# LITHUANIA'S INFORMATIVE INVENTORY REPORT 2023

## Air Pollutant Emissions 1990-2021

## under the UNECE CLRTAP and the EU NECD

**Part 1 – General information**

**Part 2 - Transport**

**Lithuanian Environmental Protection Agency**

# Contents

# Abbreviations

**BC** – black carbon;
**CEIP** – Centre on Emission Inventories and Projections;
**CPST** – Centre for Physical Sciences and Technology in Lithuania;
**CLRTAP** – Convention on long Range Transboundary Air Pollutants (ECE/EB.AIR/97);
**CORINAIR** – The Core Inventory of Air Emissions in Europe;
**SDA** – Statistics Lithuania (State Data Agency);
**DSI** – dry sorbent injection;
**EMEP/EEA** – European Monitoring and Evaluation Program / European Environmental Agency;
**EMEP/EEA 2016 or 2019 guidebook** - The EMEP/EEA air pollutant emission inventory guidebook, where 2016 or 2019 is the year when guidebook was approved;
**EMEP/CORINAIR** - Atmospheric emission inventory guidebook, Cooperative Programme for Monitoring and Evaluation on the Long-Range Transmission of Air Pollutants in Europe, The Core Inventory of Air Emissions in Europe;
**E-PRTR** – European Pollutant Release and Transfer Register;
**ESP** – electrostatic precipitation;
**FF** – fabric filter;
**FRD** – Fire and Rescue Department under the Ministry of the Interior of the Republic of Lithuania;
**GHG** – Green-house Gas;
**HCB** – hexachlorobenzene;
**IIR** – Informative Inventory Report;
**IPCC GPG 2000** – IPCC Good Practice Guidance and Uncertainty management in national Greenhouse Gas Inventories (2000);
**IPPU** - industrial processes and product use sector;
**KCA** – key category analysis;
**EPA or LEPA** – Environmental Protection Agency under the Ministry of Environmental Protection (Lithuanian Environmental Protection Agency);
**MoE** - Ministry of the Environmental Protection;
**NECD** – National Emission Ceilings directive (ES)2016/2284;
**NFR** – Nomenclature for Reporting;
**NMVOC** – non-methylated volatile organic compounds;
**PAH** – Polycyclic aromatic hydrocarbons;
**PCB** – polychlorinated biphenyl;
**PCDD/PCDF** – polychlorinated dibenzodioxins / polychlorinated dibenzofurans;
**PM** – particulate matter;
**POP** – persistent organic pollutants.
**RC** - emission reduction commitments
**SNCR** – selective non-catalytic reduction;
**TERT** - European Commission Technical Expert Review Team;
**Tier 1** – A method using readily available statistical data on the intensity of processes (activity rates) and default emission factors. These emission factors assume a linear relation between the intensity of the process and the resulting emissions. The Tier 1 default emission factors also assume an average or typical process description. This method is the simplest method, has the highest level of uncertainty and should not be used to estimate emissions from key categories;
**Tier 2** – is similar to Tier 1 but uses more specific emission factors developed on the basis of knowledge of the types of processes and specific process conditions that apply in the country for which the

inventory is being developed. Tier 2 methods are more complex, will reduce the level of uncertainty, and are considered adequate for estimating emissions for key categories;
**TFEIP** – Task Force on Emission Inventories and Projections;
**TSP** – total suspended particles;
**UN** – United Nations;
**UNFCCC** – United Nations Framework Convention on Climate Change;
**UNECE** - the United Nations Economic Commission for Europe.

# Executive summary

Inventory report of air pollutants emissions in Lithuania has been prepared by Lithuanian Environment Protection Agency (EPA) and State research institute Center for Physical Sciences and Technology (CPST) according to the Reporting Guidelines (hereinafter – Reporting Guidelines) and Gothenburg Protocol and National Emissions Ceilings Directive (NECD). The Informative Inventory Report (IIR) is submitted to the UNECE Secretariat and EEA annually.

EPA is responsible for the annual preparation and submission of the Informative Inventory Report and the inventories in the NFR format to the UNECE-LRTAP Convention institutions and the European Commission. EPA also participates in meetings under the NECD and the related expert panels.

This report includes information on the emission data from 1990 to 2021 for anthropogenic emissions of NOx, NMVOC, SO2, NH3 (main pollutants); CO (other); TSP, PM10, PM2.5, 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. Detailed information about emission trends and pollutants produced in each sector can be found under appropriate sectors and subsectors.

Lithuania's IIR Submission 2023 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.

The IIR 2023 consists of 6 parts - Part 1 General information (including main information, emission trends, implementation of recommendations, etc.); Part 2 – Transport (transport and non-road mobile sources); Part 3 - Energy; Part 4 - Industrial processes and product use; Part 5 - Agriculture; Part 6 - Waste.

The report shows how Lithuania complies to and follows the Guidelines for Reporting Emission Data for inventory preparation, how attempts to ensure transparency, accuracy, consistency, comparability, and completeness (TACCC) of the reporting. The submission of results was closely followed according to the template provided by the CLRTAP's Task Force on Emission Inventories and Protections (TFEIP) Secretariat.

Main differences from the last submission are:

1) Improved IIR by including more details on calculation methodologies, activity data, uncertainties, etc.;

2) More detailed evaluation of previously estimated categories, e.g., category 2d3i *Other Solvent use* ;

3) Improved methodologies and activity data in multiple categories, for instance, NFR 1A1a Public electricity and heat production, 2.D.3.a Domestic solvents, 2D3h Printing, 2H2 Food and beverages industry.

4) implemented recommendations, technical corrections, and revised estimates from European Commission Technical Expert Review Team (TERT) (implementation status of each observation is indicated in ANNEX 1).

There is a necessity for inventory improvement in the future, especially in categories, listed by the TERT on the last Review of National Air Pollutant Emission Inventory Data 2022 under Directive (EU) 2016/2284 and which weren't implemented during 2023 submission.

# Part 1 – General information

## 1.1. 1. INTRODUCTION

The Convention on Long-range Transboundary Air Pollution (CLRTAP) was signed in Geneva in 1979 by 34 Governments and the European Community. It was the first international document addressing problems of transboundary air pollution.

In January of 1994 the Republic of Lithuania ratified the 1979 Geneva Convention on Long-Range Transboundary Air Pollution and became a party to the Convention and its protocols. One of the obligations to the Convention on LRTAP is to submit an annual pollution emission inventory. According to the Reporting Instruction of Reporting Guidelines under the CLRTAP (ECE/EB.AIR.125) time series of emissions under nomenclature for reporting (NFR) and informative inventory reports (IIR) have to be submitted every year, including recalculated emissions for the period from 1990. Projection reports, gridded data and large point sources (LPS) information have to be reported every 4 years.

The Convention entered into force in 1983 and has been extended by eight protocols, which specify financing aspects of the cooperative monitoring and evaluation programme, address groups or individual pollutants' reduction and control issues, and other issues, such as eutrophication, acidification and ground level ozone formation. The following classes of pollutants are addressed in the inventory:

- Main pollutants ($SO_x$, $NO_x$, NMVOC, $NH_3$ );
- Particulate matter (TSP, $PM_{10}$, $PM_{2.5}$ and BC);
- Other (CO);
- Heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn);
- Persistent organic pollutants (PCBs, Dioxins, Furans, PAHs and HCB).

The trend of national emissions of the main pollutants and PM2,5 and reduction commitments under NECD for 2020-2029 are shown in the Figure below.

The 2023 Lithuanian IIR contains information on the national inventory for 2021 including descriptions of methodologies and NFR categories, input parameters, improvement, QA/QC, recalculations, analysis and interpretation of results, assessment for TACCC and other sections as formulated in ECE.EB.AIR.125 revised guidelines. Changed parameters are applied retrospectively for previous submissions and recalculated values are changed accordingly for annual submissions.

Emission estimates are mainly based on official Lithuanian Statistics: energy, production, agricultural, transport and other statistical data, which is available on the main website

https://osp.stat.gov.lt/. EMEP/EEA 2019 Guidebook is often referred to when calculating category-specific emissions.

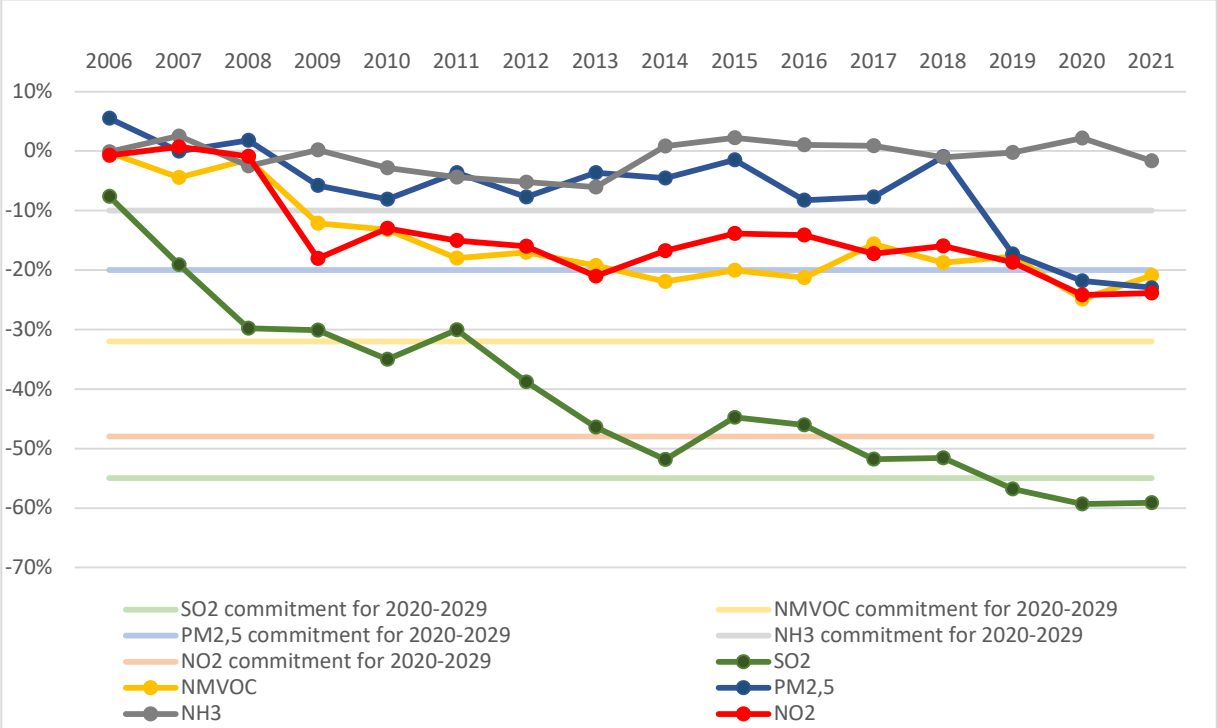



Figure 1-1. National emissions of 5 pollutants (darker shade curves) for period 2005-2021 as a percentage of base year 2005. Straight lines indicate emission reduction commitments for 2020-2029 as set out in the NECD.

## 1.2. Institutional Arrangements

The Lithuanian Environmental Protection Agency under the Ministry of Environment in 2011 was nominated to be responsible for the inventory communication by the Order No. D1-85. EPA have made a legal arrangement with State research institute Center for Physical Sciences and Technology (CPST) to compile about 30 percent of the inventory reports (transport sector, several categories from IPPU and waste sectors). Reports are delivered annually and is firstly estimated and compiled by experts of CPST. EPA's Ambient Air quality divisions specialists then recalculate, improve, check, archive and approve final

inventory version. The EPA has a legal responsibility for submission of the inventory under Convention on LRTAP and NECD.

No other institutional arrangements are made.

The inventory reports documentation is archived in EPA's computers. Information and activity data which is used to compile inventory reports is saved in the EPA database and retrieved if needed.

Inventory improvements are prioritized based on the following factors:

1) Stages 1, 2 and 3 inventory reviews, which can be accessed on ceip.at website;
2) TERT reviews and recommendations.

## 1.3. Inventory Preparation Process

Inventory preparation at EPA is carried out with the help of experts of the Center for Physical Sciences and Technology (CPST). The activity data is mainly gathered from publicly available databases. The major and most accurate database is the Official Statistics Portal managed by the State Data Agency. The main activity data sources are available in

Table 1-1.

The brief process of inventory preparation is shown in Figure 1-2.**Klaida! Nerastas nuorodos šaltinis.**. Inventory preparation process

Every year entire time series (from 1990 to the reporting year) are checked and revised, recalculations performed for changes made (error corrections, data improvement or methodology enhancement, implementation of annual inventory review recommendations). Lithuania has been reporting data regarding national total and sectoral emissions under The LRTAP convention since 2000.

The Figure 1-2 illustrates the process of inventory preparation from the first step of collecting external data to the last step, where the reporting schemes are generated for the United Nations Economic Commission for Europe/Cooperative Programme for Monitoring and Evaluation of the Longrange Transmission of Air Pollutants in Europe (UNECE/EMEP) (in the NFR format (Nomenclature For Reporting)).

## 1.4. Methods and Data Sources

Lithuania's air emission inventories are based on EMEP/EEA air pollutant emission inventory guidebook 2019 (EMEP/EEA 2019) with an exceptions in few sectors where previous versions of EMEP emission inventory guidebooks and methodologies from 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) are used. For the transport emission evaluation COPERT V model is used, like it is proposed for the compilation of EMEP/EEA emission inventories. Also, for evaluation of the emissions from some categories additional research was made, to compile data and investigate appropriate approach to fulfil Convention obligations.

Activity data for the compilation of the 1990-2021 inventory is obtained from State Data Agency, Eurostat, sectoral ministries and other enterprises and institutions. For major part of the NFR categories 2019 EMEP/EEA Guidebook with provided emission factors was applied. All methodologies (including specific) which were utilized are described for each NFR category. The most frequently used approach was Tier 2.

Table 1-1 describes the main activity data used for compilation of inventories and it's sources.

Table 1-1. Summary of the main activity data sources

| *Category* | *Activity Data* | *Source* |
|---|---|---|
| **Energy (NFR 1)** | | |
| **Energy Industries (NFR 1.A.1)** | Fuel Consumption | Official Statistics Portal (Statistics Lithuania (State Data Agency)) |
| **Residential, public and Commercial Machinery (NFR 1.A.4)** | Fuel Consumption | Official Statistics Portal (Statistics Lithuania (State Data Agency)) |
| **Oil and Gas Exploration, Transportation, Production (NFR 1.B.2)** | Fuel Production | Official Statistics Portal (Statistics Lithuania (State Data Agency)) |
| **Industrial Processes (NFR 2)** | | |
| **Mineral Products (NFR 2.A)** | Production Information | Official Statistics Portal (Statistics Lithuania (State Data Agency)) |
| | | Source-specific Information from Production Plants |
| **Solvent and Other Products Use (NFR 2.D)** | Solvent Consumption | European Asphalt Pavement Association Yearbook |
| | | Official Statistics Portal (Statistics Lithuania (State Data Agency)) |

| | | |
|---|---|---|
| | | GHG Inventory Report 2021 |
| | | Eurostat |
| | | Source-specific Information from Production Plants |
| **Agriculture (NFR 3)** | | |
| **Manure Management (3.B)** | Number of animals | Official Statistics Portal (Statistics Lithuania (State Data Agency))/ data recalculated to AAP |
| **Crop Production and Agricultural Soils (3.D)** | Fertilizers usage, waste usage beneficial for agriculture, crop areas, pesticide usage | International Fertilizer Industry Association Database |
| | | Food and Agriculture Organization of the UN, Statistics Division |
| | | Official Statistics Portal (Statistics Lithuania (State Data Agency)) |
| | | EPA Waste Registry Database |
| **Waste (NFR 5)** | | |
| **Waste Treatments (NFR 5)** | Amount of Waste | GHG Inventory Report 2021 |
| | | Fire and Rescue Department under the Ministry of the Interior of the Republic of Lithuania Database |
| | | Official Statistics Portal (Statistics Lithuania (State Data Agency)) |
| | | EPA Waste Registry Database |

## 1.5. Key categories

The determination of key categories has not been made due to insufficient resources being available.

## 1.6. QA/QC and general uncertainty evaluation

Quality assurance and Quality control (QA/QC) activities are carried out in the inventory preparation process. QC activities mostly include general methods, such as accuracy checks on data acquisition and calculations, the use of approved standardized procedures for emission calculations,

measurements, implementing of the inventory review observations, archiving information and reporting. These activities are implemented by national inventory compiler (EPA).

Uncertainty evaluation is carried out not to a full extent to insufficient resources being available.

## 1.7. General Assessment of Completeness

The NFR Report is completed using following notation keys if numerical pollutant emission value is not provided:

- NO (not occurring) is used for processes that do not occur in the country;
- NE (not estimated) appears for emissions that do happen but are not estimated due to data unavailability or negligibility of emissions;
- NA (not applicable) is used for activities that do not emit specific pollutant;
- IE (included elsewhere) for pollutant emissions which are estimated but included in another category.

Table 1-2. Sources included elsewhere (IE) in 2021

| NFR code | Included in NFR category |
|---|---|
| Stationary combustion in manufacturing industries and construction: Iron and steel (1A2a) | Stationary combustion in manufacturing industries and construction: Other 1A2gviii |
| Stationary combustion in manufacturing industries and construction: Non-ferrous metals (1A2b) | Stationary combustion in manufacturing industries and construction: Other 1A2gviii |
| Venting and flaring (oil, gas, combined oil and gas) (1B2c) | Fugitive emissions oil: Refining and storage (1B2aiv) |
| Other product use (please specify in the IIR) (2G) | Other solvent use (2.D.3.i) |

## 1.8. Pollutant Emission Trends

The emission estimates of air pollutants in Lithuania include emissions from following gases: sulphur dioxide (SO2), nitrogen oxides (NOx), carbon monoxide (CO), non-methane volatile organic

compounds (NMVOC), ammonia (NH3), particulate matter (TSP, PM10, PM2.5), heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn), PAHs, PCBs and PCDD/F.

The emissions trends (1990-2021) of nitrogen oxides, carbon monoxide, non-methane volatile organic compounds, ammonia and sulphur dioxide emissions are presented in Table 11-3 and Figure 1-3.

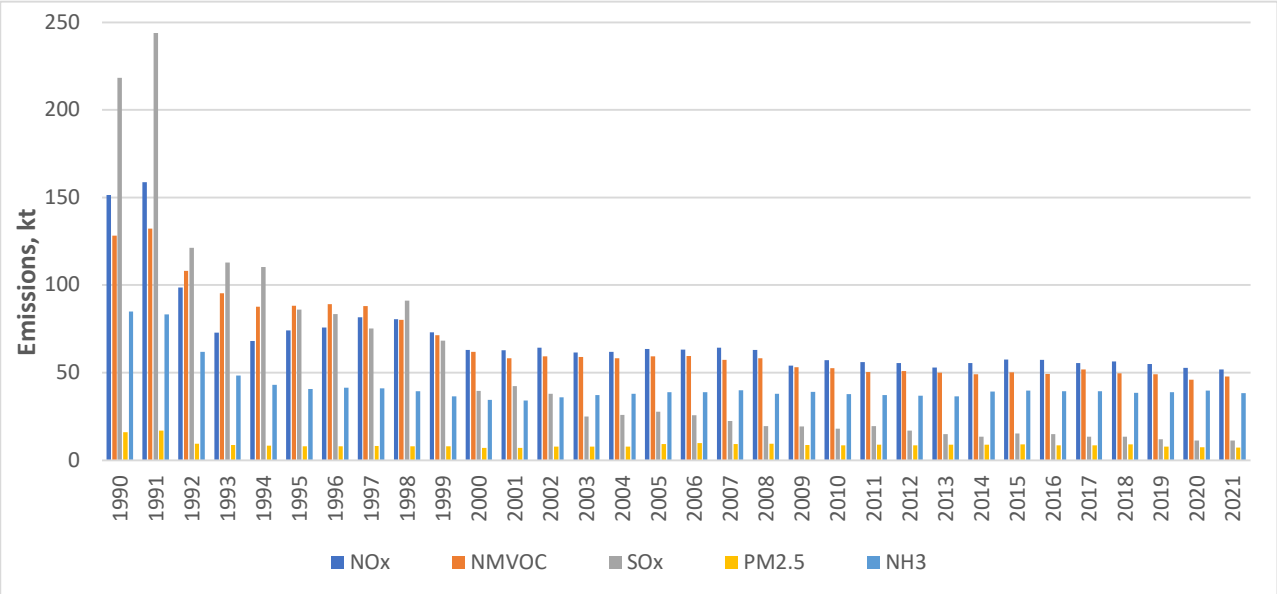



Figure 1-3. Development of emissions 1990-2021

A rapid decrease of emissions followed the decline of the country economy in the 1990 (Figure 1-3). Since 2000, the GDP has been growing continuously with economy transformation. The fluctuations of the emissions since 2005 are less visible but there is a a slight decrease especially in NOx, NMVOC and SO2 emissions.

Table 1-3. 5 main pollutant emissions in the period 1990-2021, (National total, kt)

| | NOx | NMVOC | SO2 | NH3 | PM2.5 |
|---|---|---|---|---|---|
| **1990** | 151,44 | 128,06 | 218,33 | 84,94 | 16,08 |
| **1991** | 158,80 | 132,23 | 244,00 | 83,38 | 17,03 |
| **1992** | 98,54 | 108,00 | 121,20 | 61,82 | 9,60 |

| | | | | | |
|---|---|---|---|---|---|
| **1993** | 72,92 | 95,40 | 112,91 | 48,40 | 8,81 |
| **1994** | 68,11 | 87,54 | 110,38 | 43,22 | 8,44 |
| **1995** | 74,13 | 88,08 | 86,04 | 40,73 | 7,91 |
| **1996** | 75,87 | 89,17 | 83,55 | 41,28 | 7,95 |
| **1997** | 81,57 | 88,04 | 75,14 | 40,95 | 8,06 |
| **1998** | 80,43 | 80,04 | 91,17 | 39,45 | 7,96 |
| **1999** | 73,05 | 71,34 | 68,13 | 36,60 | 7,99 |
| **2000** | 63,06 | 61,86 | 39,64 | 34,48 | 7,08 |
| **2001** | 62,79 | 58,32 | 42,38 | 34,00 | 7,10 |
| **2002** | 64,35 | 59,30 | 38,00 | 36,00 | 7,79 |
| **2003** | 61,52 | 59,00 | 24,96 | 37,19 | 7,66 |
| **2004** | 61,97 | 58,26 | 25,94 | 38,06 | 7,66 |
| **2005** | 63,53 | 59,35 | 27,73 | 38,95 | 9,34 |
| **2006** | 63,30 | 59,44 | 25,62 | 38,90 | 9,85 |
| **2007** | 64,30 | 57,29 | 22,44 | 39,95 | 9,33 |
| **2008** | 63,01 | 58,31 | 19,47 | 37,98 | 9,50 |
| **2009** | 53,96 | 53,15 | 19,38 | 39,03 | 8,80 |
| **2010** | 57,13 | 52,62 | 18,02 | 37,86 | 8,58 |
| **2011** | 56,06 | 50,46 | 19,40 | 37,25 | 9,00 |
| **2012** | 55,56 | 50,99 | 16,98 | 36,91 | 8,61 |
| **2013** | 52,91 | 50,08 | 14,86 | 36,58 | 9,00 |
| **2014** | 55,67 | 49,16 | 13,35 | 39,21 | 8,91 |
| **2015** | 57,48 | 50,20 | 15,32 | 39,75 | 9,19 |
| **2016** | 57,34 | 49,40 | 14,96 | 39,24 | 8,56 |
| 2017 | 55,65 | 51,77 | 13,37 | 39,18 | 8,61 |
| 2018 | 56,40 | 49,67 | 13,43 | 38,42 | 9,25 |
| 2019 | 54,88 | 49,25 | 11,98 | 38,74 | 7,72 |
| 2020 | 52,67 | 45,94 | 11,27 | 39,61 | 7,30 |
| 2021 | 51,88 | 47,73 | 11,34 | 38,09 | 7,19 |

The amended Gothenburg Protocol under the UNECE established emission reduction commitments (RC) for 2020 for five pollutants: NOx, SO2, NMVOC, NH3 and PM2.5 and the same RC were agreed in NECD. The RC are expressed as a percentage reduction commitment in 2020 compared to the emission level in 2005. The definitions for what counts towards compliance is different between the

Gothenburg Protocol and the NECD. For the NECD, NOx and NMVOC emissions from NFR categories 3B and 3D are excluded when determining compliance. For reporting to the UNECE, NOx emissions from NFR category 3D are excluded from the reduction commitment. Table 1-4 shows the emissions in 2005 and 2021, the achieved emission reduction in comparison with the targets under NECD.

Table 1-4. Emissions (kt) and achieved reduction under the NECD

| | NOx | NMVOC | SO2 | NH3 | PM2.5 |
|---|---|---|---|---|---|
| 2005 emissions, kt | 56,01 | 45,51 | 27,73 | 38,95 | 9,34 |
| 2021 emissions, kt | 42,63 | 36,00 | 11,34 | 38,09 | 7,19 |
| Reduction, % 2021/2005 | -23,9 | -20,9 | -59,1 | -2,2 | -23 |
| **Reduction commitments 2020 vs 2005 (NECD)** | **-48%** | **-32%** | **-55%** | **-10%** | **-20%** |

### 1.8.1. Nitrogen Oxides ($NO_x$)

Total national nitrogen oxides emissions have decreased from 151.44 kt in 1990 to 51.88 kt in 2021 (Figure 1-4. National total emission trend for NOx, 1990 – ).

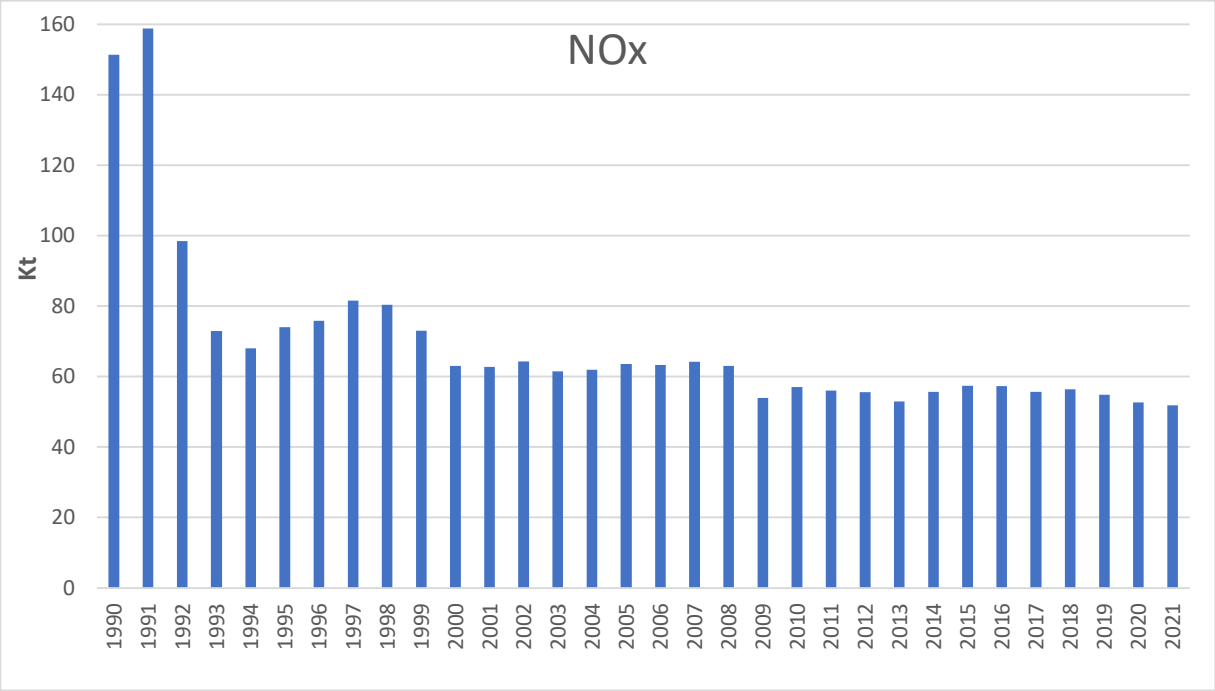



Figure 1-4. National total emission trend for NOx, 1990 – 2021

Road Transport (1.A.3) is the principal source of NOx emissions, contributing 45 % (and 23.44 kt) of the total in 2021 (Figure 1-4. National total emission trend for NOx, 1990 – 21). Energy production (including 1.A.1.a, 1.A.1.b, 1.A.1.c, 1.A.2.c, 1.A.2.d, 1.A.2.e, 1.A.2.f, 1.A.2.g.viii, 1.A.4.ai, 1.A.4.bi, 1.A.4.ci categories emissions) accounts for a decreasing percentage of the national total. The contribution of the sector in 1990 to the national total was 41.65 kt and decreased to 13.82 kt in 2021 as a result of the decrease in fuel consumption in the sector (Figure 1-5). Energy production is accounting for 26 % of NOx emissions in 2021. The remainder of the NOx emissions arise from combustion sources in agriculture and non-road mobile machinery categories.

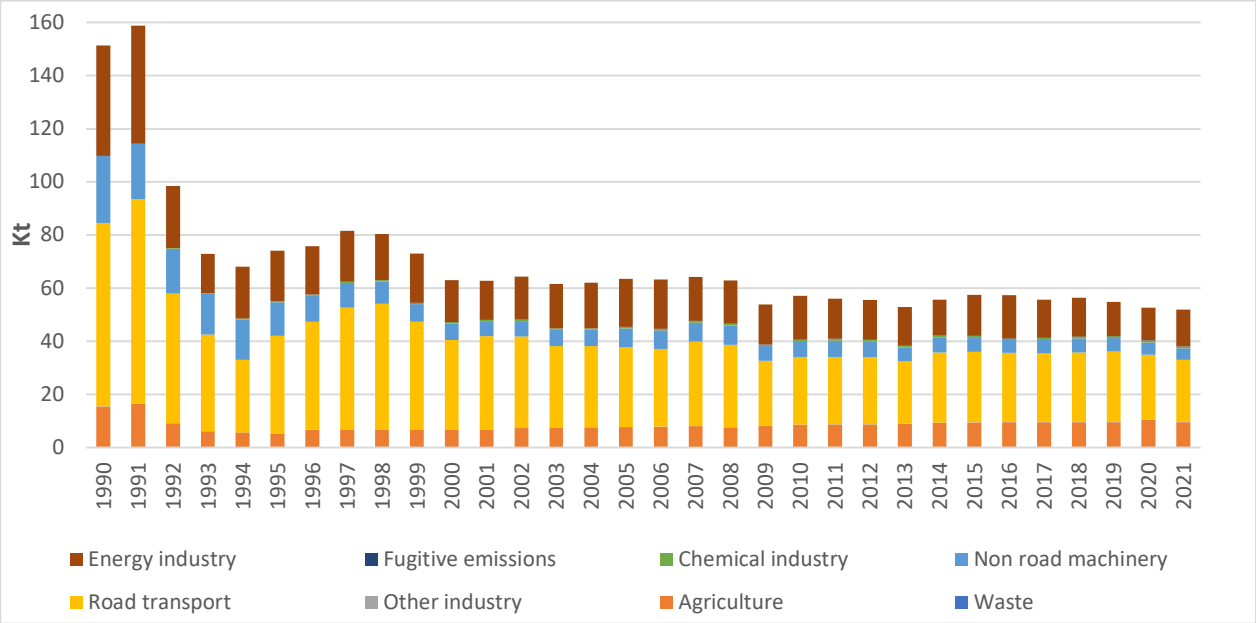



Figure 1-5. Emission trend for NOx by sectors, 1990 – 2021

Since 1990 the largest decrease of emissions has occurred in the road transport sector. It has been achieved because of fitting three-way catalysts to petrol fuelled vehicles. The decrease has been achieved also due to installation of low-$NO_X$ burners and denitrifying units in power plants and district heating plants.

### 1.8.2. Non-Methane Volatile Organic Compounds (NMVOC)

Total national non-methane volatile organic compounds emissions have decreased from 128.06 kt in 1990 to 47,73 kt in 2021 (Figure 1-6.). The emissions of NMVOC can be divided into main groups: evaporative emissions (solvent use, fugitive emissions) and incomplete combustion. The main contributors of NMVOC in the year 2021 are Fugitive emissions (1B2aiv), Energy production (1.A.1.a, 1.A.1.b, 1.A.1.c, 1.A.2.c, 1.A.2.d, 1.A.2.e, 1.A.2.f, 1.A.2.g.viii, 1.A.4.ai, 1.A.4.bi, 1.A.4.ci) and Solvent use (2.D.3.a, 2.D.3.d, 2.D.3.e, 2.D.3.f, 2.D.3.g, 2.D.3.h, 2.D.3.i) (Figure 1-7).

