 'NE'. However, in its GHG submission under UNFCCC N amounts for sewage sludge spreading are reported from 2001 onwards and default EFs are available in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review, Latvia explained that according to the 2016 EMEP/EEA Guidebook emissions are very uncertain. Latvia provided an estimate based on the 2016 EMEP/EEA Guidebook Tier 1 methodology providing evidence that emissions would be below the threshold of significance. Latvia explained, that the main reason of the use of the notation key NE was that in Latvia the data on sewage sludge used for agriculture purposes refers to the amounts of sludge that is spread to fields on certain years. But this amount could also include sewage produced in previous years and therefore a direct link of used sewage sludge amounts to human population in a certain year is not precise in the case of Latvia and detailed research is needed for NH ₃ emission calculation. The TERT recommends that Latvia use the amounts of annually spread sewage sludge as activity data and the NH ₃ EF of 0.13kg NH ₃ /kg N _{applied} (Annex 1, p.30, 2016 EMEP/EEA Guidebook), and for NO _x an EF of 0.04kg NO ₂ /kg N _{applied} (Annex 2, p.32, 2016 EMEP/EEA Guidebook).	no	Recommendation is implemented	Chapter 5.3

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	LV Response (status of implementation)	Chapter in the IIR
LV-5D-2017-0001	No	5D Wastewater Handling, NMVOC, 2005;2010;2015	For 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.	no	Recommendation taken into account, corresponding recalculations performed and described in the IIR.	Chapter 6.5.
LV-5E-2017-0001	No	5E Other waste, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , 2005;2010;2015	For 5E Other Waste the TERT noted that PM _{2.5} emissions from car and building fires were not estimated although default EFs are provided in the 2016 EMEP/EEA Guidebook. In response to a question raised during the review, Latvia provided a revised estimate for years 2005, 2010 and 2015 and stated that it will be included in the next submission. The TERT agreed with the revised estimate provided by Latvia and recommends that Latvia includes the revised estimate in its next submission. Moreover, the TERT encourages Latvia to improve the methodology by including a split among various type of housing (detached houses, terraced houses and apartments), for instance by using national statistics on housing.	RE	Emissions from fires are calculated and reported in Chapter 6.6 (NFR 5E Other waste). Information from Fire and rescue service regarding fires types are used for calculations. Information is available from year 2011. For years 1990-2010 average number of fires are used for emissions calculation.	Chapter 6.6

9 Projections

The latest projections were reported on 11.12.2017. No information is provided in this submission.

10 Submission of Latvia's gridded emissions data

The latest data were reported on 28.04.2017. No information is provided in this submission.

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Annex I: Detailed methodological descriptions

Table 1 Emission factors and assumptions for Energy sector

	NOx	NM VOC	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	
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

	NO _x	NM _{VOC}	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	
Blodiesel	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

	NO _x	NM _{VOC}	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.f ii, 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 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
Gasoline: 4-stroke	7117	18893	4	157	157	157	770368		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
NO _x	g/GJ	80	80	95	50	80
CO		4000	4000	2000	4000	300
NM VOC		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 SO₂ 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
Diesel	42.49	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	0.10	0.10	0.10
RFO	40.60	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	0.84	0.79	0.66
Gasoline	43.97	0.015	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	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
Other liquid fuel	41.86	0.65	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	0.39	0.40	0.42
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
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
Coal	23.72	1.80	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	0.48	0.57	0.49
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
Oil shale	9.20	1.60	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
RFO (marine)	40.60	2.00	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	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	0.02
Natural gas	Changes annually	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00
		EF (kt/PJ)																	
Diesel		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	0.047	0.047	0.05
RFO		0.966	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	0.405	0.384	0.32
Gasoline		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	0.0005	0.0005	0.00
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	0.05
Other liquid fuel		0.311	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	0.184	0.190	0.20
LPG		0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00
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	0.41
Coal		1.138	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	0.359	0.431	0.37
Coke		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	0.403	0.403	0.40
Oil shale		3.130	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat		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	0.51
RFO (marine)		0.966	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	0.483	0.483	0.48
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	0.04
Natural gas		0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00016	0.00

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., Randa, 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., Žirīņš, A., Rīžikovs, J., Dobeļe, G., Latvian Institute of Wood chemistry "Feasibility of processing and utilisation of used up railway sleepers"

Natural gas – allowed content of mercaptan (3 mg/m³)