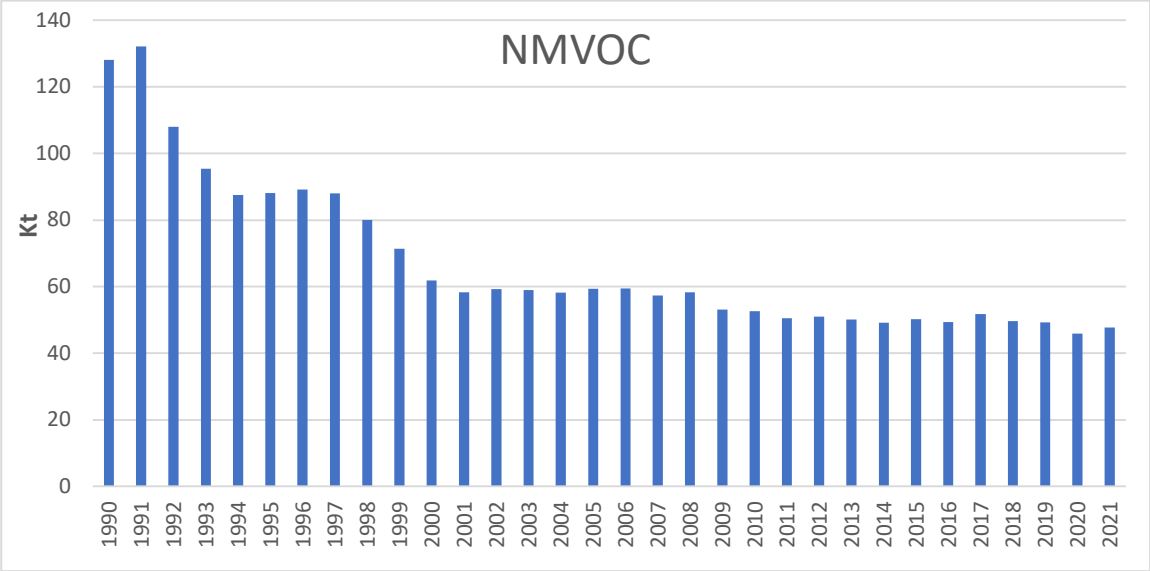



Figure 1-6. National total emission trend for NMVOC, 1990-2021

The decline in emissions since 1990 has primarily been due to reductions achieved in the road transport sector due to the introduction of vehicle catalytic converters, driven by tighter vehicle emission standards. The reductions in NMVOC emissions have been enhanced by the switching from petrol to diesel cars. Technological controls for volatile organic compounds (VOCs) in motor vehicles have been more successful than in the case of NOX, and have contributed to a significant reduction in emissions from Road Transport (1.A.3.b), responsible for 25,91 kt of NMVOC's in 1990 to 1,69 kt in 2021. (Figure ).

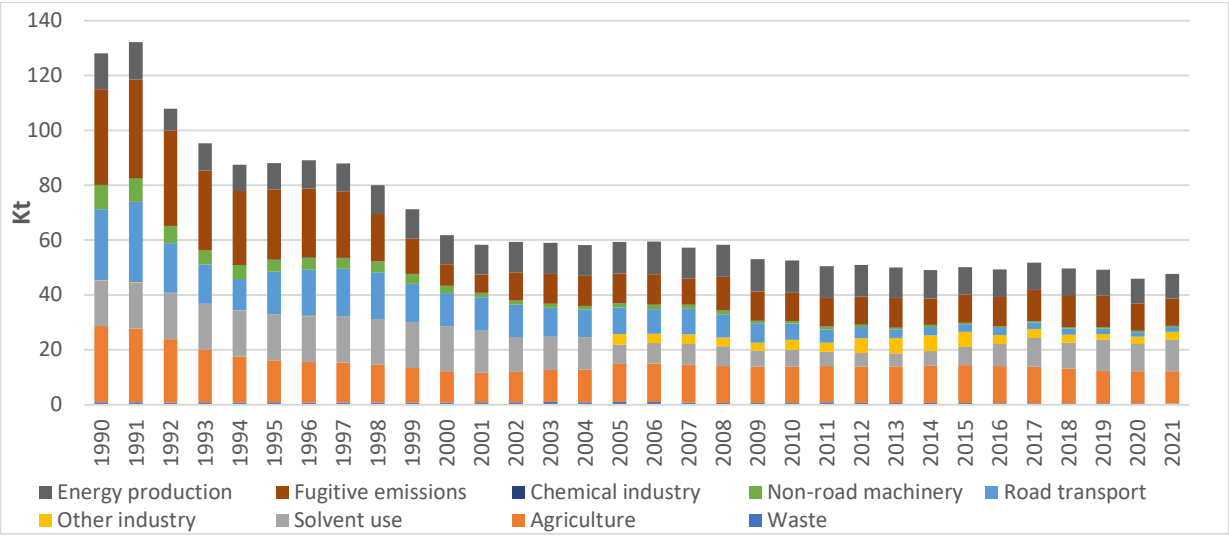



Figure 1-7. Emission trend for NMVOC by sectors, 1990-2021.

Agriculture, Solvent use, Fugitive emissions and Energy production are accounting for accordingly 25, 24, 21, 19 % of national total NMVOC emissions in 2021.

### 1.8.3. Sulphur Dioxide (SO2)

The main part of the $SO_2$ emission originates from combustion of fossil fuels, mainly coal and oil in public power plants and district heating plants. National total sulphur dioxide emissions decreased from 218,33 kt in 1990 to 11,34 kt in 2021 (Figure ). Energy production and Fugitive emissions oil: Refining /storage sectors remain the principal source of $SO_2$ emissions, contributing 92 % of the national total in 2021.

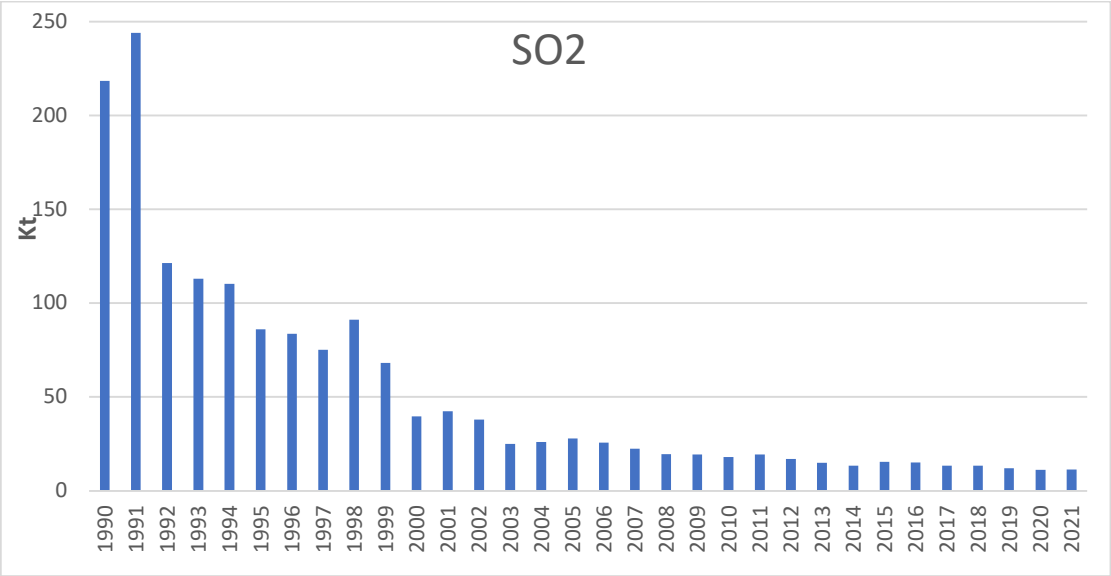



Figure 1-8. National total emission trend for $SO_2$, 1990-2021

Fugitive emissions oil: Refining / storage (1B2aiv) sector accounts for 52.7% of the total in 2021 and Stationary combustion in manufacturing industries and construction(1.A.2.c, 1.A.2.d, 1.A.2.e, 1.A.2.f,1.A.2.g.viii) and Residential combustion (1.A.4.bi) sectors account for the 18.7 %, Petroleum refining (1.A.1.b) – for 9.4%, Public electricity and heat production (1.A.1.a) contributes to 6.3% SO2 of national total emissions in 2021 (Figure 1-9).

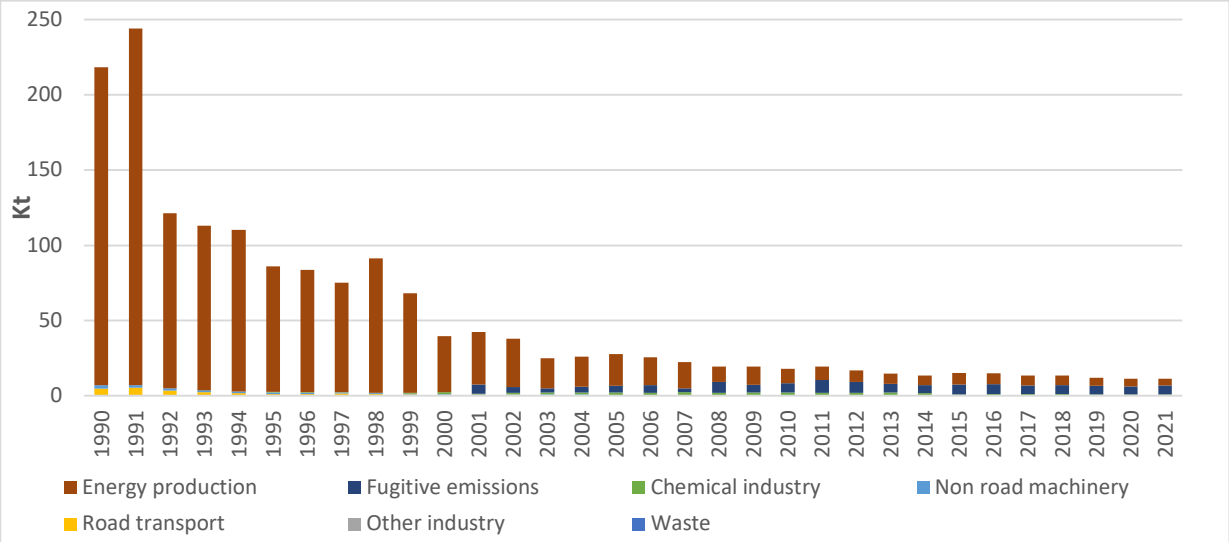



Figure 1-9. Emission trend for SO2 by sectors, 1990-2021

The large reduction of SO2 in Energy production sector is largely due to installation of desulphurisation plant, use of fuels with lower content of sulphur in public power and district heating plants, introduction of liquid fuels with lower content of sulphur and substitution of high-sulphur solid and liquid fuels to low-sulphur fuels such as natural gas. Despite the large reduction of the SO2 emissions, these plants still emit a significant part of the national total emission.

### 1.8.4. Ammonia (NH3)

The national total ammonia emissions decreased from 84,9 kt in 1990 to 38,1 kt in 2021 (Figure 1-10). This is mostly due to decreasing livestock population.

The biggest source of atmospheric emissions of $NH_3$ in 2021 was agricultural activities (96%) (Figure 1-11). Only a minor part of the total emission originates from Chemical industry, Energy production and Waste (aprox. 1.5%).

The major part of the emission from agriculture originate from livestock manure management (29 %) and agricultural soils (66 %). The largest source for manure management is losses of ammonia occurring during the handling of the manure in animal housing systems. For agricultural soils, the emissions are mainly coming from application of mineral and organic fertilisers.

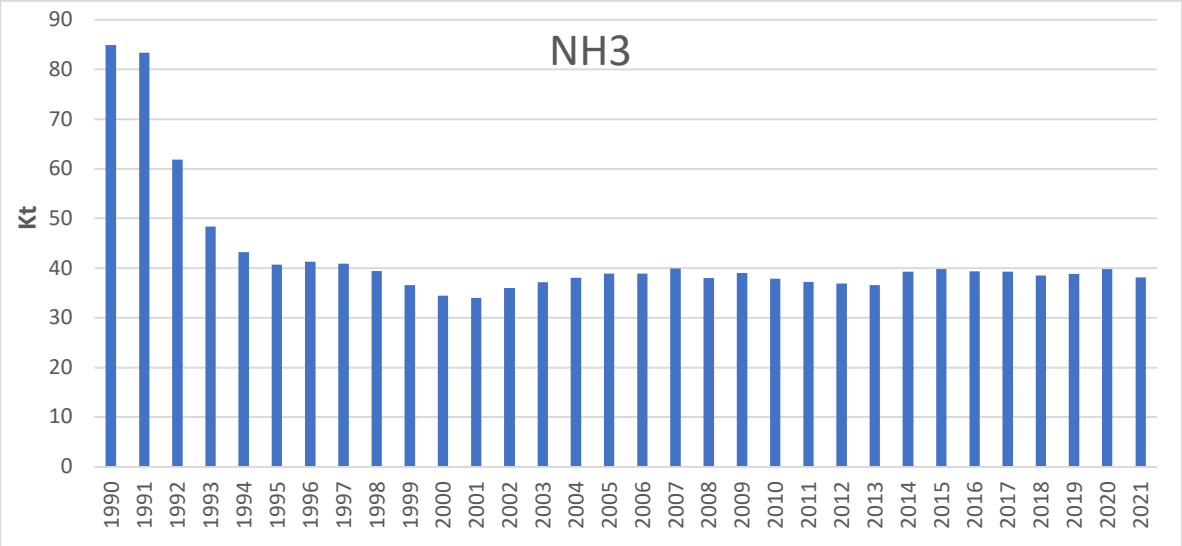



Figure 1-10. National total emission trend for NH3, 1990-2021

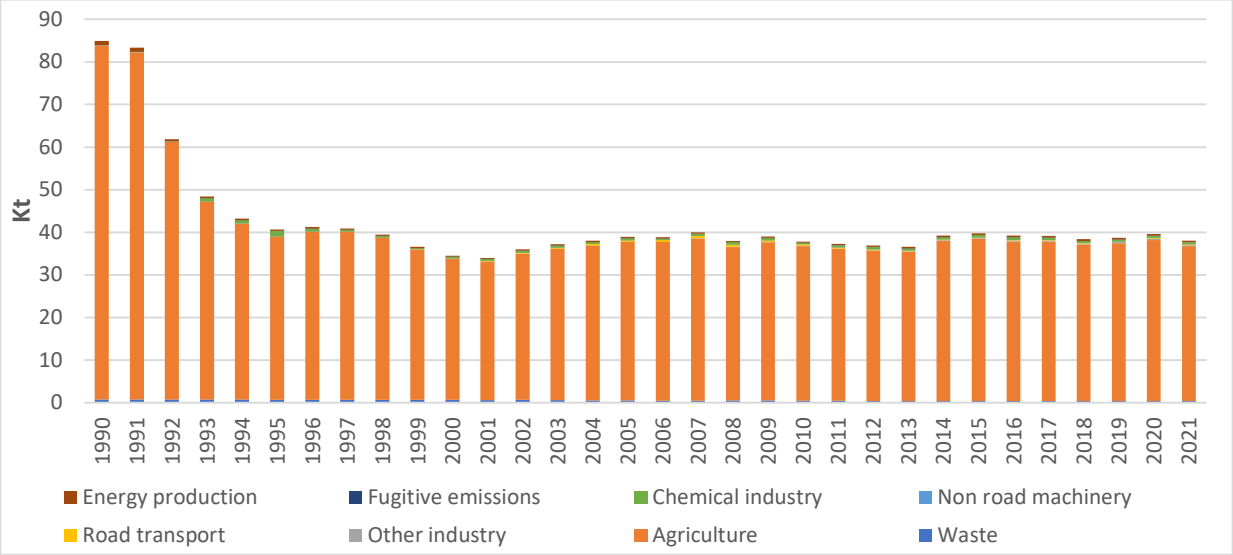



Figure 1-11. Emission trend for NH3 by sectors, 1990-2021

The emission ceilings of NECD were designed with the aim of attaining the European Community's interim environmental objectives set out in NECD. Meeting those objectives is expected to result in reduced acidification, health-and vegetation-related ground-level ozone exposure.

### 1.8.5. Particulate matter PM2.5

PM2.5 emissions have decreased from 16.1 kt in 1990 to 7.2 kt in 2021 (Figure 1-12). The largest emission source of PM2.5 are Energy production, Construction and demolition and Road transport, which contribute to 82 % of emissions (Figure 1-13). Energy sector contributes to significant PM2.5 emissions due to intensive combustion of wood, especially in Residential sector (1.A.4.bi).

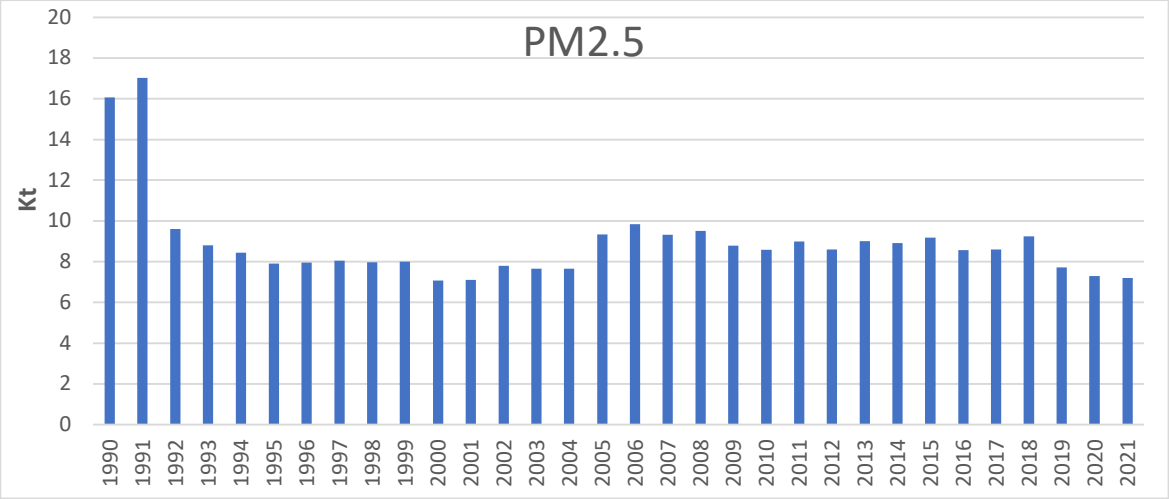



Figure 1-12. National total emission trend for PM2.5, 1990-2021

Road transport exhaust emissions account for 59 % of the transport PM2.5 emissions, while the emissions come from tyre and brake wear and road abrasion contribute to the rest of the PM2.5 emissions.

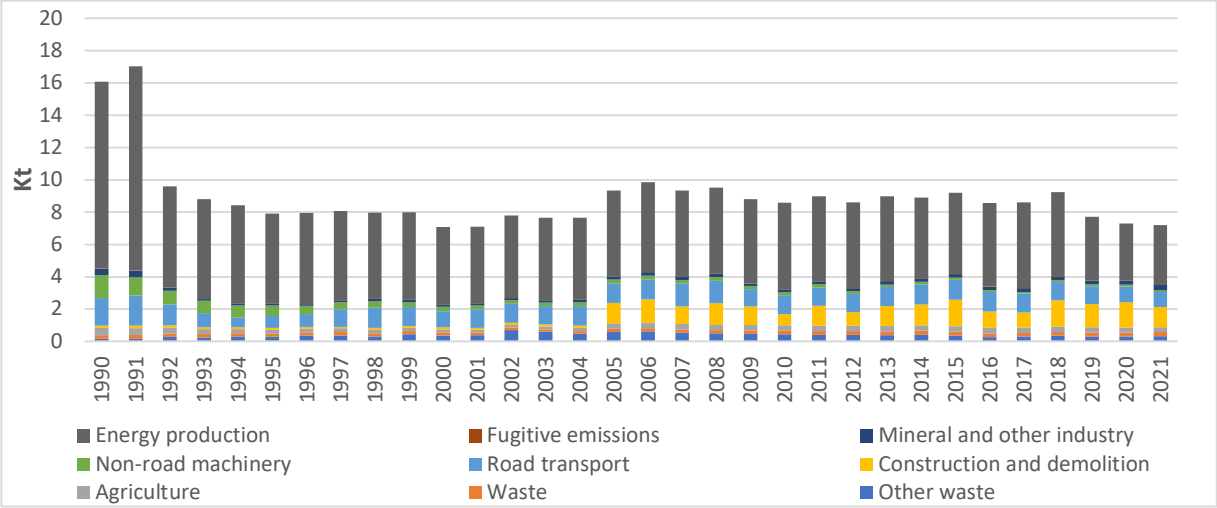



Figure 1-13. Emission trend for $PM_{2.5}$ by sectors, 1990-2021

# Part 2 – Transport

## 2. TRANSPORT (NFR 1.A.3)

Since 1990, the Government of Lithuania has adopted a number of important decisions on the reduction of transport pollution, i.e. national programs like "Transport and the Protection of Environment", "Measures for the Implementation of the National Transport Development Programme", and other programs aimed at reducing the negative impact of transport on the environment and on people's health. Due to a difficult economic situation, the implementation of these programs is slower than expected.

Please note that emissions from mobile sources are calculated based on **fuel sold** in Lithuania, thus national total emissions include, the main document, analyzing transport impact on the environment is the State Program "Transport and Environmental Protection". It includes the activities to be followed:

1. On motor road transport:

- national distribution of traffic flows.
- perfection of means for selection and training of drivers.
- trolley-bus network development in Vilnius and Kaunas.
- optimization of fuel prices.
- construction of new biotransport routes.

2. On railway transport:

- electrification of Lithuanian railways.
- pipeline transport development for oil products transportation.

3. On Sea transport:

- power supply from the municipal power network to the ships in the port.

4. On the Entire Means of Transport:

- the formation of the fleet of various means of transport, taking into account the existing ecological requirements. development and implementation of national ecological standards

Estimation of emissions in 1.A.3 *Transport* are carried out for each fuel in sub-categories are listed below:

- *Civil and International Aviation* 1.A.3.a
- *Road Transportation* 1.A.3.b
- *Railways* 1.A.3.c
- *Navigation* 1.A.3.d
- *Other Transportation* 1.A.3.e

## 2.1. Civil aviation (NFR 1A3ai(i)) and international aviation (NFR 1A3aii(i))

### 2.1.1.Overview of the Sector

This category includes activities related to air traffic within or in the surroundings of airports (landing and take-off cycles (LTO)). Civil aviation includes emissions both from domestic and international aviation LTO cycles. These categories are not key categories. This category does not include military aviation, which is reported under 1A5b sector.

Emissions from the aviation sector are split into different aircraft activities, and allocations are made according to the requirements for reporting:

1.A.3.a.i (i) International aviation LTO (civil);
1.A.3.a.ii (i) Domestic aviation LTO (civil);
1.A.3.a.i (ii) International aviation cruise (civil);
1.A.3.a.ii (ii) Domestic aviation cruise (civil).

International traffic includes all flights whose origin or final destination is a foreign airport. In Lithuania there are four international airports:

- Vilnius International Airport
- Kaunas Airport
- Palanga International Airport
- Šiauliai International Airport

### 2.1.2. Methods

Lithuania reports its air pollutants emissions according to the requirements of the CLRTAP as well as greenhouse gas according to the requirements of the UNFCCC. The nomenclature for both reportings is (almost) the same (NFR), but there are differences concerning the system boundaries. Emissions from civil aviation are accounted for differently under the CLRTAP and the UNFCCC: Only emissions from domestic flights are accounted for in the GHG inventory, while emissions from international flights are reported as memo items. For the reporting under the CLRTAP, landing and takeoff (LTO) emissions of domestic and international flights are accounted for, while emissions of international and domestic cruise flights are reported under memo items only.

| Differences between reporting under CLRTAP and UNFCCC concerning the accounting to the national total | | | CLRTAP / NFR-Templates | | | UNFCCC/CRTables | |
|---|---|---|---|---|---|---|---|
| | | | National total | National total for compliance | Memo item | National total | Bunker 1D |
| Aviation 1.A.3.a | Civil/Domestic aviation | Landing and Take-off (LTO) | Yes | Yes | No | Yes | No |
| | | Cruise | No | No | Yes | Yes | No |
| | International aviation | Landing and Take-off (LTO) | Yes | No | No | No | Yes |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Cruise | No | No | Yes | No | Yes |

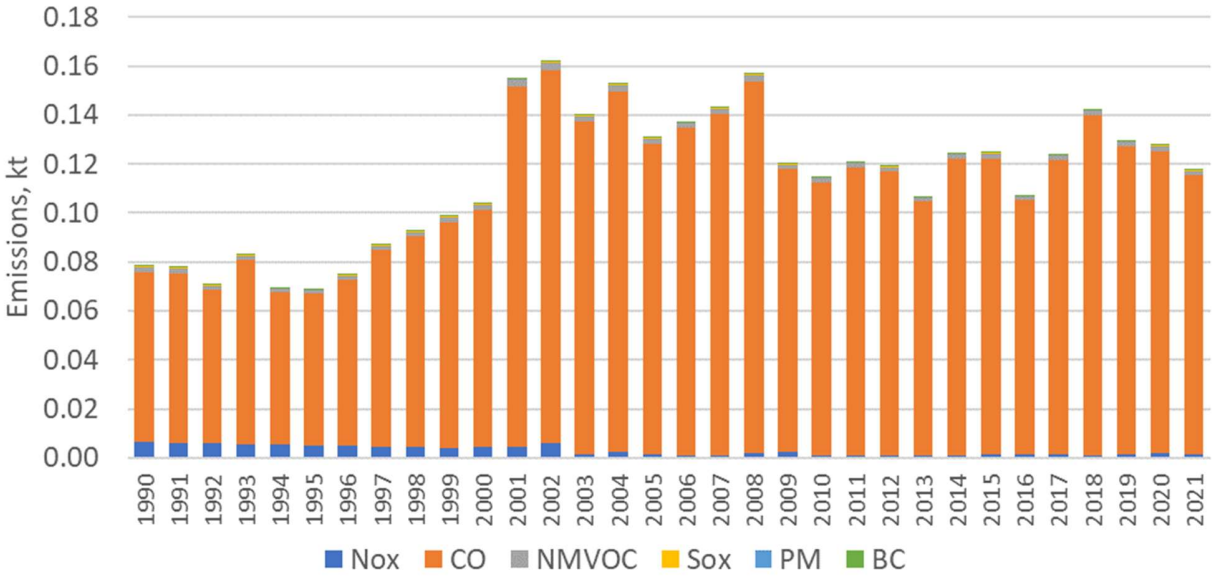



Figure 0-1 Pollutant emissions in sector 1.A.3.a.ii (i) Domestic aviation LTO (civil)

Table 0-1 Emissions from A.3.a.ii (i) Domestic aviation LTO (civil)

| | NOx | CO | NMVOC | SOx | PM | BC | Fuel, kt |
|---|---|---|---|---|---|---|---|
| 1990 | 0.0065 | 0.0695 | 0.0018 | 0.0005 | 0.00006 | 0.00002 | 0.62 |
| 1995 | 0.0051 | 0.0618 | 0.0015 | 0.0004 | 0.00004 | 0.00002 | 0.49 |
| 2000 | 0.0044 | 0.0970 | 0.0020 | 0.0004 | 0.00004 | 0.00004 | 0.45 |
| 2005 | 0.0012 | 0.1272 | 0.0021 | 0.0002 | 0.00001 | 0.00005 | 0.17 |
| 2010 | 0.0008 | 0.1118 | 0.0018 | 0.0001 | 0.00000 | 0.00004 | 0.12 |
| 2011 | 0.0009 | 0.1177 | 0.0019 | 0.0001 | 0.00001 | 0.00005 | 0.14 |
| 2012 | 0.0009 | 0.1160 | 0.0019 | 0.0001 | 0.00001 | 0.00005 | 0.13 |
| 2013 | 0.0009 | 0.1037 | 0.0017 | 0.0001 | 0.00001 | 0.00004 | 0.13 |
| 2014 | 0.0011 | 0.1209 | 0.0020 | 0.0001 | 0.00001 | 0.00005 | 0.15 |
| 2015 | 0.0012 | 0.1212 | 0.0020 | 0.0001 | 0.00001 | 0.00005 | 0.11 |
| 2016 | 0.0012 | 0.1039 | 0.0017 | 0.0001 | 0.00001 | 0.00004 | 0.11 |
| 2017 | 0.0012 | 0.1204 | 0.0020 | 0.0002 | 0.00001 | 0.00005 | 0.11 |
| 2018 | 0.0010 | 0.1387 | 0.0023 | 0.0002 | 0.00001 | 0.00005 | 0.15 |
| 2019 | 0.0012 | 0.1259 | 0.0021 | 0.0002 | 0.00001 | 0.00005 | 0.15 |
| 2020 | 0.0018 | 0.1235 | 0.0020 | 0.0002 | 0.00002 | 0.00005 | 0.15 |
| 2021 | 0.0013 | 0.1141 | 0.0019 | 0.0002 | 0.00001 | 0.00004 | 0.17 |
| **Change in 2005-2021, %** | **12** | **-10** | **-11** | **-4** | **29** | **-10** | **-5** |
| **Change in 1990-2021,%** | **-79** | **64** | **4** | **-70** | **-84** | **80** | **-73** |

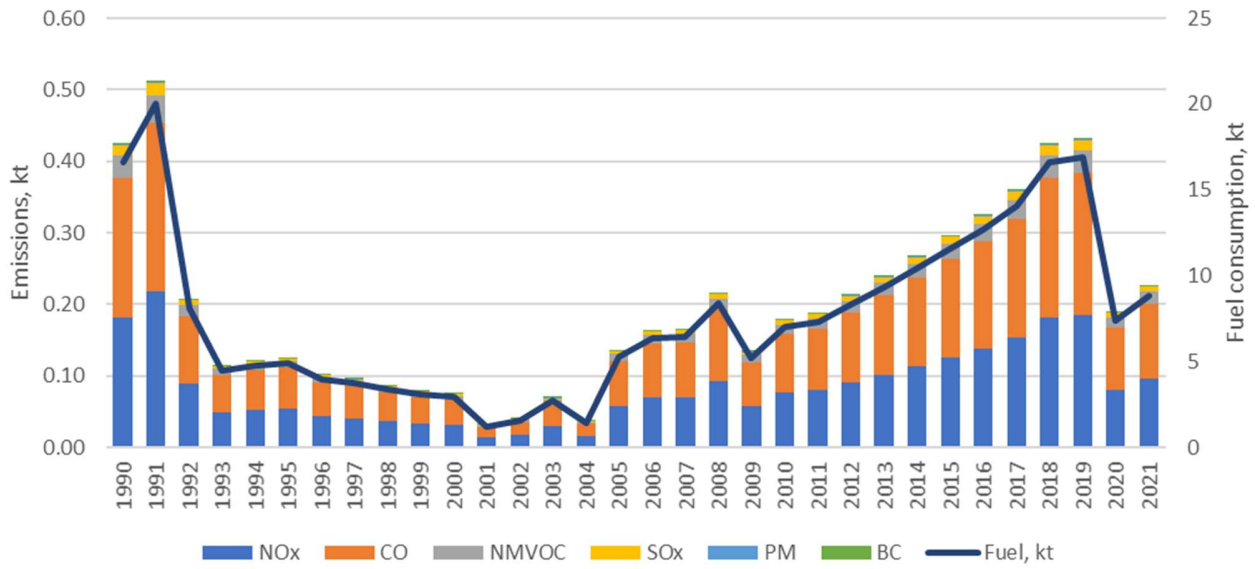



Figure 0-2 Pollutant emissions in sector 1.A.3.a.i (ii) International aviation LTO (civil)

| | NOx | CO | NMVOC | SOx | PM | BC | Fuel, kt |
|---|---|---|---|---|---|---|---|
| 1990 | 0.181 | 0.196 | 0.032 | 0.014 | 0.001 | 0.000 | 16.618 |
| 1995 | 0.053 | 0.058 | 0.009 | 0.004 | 0.000 | 0.000 | 4.881 |
| 2000 | 0.032 | 0.034 | 0.006 | 0.002 | 0.000 | 0.000 | 2.924 |
| 2005 | 0.058 | 0.062 | 0.010 | 0.004 | 0.000 | 0.000 | 5.291 |
| 2010 | 0.076 | 0.082 | 0.013 | 0.006 | 0.001 | 0.000 | 6.979 |
| 2011 | 0.080 | 0.086 | 0.014 | 0.006 | 0.001 | 0.000 | 7.325 |
| 2012 | 0.091 | 0.098 | 0.016 | 0.007 | 0.001 | 0.000 | 8.331 |
| 2013 | 0.102 | 0.110 | 0.018 | 0.008 | 0.001 | 0.000 | 9.345 |
| 2014 | 0.114 | 0.123 | 0.020 | 0.009 | 0.001 | 0.000 | 10.456 |
| 2015 | 0.126 | 0.136 | 0.022 | 0.010 | 0.001 | 0.000 | 11.566 |
| 2016 | 0.138 | 0.150 | 0.024 | 0.011 | 0.001 | 0.000 | 12.701 |
| 2017 | 0.153 | 0.166 | 0.027 | 0.012 | 0.001 | 0.000 | 14.063 |
| 2018 | 0.181 | 0.196 | 0.032 | 0.014 | 0.001 | 0.000 | 16.596 |
| 2019 | 0.184 | 0.199 | 0.032 | 0.014 | 0.002 | 0.000 | 16.889 |
| 2020 | 0.081 | 0.087 | 0.014 | 0.006 | 0.001 | 0.000 | 7.396 |
| 2021 | 0.096 | 0.104 | 0.017 | 0.007 | 0.001 | 0.000 | 8.833 |
| **Change in 2005-2021, %** | 67 | 67 | 67 | 67 | 67 | 67 | 67 |
| **Change in 1990-2021,%** | -47 | -47 | -47 | -47 | -47 | -47 | -47 |

### 2.1.3.Emission factors

EMEP/EEA 2019 Tier 1 and Tier 2 approaches have been applied. Tier 1 methodology for emission estimation in aviation, both for aviation gasoline and jet kerosene was used for time series 1990-2004. Tier 2 approach with split in LTO and cruise cycles has been applied for jet kerosene emission calculation

for time period 2006-2021. Emissions from 2006 were calculated using EUROCONTROL based on Tier 2 for jet kerosene fuel. The real share of national and international activities for the period 2005-2021 was taken from the EUROCONTROL database directly. For 1990-2004 an average for 2006-2021 was applied to calculate IEF.

Table 0-2 Emission factors used in the calculation of emissions from Civil aviation (kg/t fuel)

| | **NOx** | **CO** | **NMVOC** | **$SO_2$** | **PM** | **BC-f** |
|---|---|---|---|---|---|---|
| **Domestic** | | | | | | |
| **LTO** Aviation petrol | 4* | 1200* | 0.1* | 1.0* | 0.2* | 0.15* |
| Jet kerosene | 11.1 | 11.4 | 1.4 | 0.8 | 0.1 | 0.48 |
| **Cruise** | | | | | | |
| Jet kerosene | 13.6 | 5.3 | 0.5 | 0.84 | 0.15 | 0.15 |
| **International** | | | | | | |
| **LTO** | 10.9 | 11.8 | 1.9 | 0.84 | 0.09 | 0.15 |
| **Cruise** | 12.8** | 1.1 | 0.5 | 1.0 | 0.2 | 0.15 |

*EMEP/EEA Guidebook 2019

**Latvian NIR 2021

Net calorific values (NCVs) used to convert fuel consumption in natural units into energy units are provided in the Table 0-3.

Table 0-3 Specific net calorific values (conversion factors).

| Type of fuel | Tonne | Tonne of oil equivalent (toe) | TJ/tonne |
|---|---|---|---|
| Gasoline type jet fuel | 1.0 | 1.070 | 0.04479 |
| Kerosene type jet fuel | 1.0 | 1.031 | 0.04316 |

### 2.1.4.Activity data

The data about fuel consumption in domestic and international civil aviation is derived from SDA. For the years 1990-2021 data related to aviation gasoline and jet kerosene are those of the Statistics Lithuania database splited on international and domestic jet kerosene use; the amounts of domestic fuels use in years 1990 – 2004 were calculated based on extrapolation data on fuel share of jet kerosene used for international aviation in Lithuania. Aviation gasoline is more common as fuel for private aircraft, while the jet fuel used in aircraft, Airlines, military aircraft and other large aircraft. Cruise fuel usage is estimated as the difference between the total fuel use from aviation fuel sale statistics for domestic use and the total calculated LTO fuel use. For the LTO cycle it was assumed that 24% of the fuel use is used for domestic LTO  part of flight and 13% for International LTO. For the time series 2005-2021 EUROCONTROL data on the number of flights, fuel consumption and share of domestic and international flights were used. The emissions of NOx, SOx, PMs and CO were taken from EUROCONTROL file for LTO and Cruise separately.

EUROCONTROL data used Tier 3 methodology applying the Advanced Emissions Model (AEM). Following data were taken from the EUROCONTROL data published in 2021 into national inventory:

- fuel consumption of aviation gasoline for domestic flights (LTO and cruise);
- fuel consumption of aviation gasoline for international flights (LTO and cruise);
- fuel consumption of jet kerosene for domestic flights (LTO and cruise);
- fuel consumption of jet kerosene for international flights (LTO and cruise);
- pollutants for all subcategories.

### 2.1.5.Uncertainties and time-series consistency

Uncertainty in activity data 2005-2021 of fuel consumption is ±2%. For the 1990-2004 period uncertainty in activity data of fuel consumption is ±20%.

### 2.1.6.Source-specific QA/QC and verification

Assessment of trends were performed by a sectorial expert.

### 2.1.7.Source-specific planned improvements

No improvement planned.

### 2.1.8. Recalculations

Recalculations were done due to revised emissions according to experts recommendation to calculate and report the whole time series of NMVOC emissions from 1A3ai(i) in the NFR tables and add a detailed description of the methodology and activity data in the IIR, to clearly describe the activity data and methodology followed to calculate emissions from the aviation sector and to calculate and report cruise aviation emissions. Calculations and recalculations were done for all aviation subsectors: 1.A.3.a.i (i) International aviation LTO (civil); 1.A.3.a.ii (i) Domestic aviation LTO (civil), 1.A.3.a.i (ii) International aviation cruise (civil) and 1.A.3.a.ii (ii) Domestic aviation cruise (civil). NMVOC and PM emissions was introduced for 1990-2021. That affected results of NOx, CO, SOx emissions. The differencies is presented in Table below. Main differencies are related to fuel dissagregation between subsections.

Table 0-4. Recalculations for $NO_x$, CO and $SO_x$ for 1.A.3.a.ii (i)

| | $NO_x$, Gg | CO, Gg | $SO_x$, Gg |
|---|---|---|---|
| 1990 | 0.0385 | -0.0055 | 0.0038 |
| 1991 | 0.0378 | -0.0072 | 0.0037 |
| 1992 | 0.0361 | -0.0026 | 0.0036 |
| 1993 | 0.0353 | -0.0170 | 0.0034 |
| 1994 | 0.0347 | -0.0060 | 0.0034 |
| 1995 | 0.0329 | -0.0078 | 0.0033 |
| 1996 | 0.0322 | -0.0158 | 0.0031 |
| 1997 | 0.0304 | -0.0301 | 0.0030 |
| 1998 | 0.0307 | -0.0361 | 0.0030 |
| 1999 | 0.0209 | -0.0572 | 0.0021 |
| 2000 | 0.0186 | -0.0650 | 0.0018 |
| 2001 | 0.0195 | -0.1122 | 0.0020 |
| 2002 | 0.0148 | -0.1229 | 0.0015 |
| 2003 | 0.0214 | -0.1027 | 0.0020 |
| 2004 | 0.0434 | -0.0820 | 0.0041 |
| 2005 | 0.0017 | -0.1235 | 0.0000 |
| 2006 | 0.0021 | -0.1308 | 0.0001 |
| 2007 | 0.0011 | -0.1363 | 0.0000 |

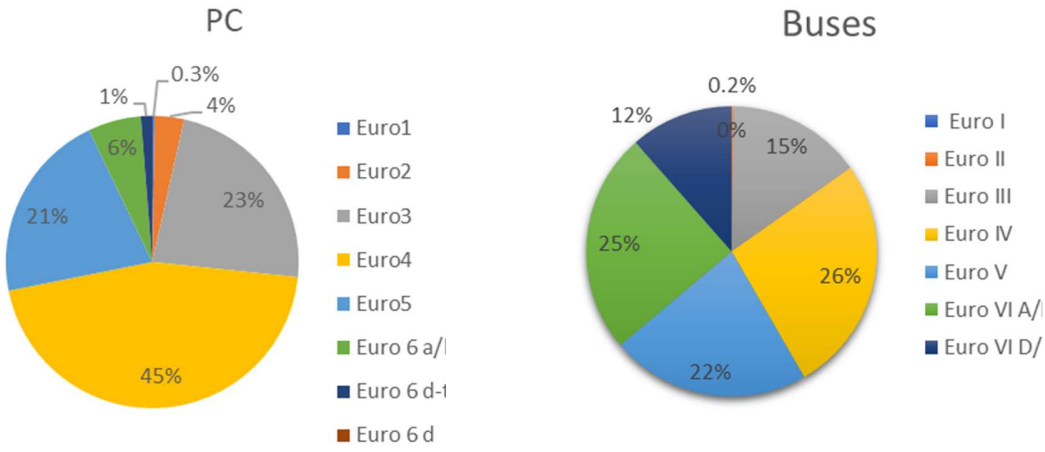
| | | | |
|---|---|---|---|
| 2008 | 0.0009 | -0.1450 | 0.0000 |
| 2009 | -0.0021 | -0.1136 | -0.0002 |
| 2010 | -0.0002 | -0.1079 | -0.0001 |
| 2011 | -0.0004 | -0.1149 | -0.0001 |
| 2012 | -0.0006 | -0.1135 | -0.0001 |
| 2013 | -0.0002 | -0.0995 | -0.0001 |
| 2014 | -0.0003 | -0.1145 | -0.0001 |
| 2015 | -0.0007 | -0.1144 | -0.0001 |
| 2016 | -0.0006 | -0.0981 | -0.0001 |
| 2017 | -0.0006 | -0.1130 | -0.0001 |
| 2018 | -0.0003 | -0.1308 | -0.0001 |
| 2019 | -0.0007 | -0.1181 | -0.0001 |
| 2020 | 0.0000 | -0.1144 | -0.0001 |
| 2021 | -0.0013 | -0.1141 | -0.0002 |

## 2.2. Road transport (1.A.3.b)

### 2.2.1.Overview of the Sector

Lithuania has a fairly well-developed road network provided with a dense road (1.291 km/km²) network (2021). At the end of 2020, the length of roads amounted to 21,238 thousand kilometers; the length of E-roads amounted to 1,750 kilometers, of which motorways – 309 km (Statistics Lithuania, 2021).

*Road transportation* is the most important emission source in the Transport sector. This sector includes all types of vehicles on roads (passenger cars (PC), light duty vehicles (LD), heavy duty trucks and buses (HD), motorcycles and mopeds (2-wheels)). The source category does not cover farm and forest tractors driving occasionally on the roads because they are included in other sectors as off-roads.



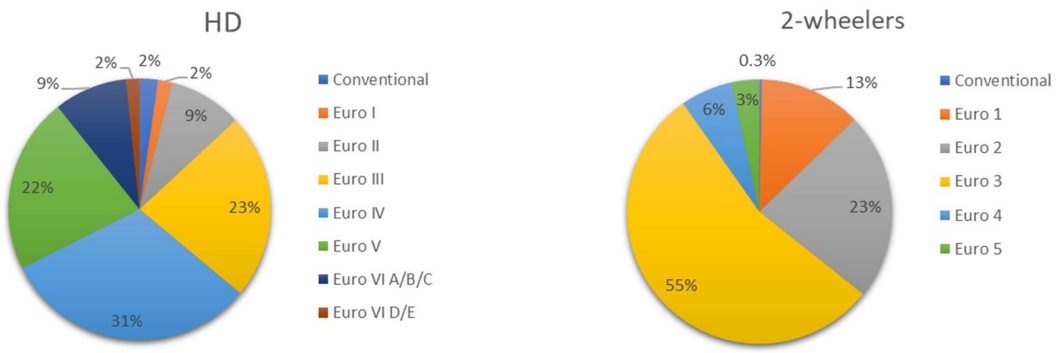



Figure 0-3 Road vehicles by standard, 2021

Activity data for mobile sources are based on official energy balance of the Lithuania prepared by the Statistics Lithuania (2020). The parameters necessary for distribution of sold fuels are transport mode, fuel type, weight of vehicle and equipment with more or less effective catalytic system. The appropriate distribution is necessary for assigning of the relevant emission factor. Sector 1A3b Road Transportation is split into five subsectors:

- 1.A.3.b i Passenger Cars
- A.3.b ii Light Duty Vehicles
- 1.A.3.b iii Heavy Duty Vehicles
- 1.A.3.b iv Mopeds & Motorcycles
- 1.A.3.b v Gasoline Evaporation
- 1.A.3.b vi Automobile tire and brake wear
- 1.A.3.b vii Automobile road abrasion

Calculations of emissions from road transport (NFR sector 1A3b) are based on:

- statistical fuel consumption data from Energy balance
- traffic intensity, estimated by Institute of Transport
- road transport fleet data, taken from Registry of Transport (State Enterprise “Regitra”). Emission factors and fuel consumption factors for NOx, NMVOC, CO, TSP and $NH_3$ emission estimations were calculated using COPERT V model. Road transport was differentiated into the passenger cars, light duty vehicles, heavy duty vehicles, buses and motorcycles categories.

Table 0-5 Trend of emissions in Road transport

| | BC | CO | NH3 | NMVOC | NOx (as NO2) | PM10 | PM2.5 | SOx (as SO2) | TSP |
|---|---|---|---|---|---|---|---|---|---|
| 1990 | 0.701 | 204.840 | 0.028 | 25.911 | 68.909 | 1.983 | 1.705 | 4.650 | 2.337 |
| 1991 | 0.763 | 246.688 | 0.032 | 29.344 | 76.940 | 2.161 | 1.858 | 5.141 | 2.550 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1992 | 0.530 | 140.091 | 0.020 | 18.048 | 48.833 | 1.467 | 1.272 | 3.391 | 1.716 |
| 1993 | 0.361 | 105.610 | 0.015 | 14.209 | 36.266 | 1.028 | 0.882 | 2.428 | 1.213 |
| 1994 | 0.235 | 84.750 | 0.012 | 11.504 | 27.301 | 0.700 | 0.591 | 1.740 | 0.840 |
| 1995 | 0.276 | 109.958 | 0.016 | 15.546 | 36.814 | 0.867 | 0.720 | 1.111 | 1.057 |
| 1996 | 0.306 | 117.709 | 0.021 | 16.884 | 40.668 | 0.958 | 0.796 | 1.226 | 1.166 |
| 1997 | 0.437 | 117.628 | 0.026 | 17.402 | 45.831 | 1.254 | 1.072 | 1.476 | 1.487 |
| 1998 | 0.524 | 110.191 | 0.040 | 17.030 | 47.426 | 1.438 | 1.245 | 1.115 | 1.684 |
| 1999 | 0.492 | 84.321 | 0.049 | 13.972 | 40.553 | 1.329 | 1.152 | 0.960 | 1.554 |
| 2000 | 0.437 | 68.577 | 0.076 | 12.220 | 33.747 | 1.171 | 1.011 | 0.802 | 1.376 |
| 2001 | 0.507 | 68.006 | 0.117 | 12.135 | 35.227 | 1.323 | 1.149 | 0.731 | 1.547 |
| 2002 | 0.508 | 66.930 | 0.156 | 11.779 | 34.426 | 1.329 | 1.147 | 0.735 | 1.562 |
| 2003 | 0.498 | 61.201 | 0.218 | 10.633 | 30.633 | 1.290 | 1.105 | 0.623 | 1.530 |
| 2004 | 0.556 | 57.851 | 0.351 | 10.076 | 30.552 | 1.409 | 1.202 | 0.538 | 1.676 |
| 2005 | 0.562 | 56.409 | 0.385 | 9.732 | 29.953 | 1.424 | 1.203 | 0.102 | 1.709 |
| 2006 | 0.585 | 55.837 | 0.431 | 9.187 | 29.249 | 1.463 | 1.223 | 0.108 | 1.773 |
| 2007 | 0.695 | 58.580 | 0.519 | 9.483 | 31.826 | 1.703 | 1.414 | 0.128 | 2.078 |
| 2008 | 0.677 | 54.624 | 0.533 | 8.579 | 31.047 | 1.657 | 1.367 | 0.129 | 2.033 |
| 2009 | 0.535 | 44.909 | 0.425 | 6.994 | 24.383 | 1.319 | 1.080 | 0.021 | 1.630 |
| 2010 | 0.589 | 37.565 | 0.322 | 5.873 | 25.506 | 1.396 | 1.150 | 0.022 | 1.714 |
| 2011 | 0.585 | 32.102 | 0.268 | 4.839 | 25.320 | 1.379 | 1.133 | 0.022 | 1.697 |
| 2012 | 0.587 | 27.814 | 0.224 | 4.091 | 25.169 | 1.367 | 1.119 | 0.022 | 1.686 |
| 2013 | 0.678 | 21.175 | 0.160 | 3.196 | 23.464 | 1.427 | 1.195 | 0.022 | 1.726 |
| 2014 | 0.712 | 20.182 | 0.144 | 3.145 | 26.415 | 1.527 | 1.265 | 0.025 | 1.865 |
| 2015 | 0.703 | 18.221 | 0.140 | 2.715 | 26.581 | 1.520 | 1.240 | 0.027 | 1.882 |
| 2016 | 0.692 | 17.004 | 0.141 | 2.608 | 26.082 | 1.516 | 1.218 | 0.030 | 1.903 |
| 2017 | 0.635 | 14.853 | 0.139 | 2.227 | 25.819 | 1.468 | 1.154 | 0.031 | 1.878 |
| 2018 | 0.594 | 15.042 | 0.147 | 2.177 | 26.121 | 1.463 | 1.125 | 0.034 | 1.902 |
| 2019 | 0.571 | 14.088 | 0.153 | 2.075 | 26.480 | 1.466 | 1.112 | 0.035 | 1.925 |
| 2020 | 0.477 | 12.679 | 0.202 | 1.804 | 24.406 | 1.291 | 0.959 | 0.036 | 1.724 |
| 2021 | 0.455 | 11.815 | 0.194 | 1.692 | 23.439 | 1.264 | 0.931 | 0.036 | 1.697 |
| **Change in 2005-2021, %** | **-35%** | **-94%** | **592%** | **-93%** | **-66%** | **-36%** | **-45%** | **-99%** | **-27%** |
| **Change in 1990-2021,%** | **-19%** | **-79%** | **-50%** | **-83%** | **-22%** | **-11%** | **-23%** | **-65%** | **-1%** |

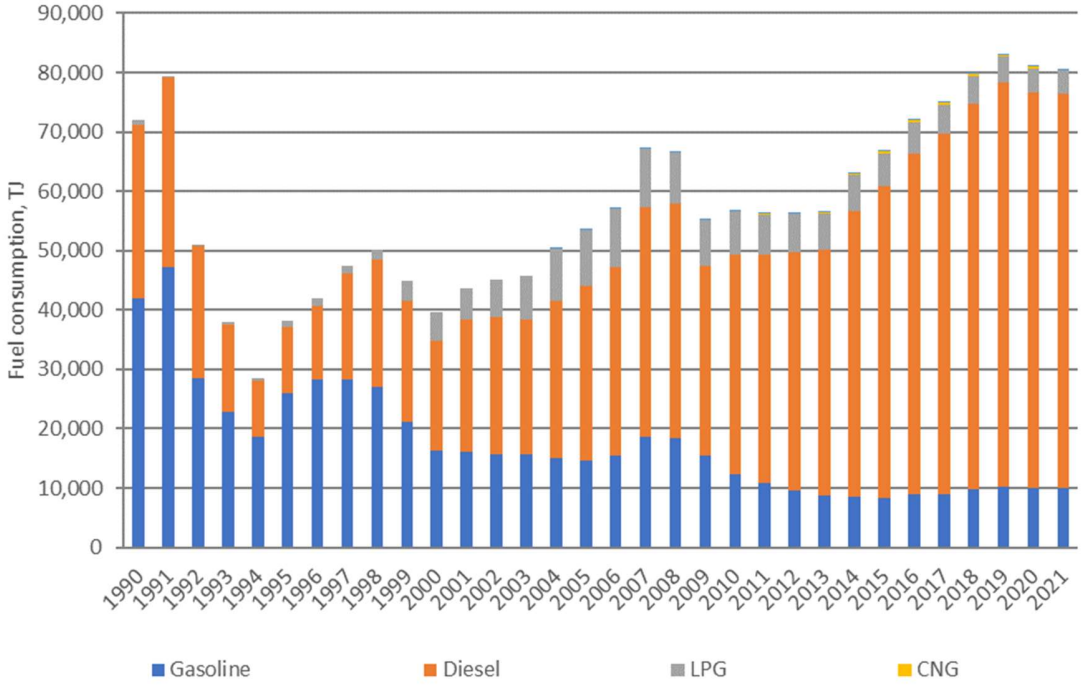



Figure 0-4 Fuel consumption in road transport in 1990-2021, TJ

Diesel and petrol fuels are mainly used in transport sector with a slow and steady increase in electromobiles. According to "Regitra" there were 2496 registered electro cars in 2021.

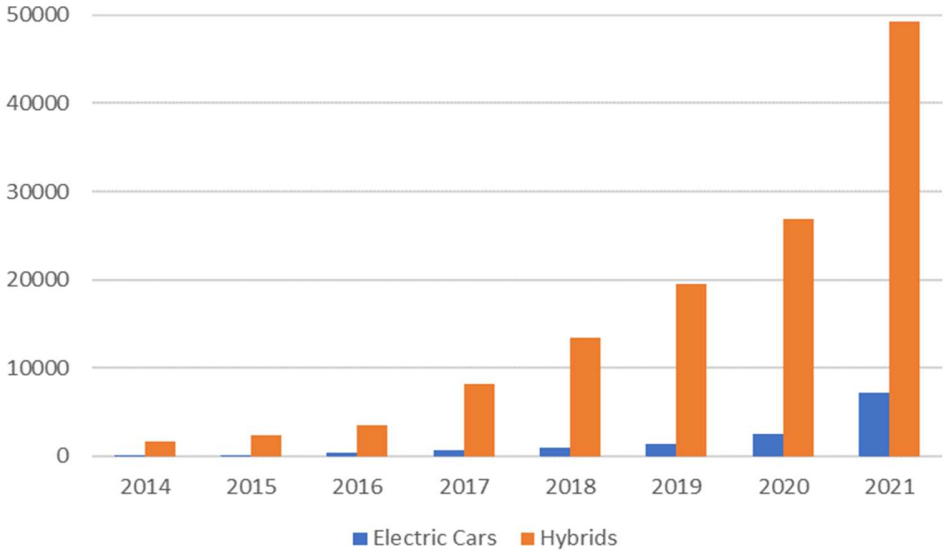



Figure 0-5 Share of electromobiles

There is a marked switch from petrol engines to diesel. The number of petrol engines (all vehicles) has decreased and as a result petrol fuel consumption has dropped between 1990 and 2020, while the number of diesel engines increased significantly from ~14 to 1067 thousand for the same period.

Passenger cars represent the most fuel-consuming vehicle category, followed by heavy-duty vehicles, light duty vehicles and 2-wheelers, are in decreasing order.

Many factors had influence on changes of energy consumption: deep economic slump in 1991-1994, fast economic growth over the period 2000-2008, dramatic reduction of economic activities in all branches of the national economy, a significant increase of energy prices, an increase of energy efficiency and other reasons. During the period 2000-2008 the energy consumption was increasing by 3.8% per annum. During this period the average growth rate of GDP was 8.1% per annum (Statistics Lithuania, Statistical Yearbook of Lithuania, 2008). The impact of global economic recession was dramatic in Lithuania. The global economic crisis had an effect on Lithuanian GDP already in 2008, but GDP growth rate in 2008 was still positive (2.6%). In 2009, GDP decreased by 14.8%. Since 2010 Lithuania's GDP has grown slightly by 1.6% in 2010, 6.0% in 2011 and 3.8% in 2012. During 2013–2014, GDP growth rates slightly slowdown and accounted 3.5% per annum. In 2015, GDP growth rate reduced by two times (to 1.8%), Increased by 6.2% import volume of goods and services and by 0.4% reduced export volume were the key drivers of slacken rate of GDP growth. 1.A.3.b.iv is highly variable as vehicle registration is highly variable due to re-registration.

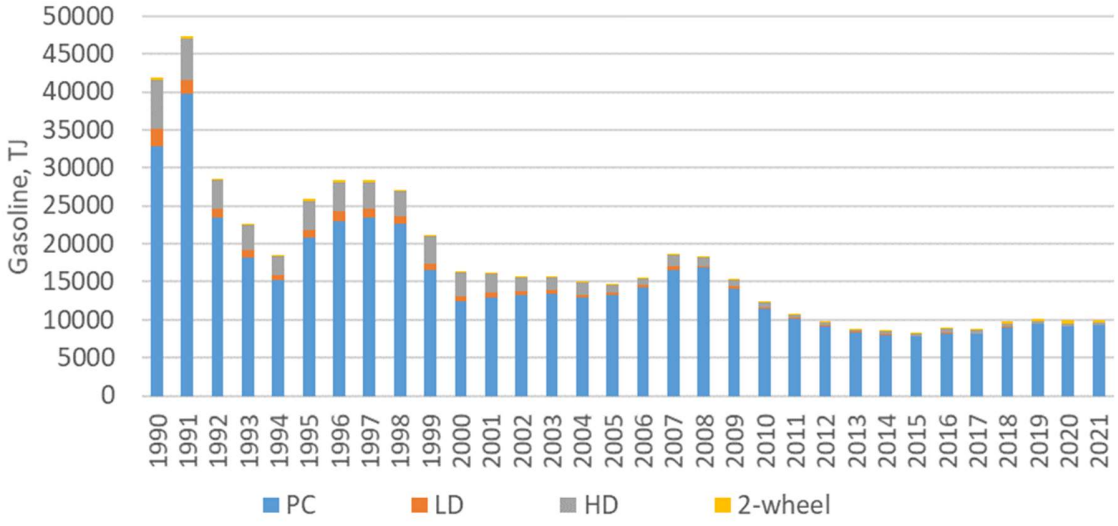



Figure 0-6 Gasoline fuel consumption per vehicle type for road transport 1990-2021

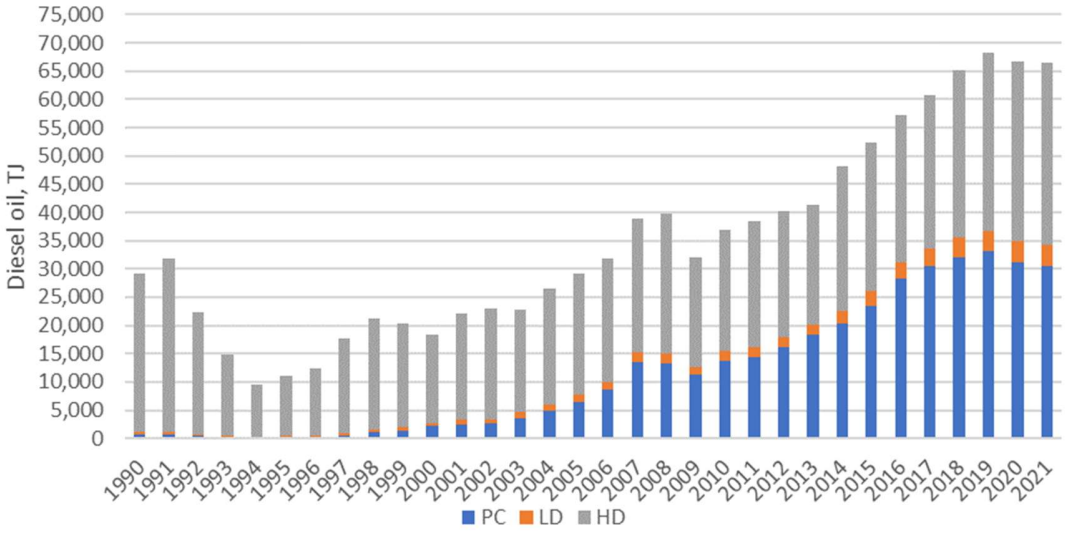



Figure 0-7 Diesel oil consumption per vehicle type for road transport 1990-2021

In 2021, fuel consumption shares for diesel passenger cars, diesel heavy-duty vehicles, gasoline passenger cars, LPG cars, diesel light duty vehicles were 40%, 38%, 11%, 5%, 5%, respectively.

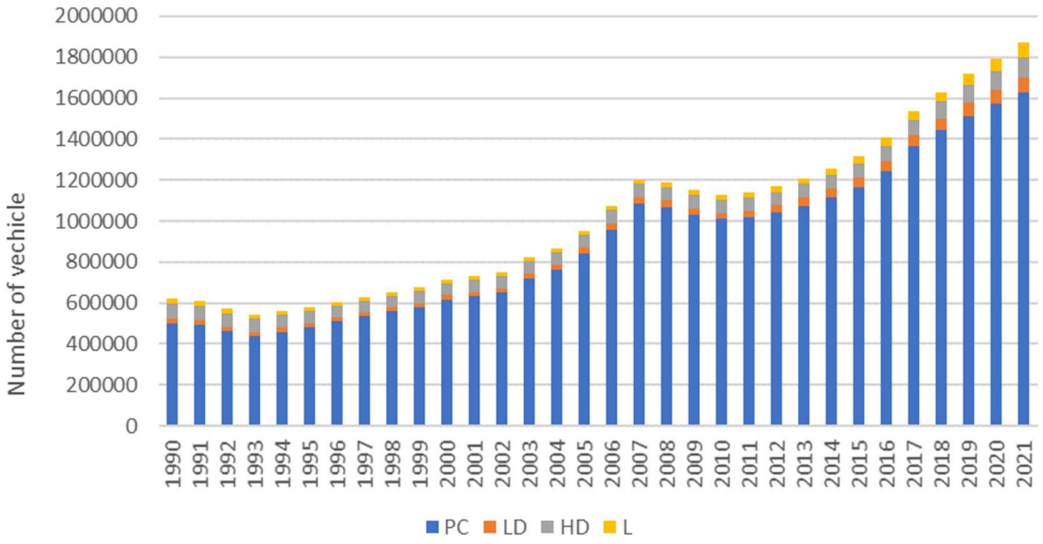



Figure 0-8 Number of vehicles in Lithuania, 1990-2021

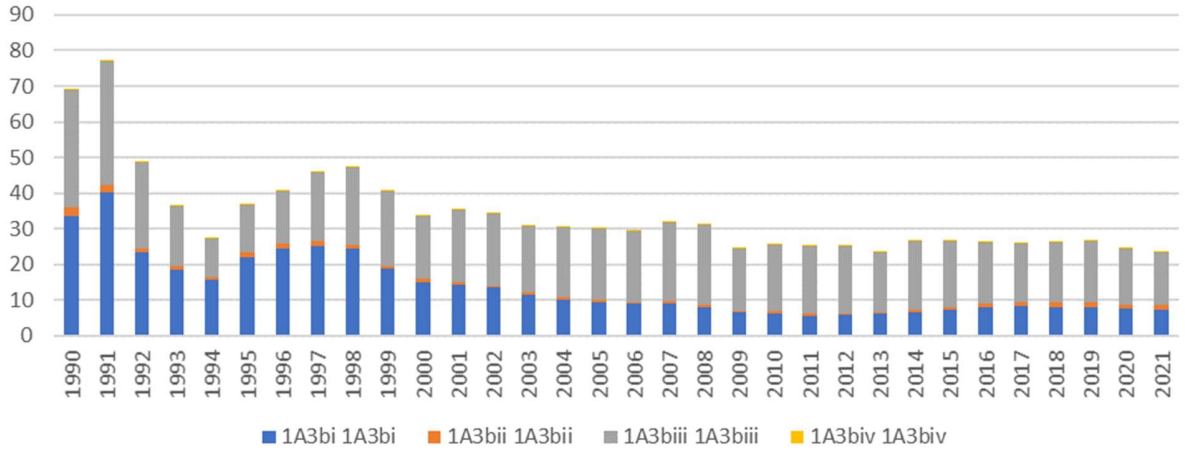



Figure 0-9 Development of NOx emissions in Road transport sector 1990-2021

Development of NOx emissions in Road transport sector is presented. Passenger cars NOx emissions contribution to Road transport has decreased by 76 % since 1990. During the whole period 1990-2021 HD vehicles contribute the biggest part to NOx emissions in Road transport sector.