Table 4 Distribution of road transport fleet by subsectors and layers, year 2016

Category	Fuel	Segment	Euro Standard	Population	Mileage, km
Passenger Cars	Petrol	Small	ECE 15/04	384	2 700
Passenger Cars	Petrol	Small	Euro 1	897	3 600
Passenger Cars	Petrol	Small	Euro 2	4 825	6 050
Passenger Cars	Petrol	Small	Euro 3	6 905	9 900
Passenger Cars	Petrol	Small	Euro 4	6 660	12 000
Passenger Cars	Petrol	Small	Euro 5	10 292	15 400
Passenger Cars	Petrol	Small	Euro 6 up to 2016	5 793	20 900
Passenger Cars	Petrol	Small	Euro 6 2017-2019	158	20 900
Passenger Cars	Petrol	Medium	ECE 15/04	4 372	2 916
Passenger Cars	Petrol	Medium	Euro 1	10 202	4 320
Passenger Cars	Petrol	Medium	Euro 2	48 280	8 580
Passenger Cars	Petrol	Medium	Euro 3	40 170	12 000
Passenger Cars	Petrol	Medium	Euro 4	22 215	15 068
Passenger Cars	Petrol	Medium	Euro 5	25 962	17 000
Passenger Cars	Petrol	Medium	Euro 6 up to 2016	9 275	20 000
Passenger Cars	Petrol	Medium	Euro 6 2017-2019	268	22 000
Passenger Cars	Petrol	Large-SUV-Executive	ECE 15/04	663	3 510
Passenger Cars	Petrol	Large-SUV-Executive	Euro 1	1 546	5 074
Passenger Cars	Petrol	Large-SUV-Executive	Euro 2	6 795	10 892
Passenger Cars	Petrol	Large-SUV-Executive	Euro 3	8 788	14 770
Passenger Cars	Petrol	Large-SUV-Executive	Euro 4	8 621	15 000
Passenger Cars	Petrol	Large-SUV-Executive	Euro 5	7 575	19 000
Passenger Cars	Petrol	Large-SUV-Executive	Euro 6 up to 2016	2 092	21 000
Passenger Cars	Petrol	Large-SUV-Executive	Euro 6 2017-2019	154	21 500
Passenger Cars	Diesel	Medium	Conventional	2 139	10 000
Passenger Cars	Diesel	Medium	Euro 1	18 649	11 000
Passenger Cars	Diesel	Medium	Euro 2	34 401	12 000
Passenger Cars	Diesel	Medium	Euro 3	52 866	13 000
Passenger Cars	Diesel	Medium	Euro 4	43 991	17 000
Passenger Cars	Diesel	Medium	Euro 5	24 733	24 586
Passenger Cars	Diesel	Medium	Euro 6 up to 2016	4 989	24 738
Passenger Cars	Diesel	Medium	Euro 6 2017-2019	236	27 212
Passenger Cars	Diesel	Large-SUV-Executive	Conventional	5 107	9 872
Passenger Cars	Diesel	Large-SUV-Executive	Euro 1	13 178	12 000
Passenger Cars	Diesel	Large-SUV-Executive	Euro 2	20 029	13 400
Passenger Cars	Diesel	Large-SUV-Executive	Euro 3	53 534	14 000
Passenger Cars	Diesel	Large-SUV-Executive	Euro 4	34 662	18 055
Passenger Cars	Diesel	Large-SUV-Executive	Euro 5	11 453	23 700
Passenger Cars	Diesel	Large-SUV-Executive	Euro 6 up to 2016	2 409	25 009
Passenger Cars	Diesel	Large-SUV-Executive	Euro 6 2017-2019	111	27 510
Passenger Cars	LPG Bifuel	Small	Conventional	1 961	15 000
Passenger Cars	LPG Bifuel	Small	Euro 1	8 891	17 300
Passenger Cars	LPG Bifuel	Small	Euro 2	13 647	20 000
Passenger Cars	LPG Bifuel	Small	Euro 3	11 404	21 000
Passenger Cars	LPG Bifuel	Small	Euro 4	7 749	22 000
Passenger Cars	LPG Bifuel	Small	Euro 5	3 770	23 460
Passenger Cars	LPG Bifuel	Small	Euro 6	170	24 621
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Conventional	297	26 000
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 1	347	27 000
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 2	328	29 000
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 3	151	35 000
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 4	304	43 000
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 5	184	47 000
Light Commercial Vehicles	LPG Bifuel	Large-SUV-Executive	Euro 6	19	47 000
Light Commercial Vehicles	Petrol	N1-II	Conventional	186	16 660
Light Commercial Vehicles	Petrol	N1-II	Euro 1	206	17 640
Light Commercial Vehicles	Petrol	N1-II	Euro 2	322	18 620
Light Commercial Vehicles	Petrol	N1-II	Euro 3	311	21 070

Category	Fuel	Segment	Euro Standard	Population	Mileage, km
Light Commercial Vehicles	Petrol	N1-II	Euro 4	632	26 880
Light Commercial Vehicles	Petrol	N1-II	Euro 5	462	31 000
Light Commercial Vehicles	Petrol	N1-II	Euro 6 up to 2017	123	31 310
Light Commercial Vehicles	Diesel	N1-II	Conventional	1 257	24 500
Light Commercial Vehicles	Diesel	N1-II	Euro 1	3 273	24 500
Light Commercial Vehicles	Diesel	N1-II	Euro 2	7 106	25 480
Light Commercial Vehicles	Diesel	N1-II	Euro 3	9 171	27 244
Light Commercial Vehicles	Diesel	N1-II	Euro 4	13 039	31 162
Light Commercial Vehicles	Diesel	N1-II	Euro 5	11 536	39 390
Light Commercial Vehicles	Diesel	N1-II	Euro 6 up to 2017	499	39 390
Heavy Duty Trucks	Petrol	>3,5 t	Conventional	922	20 000
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Conventional	284	20 000
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro I	866	20 500
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro II	552	20 800
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro III	521	28 000
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro IV	359	41 000
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro V	231	42 000
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro VI	53	43 000
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Conventional	178	20 000
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro I	469	20 500
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro II	276	20 800
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro III	359	28 000
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro IV	236	41 000
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro V	101	42 000
Heavy Duty Trucks	Diesel	Rigid 7,5 - 12 t	Euro VI	86	43 000
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Conventional	63	20 000
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro I	129	20 500
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro II	58	20 800
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro III	40	28 000
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro IV	51	41 000
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro V	16	42 000
Heavy Duty Trucks	Diesel	Rigid 12 - 14 t	Euro VI	14	43 000
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Conventional	290	29 000
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro I	811	30 000
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro II	1 000	30 500
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro III	1 684	38 000
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro IV	1 284	55 000
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro V	2 704	65 000
Heavy Duty Trucks	Diesel	Rigid 14 - 20 t	Euro VI	1 160	67 000
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Conventional	98	38 000
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro I	188	38 500
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro II	368	39 000
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro III	349	53 000
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro IV	330	60 000
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro V	522	65 000
Heavy Duty Trucks	Diesel	Rigid 20 - 26 t	Euro VI	466	70 000
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Conventional	0	38 000
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro I	0	38 500
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro II	20	39 000
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro III	19	53 000
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro IV	12	60 000
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro V	23	65 000
Heavy Duty Trucks	Diesel	Rigid 26 - 28 t	Euro VI	62	70 000
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Conventional	7	38 000
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro I	3	38 500
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro II	58	39 000
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro III	50	53 000
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro IV	48	60 000
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro V	70	65 000
Heavy Duty Trucks	Diesel	Rigid 28 - 32 t	Euro VI	47	70 000