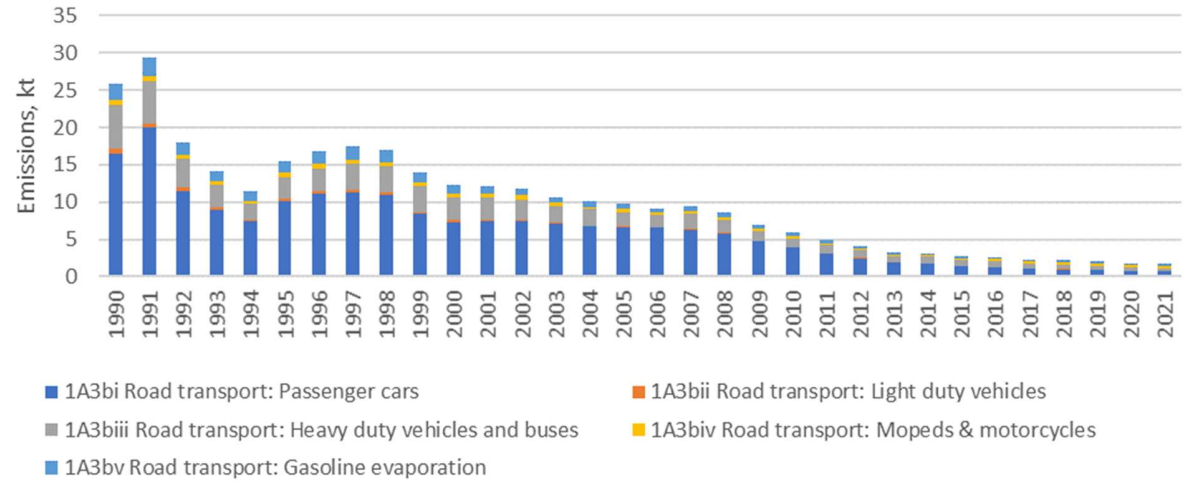



Figure 0-10 Development of NMVOC emissions in Road transport sector, 1990-2021

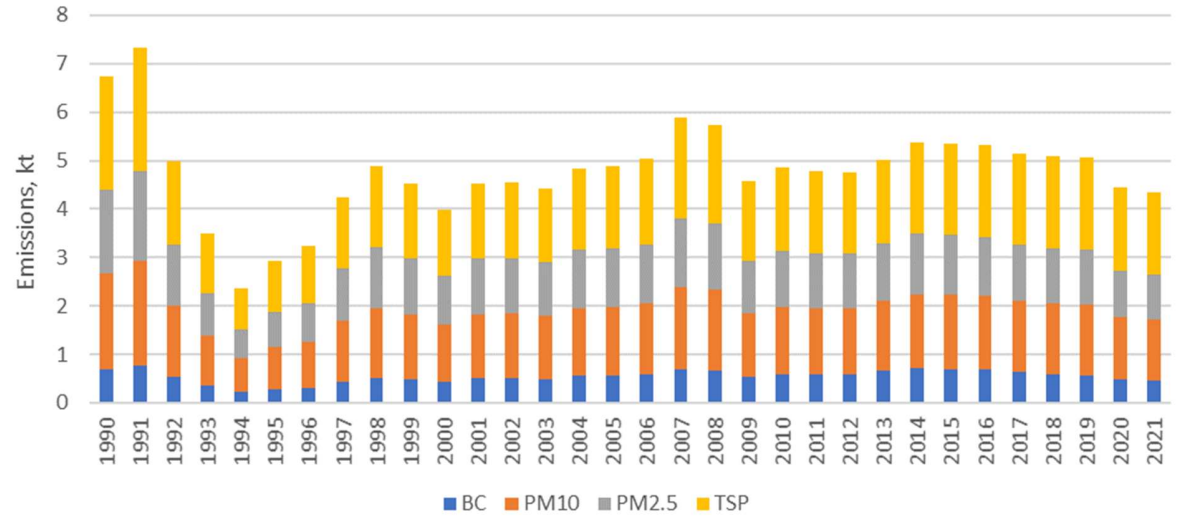



Figure 0-11 Development of PMs emissions in Road transport sector, 1990-2021

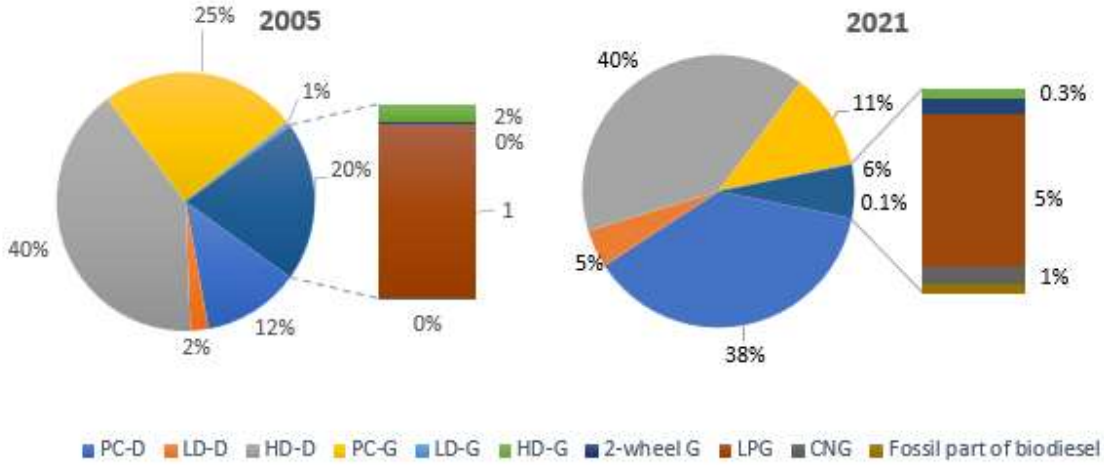



Figure 0-12 Fuel consumption share per vehicle type and fuel type for road transport in 2005 and 2021

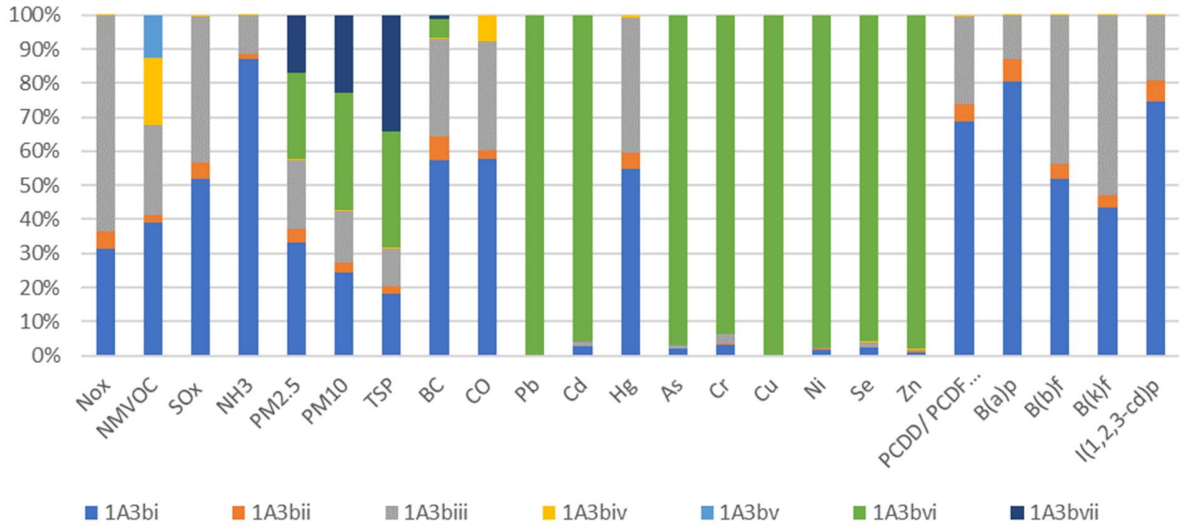



Figure 0-13 Distribution of emissions in Transport sector by subsectors in 2021, %

Passenger cars takes up the biggest part of Transport sector emissions for most of the pollutants followed by Heavy Duty vehicles. Automobile tyre and break wear contributes the biggest part (99.7 %) of Pb, Cd and As emissions.

### Methodological issues

In the Tier *3* method emissions are calculated using a combination of firm technical data and activity data. The activity data of road transport was split and filled in for a range of parameters including:

- Fuel consumed, quality of each fuel type;
- Emission controls fitted to vehicle in the fleet;
- Operating characteristics (e.g. average speed per vehicle type and per road)
- Types of roads;
- Maintenance;
- Fleet age distribution;
- Distance driven (mean trip distance);
- Climate

The model calculates vehicle mileages, fuel consumption, exhaust gas emissions, evaporative emissions of the road traffic. The balances use the vehicle stock and functions of the km driven per vehicle and year to assess the total traffic volume of each vehicle category. The production year of vehicles in this category has been taken into account by introducing different classes. which either reflects legislative steps ('ECE', 'Euro') applicable to vehicles registered in each Member State. The technology mix in each particular year depends on the vehicle category and the activity dataset considered. Lubricant use in two-stroke engines amounts only to 0.72-1.44 TJ, consequently emissions do not exceed threshold of significance (10 kt), therefore emissions from lubricant use are considered as insignificant.

For the period between 1990 and 2006, it was necessary to estimate the figures with the aid of numerous assumptions. The total emissions were calculated by summing emissions from different

sources, namely the thermally stabilized engine operation (hot) and the warming-up phase (cold start) (EEA 2000; MEET, 1999). For Tier *3* approaches cold start emissions were estimated:

$$E_{COLD;i,j} = \beta_{i,k} \times N_k \times M_k \times E_{HOT;i,k} \times (e_{COLD} / e_{HOT}\big|_{i,k} - 1) \quad (1)$$

*Where:*

$E_{COLD;i.k}$ *- cold start emissions of pollutant i(for the reference year), produced by vehicle technology k,*

$\beta_{i.k}$ *- fraction of mileage driven with a cold engine or the catalyst operated below the light-off temperature for pollutant i and vehicle [veh] technology k,*

$N_k$ *- number of vehicles of technology k in circulation,*

$M_k$ *- total mileage per vehicle [km veh$^{-1}$] in vehicle technology k,*

$e_{COLD}/e_{HOT}$ *- cold/hot emission quotient for pollutant i and vehicle of k technology,*

$$E_{total} = E_{cold} + E_{hot} \quad (2)$$

*where:*

$E_{TOTAL}$ *- total emissions (g) of compound for the spatial and temporal resolution of the application,*

$E_{HOT}$ *- emissions (g) during stabilized (hot) engine operation,*

$E_{COLD}$ *- emissions (g) during transient thermal engine operation (cold start).*

The *β*-parameter depends upon ambient temperature $t_a$ (for practical reasons the average monthly temperature was used). Since information on average trip length is not available for all vehicle classes. simplifications have been introduced for some vehicle categories. According to the available statistical data (André *et al*. 1998), a European value of 12.4 km has been established for the $l_{trip}$ value and used in estimations in Lithuania.

Due to the fact that concentrations of some pollutants during the warming-up period are many times higher than during hot operation. In this respect, a distinction is made between urban, rural and highway driving modes. Cold-start emissions are attributed mainly to urban driving (and secondarily to rural driving), as it is expected that a limited number of trips start at highway conditions. Therefore, as far as driving conditions are concerned, total emissions were calculated by means of the equation:

$$E_{Total} = E_{Urban} + E_{Rural} + E_{Highway.} \quad (3)$$

*where:*

$E_{URBAN}$*.* $E_{RURAL}$ *and* $E_{HIGHWAY}$ *- the total emissions (g) of any pollutant for the respective driving situations.*

Fuel was distributed to transport categories, types, ecology standards and driving modes according to data taken from State Enterprise Transport and Road Research Institute under the Ministry of Transport and Communications of the Republic of Lithuania.

Emissions was estimated from the fuel consumed (represented by fuel sold) and the distance travelled by the vehicles. The first approach (fuel sold) was applied.

Emission factor assumes full oxidation of the fuel. Emission equation for air pollutants for Tier *3* is:

$$Emission = \sum_{a,b,c,d} \left[ Distance_{a,b,c,d} \cdot EF_{a,b,c,d} \right] + \sum_{a,b,c,d} C_{a,b,c,d} \ . \quad (5)$$

*where:*

*Emission* - emission of air pollutants;

$EF_{a,b,c,d}$ - emission factor, kg/km;

$Distance_{a,b,c,d}$ - distance travelled during thermally stabilized engine operation phase, km;

$C_{a,b,c,d}$ - emission during (g) during transient thermal engine operation (cold start), kg;

*b* – vehicle type;

*c* – emission control technology;

*d* – driving situation (urban, rural, highway).

The annual mileage driven by the stock of vehicle per year is an important parameter in emission calculation as it affects both the total emissions calculated but also the relative contributions of the vehicle types considered. Calculations demand annual mileage per vehicle technology and the number of vehicles was supplied by the Lithuanian Road Administration and study funded by the European Commission – DG Environment and executed in collaboration with KTI, Renault, E3M-Lab/NTUA, Oekopol, and EnviCon. The source for these data is various European measurement programmes. Fuel consumption was calculated on the basis of appropriate assumptions for annual mileage of the different vehicle categories can be balanced with available fuel statistics (Ntziachristos et al. 2008). In general, the COPERT IV v.11 data are transformed into trip-speed dependent fuel consumption and emission factors for all vehicle categories and layers. The calculated fuel consumption in COPERT IV must equal the statistical fuel sale totals according to the UNFCCC and UNECE emissions reporting format. The statistical fuel sales for road transport are derived from the Statistics Lithuania.

For example, if a country has bulk fuel sold but does not have fuel use by vehicle type, they may allocate total fuel consumption across vehicle types based on the consumption patterns of their fleet (TRB's National Cooperative Highway Research Program (NCHRP) project report. Greenhouse Gas Emission Inventory Methodologies for State Transportation Departments). By applying a trial-and-error approach, it was possible to reach acceptable estimates of mileage. For each group, the emissions were estimated by combining vehicle type and annual mileage with hot emission factors, cold/hot ratios and evaporation factors.

Fuel was distributed to transport categories, types, ecology standards and driving modes according to mileage data taken from Institute of Transport and transport fleet data taken from Transport Registry.

Lubricant use in two-stroke engines amounts only to 0.72-1.44 TJ, consequently emissions do not exceed threshold of significance (10 kt), therefore emissions from lubricant use are considered as insignificant.

Lead (Pb) and other heavy metals emissions

Emissions of lead are estimated by assuming that 75 % of lead contained in the fuel is emitted into air. Then the equation is:

$$E_{Pb,j}^{CALC} = 0.75 \cdot k_{Pb,m} \cdot FC_{jm}^{CALC}. \quad (2)$$

Where, $k_{Pb,m}$ – weight related lead content of gasoline (type m) in [kg/kg fuel]. The emission factor for lead is given in Table 0-6.

Table 0-6 Emission factor for lead, g/l

| Fuel | 1990 | 2003 | 2006 | 2010 |
|---|---|---|---|---|
| **Leaded Gasoline** | 0.15 | - | - | - |
| **Unleaded Gasoline** | 0.013 | 0.005 | 0.003 | 0.0001 |

With regard to the emission of other heavy metal species, emission factors provided correspond both to fuel content and engine wear. Therefore, it is considered that the total quantity is emitted to the atmosphere (no losses in the engine). Heavy metal emissions depend on metal content in fuel. Therefore, emissions were calculated according to consumed fuel. LPG doesn't contain heavy metal; therefore, there are no heavy metals emissions from road transport using LPG.

Table 0-7 Heavy metal emission factors for all vehicle categories in [mg/kg fuel]

| Category | Cadmium | Copper | Chromium | Nickel | Selenium | Zinc |
|---|---|---|---|---|---|---|
| **Road transport** | 0.01 | 1.7 | 0.05 | 0.07 | 0.01 | 1 |

Gasoline evaporation (1.A.3.b.v)

Gasoline evaporation emissions are estimated according to mileage of separate road transport categories consuming gasoline and number of vehicles consuming gasoline. Mileage of road transport categories was estimated according to statistical fuel consumption data and mileage data estimated by Institute of Transport.

Table 0-8 NMVOC emission factors for gasoline evaporation

| | NMVOC emission factors | Units |
|---|---|---|
| **Passenger cars** | | |
| **Diurnal and hot soak emissions in summer** | 3642.00 | g/vehicle |

| | | |
|---|---|---|
| **Diurnal and hot soak emissions in winter** | 4807.00 | g/vehicle |
| **Running losses in summer** | 0.022 | g/km |
| **Running losses in winter** | 0.006 | g/km |
| **Light duty vehicle** | | |
| **Diurnal and hot soak emissions in summer** | 3642.00 | g/vehicle |
| **Diurnal and hot soak emissions in winter** | 4807.00 | g/vehicle |
| **Running losses in summer** | 0.022 | g/km |
| **Running losses in winter** | 0.006 | g/km |
| **Motorcycles** | | |
| **Diurnal and hot soak emissions in summer** | 1457.00 | g/vehicle |
| **Diurnal and hot soak emissions in winter** | 1923.00 | g/vehicle |
| **Running losses in summer** | 0.009 | g/km |
| **Running losses in winter** | 0.002 | g/km |

Tyre, brake wear and road abrasion emissions

Tyre, brake wear and road abrasion emissions are estimated according to mileage of separate road transport categories. Mileage of road transport categories was estimated according to statistical fuel consumption data, fuel consumption factors calculated by COPERT V and mileage data estimated by Institute of Transport. The resulting mileage data (Table 0-9) is used as activity rates for estimating tyre, brake wear and road abrasion emissions.

Table 0-9 Road transport mileage by categories, [km]

| **Category** | **Mileage, km** |
|---|---|
| **Passenger cars** | 7 502 454 100 |
| **Light duty vehicle** | 1 566 991 000 |
| **Heavy duty vehicle** | 1 887 711 951 |
| **Buses** | 752 344 000 |
| **Motorcycles** | 5 632 879 |
| **Mopeds** | 10 176 919 |

TSP, $PM_{10}$ and heavy metal emission factors for tyre, brake wear and road abrasion were taken from COPERT and reported in Table 0-10. $PM_{2.5}$ and $PM_{10}$ emission factors were taken from EMEP/EEA 2019 and reported in Table 0-11-Table 0-12.

Table 0-10 TSP emission factors for tyre. brake wear and road abrasion

| **Transport category** | **Emission factor (g/km)** | | |
|---|---|---|---|
| | **Tyre wear** | **Brake wear** | **Road abrasion** |
| **Motorcycles** | 0.0028 | 0.0037 | 0.0030 |

| | | | |
|---|---|---|---|
| **Passenger cars** | 0.0064 | 0.0073 | 0.0075 |
| **Light duty vehicles** | 0.0101 | 0.0115 | 0.0075 |
| **Heavy duty vehicles and buses** | 0.0270 | 0.0320 | 0.0380 |

Table 0-11 $PM_{10}$ emission factors for tyre, brake wear and road abrasion

| **Transport category** | **Emission factor (g/km)** | | |
|---|---|---|---|
| | **Tyre wear** | **Brake wear** | **Road abrasion** |
| **Motorcycles** | 0.0028 | 0.0020 | 0.0030 |
| **Passenger cars** | 0.0064 | 0.0033 | 0.0075 |
| **Light duty vehicles** | 0.0101 | 0.0052 | 0.0075 |
| **Heavy duty vehicles and buses** | 0.0270 | 0.0130 | 0.0380 |

Table 0-12 PM2.5 emission factors for tyre, brake wear and road abrasion

| **Transport category** | **Emission factor (g/km)** | | |
|---|---|---|---|
| | **Tyre wear** | **Brake wear** | **Road abrasion** |
| **Motorcycles** | 0.0001 | 0.0003 | 0.0016 |
| **Passenger cars** | 0.0003 | 0.0022 | 0.0042 |
| **Light duty vehicles** | 0.0003 | 0.0022 | 0.0042 |
| **Heavy duty vehicles and buses** | 0.0020 | 0.0071 | 0.0209 |

Table 0-13 Heavy metal fraction of tyre, brake wear and road abrasion TSP emission

| **Heavy metal** | **Tyre wear [mg/kg TSP]** | **Brake wear [mg/kg TSP]** | **Road abrasion [mg/kg TSP]** |
|---|---|---|---|
| **As** | 0.8 | 10.0 | 0 |
| **Cd** | 2.6 | 13.2 | 1 |
| **Cr** | 12.4 | 669 | 40 |
| **Cu** | 174 | 51112 | 12 |
| **Ni** | 33.6 | 463 | 20 |
| **Pb** | 107 | 3126 | 15 |
| **Zn** | 7434 | 8676 | 35 |

### Uncertainties and time-series consistency

Expert judgement suggests that the uncertainty of the activity data is approximately ±5%. The primary source of uncertainty is the activity data rather than emission factors.

### Source-specific QA/QC and verification

All quality procedures according to the Lithuanian QA/QC plan have been implemented during the work with this submission.

### Source-specific recalculations

No source specific recalculations.

### Source-specific planned improvements

No source-specific improvements.

## 2.3. Railways (NFR 1.A.3.c)

### Overview of the Sector

In 2021, the operational length of railways amounted to 1,910.7 km. The length of electrified lines remained unchanged (152.4 km). Emissions from producing electricity used in electric trains are not included in this category, but in category 1.A.1. Lithuanian Railways (lithuanian: “Lietuvos Geležinkeliai”) is the national, state-owned railway company of Lithuania. Lithuanian’s trains operate frequent services across the whole of Lithuania. In 2020, goods transport by rail amounted to 53.4 million tonnes. National goods transport by rail amounted to 15.6 million tonnes.

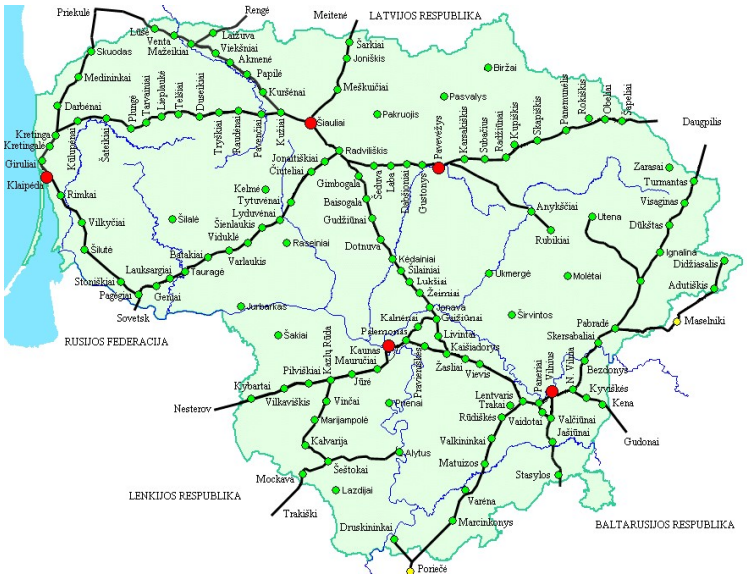



Figure 0-14 Map of Lithuanian railways

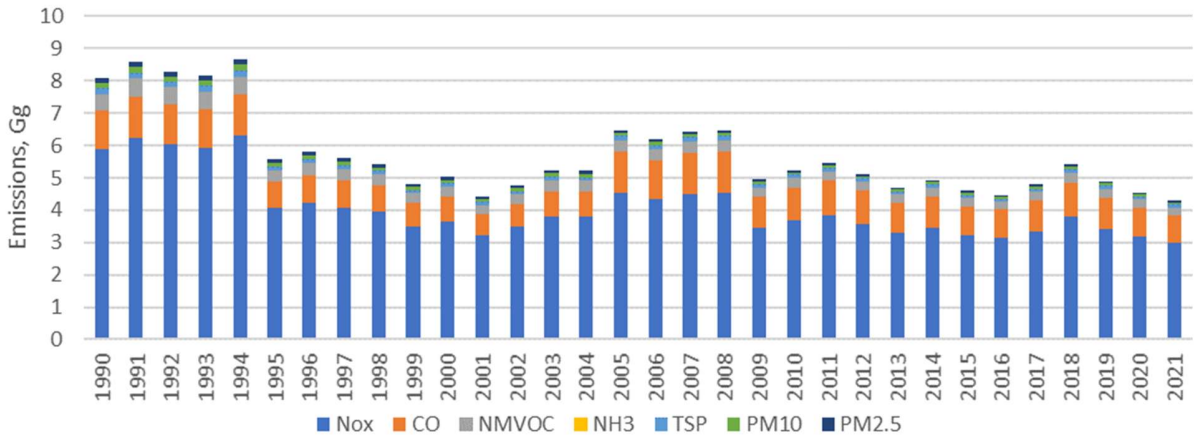



Figure 0-15 Pollutant emissions in sector 1.A.3.c

Trend in emissions (kt) is provided in Table below.

Table 0-14 Trend (%) of emissions (kt)

| | NOx (as NO2) | NMVOC | SOx (as SO2) | NH3 | PM2.5 | PM10 | TSP | BC | CO |
|---|---|---|---|---|---|---|---|---|---|
| **1990** | 5.88 | 0.52 | 0.04 | 0.00 | 0.15 | 0.16 | 0.17 | 0.00 | 1.20 |
| **1991** | 6.24 | 0.55 | 0.05 | 0.00 | 0.16 | 0.17 | 0.18 | 0.00 | 1.27 |
| **1992** | 6.03 | 0.54 | 0.05 | 0.00 | 0.16 | 0.17 | 0.17 | 0.00 | 1.23 |
| **1993** | 5.93 | 0.53 | 0.05 | 0.00 | 0.16 | 0.16 | 0.17 | 0.00 | 1.21 |
| **1994** | 6.29 | 0.56 | 0.05 | 0.00 | 0.16 | 0.17 | 0.18 | 0.00 | 1.29 |
| **1995** | 4.06 | 0.36 | 0.03 | 0.00 | 0.11 | 0.11 | 0.12 | 0.00 | 0.83 |
| **1996** | 4.22 | 0.37 | 0.03 | 0.00 | 0.11 | 0.12 | 0.12 | 0.00 | 0.86 |
| **1997** | 4.07 | 0.36 | 0.03 | 0.00 | 0.11 | 0.11 | 0.12 | 0.00 | 0.83 |
| **1998** | 3.95 | 0.35 | 0.03 | 0.00 | 0.10 | 0.11 | 0.11 | 0.00 | 0.81 |
| **1999** | 3.50 | 0.31 | 0.03 | 0.00 | 0.09 | 0.10 | 0.10 | 0.00 | 0.71 |
| **2000** | 3.66 | 0.32 | 0.02 | 0.00 | 0.10 | 0.10 | 0.11 | 0.00 | 0.75 |
| **2001** | 3.22 | 0.29 | 0.02 | 0.00 | 0.08 | 0.09 | 0.09 | 0.00 | 0.66 |
| **2002** | 3.47 | 0.31 | 0.02 | 0.00 | 0.09 | 0.10 | 0.10 | 0.00 | 0.71 |
| **2003** | 3.81 | 0.34 | 0.02 | 0.00 | 0.10 | 0.10 | 0.11 | 0.00 | 0.78 |
| **2004** | 3.79 | 0.34 | 0.02 | 0.00 | 0.10 | 0.10 | 0.11 | 0.00 | 0.77 |
| **2005** | 3.84 | 0.34 | 0.00 | 0.00 | 0.10 | 0.11 | 0.11 | 0.00 | 0.78 |
| **2006** | 3.66 | 0.32 | 0.00 | 0.00 | 0.10 | 0.10 | 0.11 | 0.00 | 0.75 |
| **2007** | 3.77 | 0.33 | 0.00 | 0.00 | 0.10 | 0.10 | 0.11 | 0.00 | 0.77 |
| **2008** | 3.81 | 0.34 | 0.00 | 0.00 | 0.10 | 0.10 | 0.11 | 0.00 | 0.78 |
| **2009** | 2.92 | 0.26 | 0.00 | 0.00 | 0.08 | 0.08 | 0.08 | 0.00 | 0.60 |
| **2010** | 3.09 | 0.27 | 0.00 | 0.00 | 0.08 | 0.08 | 0.09 | 0.00 | 0.63 |
| **2011** | 3.22 | 0.29 | 0.00 | 0.00 | 0.08 | 0.09 | 0.09 | 0.00 | 0.66 |
| **2012** | 3.03 | 0.27 | 0.00 | 0.00 | 0.08 | 0.08 | 0.09 | 0.00 | 0.62 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2013** | 2.79 | 0.25 | 0.00 | 0.00 | 0.07 | 0.08 | 0.08 | 0.00 | 0.57 |
| **2014** | 2.92 | 0.26 | 0.00 | 0.00 | 0.08 | 0.08 | 0.08 | 0.00 | 0.60 |
| **2015** | 2.74 | 0.24 | 0.00 | 0.00 | 0.07 | 0.08 | 0.08 | 0.00 | 0.56 |
| **2016** | 2.65 | 0.24 | 0.00 | 0.00 | 0.07 | 0.07 | 0.08 | 0.00 | 0.54 |
| **2017** | 2.85 | 0.25 | 0.00 | 0.00 | 0.07 | 0.08 | 0.08 | 0.00 | 0.58 |
| **2018** | 3.21 | 0.28 | 0.00 | 0.00 | 0.08 | 0.09 | 0.09 | 0.00 | 0.66 |
| **2019** | 2.91 | 0.26 | 0.00 | 0.00 | 0.08 | 0.08 | 0.08 | 0.00 | 0.59 |
| **2020** | 2.82 | 0.25 | 0.00 | 0.00 | 0.07 | 0.08 | 0.08 | 0.00 | 0.58 |
| **2021** | 2.76 | 0.24 | 0.00 | 0.00 | 0.07 | 0.08 | 0.08 | 0.00 | 0.56 |
| **Change, % 1990/2021** | **-53.03%** | **-53.03%** | **-99.06%** | **-46.31%** | **-53.03%** | **-53.03%** | **-53.03%** | **-53.03%** | **-53.03%** |
| **Change, % 2005/2021** | **-28.13%** | **-28.13%** | **-85.63%** | **-17.86%** | **-28.13%** | **-28.13%** | **-28.13%** | **-28.13%** | **-28.13%** |
| | | | | | | | | | |

## Methodological issues

The Tier 2 approach is based on apportioning the total fuel used by railways to that used by different generic locomotive technology types as the measure of activity. It assumes that the fuel can be apportion for example using statistics on the number of locomotives, categorized by type, and their average usage, e.g. from locomotive maintenance records.

For this approach the algorithm used is:

$$E_i = \sum_m \sum_j (FC_{j,m} \times EF_{i,j,m})$$

Where *Ei* - mass of emissions of pollutant *i* during inventory period; *FC* - fuel consumption; *EFi* - average emissions of pollutant *i* per unit of fuel used.

*EFi,j,m* - emission factor of pollutant *I* for each unit of fuel type *m* used by category *j* (kg/tonnes)

*m* – fuel type (diesel, gas oil)

*j* - locomotive category (shunting, rail car, line haul).