Category	Fuel	Segment	Euro Standard	Population	Mileage, km
Heavy Duty Trucks	Diesel	Rigid >32 t	Conventional	6	38 000
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro I	19	38 500
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro II	34	39 000
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro III	51	53 000
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro IV	97	60 000
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro V	38	65 000
Heavy Duty Trucks	Diesel	Rigid >32 t	Euro VI	16	70 000
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Conventional	127	29 000
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro I	347	30 000
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro II	429	30 500
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro III	723	38 000
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro IV	551	55 000
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro V	1 155	65 000
Heavy Duty Trucks	Diesel	Articulated 14 - 20 t	Euro VI	497	67 000
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Conventional	161	38 000
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro I	293	38 500
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro II	569	39 000
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro III	592	53 000
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro IV	519	60 000
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro V	849	65 000
Heavy Duty Trucks	Diesel	Articulated 20 - 28 t	Euro VI	745	70 000
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Conventional	29	38 000
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro I	37	38 500
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro II	133	39 000
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro III	149	53 000
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro IV	188	60 000
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro V	166	65 000
Heavy Duty Trucks	Diesel	Articulated 28 - 34 t	Euro VI	84	70 000
Buses	Petrol	N1-III	Euro 5	29	35 153
Buses	Diesel	Urban Buses Midi <=15 t	Conventional	131	32 567
Buses	Diesel	Urban Buses Midi <=15 t	Euro I	258	32 567
Buses	Diesel	Urban Buses Midi <=15 t	Euro II	261	32 567
Buses	Diesel	Urban Buses Midi <=15 t	Euro III	268	43 891
Buses	Diesel	Urban Buses Midi <=15 t	Euro IV	367	60 000
Buses	Diesel	Urban Buses Midi <=15 t	Euro V	626	65 000
Buses	Diesel	Urban Buses Midi <=15 t	Euro VI	164	65 000
Buses	Diesel	Coaches Standard <=18 t	Conventional	186	47 500
Buses	Diesel	Coaches Standard <=18 t	Euro I	156	48 000
Buses	Diesel	Coaches Standard <=18 t	Euro II	173	48 500
Buses	Diesel	Coaches Standard <=18 t	Euro III	166	60 000
Buses	Diesel	Coaches Standard <=18 t	Euro IV	131	73 000
Buses	Diesel	Coaches Standard <=18 t	Euro V	142	80 000
Buses	Diesel	Coaches Standard <=18 t	Euro VI	58	82 000
Buses	Diesel	Coaches Articulated >18 t	Conventional	48	47 500
Buses	Diesel	Coaches Articulated >18 t	Euro I	103	48 000
Buses	Diesel	Coaches Articulated >18 t	Euro II	172	48 500
Buses	Diesel	Coaches Articulated >18 t	Euro III	259	60 000
Buses	Diesel	Coaches Articulated >18 t	Euro IV	81	73 000
Buses	Diesel	Coaches Articulated >18 t	Euro V	18	80 000
Buses	Diesel	Coaches Articulated >18 t	Euro VI	105	82 000
L-Category	Petrol	Mopeds 2-stroke <50 cm ³	Euro 1	152	1 100
L-Category	Petrol	Mopeds 2-stroke <50 cm ³	Euro 2	1 673	2 375
L-Category	Petrol	Mopeds 2-stroke <50 cm ³	Euro 3	13 386	2 600
L-Category	Petrol	Motorcycles 2-stroke >50 cm ³	Euro 1	395	1 100
L-Category	Petrol	Motorcycles 2-stroke >50 cm ³	Euro 2	170	1 600
L-Category	Petrol	Motorcycles 2-stroke >50 cm ³	Euro 3	2 839	2 962
L-Category	Petrol	Motorcycles 2-stroke >50 cm ³	Euro 4	710	3 100
L-Category	Petrol	Motorcycles 4-stroke <250 cm ³	Euro 4	850	413
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm ³	Euro 1	2 561	1 400
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm ³	Euro 2	1 134	2 067

Category	Fuel	Segment	Euro Standard	Population	Mileage, km
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm ³	Euro 3	2 062	5 000
L-Category	Petrol	Motorcycles 4-stroke 250 - 750 cm ³	Euro 4	516	5 134
L-Category	Petrol	Motorcycles 4-stroke >750 cm ³	Euro 1	478	1 800
L-Category	Petrol	Motorcycles 4-stroke >750 cm ³	Euro 2	1 089	2 067
L-Category	Petrol	Motorcycles 4-stroke >750 cm ³	Euro 3	3 386	5 000
L-Category	Petrol	Motorcycles 4-stroke >750 cm ³	Euro 4	1 143	5 134

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	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	Natural gas	Firewood	Wood waste	Wood chips	Wood briquettes	Pelleted wood	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Production of peat briquettes																																		
Charcoal Production																					-721							353						
Energy sector	265						265													513														
Losses																	1			184														
Final consumption	62469	7	4166	8751	5170	6	40201	14	47	1398	2244	316	124		25	1459	34			13624	19917	8796	4739	454	2371	198	1338	65	343	157	118		220	143
Transport	48967		2591	8375	5136		31503			1362																			343	89				
International air transport	5116				5116																													
Domestic air transport	27			7	20																													
Road transport	41264		2591	8363			28992			1318																				343	22			
Rail transport	2379						2335			44																					67			
Inland shipping	181			5			176																											
Pipeline transport																																		
Industry and construction	4821		458	41			1560	10	47		2244	316	124		21	727	34			4563	1729	7889	4021	35	114	198	1338			2			24	41
Manufacture of metals																				46														
Manufacture of chemicals and chemical products	190		127	3			13		47											383	52	1	125										22	
Manufacture of other fabricated metal products																1				36														