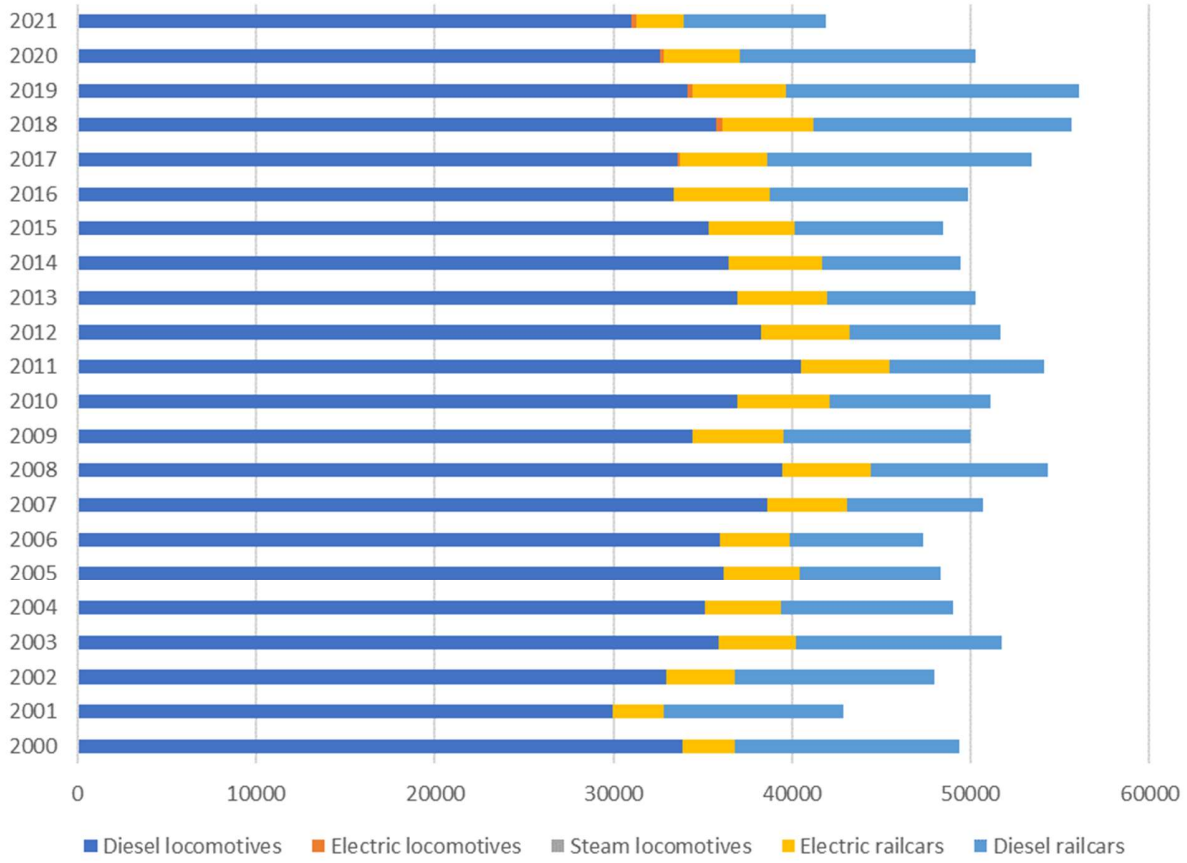



Figure 0-16 Trains technology, thous. km, 2000-2021

Emissions were estimated using fuel statistics from Statistics Lithuania. Tier 2 emission factors were taken from 2016 EMEP/EEA Guidebook 1.A.3.c category. While several EFs based on sulphur content in the fuel were used: for the 1990-2000 period 400 g Sulphur/Mg of fuel consumed, 2000-2005 – 300 g/Mg, 2005-2009 – 40 g/Mg and 8 g/Mg for every year from 2009. The following Guidebook-provided equation was used to estimate SOx emissions:

$$Emission_{SOx} = 2 \times Fuel\ consumed\ (Gg)_{Diesel} \times Sulphur\ content\ (Gg\ of\ S\ per\ Gg\ of\ diesel)$$

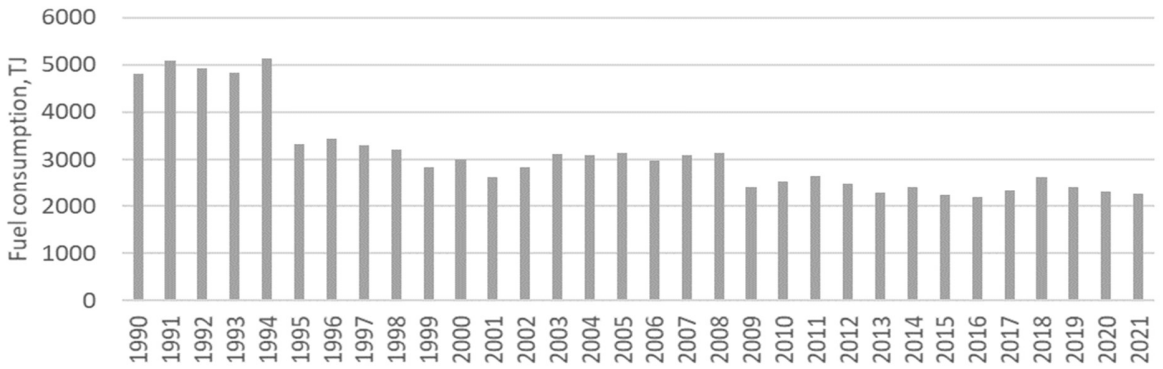


Figure 0-17 Fuel consumption in Railway 1.A.3.c sector

Fuel consumption in the railways transport decreased 52.7% from 1990 to 2021. Similar change occurred in the amounts of emissions. 1990/2021 emissions dropped by 48.9%, while 2005/2021 emissions decreased by 33.8%. SOx emissions decreased by 99.0% and 85.6% from 1990 to 2021 and from 2005 to 2021, respectively.

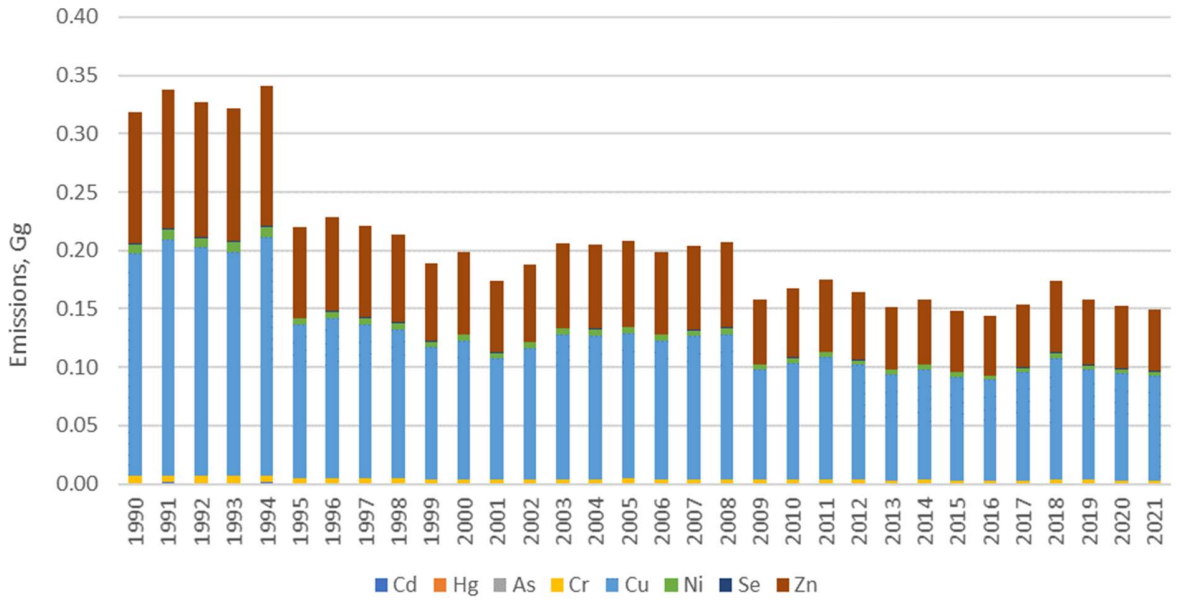



Figure 0-18 Heavy metals emissions in sector 1.A.3.c

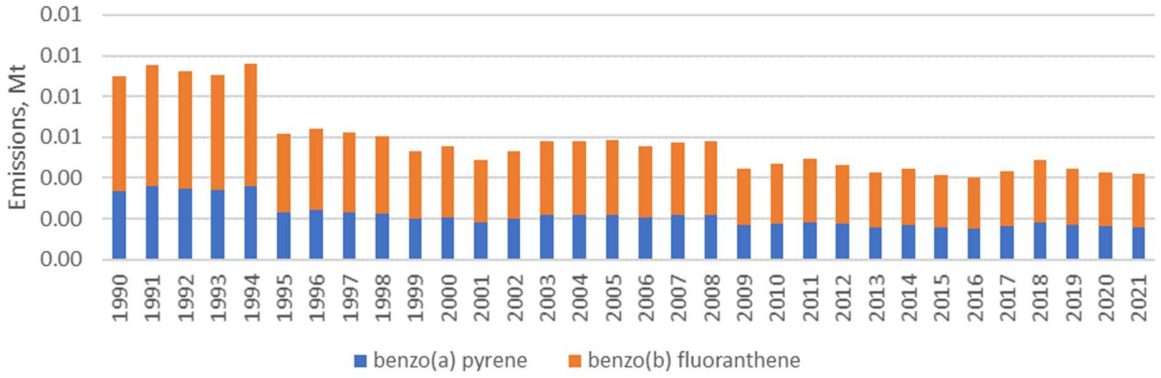



Figure 0-19 PAHs emissions in sector 1.A.3.c

B(k)f & Indeno (1,2,3-cd) pyrene and dioxins emission factor values are not available for railway emissions. It is therefore recommended to use values corresponding to old technology heavy duty vehicles from the Exhaust Emissions from Road Transport chapter (1.A.3.b.iii), BC fraction of PM (f-BC): 0.53.

### Uncertainties and time-series consistency

The uncertainty in activity data is 2%. The EF in table above provide ranges indicating the uncertainties associated with diesel fuel. In the absence of specific information, the percentage relationship between the upper and lower limiting values and the central estimate may be used to derive default uncertainty ranges associated with emission factors for additives.

### Source-specific planned improvements

No source-specific improvements.

### Source-specific recalculations

Recalculations were done in 2021 on the basis of new activity data for 2019 from Statistics Lithuania. In this submission no recalculations were done. $PM_{2.5}$ and $PM_{10}$ emissions were recalculated according to swapping the EF for PM2.5 and PM10.

| | Submission 2019, kt | Submission 2022, kt | Absolute difference, Gg $CO_2$ eq. | Relative difference, % |
|---|---|---|---|---|
| NOx (as $NO_2$) | 3.42 | 2.91 | -0.51 | -14.96 |
| $PM_{2.5}$ | 0.06 | 0.08 | 0.01 | 21.93 |
| $PM_{10}$ | 0.07 | 0.08 | 0.01 | 17.64 |
| TSP | 0.10 | 0.08 | -0.02 | -16.74 |

## 2.4. National navigation (shipping) (NFR 1.A.3.d)

### Overview of the Sector

Lithuania has ~900 km of inland waterways.


Figure 0-20 Operated inland waterways of national importance of the republic of Lithuania

here are 822 km of inland waterways of national importance of the Republic of Lithuania, 435 km of them are being operated. In 1997 the Republic of Lithuania signed European Agreement on Main Inland Waterways of International Importance (AGN agreement), according to which inland waterways of the River Nemunas and the Curonian Lagoon from Kaunas to Klaipeda are inland waterway of international importance E41 (the length – 291.2 km). All navigation period along the E41way there has to be maintained indicators as it is defined by waterways network main standards and parameters description TRANS / SC.3 / 144 of the United Nations Economic Commission. For the E41 waterway section from Klaipėda to Jurbarkas there are set these measurements: length of vessel – 100m, beam – 10m, depth of the waterway – 1,5m (draught not more than 1.3m); for the section from Jurbarkas to Kaunas: length of vessel – 100m, beam – 10m, depth of waterway – 1,2m (draught not more than 1,00m). Trends of emissions (kt) is provided in Table below.

Table 0-15 Trends of emissions (kt), %

| | NOX | NMLOJ | Sox | NH3 | PM2.5 | PM10 | TSP | BC | CO |
|---|---|---|---|---|---|---|---|---|---|
| **1990** | 0.190 | 0.0139 | 0.028 | 3.470-6 | 0.007 | 0.007 | 0.007 | 0.002 | 0.0367 |
| **1995** | 0.038 | 0.003 | 0.005 | 0.000 | 0.001 | 0.001 | 0.001 | 0.000 | 0.007 |
| **2000** | 0.110 | 0.008 | 0.014 | 0.000 | 0.004 | 0.004 | 0.004 | 0.001 | 0.021 |
| **2005** | 0.206 | 0.015 | 0.027 | 0.000 | 0.008 | 0.008 | 0.008 | 0.002 | 0.040 |
| **2006** | 0.234 | 0.017 | 0.012 | 0.000 | 0.009 | 0.009 | 0.009 | 0.003 | 0.045 |
| **2007** | 0.219 | 0.016 | 0.011 | 0.000 | 0.008 | 0.009 | 0.009 | 0.002 | 0.042 |
| **2008** | 0.232 | 0.017 | 0.006 | 0.000 | 0.008 | 0.009 | 0.009 | 0.003 | 0.045 |
| **2009** | 0.202 | 0.015 | 0.005 | 0.000 | 0.007 | 0.008 | 0.008 | 0.002 | 0.039 |
| **2010** | 0.243 | 0.018 | 0.006 | 0.000 | 0.009 | 0.009 | 0.009 | 0.003 | 0.047 |
| **2011** | 0.201 | 0.015 | 0.005 | 0.000 | 0.007 | 0.008 | 0.008 | 0.002 | 0.039 |
| **2012** | 0.184 | 0.013 | 0.005 | 0.000 | 0.007 | 0.007 | 0.007 | 0.002 | 0.035 |
| **2013** | 0.176 | 0.013 | 0.005 | 0.000 | 0.006 | 0.007 | 0.007 | 0.002 | 0.034 |
| **2014** | 0.178 | 0.013 | 0.005 | 0.000 | 0.007 | 0.007 | 0.007 | 0.002 | 0.034 |
| **2015** | 0.168 | 0.012 | 0.004 | 0.000 | 0.006 | 0.007 | 0.007 | 0.002 | 0.032 |
| **2016** | 0.162 | 0.012 | 0.004 | 0.000 | 0.006 | 0.006 | 0.006 | 0.002 | 0.031 |
| **2017** | 0.208 | 0.015 | 0.005 | 0.000 | 0.008 | 0.008 | 0.008 | 0.002 | 0.040 |
| **2018** | 0.181 | 0.013 | 0.005 | 0.000 | 0.007 | 0.007 | 0.007 | 0.002 | 0.035 |
| **2019** | 0.198 | 0.014 | 0.005 | 0.000 | 0.007 | 0.008 | 0.008 | 0.002 | 0.038 |
| **2020** | 0.14 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.03 |
| **2021** | 0.15 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.03 |
| **1990/2021** | -20.45% | -20.45% | -84.09% | -20.45% | -20.45% | -20.45% | -20.45% | -20.45% | -20.45% |
| **2005/2021** | -26.52% | -26.52% | -85.30% | -26.52% | -26.52% | -26.52% | -26.52% | -26.52% | -26.52% |
| **2020/2021** | 4.52% | 4.52% | 4.52% | 4.52% | 4.52% | 4.52% | 4.52% | 4.52% | 4.52% |

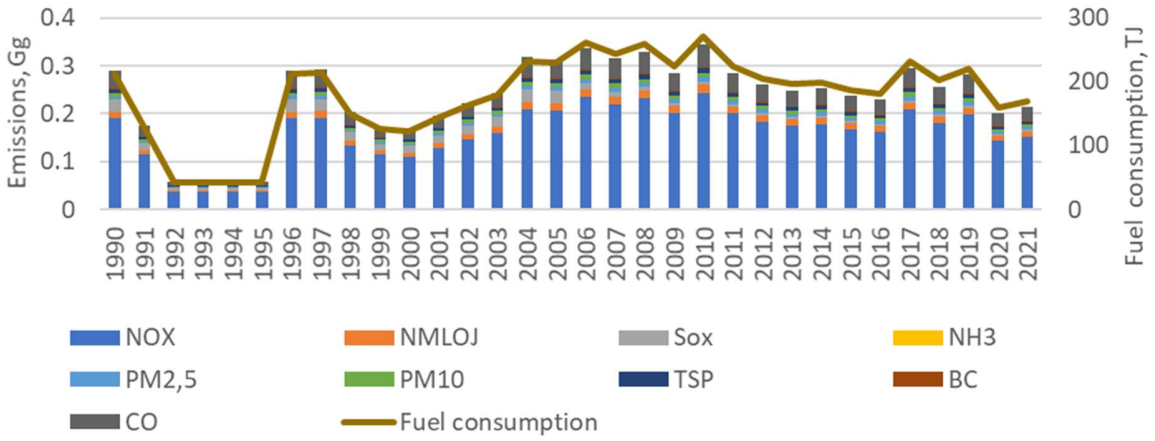



Figure 0-21 Pollutant emissions and fuel consumption in sector 1.A.3.d.ii

As seen in Figure fuel consumption decreased by 26.5 % between 2005 and 2021. This decrease is obviously due to the impact of the decreased fuel consumption in inland waterways.

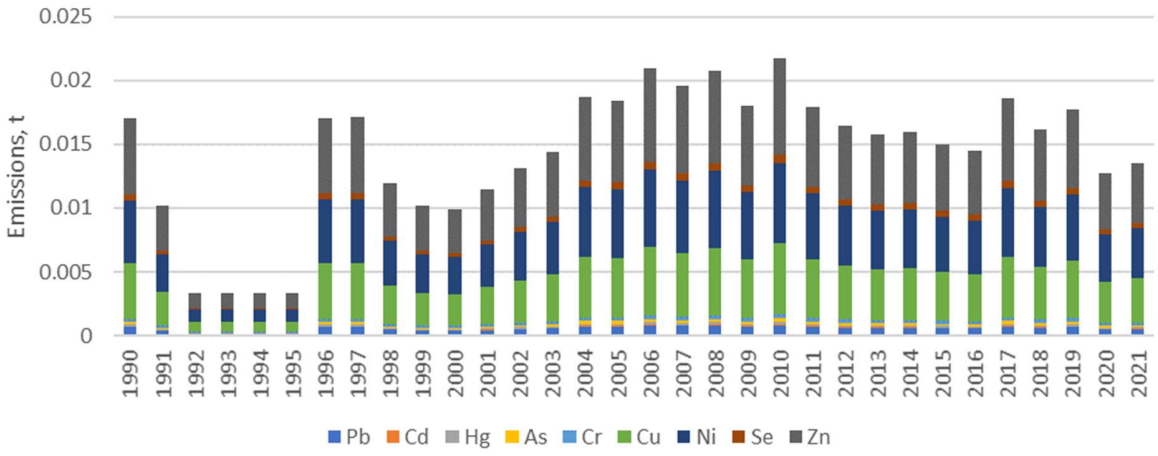



Figure 0-22 Heavy metal emissions in sector 1.A.3.d.ii

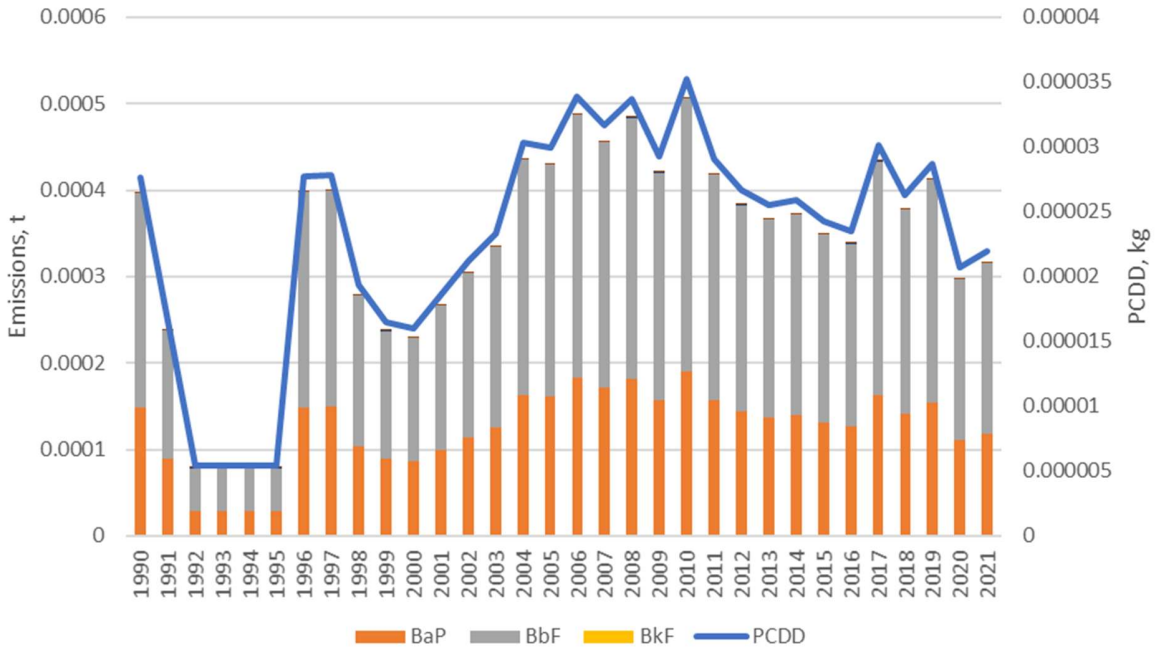



Figure 0-23 PAHs emissions in sector 1.A.3.d.ii

## Methodological issues

Emissions were calculated according to EEA emission guidebook 2013 methodology Tier 1 approach.

A simple methodology for estimating emissions is based on total fuel consumption data. which have to be multiplied by appropriate emission factors. Therefore, the equation to be applied in this case is:

$$E_i = FC \times EF_i$$

were $E_i$ - mass of emissions of pollutant *i* during inventory period; *FC* - fuel consumption; $EF_i$ - average emissions of pollutant *i* per unit of fuel used.

## Uncertainties and time-series consistency

Entec (2002) provides estimates of uncertainties for emission factors as indicated in the table below.

Table 0-16 Estimated uncertainties given as percentage related to the emission factor parameter

| | **At sea** | **Maneuvering** | **In port** |
|---|---|---|---|
| NOx | ±20% | ±40% | ±30% |
| SOx | ±10% | ±30% | ±20% |

| | | | |
|---|---|---|---|
| NMVOC | ±25% | ±50% | ±40% |
| PM | ±25% | ±50% | ±40% |
| Fuel Consumption | ±10% | ±30% | ±20% |

### Uncertainties and time-series consistency

The uncertainty in activity data is 2%. The EF in table above provide ranges indicating the uncertainties associated with gasoil fuel. In the absence of specific information, the percentage relationship between the upper and lower limiting values and the central estimate may be used to derive default uncertainty ranges associated with emission factors for additives.

### Source-specific planned improvements

No source-specific improvements.

### Source-specific recalculations

Recalculations in 2022 submission were done on the basis of corrected swapped $PM_{2.5}$ and $PM_{10}$ EF. No recalculations were done in this submission.

| | **PM2.5** | | | | **PM10** | | | |
|---|---|---|---|---|---|---|---|---|
| | Submission 2020, kt | Submission 2022, kt | Absolute difference, Gg CO2 eq. | Relative difference, % | Submission 2020, kt | Submission 2022, kt | Absolute difference, Gg CO2 eq. | Relative difference, % |
| **1990** | 0.007 | 0.007 | 0.000 | -6.67 | 0.007 | 0.007 | 0.000 | 7.14 |
| **1991** | 0.004 | 0.004 | 0.000 | -6.67 | 0.004 | 0.004 | 0.000 | 7.14 |
| **1992** | 0.001 | 0.001 | 0.000 | -6.67 | 0.001 | 0.001 | 0.000 | 7.14 |
| **1993** | 0.001 | 0.001 | 0.000 | -6.67 | 0.001 | 0.001 | 0.000 | 7.14 |
| **1994** | 0.001 | 0.001 | 0.000 | -6.67 | 0.001 | 0.001 | 0.000 | 7.14 |
| **1995** | 0.001 | 0.001 | 0.000 | -6.67 | 0.001 | 0.001 | 0.000 | 7.14 |
| **1996** | 0.007 | 0.007 | 0.000 | -6.67 | 0.007 | 0.007 | 0.000 | 7.14 |
| **1997** | 0.007 | 0.007 | 0.000 | -6.67 | 0.007 | 0.007 | 0.000 | 7.14 |
| **1998** | 0.005 | 0.005 | 0.000 | -6.67 | 0.005 | 0.005 | 0.000 | 7.14 |
| **1999** | 0.004 | 0.004 | 0.000 | -6.67 | 0.004 | 0.004 | 0.000 | 7.14 |
| **2000** | 0.004 | 0.004 | 0.000 | -6.67 | 0.004 | 0.004 | 0.000 | 7.14 |
| **2001** | 0.005 | 0.005 | 0.000 | -6.67 | 0.005 | 0.005 | 0.000 | 7.14 |
| **2002** | 0.006 | 0.005 | 0.000 | -6.67 | 0.005 | 0.006 | 0.000 | 7.14 |
| **2003** | 0.006 | 0.006 | 0.000 | -6.67 | 0.006 | 0.006 | 0.000 | 7.14 |
| **2004** | 0.008 | 0.008 | -0.001 | -6.67 | 0.008 | 0.008 | 0.001 | 7.14 |
| **2005** | 0.008 | 0.008 | -0.001 | -6.67 | 0.008 | 0.008 | 0.001 | 7.14 |
| **2006** | 0.009 | 0.009 | -0.001 | -6.67 | 0.009 | 0.009 | 0.001 | 7.14 |
| **2007** | 0.009 | 0.008 | -0.001 | -6.67 | 0.008 | 0.009 | 0.001 | 7.14 |
| **2008** | 0.009 | 0.008 | -0.001 | -6.67 | 0.008 | 0.009 | 0.001 | 7.14 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2009** | 0.008 | 0.007 | -0.001 | -6.67 | 0.007 | 0.008 | 0.001 | 7.14 |
| **2010** | 0.009 | 0.009 | -0.001 | -6.67 | 0.009 | 0.009 | 0.001 | 7.14 |
| **2011** | 0.008 | 0.007 | -0.001 | -6.67 | 0.007 | 0.008 | 0.001 | 7.14 |
| **2012** | 0.007 | 0.007 | 0.000 | -6.67 | 0.007 | 0.007 | 0.000 | 7.14 |
| **2013** | 0.007 | 0.006 | 0.000 | -6.67 | 0.006 | 0.007 | 0.000 | 7.14 |
| **2014** | 0.007 | 0.007 | 0.000 | -6.67 | 0.007 | 0.007 | 0.000 | 7.14 |
| **2015** | 0.007 | 0.006 | 0.000 | -6.67 | 0.006 | 0.007 | 0.000 | 7.14 |
| **2016** | 0.006 | 0.006 | 0.000 | -6.67 | 0.006 | 0.006 | 0.000 | 7.14 |
| **2017** | 0.008 | 0.008 | -0.001 | -6.67 | 0.008 | 0.008 | 0.001 | 7.14 |
| **2018** | 0.007 | 0.007 | 0.000 | -6.67 | 0.007 | 0.007 | 0.000 | 7.14 |
| **2019** | 0.008 | 0.007 | -0.001 | -6.67 | 0.007 | 0.008 | 0.001 | 7.14 |
| **2020** | | 0.005 | | | | 0.006 | | |
| **2021** | | 0.006 | | | | 0.006 | | |

## 2.5. Pipelines (NFR 1.A.3.e)

### Overview of the Sector

In Lithuania, natural gas is transported via gas transmission and distribution systems. Statistics Lithuania started collecting data on consumption of natural gas used for gas transportation in pipeline compressor stations from 2001.

JSC “Lietuvos Dujos” is the operator of Lithuania’s natural gas transmission system in charge of the safe operation, maintenance and development of the system. The transmission system is comprised of gas transmission pipelines, gas compressor stations, gas metering and distribution stations (Table 0-17).

Table 0-17 Lithuanian natural gas transmission system

| **Gas transmission pipelines** | **Gas distribution stations** | **Gas metering stations** | **Gas compressor stations** |
|---|---|---|---|
| 1.9 thous. km | 65 stations | 3 stations | 2 stations |


Figure 0-24 Gas distribution network in Lithuania

Transport via pipelines includes transport of gases via pipelines.

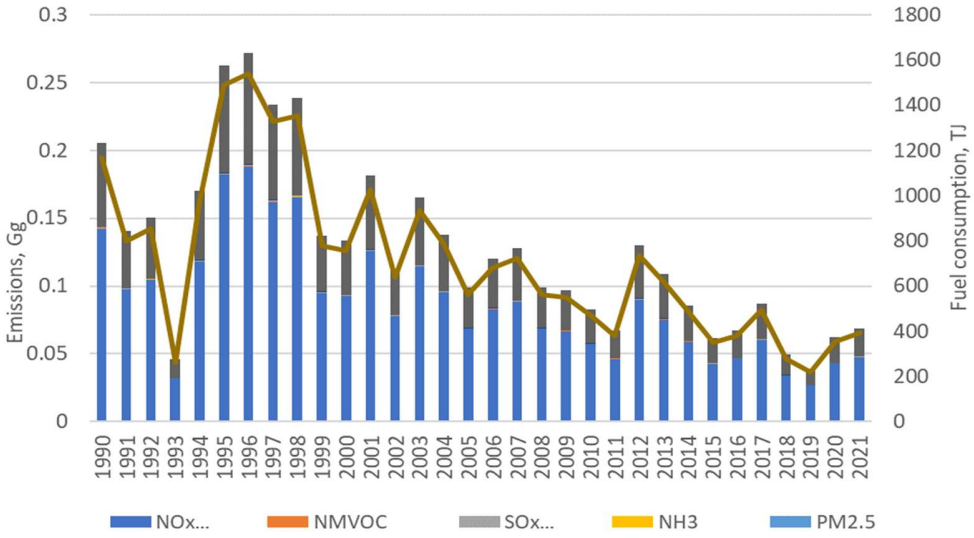



Figure 0-25 Pollutant emissions and fuel consumption in sector 1.A.3.e.i

### Methodological issues

Statistics Lithuania has started collecting data on consumption of natural gas used for gas transportation in pipeline compressor stations from 2001. For the period prior to 2001 data on use of natural gas for transmission are not available.

The surrogate method to estimate unavailable data during 1990-2000 was used since the extrapolation approaches should not be done to long periods and inconsistent trend. To evaluate more accurate relationships the regression analysis was developed by relating emissions to more than one statistical parameter. The relationship between gas pipeline emissions and surrogate data was developed on the basis of underlying activity data during multiple years. PM2.5 and PM10 emissions were calculated as TSP=PM10=PM2.5.

### Uncertainties and time-series consistency

The uncertainty in activity data (fuel use) is 5%.

### Source-specific QA/QC and verification

All quality procedures according to the Lithuanian QA/QC plan have been implemented during the work with this submission.

### Source-specific recalculations

No recalculations were done.

## 3. NON-ROAD MOBILE SOURCES (1.A.4.aii-cii(iii), 1.A.5.b)

### NR mobile source category description

This chapter covers several mobile sources. More specifically, the types of equipment covered in this chapter are included in the following NFR categories:

- Commercial and institutional mobile machinery (NFR 1.A.4.a.ii);
- Mobile combustion used in residential areas: household and gardening mobile machinery (NFR 1.A.4.b ii);
- Off-road vehicles and other machinery used in agriculture/forestry mobile machinery (excluding fishing) (NFR 1.A.4.c ii);
- Fishing (NFR 1.A.4.c iii);
- Mobile combustion in manufacturing industries and construction (NFR 1.A.2.g vii);
- Other mobile including military mobile machinery (NFR 1.A.5.b);

All these mobile sources are aggregated in one chapter because each of these sectors have minor importance into total emissions.

## Methodological issues

This sector covers a mixture of equipment which is distributed across a wide range of sectors, typically land based, and is commonly referred to collectively as “Non-Road Mobile Machinery” (NRMM). Despite this diversity there is the common theme that all the equipment covered uses reciprocating engines, fueled with liquid hydrocarbon-based fuels. They comprise both diesel- (compression ignition), petrol- and LPG- (spark ignition) engine machinery. The diesel engines range from large diesel engines >200 kW (installed in cranes, graders/scrapers, bulldozers, etc.) to small diesel engines, around 5 kW, fitted to household and gardening equipment (e.g. lawn and garden tractors, leaf blowers, etc.).

Data on fuel consumption by off-road vehicles and machinery in industry, construction, agriculture, fishery, forestry and residential zones are not collected separately and provided in statistical reports but included in overall fuel consumption by separate sectors (industry, construction, agriculture, fishery, commercial and public services). Consumption of motor gasoline and diesel oil in these sectors as shown in energy balances provided by the Statistics Lithuania actually should be assigned to consumption by off-road machinery. Therefore, consumption of motor gasoline and diesel oil can be separated from other fuels and emissions caused by off-road vehicles can be calculated from these data. Off-road machinery engine on diesel oil provide better fuel efficiency, excellent oxidation resistance, higher engine reliability. In this reason dieselisation from about 1999 occurred.