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	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	Natural gas	Firewood	Wood waste	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 other non-metallic mineral products	379						255						124			650				1184	4		20		1	198	1338			2				
Manufacture of transport equipment	21		5				16													44	2			1	1									
Machinery	33		17				16								10					205	16	14	49	1	29									
Mining and quarrying	116			1			115										34			32	3				6									
Manufacture of food products, beverages and tobacco	333		190	1			114	7						21	46					1400	79		201	8	29							2	41	
Manufacture of paper and paper products	6		4				2								1					86	1	10												
Manufacture of wood and of products of wood and cork	604		34	15			362					193			3					548	1492	7778	3577	24	15									
Construction	2994		77	20			651	2			2244				10					344	60	2		1	21									
Manufacture of textiles	5		1				4								1					183	3				6									
Manufacture of other products	140		3	1			12	1				123			5					72	17	84	49		6									
Other sectors	8681	7	1117	335	34	6	7138	4		36				4	732					9061	18188	907	718	419	2257			65		66	118		196	102
Other consumers - commercial	1590	7	242	33	34	6	1262	4						2	225					3993	1678	575	516	26	443						118			

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	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	Natural gas	Firewood	Wood waste	Wood chips	Wood briquettes	Pelleted wood	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
and public sector																																		
Households	2140		766	220			1154									498				4510	16328	316		391	1764			65						
Crop and animal production, hunting and related service activities; forestry and logging	4630		109	81			4404			34					2	9				555	177	16	202	2	48					66		196	102	
Fishing	321			1			318			2										3	5			2										

Table 2 Fuel consumption in Energy sector (stationary combustion), TJ

1.A.1 Energy Industries

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.A.1. Energy Industries																			
Total	94338	50514	42657	44355	43268	43796	41000	40407	41916	39400	38929	37897	45595	42380	40380	46021	43786	46642	50940
Liquid Fuels	40437	20519	7900	5235	5033	3576	3055	2365	1511	1389	905	1194	918	848	662	466	319	283	295
Solid Fuels	2305	1395	371	398	285	209	210	183	105	341	446	472	419	419	513	424	175	105	152
Peat	2089	3430	2351	1230	1005	663	70	60	30	29	20	10	11	9	NO	40	NO	NO	NO
Gaseous Fuels	49029	24107	28803	33510	32497	34074	32371	33306	35181	32613	32650	31236	38687	35607	31872	33926	29870	31395	32108
Biomass	436	1063	3232	3940	4406	5245	5206	4464	5089	5028	4908	4956	5531	5494	7333	11165	13422	14859	18385
Other Fossil Fuels	42	NO	NO	42	42	29	88	29	NO	NO	NO	29	29	3	NO	NO	NO	NO	NO
1.A.1.a. Public Electricity and Heat Production																			
Total	92473	48590	39919	42931	41998	42183	39348	39061	40483	38378	37639	36780	44274	40852	39004	44541	42276	45330	49794
Liquid Fuels	40098	20266	6350	5065	4821	3406	2843	2153	1299	1219	693	1031	705	593	492	211	33	28	30
Solid Fuels	2305	1395	371	398	285	209	210	183	105	341	446	472	419	419	513	424	175	105	152
Peat	1378	2703	1970	1125	995	653	60	40	20	20	20	10	11	9	NO	40	NO	NO	NO
Gaseous Fuels	48214	23163	27996	32633	31691	33199	31499	32434	34242	32043	31845	30739	37812	34664	30895	32997	29040	30712	31595
Biomass	436	1063	3232	3668	4164	4687	4648	4222	4817	4755	4635	4499	5298	5164	7104	10869	13028	14485	18017
Other Fossil Fuels	42	NO	NO	42	42	29	88	29	NO	NO	NO	29	29	3	NO	NO	NO	NO	NO
Diesel oil	5524	85	127	42	42	42	42	42	42	43	43	16	15	25	127	94	22	14	11
RFO	32561	20016	5279	4425	4425	3207	2801	2111	1218	1137	650	1015	690	568	365	113	10	13	18
LPG	46	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	1	1	1
Other liquid	1967	126	NO	126	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	39	944	472	354	157	NO	NO	39	39	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	2305	1395	371	398	285	209	210	183	105	341	446	472	419	419	513	424	175	105	152
Peat briquettes	31	77	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO	NO	NO
Peat	1347	2626	1970	1125	995	653	60	40	20	20	20	10	10	9	NO	40	NO	NO	NO
Natural gas	48214	23163	27996	32633	31691	33199	31499	32434	34242	32043	31845	30739	37812	34664	30895	32997	29040	30712	31595
Wood	436	1045	3191	3617	4097	4644	4570	4132	4741	4675	4556	4390	5120	4635	5793	9198	11184	12286	15662
Sludge gas	NO	18	41	51	67	43	78	90	76	80	79	100	114	100	105	97	91	99	107
Landfill gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	9	18	22	22	14	16	13	13
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	37	355	1145	1560	1737	2086	2234
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8	52	39	NO	NO	NO	NO
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO	NO	NO
Waste oils	42	NO	NO	42	42	29	88	29	NO	NO	NO	29	29	3	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries																			
Total	1865	1924	2738	1424	1270	1613	1652	1346	1433	1022	1290	1117	1321	1528	1376	1480	1510	1312	1146
Liquid Fuels	339	253	1550	170	212	170	212	212	212	170	212	163	213	255	170	255	286	255	265

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	711	727	381	105	10	10	10	20	10	9	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	815	944	807	877	806	875	872	872	939	570	805	497	875	943	977	929	830	683	513
Biomass	NO	NO	NO	272	242	558	558	242	272	273	273	457	233	330	229	296	394	374	368
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	212	212	127	170	212	170	212	212	212	170	212	163	213	255	170	255	286	255	265
RFO	81	41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	46	NO	NO	NO	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	NO	NO	1423	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
Peat	711	727	381	105	10	10	10	20	10	9	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	815	944	807	877	806	875	872	872	939	570	805	497	875	943	977	929	830	683	513
Wood	NO	NO	NO	272	242	558	558	242	272	273	273	457	233	330	229	296	394	374	368

1.A.2 Manufacturing Industries and Construction

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.A.2 Manufacturing Industries and Construction																			
Total	58640	29837	20526	20910	21411	21329	22992	24014	25616	24380	23176	22377	26693	25255	27930	26004	26913	26320	23698
Liquid Fuels	29747	16745	7575	4681	3966	4417	4277	2866	4075	3847	3076	2946	3500	2298	2649	2576	2254	2014	2193
Solid Fuels	1545	650	252	252	253	262	236	971	1394	1967	1997	1363	1861	2229	2149	1406	1336	1014	727
Peat	NO	15	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	14	2	2	24	24	11	34
Gaseous Fuels	25894	10014	9873	11583	12838	12729	13157	13680	13395	12881	11836	9261	10537	7578	7952	6259	5258	5262	4755
Biomass	617	2414	2733	3926	3487	3391	4795	5584	6462	5415	5895	8674	10319	12399	14301	14624	16762	16771	15077
Other Fossil Fuels	837	NO	94	469	866	530	517	914	290	270	372	133	462	749	877	1115	1279	1248	913
Gasoline	880	44	44	44	69	44	88	88	88	88	88	44	44	44	44	44	43	48	41
Diesel oil	5564	1485	1484	1357	1231	1187	1357	1400	1527	1997	1657	1530	1359	1785	1997	1996	1722	1547	1560
RFO	22532	14413	3411	1625	1178	813	487	529	529	451	366	366	335	162	203	81	31	13	10
LPG	46	91	46	46	46	46	92	92	137	137	91	91	91	228	366	413	423	406	458
Jet fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other kerosene	432	86	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	293	586	1130	1215	1047	1214	1047	210	1089	963	795	711	1005	NO	NO	42	35	NO	NO
Petroleum coke	NO	NO	NO	NO	198	956	1088	429	627	132	NO	165	627	NO	NO	NO	NO	NO	124
Shale oil	NO	39	1417	394	197	157	118	118	78	79	79	39	39	79	39	NO	NO	NO	NO
Coal	1280	597	226	226	226	235	209	917	1362	1967	1997	1363	1861	2229	2067	1379	1336	1014	727

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Coke	237	53	26	26	27	27	27	54	32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	82	27	NO	NO	NO
Oil shale	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	NO	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	NO	NO	4	4	1	NO
Peat	NO	NO	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	10	2	2	20	20	10	34
Natural gas	25894	10014	9873	11583	12838	12729	13157	13680	13395	12881	11836	9261	10537	7578	7952	6259	5258	5262	4755
Wood	617	2414	2696	3856	3393	3309	4706	5535	6425	5387	5797	8633	9801	11187	12921	13530	15368	15528	14159
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	41
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	3	2	1	8	8	1	4	2	4	3	2
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	18	125	57	124	80	67
Municipal wastes (biomass fraction)	NO	NO	37	70	94	82	89	49	34	26	98	33	510	1193	1250	1035	1266	1130	808
Waste oils	837	NO	NO	293	628	322	293	789	205	205	234	88	58	85	58	29	29	29	21
Industrial wastes (used tires)	NO	NO	94	176	238	208	224	125	85	65	58	15	77	321	240	379	335	273	148
Municipal wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	80	30	327	343	579	707	915	946	743
1.A.2.a. Iron and Steel																			
Total	6331	3065	5076	5142	4861	4932	5016	4804	5059	5081	4738	4187	4870	1207	1633	583	13	406	46
Liquid Fuels	1219	705	1172	1042	963	963	963	126	963	963	917	792	1006	NO	NO	NO	NO	NO	NO
Solid Fuels	NO	NO	NO	NO	NO	NO	27	27	5	NO	NO	NO	26	27	184	32	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	4275	2360	3904	4058	3898	3969	4026	4125	4091	4118	3821	3395	3838	1180	1449	551	13	406	46
Biomass	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	42	NO	NO	NO	526	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	42	NO	42	NO	NO	NO	NO	42	NO	NO	NO	NO	1	NO	NO	NO	NO	NO	NO
RFO	1177	203	NO	NO	NO	NO	NO	NO	NO	NO	122	81	NO	NO	NO	NO	NO	NO	NO
Other liquid	NO	502	1130	963	963	963	963	84	963	963	795	711	1005	NO	NO	NO	NO	NO	NO
Shale oil	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	26	27	102	5	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	27	27	5	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	82	27	NO	NO	NO
Natural gas	4275	2360	3904	4058	3898	3969	4026	4125	4091	4118	3821	3395	3838	1180	1449	551	13	406	46

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Waste oils	837	NO	NO	42	NO	NO	NO	526	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.b. Non-Ferrous Metals																			
Total	NO	NO	168	232	269	302	269	203	204	201	134	101	135	172	173	138	72	61	37
Liquid Fuels	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	3	NO	NO	NO	NO
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	1	NO	NO	1	1
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	NO	NO	168	190	269	302	269	203	204	201	134	101	135	168	168	138	72	60	36
Biomass	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	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
Diesel oil	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	3	NO	NO	NO	NO
Coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	1	NO	NO	1	1
Natural gas	NO	NO	168	190	269	302	269	203	204	201	134	101	135	168	168	138	72	60	36
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO	NO
1.A.2.c. Chemicals																			
Total	4070	5645	486	479	469	449	452	471	539	455	854	773	888	724	807	804	880	770	767
Liquid Fuels	3643	4547	122	164	162	122	NO	NO	NO	NO	124	126	94	131	154	137	159	148	140
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	11	NO	NO
Gaseous Fuels	427	1090	317	269	278	308	405	442	480	381	513	518	606	404	371	385	316	330	390
Biomass	NO	7	47	46	29	19	47	29	59	74	188	130	188	188	282	262	394	292	237
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	127	NO	NO	NO	NO	NO	NO	NO	NO	NO	43	85	85	85	17	NO	15	9	13
RFO	3127	4547	122	122	162	122	NO	NO	NO	NO	81	41	9	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	46	137	137	144	139	127
Other kerosene	389	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	NO	NO	NO	42	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	1	NO	NO	NO	NO	NO
Peat briquettes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	10	NO	NO
Natural gas	427	1090	317	269	278	308	405	442	480	381	513	518	606	404	371	385	316	330	390
Wood	NO	7	47	46	29	19	47	29	56	72	187	127	187	169	210	208	278	221	179
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	3	2	1	3	1	1	NO	NO	1	1	NO
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	18	72	54	115	70	58
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO	NO	NO	NO	NO	NO	NO	NO