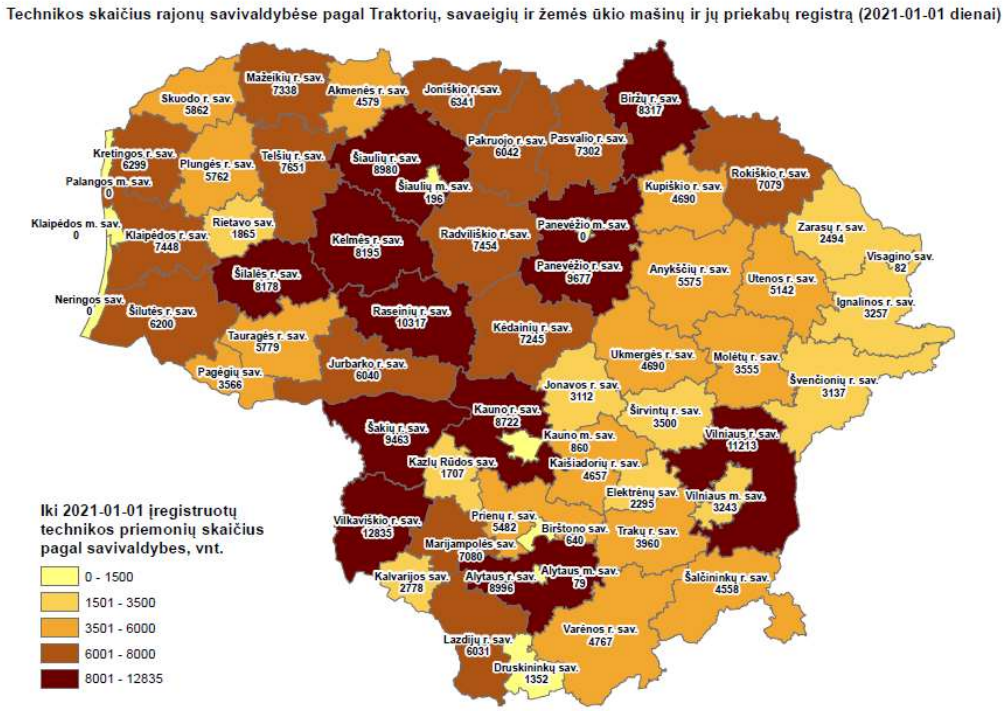
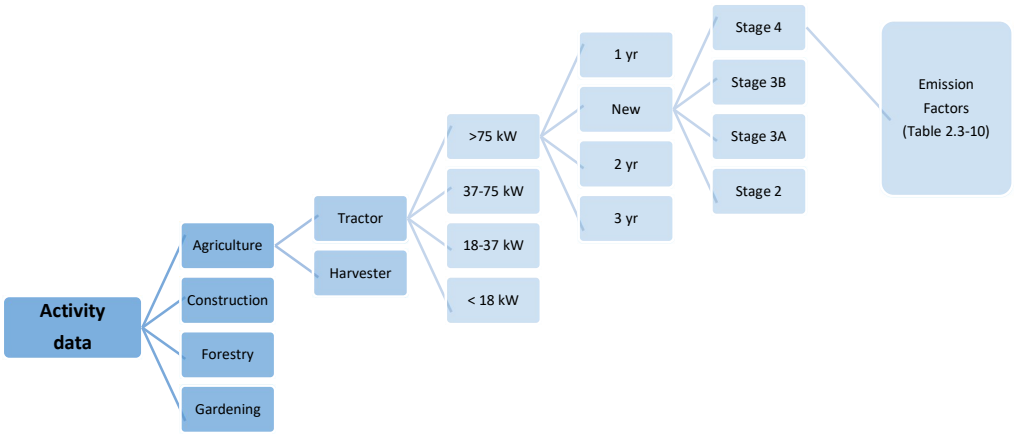



Figure 0-26 Number of off-road vehicles i 2020 (State Enterprise Agricultural Information and Rural Business Center)

The vehicles were distributed by age and engine type.




EFs were applied provided for Tier 2 in EMEP/EEA Emission Guidebook (2019).

Table 0-18 Tier 2 EF for off-road machinery (diesel) 1.A.4.a ii

| **Technology** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Units** | **< 1981** | **1981-1990** | **1991-Stage I** | **Stage I** | **Stage II** | **Stage IIIA** | **Stage IIIB** | **Stage IV** | **Stage V** |
| BC | g/toes fuel | 3414 | 2369 | 2001 | 800 | 825 | 758 | 78 | 78 | 56 |
| $CH_4$ | g/tons fuel | 199 | 171 | 144 | 42 | 39 | 36 | 15 | 13 | 23 |
| CO | g/tons fuel | 20690 | 18890 | 16258 | 6639 | 7135 | 6826 | 6445 | 6019 | 7352 |
| $CO_2$ | kg/tons fuel | 3160 | 3160 | 3160 | 3160 | 3160 | 3160 | 3160 | 3160 | 3160 |
| $N_2O$ | g/tons fuel | 121 | 128 | 135 | 137 | 136 | 136 | 137 | 137 | 136 |
| $NH_3$ | g/tons fuel | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| NMVOC | g/tons fuel | 8077 | 6962 | 5851 | 1725 | 1587 | 1470 | 625 | 536 | 930 |
| NOx | g/tons fuel | 26552 | 33942 | 43552 | 31077 | 22101 | 15653 | 11933 | 1570 | 7663 |
| $PM_{10}$ | g/tons fuel | 6207 | 4308 | 3642 | 1005 | 1034 | 950 | 98 | 98 | 116 |
| $PM_{2.5}$ | g/tons fuel | 6207 | 4308 | 3642 | 1005 | 1034 | 950 | 98 | 98 | 116 |
| TSP | g/tons fuel | 6207 | 4308 | 3642 | 1005 | 1034 | 950 | 98 | 98 | 116 |

Table 0-19 Tier 2 EF for off-road machinery (Diesel oil) 1.A.c ii

| **Technology** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Units** | **< 1981** | **1981-1990** | **1991-Stage I** | **Stage I** | **Stage II** | **Stage IIIA** | **Stage IIIB** | **Stage IV** | **Stage V** |
| BC | g/tons fuel | 3221 | 2221 | 1074 | 727 | 483 | 416 | 74 | 73 | 9 |
| $CH_4$ | g/tons fuel | 191 | 158 | 110 | 38 | 29 | 29 | 29 | 13 | 13 |
| CO | g/tons fuel | 19804 | 17566 | 14147 | 6463 | 6104 | 6035 | 6087 | 6024 | 6077 |
| *$CO_2$* | *kg/tons fuel* | *3160* | *3160* | *3160* | *3160* | *3160* | *3160* | *3160* | *3160* | *3160* |
| $N_2O$ | g/tons fuel | 122 | 129 | 137 | 138 | 138 | 139 | 139 | 139 | 139 |
| $NH_3$ | g/tons fuel | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| NMVOC | g/tons fuel | 7760 | 6439 | 4493 | 1544 | 1181 | 1173 | 544 | 530 | 526 |
| NOx | g/tons fuel | 29901 | 37383 | 49002 | 30799 | 20612 | 12921 | 9318 | 1587 | 1861 |
| $PM_{10}$ | g/tons fuel | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 |
| $PM_{2.5}$ | g/tons fuel | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 |
| TSP | g/tons fuel | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 | 5861 |

Table 0-20 Tier 2 EF for off-road machinery 1.A.4.a ii, 1.A.4.b ii, 1.A.4.c ii (Gasoline: two-stroke)

| **Technology** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Units** | **< 1981** | **1981-1990** | **1991-Stage I** | **Stage I** | **Stage II** | **Stage IIIA** | **Stage IIIB** | **Stage IV** | **Stage V** |
| BC | g/tons fuel | 352 | 239 | 193 | 184 | 215 | 215 | 215 | 215 | 214 |
| $CH_4$ | g/tons fuel | 22483 | 19462 | 17284 | 16979 | 8517 | 8517 | 8517 | 8517 | 8539 |
| CO | g/tons fuel | 754523 | 699494 | 621083 | 620519 | 695237 | 695237 | 695237 | 695237 | 694870 |
| $CO_2$ | kg/tons fuel | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 |
| $N_2O$ | g/tons fuel | 12 | 16 | 16 | 18 | 20 | 20 | 20 | 20 | 20 |
| $NH_3$ | g/tons fuel | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NMVOC | g/tons fuel | 298703 | 258562 | 229630 | 225579 | 113157 | 113157 | 113157 | 113157 | 111450 |
| NOx | g/tons fuel | 1050 | 1682 | 1852 | 3445 | 2495 | 2495 | 2495 | 2495 | 2490 |
| PM10 | g/tons fuel | 7037 | 4786 | 3869 | 3683 | 4299 | 4299 | 4299 | 4299 | 4278 |
| PM2.5 | g/tons fuel | 7037 | 4786 | 3869 | 3683 | 4299 | 4299 | 4299 | 4299 | 4278 |
| TSP | g/tons fuel | 7037 | 4786 | 3869 | 3683 | 4299 | 4299 | 4299 | 4299 | 4278 |

Table 0-21 Tier 2 EF for off-road machinery 1.A.4.a ii, 1.A.4.b ii, 1.A.4.c ii (gasoline: four-stroke)

| **Technology** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Units** | **< 1981** | **1981-1990** | **1991-Stage I** | **Stage I** | **Stage II** | **Stage IIIA** | **Stage IIIB** | **Stage IV** | **Stage V** |
| BC | g/tons fuel | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| $CH_4$ | g/tons fuel | 710 | 910 | 672 | 650 | 568 | 568 | 568 | 568 | 468 |
| CO | g/tons fuel | 1214855 | 836966 | 768445 | 774457 | 804157 | 804157 | 804157 | 804157 | 778282 |
| $CO_2$ | kg/tons fuel | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 | 3197 |
| $N_2O$ | g/tons fuel | 56 | 55 | 59 | 59 | 60 | 60 | 60 | 60 | 59 |
| $NH_3$ | g/tons fuel | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| NMVOC | g/tons fuel | 20182 | 25852 | 19082 | 18469 | 16126 | 16126 | 16126 | 16126 | 13293 |
| NOx | g/tons fuel | 2429 | 5743 | 7129 | 7088 | 6676 | 6676 | 6676 | 6676 | 5354 |
| PM10 | g/tons fuel | 148 | 147 | 157 | 159 | 159 | 159 | 159 | 159 | 159 |
| PM2.5 | g/tons fuel | 148 | 147 | 157 | 159 | 159 | 159 | 159 | 159 | 159 |
| TSP | g/tons fuel | 148 | 147 | 157 | 159 | 159 | 159 | 159 | 159 | 159 |

Table 0-22 Tier 2 HM and POP EFs for off-road machinery 1.A.4.a ii, 1.A.4.b ii, 1.A.4.c ii

| | | **Diesel** | **Gasoline** |
|---|---|---|---|
| **Pollutant** | **Units** | **Emission factor** | |
| Cadmium | mg/kg fuel | 0.010 | 0.010 |

| | | | |
|---|---|---|---|
| Copper | mg/ kg fuel | 1.70 | 1.70 |
| Chromium | mg/ kg fuel | 0.050 | 0.050 |
| Nickel | mg/ kg fuel | 0.07 | 0.07 |
| Selenium | mg/ kg fuel | 0.01 | 0.01 |
| Zinc | mg/ kg fuel | 1.00 | 1.00 |
| Benz(a)anthracene | µg/kg fuel | 80 | 75 |
| Benzo(b)fluoranthene | µg/kg fuel | 50 | 40 |
| Dibenzo(a,h)anthracene | µg/kg fuel | 10 | 10 |
| Benzo(a)pyrene | µg/kg fuel | 30 | 40 |
| Chrysene | µg/kg fuel | 200 | 150 |
| Fluoranthene | µg/kg fuel | 450 | 450 |
| Phenanthene | µg/kg fuel | 2500 | 1200 |

**BC**: For agriculture, forestry, industry and gasoline/LPG machinery, the following BC fractions of PM (f-BC) are used: 0.57, 0.65, 0.62 and 0.05.

**$SO_2$:** The emissions of $SO_2$ are estimated by assuming that all Sulphur in the fuel is transformed completely into $SO_2$ using the formula:

$$E_{SO2} = 2\ \Sigma k_{S,l}\, b_{j,l}$$

where

$k_{S,l}$ = weight related Sulphur content of fuel of type [kg/kg],

$b_{j,l}$ = total annual consumption of fuel of type *l* in [kg] by source category *j*.

Table 0-23 Sulphur content of fuel (by weight)

| NFR | Fuel | 1990 | 2000 | 2001 | 2003 | 2004 | 2005 | 2006 | 2009 | 2010 - |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A2gvii 1A4aii | Gasoline | 0.10% | 0.10% | 0.05% | 0.015% | 0.013% | 0.005% | 0.002% | 0.002% | 0.002% |
| 1A4bii 1A4ciii | Diesel | 0.50% | 0.50% | 0.05% | 0.035% | 0.030% | 0.005% | 0.004% | 0.002% | 0.002% |
| 1A4cii | Light fuel oil | 0.50% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0.10% |

Table 0-24 Sulphur content and $SO_2$ EFs used in Off-road sector

| | 1990-1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Diesel** | | | | | | | | | | | | | 0.2 | | | | | | | | 0.1 |
| **Gasoline** | 0.015 | | | | | | | | | | 0.02 | | | 0.01 | | | | | | | 0.0005 |

Notes:

Gasoline, diesel oil – EU legislation

**Lead**: Pb emissions are estimated according to the calculation that 75% of lead contained in gasoline is emitted into the air. Equation:

$$E_{Pb} = 0.75 \times k \times FC$$

where

$E_{Pb}$ – Pb emissions;

*k* – weight-related lead content of gasoline (kg/kg);

*FC* – fuel consumption.

Table 0-25 Lead content in gasoline (g/l)

| Fuel | Leaded gasoline | Unleaded gasoline |
|---|---|---|
| 1990 | 0.15 | 0.013 |
| 2003 | - | 0.005 |
| 2006 | - | 0.003 |
| 2010 | - | 0.0001 |

Data need be used to split the total fuel consumption into engine technology layers for each following year starting from 2013 inventory year as Country specific data available only from 2013.

Table 0-26 Average year specific fuel consumption (%) per engine age and inventory year for diesel-fueled non-road machinery in 1.A.4.a.ii and 1.A.2.g ii

| | 2013 | 2014 | 2015 | 2016 | 2017-2021 |
|---|---|---|---|---|---|
| <1981 | 0 | 0 | 0 | 0 | 0 |
| 1981-1990 | 0 | 0 | 0 | 0 | 0 |
| 1991-Stage I | 5 | 4 | 3 | 3 | 3 |
| Stage I | 0 | 0 | 0 | 0 | 0 |
| Stage II | 29 | 18 | 7 | 4 | 3 |
| Stage IIIA | 58 | 62 | 66 | 60 | 52 |
| Stage IIIB | 8 | 16 | 24 | 25 | 27 |
| Stage IV | 0 | 0 | 1 | 8 | 15 |
| Stage V | 0 | 0 | 0 | 0 | 0 |

Table 0-27 Average year specific fuel consumption (%) per engine age and inventory year for diesel-fueled non-road machinery in 1.A.4.c.ii

| | 2013 | 2014 | 2015 | 2016 | 2017-2021 |
|---|---|---|---|---|---|
| <1981 | 0 | 0 | 0 | 0 | 0 |
| 1981-1990 | 0 | 0 | 0 | 0 | 0 |
| 1991-Stage I | 42 | 36 | 31 | 26 | 22 |
| Stage I | 9 | 10 | 10 | 10 | 9 |
| Stage II | 18 | 18 | 18 | 19 | 19 |
| Stage IIIA | 24 | 24 | 24 | 24 | 24 |
| Stage IIIB | 7 | 12 | 14 | 14 | 14 |
| Stage IV | 0 | 0 | 4 | 10 | 16 |
| Stage V | 0 | 0 | 0 | 0 | 0 |

Table 0-28 Average year specific fuel consumption (%) per engine age and inventory year for diesel-fueled non-road machinery in 1.A.2.g.vii

| | 2013 | 2014 | 2015 | 2016 | 2017-2021 |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| <1981 | 0 | 0 | 0 | 0 | 0 |
| 1981-1990 | 0 | 0 | 0 | 0 | 0 |
| 1991-Stage I | 5 | 4 | 3 | 3 | 3 |
| Stage I | 0 | 0 | 0 | 0 | 0 |
| Stage II | 29 | 18 | 7 | 4 | 3 |
| Stage IIIA | 58 | 62 | 66 | 60 | 52 |
| Stage IIIB | 8 | 16 | 24 | 25 | 27 |
| Stage IV | 0 | 0 | 1 | 8 | 15 |
| Stage V | 0 | 0 | 0 | 0 | 0 |

Table 0-29 Average year specific fuel consumption (%) per engine age and inventory year for 2-stroke motor gasoline-fueled non-road machinery in 1.A.4.a.ii, 1.A.4.b.ii and 1.A.4.c.ii

| | **2013** | **2014** | **2015** | **2016** | **2017-2021** |
|---|---|---|---|---|---|
| 1981-1990 | 0 | 0 | 0 | 0 | 0 |
| 1991-Stage I | 10 | 0 | 0 | 0 | 0 |
| Stage I | 27 | 27 | 18 | 8 | 0 |
| Stage II | 63 | 73 | 82 | 92 | 100 |
| Stage V | 0 | 0 | 0 | 0 | 0 |

Table 0-30 Average year specific fuel consumption (%) per engine age and inventory year for 4-stroke motor gasoline-fueled non-road machinery in 1.A.4.a.ii, 1.A.4.b.ii and 1.A.4.c.ii

| | **2013** | **2014** | **2015** | **2016** | **2017-2021** |
|---|---|---|---|---|---|
| 1981-1990 | 0 | 0 | 0 | 0 | 0 |
| 1991-Stage I | 25 | 17 | 8 | 0 | 0 |
| Stage I | 23 | 22 | 18 | 18 | 9 |
| Stage II | 52 | 61 | 74 | 82 | 91 |
| Stage V | 0 | 0 | 0 | 0 | 0 |

## 1.1. Commercial and institutional (mobile) (1.A.4.a.ii)

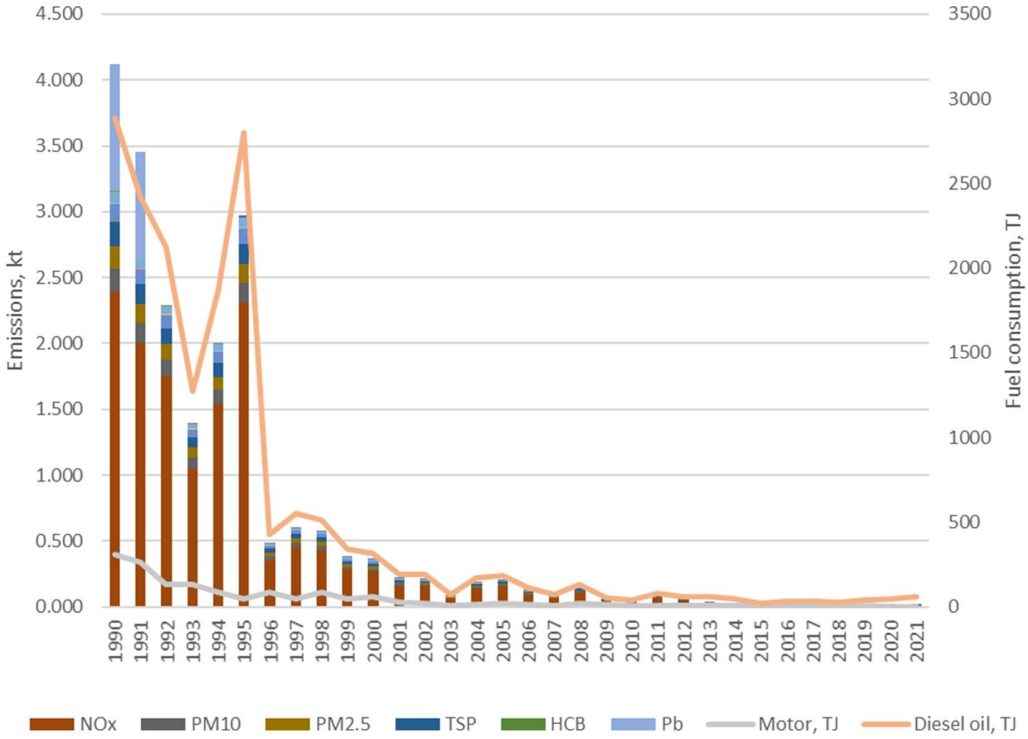



Figure 0-27 Pollutant emissions and fuel consumption in sector 1.A.4.a.ii

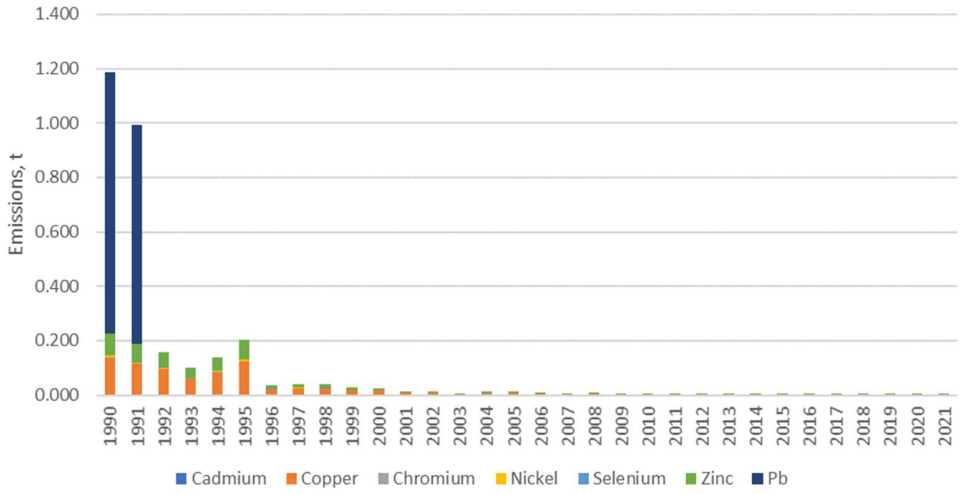



Figure 0-28 Heavy metal and PAHs emissions in sector 1.A.4.a.ii

Table 0-31 Trends of emissions 1.A.4.a ii (kt), %

| | BC | CO | NH3 | NMVOC | NOx | PM10 | PM2.5 | TSP |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **1990** | 0.096 | 5.126 | 0.001 | 1.835 | 2.390 | 0.179 | 0.170 | 0.179 |
| **1995** | 0.095 | 1.380 | 0.001 | 0.465 | 2.303 | 0.152 | 0.143 | 0.152 |
| **2000** | 0.014 | 0.904 | 0.000 | 0.326 | 0.265 | 0.022 | 0.021 | 0.022 |
| **2005** | 0.007 | 0.318 | 0.000 | 0.114 | 0.154 | 0.011 | 0.011 | 0.011 |
| **2010** | 0.002 | 0.110 | 0.000 | 0.040 | 0.033 | 0.003 | 0.003 | 0.003 |
| **2011** | 0.003 | 0.162 | 0.000 | 0.058 | 0.065 | 0.005 | 0.005 | 0.005 |
| **2012** | 0.003 | 0.172 | 0.000 | 0.062 | 0.052 | 0.004 | 0.004 | 0.004 |
| **2013** | 0.001 | 0.163 | 0.000 | 0.038 | 0.024 | 0.002 | 0.002 | 0.002 |
| **2014** | 0.001 | 0.115 | 0.000 | 0.024 | 0.018 | 0.001 | 0.001 | 0.001 |
| **2015** | 0.000 | 0.096 | 0.000 | 0.018 | 0.006 | 0.001 | 0.001 | 0.001 |
| **2016** | 0.000 | 0.067 | 0.000 | 0.012 | 0.010 | 0.001 | 0.001 | 0.001 |
| **2017** | 0.000 | 0.084 | 0.000 | 0.013 | 0.011 | 0.001 | 0.001 | 0.001 |
| **2018** | 0.000 | 0.084 | 0.000 | 0.013 | 0.011 | 0.001 | 0.001 | 0.001 |
| **2019** | 0.001 | 0.134 | 0.000 | 0.021 | 0.007 | 0.001 | 0.001 | 0.001 |
| **2020** | 0.000 | 0.071 | 0.000 | 0.011 | 0.007 | 0.001 | 0.001 | 0.001 |
| **2021** | 0.000 | 0.073 | 0.000 | 0.011 | 0.009 | 0.001 | 0.001 | 0.001 |
| **2005-2021, %** | **-95.12** | **-77.19** | **-67.31** | **-90.21** | **-94.10** | **-95.31** | **-95.06** | **-95.31** |
| **1990-2021, %** | **-99.64** | **-98.58** | **-97.90** | **-99.39** | **-99.62** | **-99.70** | **-99.68** | **-99.70** |

## 1.2. Residential: Household and gardening (mobile) (1.A.4.b.ii)

This category has been covered in PART 3 – Energy .

## 1.3. Agriculture, forestry and fishing: National fishing (1.A.4.c.iii)

Table 0-32 Trends of emissions (kt), %

| | NOX | NMLOJ | Sox | NH3 | PM2,5 | PM10 | TSP | BC | CO |
|---|---|---|---|---|---|---|---|---|---|
| **1990** | 5.2E-04 | 3.8E-05 | 6.8E-05 | 9.5E-09 | 1.9E-05 | 2.0E-05 | 2.0E-05 | 5.9E-06 | 1.0E-04 |
| **1995** | 1.7E-04 | 1.2E-05 | 2.2E-05 | 3.0E-09 | 6.0E-06 | 6.5E-06 | 6.5E-06 | 1.9E-06 | 3.2E-05 |
| **2000** | 4.0E-04 | 2.9E-05 | 5.2E-05 | 7.2E-09 | 1.4E-05 | 1.5E-05 | 1.5E-05 | 4.5E-06 | 7.6E-05 |
| **2005** | 5.4E-04 | 3.9E-05 | 7.0E-05 | 9.8E-09 | 2.0E-05 | 2.1E-05 | 2.1E-05 | 6.1E-06 | 1.0E-04 |
| **2010** | 1.9E-04 | 1.4E-05 | 5.0E-06 | 3.5E-09 | 7.0E-06 | 7.5E-06 | 7.5E-06 | 2.2E-06 | 3.7E-05 |
| **2015** | 3.5E-04 | 2.5E-05 | 9.0E-06 | 6.3E-09 | 1.3E-05 | 1.4E-05 | 1.4E-05 | 3.9E-06 | 6.7E-05 |
| **2016** | 3.8E-04 | 2.8E-05 | 1.0E-05 | 7.0E-09 | 1.4E-05 | 1.5E-05 | 1.5E-05 | 4.3E-06 | 7.4E-05 |
| **2017** | 3.8E-04 | 2.8E-05 | 1.0E-05 | 7.0E-09 | 1.4E-05 | 1.5E-05 | 1.5E-05 | 4.3E-06 | 7.4E-05 |
| **2018** | 3.8E-04 | 2.8E-05 | 1.0E-05 | 7.0E-09 | 1.4E-05 | 1.5E-05 | 1.5E-05 | 4.3E-06 | 7.4E-05 |
| **2019** | 2.3E-04 | 1.7E-05 | 6.0E-06 | 4.2E-09 | 8.4E-06 | 9.0E-06 | 9.0E-06 | 2.6E-06 | 4.4E-05 |
| **2020** | 2.7E-04 | 2.0E-05 | 7.0E-06 | 4.9E-09 | 9.8E-06 | 1.1E-05 | 1.1E-05 | 3.0E-06 | 5.2E-05 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2021** | 2.7E-04 | 2.0E-05 | 7.0E-06 | 4.9E-09 | 9.8E-06 | 1.1E-05 | 1.1E-05 | 3.0E-06 | 5.2E-05 |
| **1990/2021** | **-40.74%** | **-40.74%** | **-88.15%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** |
| **2005/2021** | **-42.86%** | **-42.86%** | **-88.57%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** |
| **2020/2021** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** |

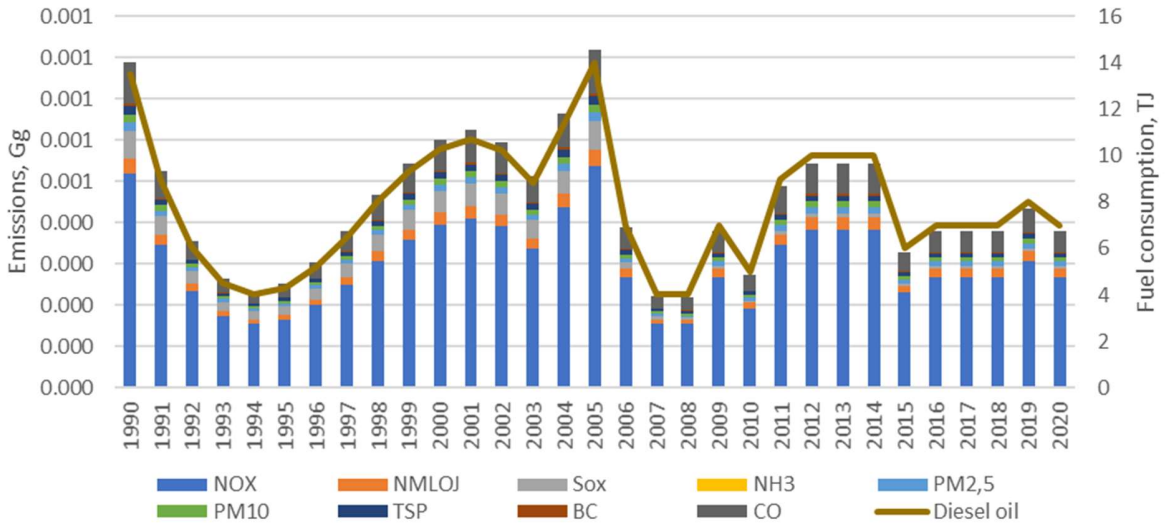



Figure 0-29 Pollutant emissions in sector 1.A.4.c.iii

| | Pb | Cd | Hg | As | Cr | Cu | Ni | Se | Zn |
|---|---|---|---|---|---|---|---|---|---|
| **1990** | 1.76E-06 | 1.35E-07 | 4.05E-07 | 5.40E-07 | 6.75E-07 | 1.19E-05 | 1.35E-05 | 1.35E-06 | 1.62E-05 |
| **1995** | 5.59E-07 | 4.30E-08 | 1.29E-07 | 1.72E-07 | 2.15E-07 | 3.78E-06 | 4.30E-06 | 4.30E-07 | 5.16E-06 |
| **2000** | 1.34E-06 | 1.03E-07 | 3.09E-07 | 4.12E-07 | 5.15E-07 | 9.06E-06 | 1.03E-05 | 1.03E-06 | 1.24E-05 |
| **2005** | 1.82E-06 | 1.40E-07 | 4.20E-07 | 5.60E-07 | 7.00E-07 | 1.23E-05 | 1.40E-05 | 1.40E-06 | 1.68E-05 |
| **2010** | 6.50E-07 | 5.00E-08 | 1.50E-07 | 2.00E-07 | 2.50E-07 | 4.40E-06 | 5.00E-06 | 5.00E-07 | 6.00E-06 |
| **2011** | 1.17E-06 | 9.00E-08 | 2.70E-07 | 3.60E-07 | 4.50E-07 | 7.92E-06 | 9.00E-06 | 9.00E-07 | 1.08E-05 |
| **2012** | 1.30E-06 | 1.00E-07 | 3.00E-07 | 4.00E-07 | 5.00E-07 | 8.80E-06 | 1.00E-05 | 1.00E-06 | 1.20E-05 |
| **2013** | 1.30E-06 | 1.00E-07 | 3.00E-07 | 4.00E-07 | 5.00E-07 | 8.80E-06 | 1.00E-05 | 1.00E-06 | 1.20E-05 |
| **2014** | 1.30E-06 | 1.00E-07 | 3.00E-07 | 4.00E-07 | 5.00E-07 | 8.80E-06 | 1.00E-05 | 1.00E-06 | 1.20E-05 |
| **2015** | 7.80E-07 | 6.00E-08 | 1.80E-07 | 2.40E-07 | 3.00E-07 | 5.28E-06 | 6.00E-06 | 6.00E-07 | 7.20E-06 |
| **2016** | 9.10E-07 | 7.00E-08 | 2.10E-07 | 2.80E-07 | 3.50E-07 | 6.16E-06 | 7.00E-06 | 7.00E-07 | 8.40E-06 |
| **2017** | 9.10E-07 | 7.00E-08 | 2.10E-07 | 2.80E-07 | 3.50E-07 | 6.16E-06 | 7.00E-06 | 7.00E-07 | 8.40E-06 |
| **2018** | 9.10E-07 | 7.00E-08 | 2.10E-07 | 2.80E-07 | 3.50E-07 | 6.16E-06 | 7.00E-06 | 7.00E-07 | 8.40E-06 |
| **2019** | 1.04E-06 | 8.00E-08 | 2.40E-07 | 3.20E-07 | 4.00E-07 | 7.04E-06 | 8.00E-06 | 8.00E-07 | 9.60E-06 |
| **2020** | 9.10E-07 | 7.00E-08 | 2.10E-07 | 2.80E-07 | 3.50E-07 | 6.16E-06 | 7.00E-06 | 7.00E-07 | 8.40E-06 |
| **2021** | 1.04E-06 | 8.00E-08 | 2.40E-07 | 3.20E-07 | 4.00E-07 | 7.04E-06 | 8.00E-06 | 8.00E-07 | 9.60E-06 |
| **1990/2021** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** | **-40.74%** |
| **2005/2021** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** | **-42.86%** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2020/2021** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** | **14.29%** |