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.A.2.d. Pulp, Paper and Print																			
Total	2956	326	124	176	182	214	213	255	281	217	208	264	260	223	176	200	106	106	104
Liquid Fuels	203	81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	14	6	NO	6	6	6
Solid Fuels	28	56	NO	28	28	26	26	26	26	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	2724	101	101	135	134	168	167	202	235	201	201	101	101	101	68	103	97	95	86
Biomass	NO	87	23	13	20	20	20	27	20	16	7	163	156	108	102	97	3	5	11
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	14	6	NO	2	2	2
RFO	203	81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	4	4
Coal	28	56	NO	28	28	26	26	26	26	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
Natural gas	2724	101	101	135	134	168	167	202	235	201	201	101	101	101	68	103	97	95	86
Wood	NO	87	23	13	20	20	20	27	20	16	7	163	156	108	102	97	3	5	11
1.A.2.e. Food Processing, Beverages and Tobacco																			
Total	15020	8394	6167	5366	5452	4763	5219	5315	5131	4254	3351	3086	2908	2694	2911	2789	2636	2216	2265
Liquid Fuels	10547	4693	2970	1651	1442	1034	873	912	916	673	420	586	566	376	500	475	378	267	311
Solid Fuels	1069	309	140	140	141	158	105	132	106	79	79	52	52	16	27	25	24	24	46
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	NO	NO	NO	NO	NO	NO
Gaseous Fuels	3177	3065	2607	2775	2985	2764	3238	3149	3249	2684	2370	1930	1919	1886	1819	1808	1729	1627	1476
Biomass	228	327	450	800	842	719	916	1034	772	701	394	488	339	360	536	452	476	269	411
Other Fossil Fuels	NO	NO	NO	NO	42	88	88	88	88	117	88	30	29	56	29	29	29	29	21
Diesel oil	3229	552	552	467	340	340	340	297	255	213	212	212	170	85	121	170	152	111	114
RFO	7105	4060	1745	975	893	609	406	406	447	329	122	244	285	121	203	81	31	8	7
LPG	46	NO	NO	46	46	46	46	46	91	91	46	91	72	91	137	182	160	148	190
Jet fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other kerosene	NO	NO	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	167	42	NO	84	84	NO	42	84	84	NO	NO	NO	NO	NO	NO	42	35	NO	NO
Shale oil	NO	39	630	79	79	39	39	79	39	40	40	39	39	79	39	NO	NO	NO	NO
Coal	911	256	114	114	114	131	105	105	79	79	79	52	52	16	27	25	24	24	46
Coke	158	53	26	26	27	27	NO	27	27	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	NO	NO	NO	NO	NO	NO
Natural gas	3177	3065	2607	2775	2985	2764	3238	3149	3249	2684	2370	1930	1919	1886	1819	1808	1729	1627	1476
Wood	228	327	450	800	842	719	916	1034	772	701	394	483	333	360	535	449	467	230	361

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	41
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5	6	NO	1	NO	NO	NO	NO
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	9	10	9
Waste oils	NO	NO	NO	NO	42	88	88	88	88	117	88	30	29	56	29	29	29	29	21
1.A.2.f. Non-metallic minerals																			
Total	9496	4052	2512	2797	3673	3903	3648	4271	4296	4484	4307	2694	4555	5271	5573	5062	5400	4801	3941
Liquid Fuels	3585	2562	1521	482	358	1367	1209	764	920	379	207	293	864	298	291	297	275	281	379
Solid Fuels	170	114	28	28	28	26	26	682	1127	1809	1888	1285	1757	2136	1910	1299	1254	957	650
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	5734	1282	808	1821	2352	1884	1845	2381	1878	1979	1782	942	1010	977	1280	1344	1353	1208	1186
Biomass	7	94	61	82	111	184	139	144	169	165	175	100	520	1196	1273	1035	1269	1135	835
Other Fossil Fuels	NO	NO	94	385	824	442	429	300	202	153	255	74	404	664	819	1086	1250	1219	892
Diesel oil	127	84	42	42	42	42	42	255	212	127	127	128	237	298	291	297	275	280	255
RFO	3289	2436	731	162	NO	NO	NO	41	NO	81	41	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	1	NO
Other kerosene	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	126	42	NO	42	NO	251	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum coke	NO	NO	NO	NO	198	956	1088	429	627	132	NO	165	627	NO	NO	NO	NO	NO	124
Shale oil	NO	NO	748	236	118	118	79	39	39	39	39	NO	NO	NO	NO	NO	NO	NO	NO
Coal	142	114	28	28	28	26	26	682	1127	1809	1888	1285	1757	2136	1910	1299	1254	957	650
Oil shale	28	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
Natural gas	5734	1282	808	1821	2352	1884	1845	2381	1878	1979	1782	942	1010	977	1280	1344	1353	1208	1186
Wood	7	94	24	12	17	102	50	95	135	139	77	67	10	3	23	NO	NO	3	25
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	2	2
Municipal wastes (biomass fraction)	NO	NO	37	70	94	82	89	49	34	26	98	33	510	1193	1250	1035	1266	1130	808
Waste oils	NO	NO	NO	209	586	234	205	175	117	88	117	29	NO	NO	NO	NO	NO	NO	NO
Industrial wastes (used tires)	NO	NO	94	176	238	208	224	125	85	65	58	15	77	321	240	379	335	273	148
Municipal wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	80	30	327	343	579	707	915	946	743

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.A.2.g. Other																			
Total	20768	8356	5993	6718	6504	6766	8175	8695	10106	9688	9583	11272	13077	14964	16657	16429	17805	17960	16538
Liquid Fuels	10551	4156	1790	1300	1041	931	1233	1064	1276	1832	1408	1149	967	1477	1695	1667	1436	1312	1357
Solid Fuels	278	170	84	56	56	52	52	104	130	79	30	26	26	47	27	50	58	32	29
Peat	NO	15	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	11	2	2	4	13	11	34
Gaseous Fuels	9557	2115	1968	2335	2922	3334	3208	3177	3258	3318	3014	2275	2928	2862	2797	1930	1678	1536	1535
Biomass	382	1899	2152	2985	2485	2449	3673	4350	5442	4459	5132	7793	9116	10547	12107	12778	14620	15069	13583
Other Fossil Fuels	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	29	29	29	29	NO	NO	NO	NO
Gasoline	880	44	44	44	69	44	88	88	88	88	88	44	44	44	44	44	43	48	41
Diesel oil	2039	849	848	806	849	805	975	806	1060	1657	1275	1105	863	1301	1559	1529	1278	1145	1176
RFO	7632	3086	813	366	123	82	82	82	82	41	NO	NO	41	41	NO	NO	NO	5	3
LPG	NO	91	46	NO	NO	NO	46	46	46	46	45	NO	19	91	92	94	115	114	137
Other kerosene	NO	86	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	NO	NO	NO	84	NO	NO	42	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	39	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	199	170	84	56	56	52	52	104	130	79	30	26	26	47	27	50	58	32	29
Coke	79	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	NO	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	4	3	1	NO
Peat	NO	NO	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	10	2	2	NO	10	10	34
Natural gas	9557	2115	1968	2335	2922	3334	3208	3177	3258	3318	3014	2275	2928	2862	2797	1930	1678	1536	1535
Wood	382	1899	2152	2985	2485	2449	3673	4350	5442	4459	5132	7793	9115	10547	12051	12776	14620	15069	13583
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	2	2	NO	NO	NO
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	54	NO	NO	NO	NO
Waste oils	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	29	29	29	29	NO	NO	NO	NO

1.A.4 Other Sectors

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.A.4 Other Sectors																			
Total	102092	60182	49117	54029	53828	57273	59428	59055	58857	59344	55403	58823	52940	51629	53939	50148	49268	44412	44549
Liquid Fuels	27829	8817	6888	7363	6919	7887	7936	7807	8456	7888	7114	7778	8334	8351	8351	8476	8753	8887	8659
Solid Fuels	22398	5180	2162	2988	2390	2203	2150	2045	1940	1940	1783	1574	2098	1861	983	1075	962	831	799
Peat	1128	391	41	15	NO	10	NO	20	40	61	31	16	21	32	32	NO	11	NO	NO
Gaseous Fuels	24289	7150	6218	7061	8098	8795	9651	9632	9983	11027	10959	10241	11819	10343	10477	9809	9670	9101	9888
Biomass	26448	38643	33808	36561	36295	38321	39574	39523	38380	38399	35487	39215	30659	31042	34097	30788	29872	25593	25199
Other Fossil Fuels	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO	4

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gasoline	1672	88	264	220	195	220	220	308	352	352	308	308	308	440	395	440	354	289	335
Diesel oil	16189	5267	4589	5099	4886	5651	5863	5566	6288	6288	5566	6365	6942	6902	6896	6981	7234	7588	7149
RFO	6415	1664	772	772	569	528	447	527	406	40	80	41	44	5	NO	NO	NO	1	4
LPG	2961	1366	1184	1230	1185	1321	1321	1367	1367	1184	1139	1047	1023	1002	1055	1055	1165	1009	1124
Jet fuel	NO	86	NO	NO	NO	NO	43	NO	43	24	21	17	17	2	4	NO	NO	NO	34
Other kerosene	215	346	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	6
Other liquid	377	NO	NO	42	84	167	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	79	NO	NO	NO	NO	39	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	27
Coal	22398	5180	2162	2988	2390	2203	2150	2045	1940	1940	1783	1574	2098	1861	983	1075	962	831	772
Peat briquettes	836	309	31	15	NO	NO	NO	NO	NO	1	1	6	1	3	4	NO	1	NO	NO
Peat	292	82	10	NO	NO	10	NO	20	40	60	30	10	20	29	28	NO	10	NO	NO
Natural gas	24289	7150	6218	7061	8098	8795	9651	9632	9983	11027	10959	10241	11819	10343	10477	9809	9670	9101	9888
Wood	26448	38643	33808	36561	36249	38159	39302	39211	38080	38067	35123	38811	30222	30442	33226	29652	28585	24043	23716
Charcoal	NO	NO	NO	NO	NO	NO	30	60	30	45	60	60	60	60	59	90	90	60	65
Landfill gas	NO	NO	NO	NO	46	162	242	251	259	271	290	314	314	327	325	357	353	407	396
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	91	358	523	673	887	836
Straws	NO	NO	NO	NO	NO	NO	NO	NO	11	16	14	29	59	43	38	58	99	106	120
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5	79	90	108	71	90	66
Waste oils	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO	4
1.A.4.a. Commercial/Institutional																			
Total	40346	16517	11356	12366	13179	13856	15142	14292	14964	15997	13248	12578	13329	11772	12743	12526	12038	11770	11348
Liquid Fuels	13453	2890	1715	1928	1818	2207	2167	1860	2289	1902	1596	1586	1619	1397	1859	1939	2129	2243	1606
Solid Fuels	14913	2903	1565	1536	1423	1338	1285	1049	1075	1075	918	735	1023	891	354	519	407	323	292
Peat	672	114	31	15	NO	10	NO	20	40	61	31	16	1	32	32	NO	11	NO	NO
Gaseous Fuels	6090	2328	3054	3347	4103	4278	4680	4598	4851	5676	5679	5415	5623	5055	4952	4477	4401	4166	4514
Biomass	5218	8282	4991	5497	5709	5965	6894	6737	6651	7253	4995	4826	5054	4398	5546	5591	5090	5038	4934
Other Fossil Fuels	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO	2
Gasoline	44	NO	88	77	46	44	44	44	44	44	44	44	44	88	44	88	44	44	33
Diesel oil	8116	1189	1020	1190	1317	1530	1657	1275	1700	1657	1360	1393	1418	1251	1713	1755	1924	2054	1273
RFO	4953	1177	528	528	325	284	244	365	365	40	80	41	41	2	NO	NO	NO	1	4
LPG	46	91	NO	91	46	182	137	137	137	137	91	91	99	54	98	96	161	144	249
Jet fuel	NO	86	NO	NO	NO	NO	43	NO	43	24	21	17	17	2	4	NO	NO	NO	34
Other kerosene	43	346	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	6
Other liquid	251	NO	NO	42	84	167	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	79	NO	NO	NO	NO	39	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	27
Coal	14913	2903	1565	1536	1423	1338	1285	1049	1075	1075	918	735	1023	891	354	519	407	323	265