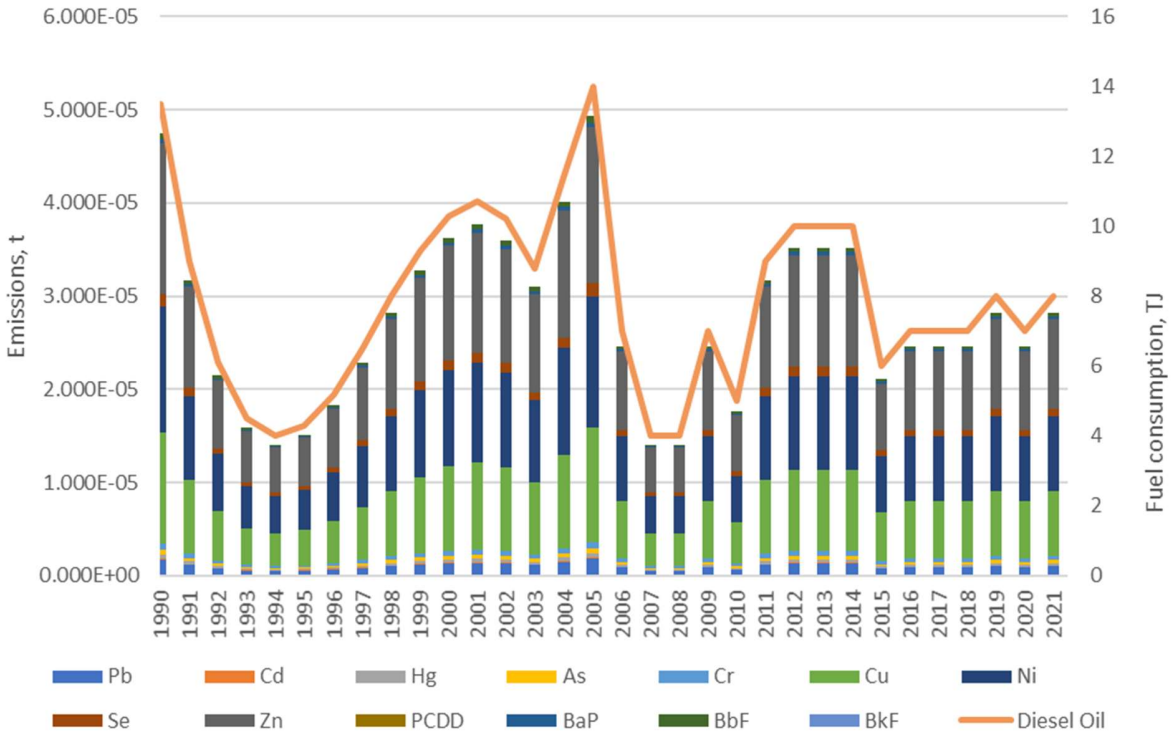



Figure 0-30 Heavy metal and PAHs emissions in sector 1.A.4.c.iii

## 1.4. Other mobile including military mobile machinery (1.A.5.b)

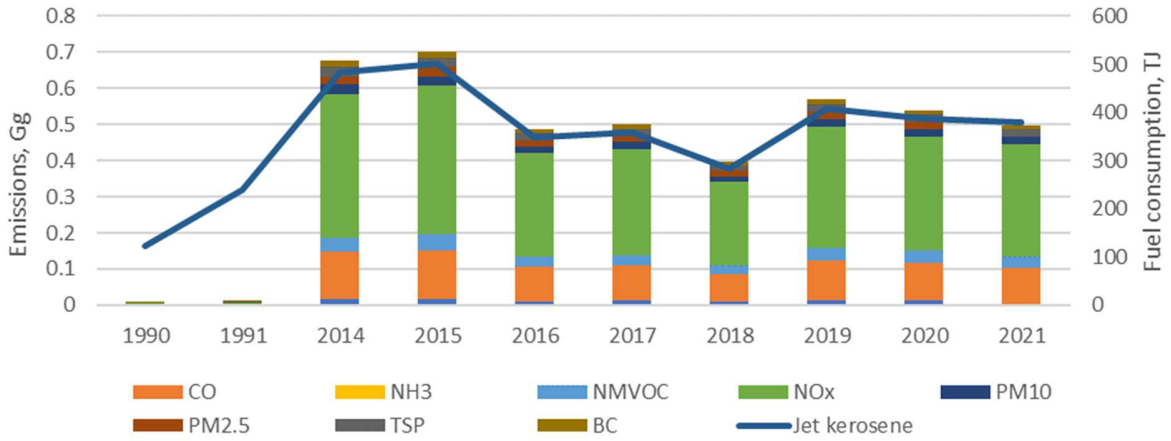



Figure 0-31 Pollutant emissions and fuel consumption in sector 1.A.5.b

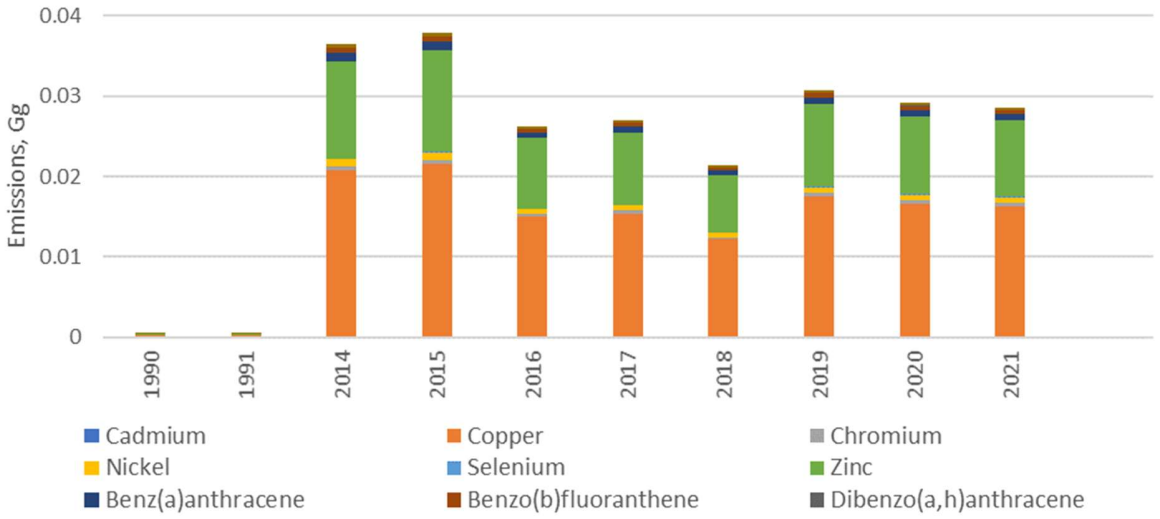



Figure 0-32 Heavy metals and PAHs emissions in sector 1.A.5.b

## ANNEX 1. Implementation of NECD 2022 Review Recommendations

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2017 (6) | LT-2D3d-2017-0001 | Yes | 2D3d Coating Applications, NMVOC, 1990-2020 | UPTC | TC | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For category 2D3d Coating Applications and NMVOC in all years, the TERT noted that a Tier 1 method is used to calculate the emissions of a key category. This was raised during the 2017, 2018, 2019, 2020 and 2021 NECD inventory review. The TERT noted that in response to a question raised during the review, Lithuania did not provide a clear response to questions from the TERT. Since the activity data used by Lithuania was lower than the activity data in Eurostat, and since a Tier 1 method was used for a key category, the TERT decided to calculate a technical correction for 2005 and 2018-2020, which was accepted by Lithuania. The estimated emissions demonstrate that the issue is above the threshold of significance for all years (i.e. 2005, 2018-2020).<br>**The TERT recommends that Lithuania include the <u>revised estimates</u> in its next submission and improve the transparency of the IIR for 2D3d Coating Applications.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2017 (6) | LT-2D3i-2017-0001 | No | 2D3i Other Solvent Use, SO2, NOX, NH3, NMVOC, PM2.5, 1990-2020 | No | TC | No | **Implemented** |
| **Assessment of the implementation of the initial recommendation**<br>For category 2D3i Other Solvent Use, NMVOC and all years, the TERT noted that no emissions have been estimated for Glass Wool Induction, Mineral Wool Induction, Fat, edible and non-edible oil extraction, Wood preservation, Vehicles dewaxing, Treatment of vehicles, Application of glues and adhesives, Aircraft de-icing and Use of shoes. Furthermore, the TERT noted that only emissions from fireworks are reported, even though emissions from tobacco smoking are described in the IIR chapter 3.14. This was raised during the 2017, 2018, 2019, 2020 and 2021 NECD inventory review. In response to a question raised during the review, Lithuania explained that emissions from shoe wearing are allocated to 2D3g and glass wool production does not occur. In this sector, only emissions from fireworks have been reported. Lithuania did not provide a revised estimate. The TERT decided to calculate a technical correction for 2005 and 2018-2020, based on the solvent emission inventory of ESIG, which was accepted by Lithuania. The estimates demonstrate that the | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| issue is above the threshold of significance for all years (i.e. 2005, 2018-2020).<br>**The TERT recommends that Lithuania include the <u>revised estimates</u> in its next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE, TC, or UPTC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3-2022-0001 | Yes | 3 Agriculture, SO2, NOX, NH3, NMVOC, PM2.5, CO, 1990-2020 | NA | TC | No | Implemented |
| **Recommendation**<br>For Category 3 Agriculture and for all years and pollutants there is limited information from Lithuania in the IIR. For categories 3Dc and 3De (PM and NMVOC) some information is given, but for categories 3B1a, 3B1b, 3B2, 3B3, 3B4a, 3B4d, 3B4e, 3B4f, 3B4gi, 3B4gii, 3B4giii, 3B4giv, 3B4h, 3Da1, 3Da2a, 3Da2b, 3Da2c, 3Da3, 3Da4, 3Db, 3Dd, 3Df, 3F and 3I, and for all pollutants in these categories, no information is provided in the IIR on emissions sources, activity data, methods and recalculations. The TERT noted that in response to a question raised during the review, Lithuania did not provide a clear response to questions from the TERT. The TERT decided to calculate technical corrections for $NO_X$ and the years 2018, 2019 and 2020, and for $NH_3$ and the years 2005, 2018, 2019 and 2020, using the N-flow tool, which were accepted by Lithuania. The estimates demonstrate that the issue is above the threshold of significance for $NO_X$ (2018, 2019, 2020) and $NH_3$ (2005, 2018, 2019, 2020).<br>**The TERT recommends that Lithuania include a <u>revised estimate</u> for $NO_X$ and $NH_3$ for 2005 ($NH_3$ only), 2018, 2019 and 2020 in its next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3Da3-2022-0001 | Yes | 3Da3 Urine and Dung Deposited by Grazing Animals, NH3, 1990-2020 | NA | TC | No | Implemented |
| **Recommendation**<br>For category 3Da3 Urine and Dung Deposited by Grazing Animals and for the pollutant $NH_3$ and for all years, the TERT noted that the value for 2005 is statistically greater than emissions between 2000-2010. In response to a question raised during the review, Lithuania did not provide a clear response. The TERT decided to calculate a technical correction for the years 2005 and 2018-2020, using the N-flow tool, which was accepted by Lithuania. The revision was required due to a recalculation of emissions from 3B Manure Management in another observation, which then influenced the emissions in 3D Crop Production and Agricultural Soils. The estimates demonstrate that the issue is above the threshold of significance for 2005 and 2018-2020.<br>**The TERT recommends that Lithuania include a <u>revised estimate</u> for 3Da3 Urine and Dung Deposited by Grazing Animals in its next submission.** | | | | | | | |

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| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-5A-2022-0002 | No | 5A Biological Treatment of Waste - Solid Waste Disposal on Land, NMVOC, 2005-2020 | NA | TC | Yes | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 5A Biological Treatment of Waste - Solid Waste Disposal on Land and NMVOC and all years, the TERT noted that that a Tier 1 method is used for a key category. The TERT considers that a Tier 2 method is feasible and recommends Lithuania to base the NMVOC emissions on NMVOC content in landfill gas, and use $CH_4$ emission ratio per ton of disposed waste (based on the UNFCCC reporting), convert it into a volume of $CH_4$ per ton of disposed waste (using the molar volume of $CH_4$) and then into a volume of biogas per ton of disposed waste (applying the fraction of $CH_4$ in biogas F = 50%) and then apply the fraction of NMVOC in biogas (5.65 g/$m^3$ NMVOC of landfill gas), presented in the note at the bottom of table 3-1, chapter 5A of the 2019 EMEP/EEA Guidebook. Lithuania explained that it prefers to receive a technical correction from the TERT rather than providing a revised estimate during the inventory review. The TERT decided to calculate a technical correction for the years 2005, 2018, 2019 and 2020, which was accepted by Lithuania. The estimates demonstrate that the issue is above the threshold of significance for 2005.<br>**The TERT recommends that Lithuania include a <u>revised estimate</u> for 5A Biological Treatment of Waste - Solid Waste Disposal on Land in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-1B2ai-2022-0001 | No | 1B2ai Fugitive Emissions Oil: Exploration, Production, Transport, NMVOC, 1990-2020 | NA | RE | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 1B2ai Fugitive Emissions Oil: Exploration, Production, Transport, NMVOC and all years, the TERT noted that Lithuania had revised emissions strongly upwards (for all years 2006 to 2019) but had not revised emissions for 2005 or 2020, resulting in a time series where emissions 2006-2019 were about 50 to 200 times higher than for 2005 and 2020. In response to a question raised during the review, Lithuania provided a calculation sheet with an appropriate Tier 2 emission calculation for years 1990-2020. Lithuania provided revised | | | | | | | |

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| estimates for years 2018 and 2019 and stated that these would be included in the next submission. The TERT agreed with the revised estimate provided by Lithuania.<br>**The TERT recommends that Lithuania include the revised estimates in its 2023 NFR and IIR submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2021 (2) | LT-2A5b-2021-0002 | Yes | 2A5b Construction and Demolition, PM2.5, PM10, 2005-2020 | RE | RE | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For 2A5b Construction and Demolition, for $PM_{10}$ and $PM_{2.5}$ emissions for 2005-2020 the TERT noted that there is a lack of transparency regarding how the emissions are estimated. This was raised during the 2021 NECD inventory review. As part of the 2021 review cycle, there was an exchange on data for road constructions and agreements on PTC. In addition, a capacity building project to estimate these emissions took place. The TERT noted that $PM_{10}$ and $PM_{2.5}$ emissions were included in the 2022 submission for this category. However, in the 2022 IIR no description of the method, activity data and emissions were included and the TERT was unable to review the emission estimate. In response to a question raised during the review, Lithuania provided a calculation file for the related emissions and the TERT concluded that the wrong precipitation-evaporation factor was included in the calculations. Lithuania provided revised estimates for all the years using the right factor. The TERT agreed with the revised estimates.<br>**The TERT recommends that Lithuania include the revised estimates in its 2023 NFR and IIR submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2021 (2) | LT-2A5c-2021-0001 | No | 2A5c Storage, Handling and Transport of Mineral Products, PM10, 2005-2020 | No | RE | No | Partly implemented (NFR) |
| **Assessment of the implementation of the initial recommendation**<br>For $PM_{10}$ for category 2A5c Storage, Handling and Transport of Mineral Products, for 2005-2020, the TERT noted that there were still no estimates while emissions for $PM_{2.5}$ were reported. According to Tier 2 EF from the 2019 EMEP/EEA Guidebook for this category, emissions of $PM_{10}$ would typically be 10 times higher than emissions of $PM_{2.5}$. This was raised during the 2021 NECD inventory review. In response to a question raised during the review, Lithuania provided revised estimates for years 2005, 2018-2020 for $PM_{10}$. The TERT agreed with the revised estimates provided by Lithuania.<br>**The TERT recommends that Lithuania include the revised estimates in its 2023 NFR and IIR submission.** | | | | | | | |

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2022 (1) | LT-2C1-2022-0001 | No | 2C1 Iron and Steel Production, PM2.5, PM10, 2010-2019 | NA | RE | No | Partly implemented (NFR) |
| **Recommendation**<br>For 2C1 Iron and Steel Production for $PM_{2.5}$ and $PM_{10}$ for 2010-2019, the TERT noted that no emissions are reported while there was production (activity data reported for 2010-2019). In response to a question raised during the review, Lithuania sent a calculation file. Lithuania agreed to provide these as revised estimates for the years 2018 and 2019 and stated that they would be included in the next submission. The TERT agreed with the revised estimates provided by Lithuania.<br>**The TERT recommends that Lithuania include the revised estimate in its 2023 NFR and IIR submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2020 (3) | LT-0A-2020-0001 | No | 0A National Total - National total for the entire territory - Based on fuel sold/fuel used, $SO_2$, $NO_X$, $NH_3$, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Pb, PCDD/F, $PM_{10}$, CO, BC, 1990-2018 | No | No | No | Will be implemented during the next reporting cycle. |
| **Assessment of the implementation of the initial recommendation**<br>The TERT noted that there is a lack of transparency regarding the IIR, specifically regarding the uncertainty assessment. The TERT noted that the methods used for the assessment of the uncertainty are only briefly described in the IIR for some sectors (1B1b, 5A, 5B2, 5C1bv) and some uncertainties are explained for different categories (2A3, 5D2). A description of all methods and assumptions is missing in the IIR. This was raised during the 2020 and 2021 NECD inventory review. In response to a question raised during the review, Lithuania explained that for fuel combustion sectors (1A1-1A4) default guidebook factors are used whereas uncertainty for fuel distribution among combustion devices is unknown.<br>**The TERT recommends Lithuania to clearly describe the methodology used for estimating the uncertainties for all pollutants and key categories, how the individual uncertainties are derived, and information on the overall uncertainties by pollutant, sector and year.** | | | | | | | |

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2022 (1) | LT-0A-2022-0001 | No | 0A National Total - National total for the entire territory - Based on fuel sold/fuel used, $SO_2$, $NO_X$, $NH_3$, NMVOC, $PM_{2.5}$, $PM_{10}$, 1990-2020 | NA | No | No | |
| **Recommendation**<br>The TERT notes that the value 'zero' is reported for multiple pollutants across multiple years and NFR sectors. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania confirmed that these will be corrected or appropriate notation keys will be used in the 2023 submission.<br>**The TERT recommends that Lithuania use the appropriate notation keys to indicate where no emission estimate are available or have not been estimated (and a very clear description why not) or where no emissions occur.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2019 (4) | LT-1A1a-2019-0001 | Yes | 1A1a Public Electricity and Heat Production, Hg, Pb, NOX, 1990-2020 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For 1A1 Energy Industries and 1A2 Manufacturing Industries and Construction, all fuels for all years, the TERT noted that there is a lack of transparency regarding the methodologies used. This does not relate to an over- or under-estimate of emissions. This was raised during the 2019, 2020 and 2021 NECD inventory review. In response to a question raised during the 2022 review, Lithuania explained that a better description would be included in the IIR.<br>**The TERT recommends that Lithuania include more transparent and complete information of methodologies, emission factors, abatement efficiencies and recalculations (if any) in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-1A3ai(i)-2022-0001 | No | 1A3ai(i) International Aviation LTO (Civil), NMVOC, 1990-2018 | NA | No | No | Implemented |

**Recommendation**
The TERT noted that the notation key 'NE' (not estimated) is used for category 1A3ai(i) International aviation LTO (civil), NMVOC, 1990-2018, while a Tier 1 method is available in the 2019 EMEP/EEA Guidebook. In response to a question raised during the review, Lithuania answered that the activity data would be derived from the UNFCCC inventory for calculations.
**The TERT notes that the impact on national total is very small (i.e., < 0.004%) and recommends that Lithuania calculate and report the whole time series of NMVOC emissions from 1A3ai(i) in the NFR tables and add a detailed description of the methodology and activity data in the IIR.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2021 (2) | LT-1A3ai(i)-2021-0003 | No | 1A3ai(i) International Aviation LTO (Civil), SO2, NOX, 2005, 2018, 2019 | No | No | No | Implemented |

**Assessment of the implementation of the initial recommendation**
Following up on the previous recommendation LT-1A3ai(i)-2021-0003, the TERT found that recalculations in $NO_X$ and $SO_X$ of sector 1A3ai(i) International Aviation LTO (Civil) exist in the 2022 submission (NFR values) for the years 2005, 2018, 2019. For example, recalculation of $NO_X$ in 2019 is >10%. In addition, values for years prior to 2005 are not estimated ('NE'). The IIR has no information on recalculations and this was also the case in the previous (2021) submission, i.e. no justification for recalculations. In response to a question raised during the review, Lithuania answered that the recalculation was done according to the newest EUROCONTROL calculated and provided data.
**The TERT recommends that Lithuania clearly describe each year in the IIR the recalculations undertaken compared to the previous year and clearly explain the reason behind these recalculations. In addition, the TERT recommends that Lithuania calculate and report $NO_X$ and $SO_X$ emissions from 1A3ai(i) International Aviation LTO (Civil) for the whole time series, i.e., also for years prior to 2005, which are currently reported as 'NE'.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2021 (2) | LT-1A3ai(i)-2021-0002 | No | 1A3ai(i) International Aviation LTO (Civil), SO2, NOX, NH3, NMVOC, PM2.5, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM10, CO, BC, TSP, 1990-2020 | No | No | No | Implemented |

**Assessment of the implementation of the initial recommendation**

Following up on the previous recommendation LT-1A3ai(i)-2021-0002, the TERT found possible inconsistencies in the activity data and hence emissions of 1A3ai(i) International aviation LTO (civil). Specifically, liquid fuels have values for 2005, 2018, 2019, while all remaining activity data categories have zero values. As a result, it is not clear which activity data is used and how emissions are calculated for international flights. The time series of emissions and IEF for NMVOC and $PM_{2.5}$ show large fluctuations, while $PM_{10}$ have zero values. In response to a question raised during the review, Lithuania answered that recalculation for CO, $SO_X$ and $NO_X$ was due to the new EUROCONTROL database covering 2005-2019, where no PM fractions and NMVOC were provided. The new EUROCONTROL database for 2020 contains PM fractions and NMVOC are reported, so this will be provided in the next submission 2023.

**The TERT recommends that Lithuania in the next submission 2023: 1) clearly describe in the IIR the activity data and methodology followed to calculate emissions from the aviation sector – currently, the description in the IIR lacks transparency; 2) clearly describe in the IIR the recalculations undertaken compared to previous year and explain the reason behind these recalculations; 3) calculate and report all PM and NMVOC emissions from 1A3ai(i) International Aviation LTO (Civil) for the whole time series from 1990 onward. It is noted that, based on 2019 values, the impact on the national total is estimated < 0.09% for NMVOC and < 0.33% for $PM_{2.5}$, i.e., below the threshold of significance.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2017 (6) | LT-1A3ai(ii)-2017-0001 | No | 1A3ai(ii) International Aviation Cruise (Civil) - Memo Item, SO2, NOX, NH3, NMVOC, PM2.5, 1990-2020 | No | No | No | Implemented |

**Assessment of the implementation of the initial recommendation**

Following up on the previous recommendation LT-1A3ai(ii)-2017-0001, the TERT noted that cruise emissions (memo item) from international and domestic aviation 1A3ai(ii), 1A3aii(ii) are not reported in the NFR tables, while in the IIR it is stated that 'emissions of international and domestic cruise flights are reported under memo items only'. Hence, there is an inconsistency between NFR and IIR. This issue has been raised every year since 2017. In response to a question raised during the review, Lithuania answered that emissions are provided directly from the EUROCONTROL database for different calculations for CLRTAP and UNFCCC and that no cruise data was included in the national total.

**The TERT understands that cruise emissions do not contribute to the national total and recommends that Lithuania calculate and report cruise aviation emissions in the next submission 2023 in order to improve the completeness of the inventory.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
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|---|---|---|---|---|---|---|---|
| 2022 (1) | LT-1A3aii(i)-2022-0001 | No | 1A3aii(i) Domestic Aviation LTO (Civil), NMVOC, 1990-2018 | NA | No | No | Implemented |
| **Recommendation**<br>The TERT noted that the notation key 'NE' (not estimated) is used for category 1A3aii(i) Domestic aviation LTO (civil), NMVOC, 1990-2018, while a Tier 1 method is available in the 2019 EMEP/EEA Guidebook. Studying the IIR, no relevant explanation was found. In response to a question raised during the review, Lithuania answered that the activity data would be derived from the UNFCCC inventory for calculations.<br>**The TERT acknowledges that the impact on the national total is very small (i.e., < 0.0003%) and recommends that Lithuania properly calculate and report the whole time series of NMVOC emissions from 1A3aii(i) in the NFR tables and provide a detailed description of methodology and activity data in the IIR.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2021 (2) | LT-1A3aii(i)-2021-0001 | No | 1A3aii(i) Domestic Aviation LTO (Civil), $SO_2$, $NO_X$, $NH_3$, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, $PM_{10}$, CO, BC, TSP, 1990-2020 | No | No | No | Will be implemented during the next reporting cycle. |
| **Assessment of the implementation of the initial recommendation**<br>Following up on the previous recommendation LT-1A3aii(i)-2021-0001, the TERT found possible inconsistencies in the activity data and hence emissions of 1A3aii(i) Domestic Aviation LTO (Civil). Specifically, liquid fuels have values for 2018, 2019, while other activity (assumed to be the number of LTO cycles) has values only for years prior to 2004. As a result, and due to lack of a detailed description in the IIR, it is not clear which activity data is used and how emissions are calculated for domestic flights. The time series of emissions and IEF for $NO_X$, NMVOC, $SO_X$, and $PM_{2.5}$ look very strange, while $PM_{10}$ have zero values. In response to a question raised during the review, Lithuania answered that activity data and emissions would be revised on the basis of EUROCONTROL data.<br>**The TERT recommends that Lithuania revise the whole time series of activity data and all pollutant emissions of domestic aviation sector 1A3aii(i) in the 2023 submission and provide correct NFR values and detailed description in the IIR. It is noted that, based on 2019 values, the impact on national total is estimated as follows: < 0.001% for $NO_X$, < 0.0003% for NMVOC, < 0.0004% for $SO_X$, and < 0.00009% for $PM_{2.5}$ (and, consequently, $PM_{10}$).** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |

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|---|---|---|---|---|---|---|---|
| 2022 (1) | LT-1A3c-2022-0001 | Yes | 1A3c Railways, NOX, 2019 | NA | No | No | Implemented |
| **Recommendation**<br>The TERT noted that significant recalculations have been applied (>10% change) for the key category 1A3c Railways, $NO_X$, 2019. Studying the IIR, no relevant explanation was found. In response to a question raised during the review, Lithuania answered that recalculations were done on the basis of new activity data from Statistics Lithuania.<br>**The TERT recommends that Lithuania carefully update the IIR each year, including recalculations per sector and describing the reasons behind these recalculations.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2021 (2) | LT-1A3c-2021-0001 | No | 1A3c Railways, PM10, BC, 2018-2019 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>Following up on the previous recommendation LT-1A3c-2021-0001, the TERT noted that $PM_{10}$ emissions for sector 1A3c Railways, year 2019, have been recalculated in the 2022 submission (NFR values), following the trend of activity (i.e., 9% reduction from 2018 to 2019). However, this recalculation has not been found in the IIR. In response to a question raised during the review, Lithuania provided explanations related to emission factors of $PM_{2.5}$, $PM_{10}$, and BC, without clarifying why this recalculation is not described in the IIR.<br>**The TERT recommends that each year Lithuania describe in the IIR the recalculations performed for each sector compared to the previous year and explain the reasons behind these recalculations.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-1A3dii-2022-0001 | No | 1A3dii National Navigation (Shipping), PM2.5, PM10, 1990-2020 | NA | No | No | Implemented |
| **Recommendation**<br>For category 1A3dii National Navigation (Shipping), years 1990-2020, the TERT noted that the $PM_{2.5}$ estimate was larger than $PM_{10}$, which was not expected. In response to a question raised during the review, Lithuania provided a revised estimate for all years, swapping the values of $PM_{2.5}$ and $PM_{10}$ and explaining that this was due to a swapping of the corresponding $PM_{2.5}$ and $PM_{10}$ emission factors. The impact on the national total is below the threshold of significance (i.e. < 0.006% in 2020).<br>**The TERT agreed with the revised estimate provided by Lithuania and recommends that it will be included in its 2023 NFR tables and IIR submission.** | | | | | | | |

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2022 (1) | LT-1A3dii-2022-0002 | No | 1A3dii National Navigation (Shipping), PM2.5, PM10, 2005, 2010, 2020 | NA | No | No | Implemented |
| **Recommendation**<br>The TERT noted that the $PM_{10}$ estimate for category 1A3dii National Navigation (Shipping), years 2005, 2010, 2020, is lower compared to $PM_{2.5}$ (ratio 0.93), which is not expected. Studying the IIR, no relevant explanation was found. In response to a question raised during the review, Lithuania answered that this was due to a misplacement of emission factors for diesel oil between $PM_{2.5}$ and $PM_{10}$ and provided corrected values, which confirmed that $PM_{2.5}$ is smaller than $PM_{10}$.<br>**The TERT acknowledges that the impact on the national total is very small (i.e., < 0.08%) and recommends that these corrected values of $PM_{2.5}$, $PM_{10}$ be included in the next submission of IIR and NFR tables.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2017 (6) | LT-1A3ei-2017-0001 | No | 1A3ei Pipeline Transport, PM2.5, PM10, 1990-2020 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>Following up on the previous recommendation LT-1A3ei-2017-0001, the TERT found that $PM_{2.5}$ and $PM_{10}$ emissions from 1A3ei Pipeline Transport are still reported as 'NA'. This issue has been raised already since 2017 and $PM_{2.5}$ estimate values were provided during the 2020 review. The IIR does not provide further information on the issue. In response to a question raised during the review, Lithuania answered that in order to avoid under-estimation and based on practice from 1A4, emission factors for TSP=$PM_{2.5}$=$PM_{10}$ would be implemented.<br>**The TERT acknowledges that the impact on the national total is very small (<0.03%) and recommends that Lithuania properly calculate and report all PM emissions from 1A3ei in the NFR tables and provide a description of the methodology and activity data in the IIR.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |

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|---|---|---|---|---|---|---|---|
| 2017 (6) | LT-1A4bii-2017-0001 | No | 1A4bii Residential: Household and Gardening (Mobile), $SO_2$, $NO_X$, $NH_3$, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, $PM_{10}$, CO, 1990-2020 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>Following up on the previous recommendation LT-1A4bii-2017-0001, the TERT found that emissions from 1A4bii Residential: Household and Gardening (Mobile) are reported in the NFR tables as a flat line (i.e., steady activity and IEF over the years) for all main pollutants and PM for all years. On the other hand, the IIR states that 'Activity from household and gardening (mobile) in Lithuania not occurred. Data are consistent with UNFCCC inventorying where 'NO' key also provided later than 1995' and no further information is provided. As a result, there is an inconsistency between NFR values and IIR description, and the methodology used to calculate these emissions is unclear. In response to a question raised during the review, Lithuania answered that activity data for years 1996-2020 were taken from the IIASA database 'TSAP 16 underlying assumptions - GAINS details' - 40 TJ each year and emission factors were taken from the 2019 EMEP/EEA Guidebook, chapter 1A4 Non-road mobile sources and machinery, Table 3-1 Tier 1 emission factors for off-road machinery (average of all values available for 1A4bii depending on fuel, 2/4-stroke).<br>**The TERT welcomes these clarifications from Lithuania and recommends that the IIR be updated next year in order to properly describe the methodology followed for emission calculations, activity data, assumption and parameters used.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2017 (6) | LT-1A4ciii-2017-0001 | No | 1A4ciii Agriculture/Forestry/Fishing: National Fishing, $NH_3$, 1990-2020 | No | No | No | Will be implemented during the next reporting cycle. |
| **Assessment of the implementation of the initial recommendation**<br>Following up on the previous recommendation LT-1A4ciii-2017-0001, the TERT found that $NH_3$ emissions from 1A4ciii Agriculture/Forestry/Fishing: National Fishing are reported in the 2022 NFR tables and are the same as in the 2021 submission, hence, there is no recalculation. However, the IIR does not contain any methodology or activity data information related to 1A4ciii.<br>**The TERT recommends that Lithuania improve the transparency of the IIR by providing methodological and activity data information related to 1A4ciii Agriculture/Forestry/Fishing: National Fishing.** | | | | | | | |
| Review year of initial recommendation (number of years it | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |

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| has been recommended) | | | | | | | |
| 2022 (1) | LT-1A4ciii-2022-0001 | No | 1A4ciii Agriculture/Forestry/Fishing: National Fishing, $PM_{2.5}$, 1990-2020 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>The TERT noted that the $PM_{2.5}$ estimate for category 1A4ciii Agriculture/Forestry/Fishing: National Fishing, all years, is larger than $PM_{10}$, which is not expected. Studying the IIR, no relevant explanation was found. In response to a question raised during the review, Lithuania answered that this was due to a misplacement of emission factors between $PM_{2.5}$ and $PM_{10}$ and provided corrected values from which it is confirmed that $PM_{2.5}$ is smaller than $PM_{10}$.<br>**The TERT acknowledges that the impact on national total is very small (i.e., < 0.0002%) and recommends that these corrected values of $PM_{2.5}$ and $PM_{10}$ be included in the next submission of IIR and NFR tables.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2021 (2) | LT-1B2aiv-2021-0001 | Yes | 1B2aiv Fugitive Emissions Oil: Refining / Storage, NMVOC, 2005-2020 | No | No | No | Will be implemented during the next reporting cycle. |
| **Assessment of the implementation of the initial recommendation**<br><br>For NFR sector '1B2aiv Fugitive emissions oil: Refining and storage', pollutant NMVOC and calendar years 2005 to 2020, the TERT already noted during the 2021 review that significant recalculations have been applied in the year 2021 NECD inventory submission compared to the year 2020 submission. This source is a Key Category[1] with emissions of 9.5 kt, a share of 20.1% of total NMVOC emissions in 2020, which is high when compared to other EU Member States.<br><br>Lithuania explains in their 2022 IIR (chapter 3.4) that emission estimates are taken from the refinery plant reports, equivalent to a Tier 3 EMEP/EEA Guidebook methodology. During the 2022 NECD inventory review, the TERT found the company report for the refinery 'ORLEN Lietuva', the only crude oil refinery in Lithuania, with environmental information from 2021 (https://www.orlenlietuva.lt/EN/Company/Reports/Pages/Reports.aspx). On page 57 of the company report it states that "VOC emissions reached 9,2 thousand tons in 2021 and did not change compared to emission levels in 2020". The TERT considers that this | | | | | | | |

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| evidence explains and justifies the comparably high NMVOC emission estimates for '1B2aiv Fugitive emissions oil: Refining and storage' reported by Lithuania for the calendar year 2020 as part of the 2022 NECD inventory submission.<br><br>Furthermore, the TERT analysed available E-PRTR emission data for the calendar years 2007-2017 of the same facility ("AB "ORLEN Lietuva", FacilityInspireID: LT.CAED/166451720.FACILITY), which show comparable high levels of NMVOC emissions (e.g. 10.4 kt for 2017).<br><br>As part of the question-and-answer phase of the NECD inventory review, the TERT asked Lithuania to provide further information as to why their emission estimates are very high compared to other Member States. Lithuania explained that the high emissions are due to the operator applying an old methodology when estimating the emissions. As part of the same reply, Lithuania provided a detailed list of NMVOC reduction measures which they consider should be taken into account for revised emission estimates from the year 2005 onward and which would lead to lower emission estimates.<br><br>However, the TERT was not able to find reasons that would underpin the Lithuanian statement according to which the methodology used by the company leads to over-estimates. The TERT noted that the same methodology has also been applied for reporting emission estimates to the E-PRTR. | |
| Lithuania further submitted a revised estimate (sent by email to the NECD core team and not via the EMRT, which has been forwarded to the TERT) for NFR sector '1B2aiv Fugitive emissions oil: Refining and storage', pollutant NMVOC emissions and the calendar years 2005 to 2020. These estimates, lower than the previous ones, are based on a Tier 2 methodology provided in the 2019 EMEP/EEA Guidebook.<br><br>As part of these revised NMVOC emission estimate, Lithuania added the non-diffuse NMVOC emissions to the revised diffuse NMVOC emissions.<br><br>In summary, the NMVOC estimate has been estimated as follows:<br><br>1. Estimate the NMVOC diffuse emissions using a constant emission factor of 0.2 kg/t of crude oil input, using a Tier 2 EMEP/EEP guidebook methodology = result A<br><br>2. Estimate the non-diffuse emissions by assuming a constant share of about 11.3% of the original (very high) emission estimate provided by the operator = result B<br><br>3. Estimate emission reduction measures from the diffuse NMVOC emission estimate assuming a constant share of about 3.6% of the original (very high) emission estimate provided by the operator = result C<br><br>4. The final revised estimate as follows: (result A- result C)+ result B = Revised Estimate | |

As a result, the revised NMVOC emission estimate for NFR sector 1B2aiv (including non-diffuse and diffuse emissions based on a mixture of Guidebook Tier 2 Emission Factor and the original 'high' operator data) adds up to a total of 2.98 kt NMVOC for 2005 and 2.73 kt NMVOC for 2020.

After reviewing the approach applied by Lithuania to estimate the revised emission estimate, the TERT concluded that this methodology does not comply with the EMEP/EEA guidelines because it combines an EMEP/EEA Tier 2 method with additional abatement measures. More importantly, the EMEP/EEA Tier 2 method used by Lithuania is derived from reported average EU E-PRTR data and therefore already incorporates emission reductions attributed to implemented abatement measures; therefore, those cannot be subtracted again (result C above), to avoid double counting these emission reductions. Furthermore, the TERT noted that the methodology of abatement subtraction (-0.061 kt NMVOC) is also not consistent with data provided by the operator (-0.312 kt NMVOC since 2005). In addition, the TERT concluded that the change from a higher Tier (Tier 3) to a lower Tier (Tier 2) methodology for a key source estimation is not in line with the EMEP Reporting Guidelines.

Due to above mentioned issues, the revised estimate was not accepted by the TERT. The TERT sent a follow up question after the centralized review and asked Lithuania for a well justified revised estimate. Lithuania replied with the identical revised estimate that had already been sent by e-mail on the 17 June 2022 (and rejected). The TERT rejected the revised estimate again.

As next steps, the TERT recommends Lithuania to gather more information from the operator on the exact methodology used to estimate NMVOC emissions at the plant, so that Lithuania can improve the reliability and consistency of its own emission inventory data reporting under the NECD and under E-PRTR/IED. The TERT also recommends Lithuania to provide sufficient arguments for either using the company data or rejecting it.

Overall, the TERT concluded that Lithuania has not provided a revised estimate which was transparent enough to be accepted by the TERT. It is currently not possible for the TERT to provide a numerical emission estimate with an adequate level of certainty as the TERT has only limited data available. Therefore, this issue is flagged as a recommendation only. Thus, the NMVOC emissions estimates for '1B2aiv Fugitive emissions oil: Refining and storage' should stay as reported by Lithuania in their submission on 15 February 2022.

**The TERT recommends that Lithuania, preferably in consultation with the refinery operator, develop a more accurate methodology for NMVOC emissions from 1B2aiv 'Fugitive emissions oil: Refining and storage' for inclusion in next year's inventory submission.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2018 (5) | LT-2-2018-0002 | No | 2 Industry, NMVOC, 1990-2020 | No | No | No | Implemented |

**Assessment of the implementation of the initial recommendation**
For 2B10a Chemical Industry: Other and pollutant NMVOC, the TERT noted that the previous recommendation (LT-2-2018-0002) has not yet been implemented. Lithuania has not included a description of this category in its IIR and as such has not provided the methodology for emission estimates of NMVOC for the years 1990-2020. This issue was raised during the 2018, 2019, 2020 and 2021 NECD inventory review and has not been included in a list of improvements. The TERT noted that the issue is below the threshold of significance for a technical correction. In response to a question raised during the review, Lithuania explained that it would hire a chemist for compiling the inventory in chemistry and solvent related sectors.
**The TERT reiterates the recommendation that Lithuania include in its next submission sufficient detail on the methods used for estimating emissions, on the time series consistency, quality checks done, list of improvements, etc,. to significantly improve transparency.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
|---|---|---|---|---|---|---|---|
| 2022 (1) | LT-2-2022-0001 | Yes | 2 Industry, PM10, 2020 | NA | No | Yes | Partly implemented |

**Recommendation**
For 2A5a Quarrying and Mining of Minerals Other Than Coal for $PM_{2.5}$ and $PM_{10}$ for 2020, the TERT noted that Lithuania used a Tier 1 method for a key category while a Tier 2 method exists. This finding could be related to an over- or under-estimate of emissions with an impact on total emissions that is above the threshold of significance. In response to a question raised during the review, Lithuania provided a revised estimate, which was not been accepted by the TERT because the revised estimate is based on the Tier 2 method from the 2016 EMEP/EEA Guidebook. For the 2022 NECD inventory review, revised estimates are expected to be based on the methodologies of the most recent 2019 EMEP/EEA Guidebook. It is currently not possible for the TERT to provide a numerical emission estimate with an adequate level of certainty as the TERT has no activity data available.
**Therefore, this issue is flagged as a recommendation only, however the TERT strongly recommends that Lithuania develop a Tier 2 method for $PM_{2.5}$ and $PM_{10}$ emissions from 2A5a Quarrying and Mining of Minerals Other Than Coal for inclusion in next year's inventory submission.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
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| 2017 (6) | LT-2B1-2017-0001 | No | 2B1 Ammonia Production, NMVOC, 1990-2020 | No | No | No | Will be implemented |

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| | | | | | | | during the next reporting cycle. |
| **Assessment of the implementation of the initial recommendation**<br>For category 2B1 Ammonia Production, the TERT noted that the reiterated recommendation made during the 2021 NECD inventory review (LT-2B1-2017-0001) has been implemented only partially. In the 2022 submission, NMVOC emissions were reported for the years 2005 and 2017-2020 and were reported 'NE' for all the other years. $NO_X$ and $NH_3$ emissions were reported 'IE' before 2005. This leads to a time series inconsistency. The TERT identified strong variations in IEF throughout the time series for $NO_X$ and $NH_3$, without any explanation in the IIR. The TERT found that the IIR does not provide any information on this sector. The TERT also found that the IEF for $NO_X$ emissions is significantly higher for 2019 compared to 2005-2017. The TERT noted that there is a lack of transparency. The TERT is not able to determine whether this relates to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania explained that data of the chemical plant operator were used and that these only contain total emissions and no emissions for separate processes.<br>**The TERT recommends that Lithuania include emission estimates for the complete time series in its next submission. Furthermore, the TERT recommends that Lithuania collect more information from the operator concerning emissions of the different processes, if possible, including the methodology used by the operator to estimate emissions. Finally, the TERT recommends that Lithuania include in its next IIR a proper description of this sector, including the nature of the processes and when significant changes occurred to the production processes, the abatement techniques used by the operator and when they were installed, the method for estimating emissions, the activity data (if relevant), the QA checks done, explanations for strong variations in emissions and implied emission factors.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-2B2-2022-0001 | No | 2B2 Nitric Acid Production, $NO_X$, $NH_3$, 2020 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 2B2 Nitric Acid Production for $NO_X$ and $NH_3$ for 2020 the TERT noted that emissions are reported using notation key 'IE' in the NFR without any explanation for this notation key in the IIR. The TERT noted that there is a lack of transparency regarding these emission estimates. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania explained that ammonia and nitric acid are produced by the same chemical plant and that an official request on behalf of the Lithuanian EPA would be sent to the chemical plant operator.<br>**The TERT recommends that in its next submission Lithuania report emissions from ammonia and nitric acid in the respective categories and that Lithuania include information on the processes, the abatement technologies, the estimates (method, data, emission factor) and quality assurance checks performed.** | | | | | | | |

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
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| 2022 (1) | LT-2B10a-2022-0001 | No | 2B10a Chemical Industry: Other, $NO_X$, 2020 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 2B10a Chemical Industry: Other for $NO_X$ for 2020 the TERT noted that emissions increased sharply compared with 2019, without any explanation in the IIR. The TERT noted that there is a lack of transparency regarding these emission estimates. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania explained that ammonia and nitric acid are produced by the same chemical plant and that an official request on behalf of the Lithuanian EPA would be sent to the chemical plant operator.<br>**The TERT recommends that in its next submission Lithuania report emissions from ammonia and nitric acid in the respective categories and that Lithuania include information on the processes, the abatement technologies, the estimates (method, data, emission factor) and quality assurance checks performed.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-2D3b-2022-0001 | No | 2D3b Road Paving with Asphalt, PM2.5, PM10, 1990-2020 | NA | No | No | Implemented |
| **Recommendation**<br>For $PM_{2.5}$ and $PM_{10}$ emissions in 2D3b Road Paving with Asphalt (all years), the TERT noted that the emission factors used for $PM_{10}$ and $PM_{2.5}$ are a factor 100 lower than the default emission factor from the 2019 EMEP/EEA Guidebook, chapter 2D3b, table 3-2. In response to a question raised during the review, Lithuania provided the calculation sheet that showed that the emission were corrected by a factor 100, but Lithuania did not explain why this correction was applied. It is not clear whether the correction is justified by abatement applied in this sector. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania explain the applied emission factors and the abatement (if applicable) in the 2023 IIR, or that Lithuania update the emissions in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |

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| has been recommended) | | | | | | | |
| 2022 (1) | LT-2D3c-2022-0001 | No | 2D3c Asphalt Roofing, NMVOC, 1990-2020 | NA | No | No | Implemented |
| **Recommendation**<br>For NMVOC emissions in 2D3c Asphalt Roofing (all years), the TERT noted that emissions have only been reported for the years 2005 and 2020, while activity data is reported for all years. The TERT also noted that chapter 3.8 of the IIR explains that activity data on production of roofing materials was provided by the producer, but the NFR tables show bitumen consumption as activity data (equal to the activity data in 2D3b). In response to a question raised during the review, Lithuania explained that there is a single company in Lithuania producing asphalt roofing materials, which produces bitumen tiles as well as roll roofing materials. Data on production of roofing materials was provided by the producer and is available for the period 2001-2020. According to the producer, asphalt roofing materials were also produced in 1990-2000, but data for this period is not available. Production of the asphalt roofing materials in 1990-2000 was estimated based on annual average use of bitumen. Lithuania also explained that emissions of NMVOC, PMs, BC and CO are calculated for whole period. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania include data on production of roofing materials in the NFR tables, and that Lithuania include the emissions for the years 1990-2004 and 2006-2019 in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-2D3c-2022-0002 | No | 2D3c Asphalt Roofing, PM2.5, 1990-2020 | NA | No | No | Implemented |
| **Recommendation**<br>For $PM_{2.5}$ emissions in 2D3c Asphalt Roofing (all years), the TERT noted that emissions have only been reported for the years 2005 and 2020, while activity data is reported for all years. The TERT also noted that chapter 3.8 of the IIR explains that activity data on production of roofing materials was provided by the producer, but the NFR tables show bitumen consumption as activity data (equal to the activity data in 2D3b). In response to a question raised during the review, Lithuania explained that there is a single company in Lithuania producing asphalt roofing materials, which produces bitumen tiles as well as roll roofing materials. Data on production of roofing materials was provided by the producer and is available for the period 2001-2020. According to the producer, asphalt roofing materials were also produced in 1990-2000, but data for this period is not available. Production of the asphalt roofing materials in 1990-2000 was estimated based on annual average use of bitumen. Lithuania also explained that emissions of NMVOC, PMs, BC and CO are calculated for whole period. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania include data on production of roofing materials in the NFR tables, and that Lithuania include the emissions for the years 1990-2004 and 2006-2019.** | | | | | | | |

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
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| 2017 (6) | LT-2D3e-2017-0001 | No | 2D3e Degreasing, NMVOC, 1990-2020 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For NMVOC emissions in 2D3e Degreasing (all years), the TERT noted that it was not clear what activity data and emission factors were used in the emission calculation. In response to a question raised during the review, Lithuania provided the emission calculation Excel spreadsheet. This Excel spreadsheet showed that the activity data in the NFR tables is incorrect. The activity data in the NFR table refers to activity data of only one component in the spreadsheet, while activity data of multiple components were included in the emission calculation. The TERT also noted that Lithuania assumed the implementation of abatement techniques, but the combination of the 2019 EMEP/EEA Guidebook default emission factor with the abatement efficiency results in a different emission factor than the emission factor applied by Lithuania. It was not clarified during the review what causes the differences in emission factor. The TERT noted that the issue is below the threshold of significance for a technical correction. The TERT also noted that there is a time series consistency, as the emissions in 1990-2002 are calculated in a different way than the emissions in 2003-2020.<br>**The TERT recommends that Lithuania correct the activity data in the NFR tables, and that Lithuania calculate the emission factor by multiplying the default emission factor with (1 - abatement efficiency) and with the share of the abatement technology. Furthermore, the TERT recommends that Lithuania improve the time series consistency by improving the emission estimates for 1990-2002.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2017 (6) | LT-2D3g-2017-0001 | No | 2D3g Chemical Products, NMVOC, 1990-2020 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For NMVOC emissions in NFR 2D3g Chemical Products (all years), the TERT noted that the emission estimate for this sector is incomplete, because no emissions were estimated for polyurethane and polystyrene foam processing; rubber processing; tyre production; pharmaceutical products manufacturing; manufacture of paints, inks and glues; adhesive tape manufacturing; leather tanning. This was raised during the 2017, 2018, 2019, 2020 and 2021 NECD inventory review. In response to a question raised during the review, Lithuania provided an Excel spreadsheet and a report on emissions in the sector 2D3g. It contains activity data and emissions for most of the activities. The TERT noted that the activity data for polyurethane foam processing in the Excel sheet was probably incorrect, as Lithuania used activity data for Polyethylene terephthalate instead of activity data for Polyurethanes. The TERT noted that the issue is below the threshold of significance for a technical correction. | | | | | | | |

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| **The TERT recommends that Lithuania report the NMVOC emissions from the missing processes in 2D3g Chemical Products (polyurethane and polystyrene foam processing; rubber processing; tyre production; pharmaceutical products manufacturing; manufacture of paints, inks and glues; adhesive tape manufacturing; leather tanning), and clearly describe the methodology in the IIR in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2019 (4) | LT-2D3h-2019-0001 | No | 2D3h Printing, NMVOC, 1990-2017 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For NMVOC emissions in 2D3h Printing (2005-2020), the TERT noted that it was not clear what emission factor was applied by Lithuania. In response to a question raised during the review, Lithuania provided the Excel spreadsheet with the calculations. The spreadsheet showed that abatement technology is taken into account in the emission calculations. It is assumed in the calculations by Lithuania that abatement technology is in place for the complete time series 2005-2020. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania check the degree of implementation of abatement technology, especially for 2005, and provide detailed explanation in the 2023 IIR regarding the abatement efficiency and the assumptions made by Lithuania.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3B1b-2022-0001 | Yes | 3B1b Manure Management - Non-Dairy Cattle, NH3, 2005, 2010-2019 | NA | No | No | Implemented |
| **Recommendation**<br>For key category 3B1b Manure Management - Non-Dairy Cattle for the pollutant $NH_3$ and years 2005, 2010-2019, the TERT noted that there is a lack of transparency because significant recalculations have been applied (>10% change) but no information is given to explain this. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania provided some brief explanation for the recalculations.<br>**The TERT recommends that Lithuania include a detailed explanation of the methods used and the reasons for recalculations in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |

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| has been recommended) | | | | | | | |
| 2022 (1) | LT-3B2-2022-0001 | No | 3B2 Manure Management - Sheep, $PM_{2.5}$, 2005 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For category 3B2 Manure Management - Sheep for the pollutant $PM_{2.5}$, and for the value for 2005, the TERT noted that there is a lack of transparency because the emission value is statistically greater than emissions between 2000-2010, but the reasons for the time series variability are not explained. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania sent a spreadsheet to provide the activity data and the calculations.<br>**The TERT recommends that Lithuania clearly explain the reasons behind this time series variability in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3B3-2022-0001 | No | 3B3 Manure Management - Swine, $NH_3$, 2020 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 3B3 Manure Management – Swine, the pollutant $NH_3$, and the year 2020, the TERT noted that the value in the NFR table (1.63304) does not match the value (1.81) in Annex VIII to the IIR (this annex is the N-flow tool) and that, therefore, there may be an under-estimate of emissions. In response to a question raised during the review, Lithuania explained that in 2020 the impact of $NH_3$ abatement measures used by large swine farms was estimated. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that in future submissions Lithuania provide more explanation of the methods used to estimate emissions, including how abatement measures are accounted for.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3B4d-2022-0001 | No | 3B4d Manure Management - Goats, $NH_3$, 2005 | NA | No | No | Will be implemented |

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| | | | | | | | during the next reporting cycle. |
| **Recommendation**<br>For category 3B4d Manure Management - Goats for the pollutant $NH_3$, the TERT noted that there is a lack of transparency because the emission value for 2005 is statistically greater than emissions between 2000-2010. This does not relate to an over- or under-estimate of emissions that is above the threshold for significance. In response to a question raised during the review, Lithuania sent a spreadsheet to provide the activity data and the calculations but did not provide any explanation.<br>**The TERT recommends that Lithuania clearly explain the reasons behind this time series variability in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3B4d-2022-0002 | No | 3B4d Manure Management - Goats, $PM_{2.5}$, 2005 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For category 3B4d Manure Management - Goats for the pollutant $PM_{2.5}$, the TERT noted that there is a lack of transparency because the emission value for 2005 is statistically greater than emissions between 2000-2010. This does not relate to an over- or under-estimate of emissions that is above the threshold for significance. In response to a question raised during the review, Lithuania sent a spreadsheet to provide the activity data and the calculations but did not provide any explanation.<br>**The TERT recommends that Lithuania clearly explain the reasons behind this time series variability in the next IIR submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3B4giii-2022-0001 | No | 3B4giii Manure Management - Turkeys, $PM_{2.5}$, 2005 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For category 3B4giii Manure Management - Turkeys for the pollutant $PM_{2.5}$ and for the value for 2005, the TERT noted that there is a lack of transparency because the emission value is statistically greater than emissions between 2000-2010, but the reasons for the time series variability are not explained. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the | | | | | | | |

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| review, Lithuania sent a spreadsheet to provide the activity data and the calculations.<br>**The TERT recommends that Lithuania explain the reasons behind this time series variability clearly in the next IIR submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3B4giv-2022-0001 | No | 3B4giv Manure Management - Other Poultry, $NO_X$, 2005 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For category 3B4giv Manure Management - Other Poultry for the pollutant $NO_X$, and for the value for 2005, the TERT noted that there is a lack of transparency because the emission value is statistically greater than emissions between 2000-2010, but the reasons for the time series variability are not explained. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania sent a spreadsheet to provide the activity data and the calculations.<br>**The TERT recommends that Lithuania clearly explain the reasons behind this time series variability in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-3B4giv-2022-0002 | No | 3B4giv Manure Management - Other Poultry, $PM_{2.5}$, 2005 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For category 3B4giv Manure Management - Other Poultry for the pollutant $PM_{2.5}$, and for the value for 2005, the TERT noted that there is a lack of transparency because the emission value is statistically greater than emissions between 2000-2010, but the reasons for the time series variability are not explained. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania sent a spreadsheet to provide the activity data and the calculations.<br>**The TERT recommends that Lithuania clearly explain the reasons behind this time series variability in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |

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| has been recommended) | | | | | | | |
| 2022 (1) | LT-3B4h-2022-0002 | No | 3B4h Manure Management - Other Animals, $PM_{2.5}$, 2005 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For category 3B4h Manure Management - Other Animals for the pollutant $PM_{2.5}$, and for the value for 2005, the TERT noted that there is a lack of transparency because the emission value is statistically greater than emissions between 2000-2010, but the reasons for the time series variability are not explained. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania sent a spreadsheet to provide the activity data and the calculations.<br>**The TERT recommends that Lithuania clearly explain the reasons behind this time series variability in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2018 (5) | LT-3D-2018-0001 | Yes | 3D Crop Production and Agricultural Soils, NH3, 1990-2020 | UPTC | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For category 3D Crop Production and Agricultural Soils, for $NH_3$ emissions for the entire period 1990-2020, the TERT noted that there is a lack of transparency because there is no information provided in the IIR. This was raised during the 2018, 2019, 2020 and 2021 NECD inventory reviews. The TERT notes that discussions with Lithuania on the difficulties with making a corrected estimate already took place during the review .<br>**The TERT recommends that Lithuania provide detailed information in the IIR on the emissions sources, the activity data and the methods used for estimating emissions.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2021 (2) | LT-3Da1-2021-0001 | Yes | 3Da1 Inorganic N-Fertilizers, NH3, NOX, 1990-2020 | No | No | No | Implemented |
| **Assessment of the implementation of the initial recommendation**<br>For category 3Da1 Inorganic N-Fertilizers for the pollutants $NH_3$ and $NO_X$ and all years, the TERT noted that there is a lack of transparency regarding significant recalculations (>10% change) that were applied in the 2021 submission. This was raised during the 2021 NECD | | | | | | | |

inventory review. The changes effected by the recalculations are also found in the 2022 submission, in which the relevant emission values for the historical time series are similar to those in the 2021 submission. Furthermore, no information is provided in the IIR on emissions sources, activity data, methods and recalculations. In response to a question raised during the review, Lithuania provided a calculation spreadsheet and a document that briefly explains the sources of activity data and the method. The emission values provided by Lithuania are the same as those in the NFR tables. The TERT concluded that there is no over- or under-estimate exceeding the threshold of significance.

**The TERT recommends that Lithuania provide information in the next IIR submission on emissions sources, activity data, methods and recalculations.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
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| 2022 (1) | LT-3Dc-2022-0001 | Yes | 3Dc Farm-Level Agricultural Operations Including Storage, Handling and Transport of Agricultural Products, PM2.5, 2010-2019 | NA | No | No | Implemented |

**Recommendation**

For key category 3Dc Farm-Level Agricultural Operations Including Storage, Handling and Transport of Agricultural Products for the pollutant $PM_{2.5}$ and years 2010-2019, the TERT noted that there is a lack of transparency because significant recalculations have been applied (>10% change) but no information is given to explain this. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania explained that "The Tier 2 methodology was applied".

**The TERT recommends that Lithuania include a detailed explanation of the methods used and the reasons for recalculations in the next submission.**

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
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| 2022 (1) | LT-3De-2022-0001 | Yes | 3De Cultivated Crops, NMVOC, 2013-2019 | NA | No | No | Will be implemented during the next reporting cycle. |

**Recommendation**

For key category 3De Cultivated Crops for the pollutant NMVOC and years 2013-2019, the TERT noted that there is a lack of transparency

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| because significant recalculations have been applied (>10% change) but no information is given to explain this. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Lithuania explained that "The Tier 2 methodology was applied".<br>**The TERT recommends that Lithuania include a detailed explanation of the methods used and the reasons for recalculations in the next submission.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-5-2022-0001 | No | 5 Waste, $SO_2$, $NO_X$, NMVOC, $PM_{2.5}$, $PM_{10}$, 2005-2020 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 5C1bv Cremation, for $SO_2$, $NO_X$, NMVOC and PM emissions and all years, the TERT noted an inconsistency in the calculation and following the described methodology the TERT received different results. In response to a question raised during the review, Lithuania said that it would use the Tier 1 emission factors from Table 3-1 of the 2019 EMEP/EEA Guidebook for next year's reporting. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania carry out recalculations for category 5C1bv Cremation and provide a detailed description of methodology and data used in its next IIR.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-5A-2022-0001 | No | 5A Biological Treatment of Waste - Solid Waste Disposal on Land, $PM_{2.5}$, $PM_{10}$, 1990-2020 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 5A Biological Treatment of Waste - Solid Waste Disposal on Land, PM emissions and all years, the TERT noted the activity data used for estimating PM emissions, which should include landfilled demolition & construction and other mineral waste) was not provided in the IIR. In response to a question raised during the review, Lithuania explained that landfilling of mineral waste has been evaluated for 2005 and 2019, but it is still not clear for the TERT if the emissions have been included. The TERT noted that the issue is below the threshold of significance for a technical correction, as Eurostat data on the amount of mineral waste from construction and demolition were used for | | | | | | | |

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| a rough estimate.<br>**The TERT recommends that Lithuania report activity data used (including source) and emissions factors to calculate PM emissions in its IIR 2023.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-5C1bii-2022-0001 | No | 5C1bii Hazardous Waste Incineration, $PM_{2.5}$, $PM_{10}$, 1990-2020 | NA | No | No | Will be implemented during the next reporting cycle. |
| **Recommendation**<br>For 5C1bii Hazardous Waste Incineration for $PM_{2.5}$ and $PM_{10}$ emissions and all years, the TERT noted inconsistencies in the time series. In response to a question raised during the review, Lithuania referred to different abatement efficiencies used, which does not fully explain the issue. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania include in its next IIR information on the methodology (type of abatement efficiencies applied) and data (activity data and emission factor) and include a trend description, especially if there are any outliers.** | | | | | | | |
| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
| 2022 (1) | LT-5C2-2022-0001 | Yes | 5C2 Open Burning of Waste, SO2, NOX, NMVOC, PM2.5, PM10, 2005-2020 | NA | No | No | Implemented |
| **Recommendation**<br>For 5C2 Open Burning of Waste, all main pollutants (except $NH_3$) and years 2005-2020, the TERT noted that the IIR states that emission are not occurring, but in the NFR table emissions are reported. It was also noted that $SO_2$ emissions are zero in 2005, while for other years values are reported. In response to a question raised during the review, Lithuania explained that the methodology used (average amount of waste burned for arable farmland) is estimated to be 25 kg/hectare and multiplied with Tier 1 default emission factor. The missing value for $SO_2$ in 2005 is due to a mistake in Excel. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania include a description of the methodology (including information if orchard or forest residues are also included or if there is any legislation banning this practise) and provide the activity data and emission factors used.** | | | | | | | |

| Review year of initial recommendation (number of years it has been recommended) | Observation | Key Category | NFR, Pollutant(s), Year(s) | RE, TC or UPTC in 2021 | RE in TC in 2022 | Tier 1 used for Key Category | **Implementation status** |
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| 2022 (1) | LT-5E-2022-0001 | Yes | 5E Other Waste, PM2.5, 2019 | NA | No | No | Implemented |
| **Recommendation**<br>For $PM_{2.5}$ emissions from 5E Other Waste the TERT noted that significant recalculations have been applied (>10% change) for the year 2019. However, the IIR does not provide any information on this category. In response to a question raised during the review, Lithuania clarified that in the 2021 submission all fire cases – not only relevant to 5E – were reported as AD for the year 2019. In the 2022 submission, activity data for the year 2019 were estimated very roughly. Additionally, Lithuania provided activity data for this category from the Statistics of the Lithuanian Fire and Rescue Department, which will be applied in the submission 2023. The TERT noted that the issue is below the threshold of significance for a technical correction.<br>**The TERT recommends that Lithuania estimate $PM_{2.5}$ emissions from category 5E Other Waste taking activity data from the Statistics of the Lithuanian Fire and Rescue Department into account and that Lithuania provide information on methodology, activity data and applied emission factor in the IIR 2023.** | | | | | | | |