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Peat briquettes	511	62	31	15	NO	NO	NO	NO	NO	1	1	6	1	3	4	NO	1	NO	NO
Peat	161	52	NO	NO	NO	10	NO	20	40	60	30	10	NO	29	28	NO	10	NO	NO
Natural gas	6090	2328	3054	3347	4103	4278	4680	4598	4851	5676	5679	5415	5623	5055	4952	4477	4401	4166	4514
Wood	5218	8282	4991	5497	5663	5803	6652	6485	6381	6966	4691	4482	4680	3997	5163	5087	4603	4512	4455
Landfill gas	NO	NO	NO	NO	46	162	242	251	259	271	290	314	314	327	325	357	353	407	396
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	49	69	74	68
Straws	NO	NO	NO	NO	NO	NO	NO	NO	11	16	14	29	57	43	24	44	53	30	15
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	31	34	54	12	15	NO
Waste oils	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO	2
1.A.4.b. Residential																			
Total	35751	37659	32851	36298	35666	37702	38261	38948	37955	37271	37067	40809	33561	33797	35117	31228	30846	25862	26012
Liquid Fuels	4908	1402	1443	1441	1441	1398	1443	1577	1621	1438	1393	2025	2237	2229	2236	2237	2283	2055	2140
Solid Fuels	6404	1821	512	1338	854	787	787	944	813	813	813	813	1049	944	577	530	531	501	498
Peat	425	252	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	NO	NO	NO	NO	NO	NO
Gaseous Fuels	4004	4181	2659	3001	3293	3667	3958	4193	4326	4587	4693	4304	5219	4480	4481	4266	4252	4116	4510
Biomass	20010	30003	28227	30518	30078	31850	32073	32234	31195	30433	30168	33667	25036	26144	27823	24195	23780	19190	18864
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	NO	NO	132	132	132	132	132	220	264	264	264	264	264	264	263	264	264	220	220
Diesel oil	1912	127	127	170	170	127	127	127	127	127	127	850	1062	1062	1062	1062	1062	1062	1154
RFO	41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	2869	1275	1184	1139	1139	1139	1184	1230	1230	1047	1002	911	911	903	911	911	957	773	766
Other kerosene	86	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	6404	1821	512	1338	854	787	787	944	813	813	813	813	1049	944	577	530	531	501	498
Peat briquettes	294	232	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	131	20	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	NO	NO	NO	NO	NO	NO
Natural gas	4004	4181	2659	3001	3293	3667	3958	4193	4326	4587	4693	4304	5219	4480	4481	4266	4252	4116	4510
Wood	20010	30003	28227	30518	30078	31850	32043	32174	31165	30388	30108	33607	24974	26084	27764	24105	23690	19130	18799
Charcoal	NO	NO	NO	NO	NO	NO	30	60	30	45	60	60	60	60	59	90	90	60	65
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	NO	NO	NO	NO	NO	NO
1.A.4.c. Agriculture/Forestry/Fisheries																			
Total	25995	6005	4910	5365	4983	5716	6025	5815	5938	6077	5088	5436	6050	6059	6079	6394	6383	6781	7189
Liquid Fuels	9468	4526	3730	3994	3660	4282	4326	4370	4546	4548	4125	4167	4478	4725	4255	4300	4341	4589	4913
Solid Fuels	1081	456	85	113	113	78	78	52	52	52	52	26	26	26	52	26	24	7	9
Peat	31	25	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	14195	641	505	712	702	850	1014	841	806	764	587	521	977	808	1044	1066	1017	819	864
Biomass	1220	358	590	546	508	506	607	552	534	713	324	722	569	500	727	1002	1001	1366	1401
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2
Gasoline	1628	88	44	11	17	44	44	44	44	44	NO	NO	NO	88	88	88	46	25	82

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel oil	6161	3951	3442	3739	3399	3994	4079	4164	4461	4504	4079	4122	4462	4589	4121	4164	4248	4472	4722
RFO	1421	487	244	244	244	244	203	162	41	NO	NO	NO	3	3	NO	NO	NO	NO	NO
LPG	46	NO	NO	NO	NO	NO	NO	NO	NO	NO	46	45	13	45	46	48	47	92	109
Other kerosene	86	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	1081	456	85	113	113	78	78	52	52	52	52	26	26	26	52	26	24	7	9
Peat briquettes	31	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	14195	641	505	712	702	850	1014	841	806	764	587	521	977	808	1044	1066	1017	819	864
Wood	1220	358	590	546	508	506	607	552	534	713	324	722	568	361	299	460	292	401	462
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	91	358	474	604	814	768
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	14	14	46	76	105
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	48	56	54	59	75	66
Waste Oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2

1.A.5 Other

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.A.5 Other (Not elsewhere specified)																			
Total	NO	NO	2	2	94	84	131	104	103	39	47	73	107	98	100	88	128	130	155
Liquid Fuels	NO	NO	2	2	94	84	131	104	103	39	47	73	107	98	100	88	128	130	155
Solid Fuels	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
Gaseous Fuels	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
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	NO	NO	2	2	2	2	3	2	6	1	5	1	0	NO	NO	NO	NO	NO	NO
Diesel oil	NO	NO	NO	NO	75	65	111	77	73	14	21	49	87	80	79	63	105	112	121
Jet fuel	NO	NO	NO	NO	17	17	17	24	24	24	21	23	20	18	21	24	23	18	34

Annex III: 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

NFR Code	Longname
3B4h	Manure management - Other animals (please specify in IIR)
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)
1A3aai(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)