ODBOR
EMISIE
A BIOPALIVÁ

INFORMATIVE INVENTORY REPORT 2024

SLOVAK REPUBLIC

MINISTERSTVO
ŽIVOTNÉHO PROSTREDIA
SLOVENSKEJ REPUBLIKY

SHMÚ

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INFORMATIVE INVENTORY REPORT 2024

SUBMISSION UNDER THE CLRTAP AND NECD
SLOVAK REPUBLIC

MINISTERSTVO
ŽIVOTNÉHO PROSTREDIA
SLOVENSKEJ REPUBLIKY

SHMÚ

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PREFACE

Title of report	Informative Inventory Report 2023 Slovak Republic. Air Pollutant Emissions 1990-2021.
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The Slovak Republic Informative Inventory Report (SK IIR) is an official document accompanying the emission inventory submission of the Slovak Republic under the Convention on Long-Range Transboundary Air Pollution (LRTAP Convention). Since the Directive (EU) 2016/22841 on the reduction of national emissions of certain atmospheric pollutants (NECD) was adopted, this report represents also the official document as required in the new NEC Directive.

SK IIR is annually prepared by the Slovak Hydrometeorological Institute (SHMÚ) at the Department of Emissions and Biofuels as a responsible body and approved by the Ministry of Environment of the Slovak Republic (MŽP SR), and annually delivered to the United Nations Economic Commission for Europe (UNECE) Environment and Human Settlements Division of the emission inventory and projections and European Commission.

The general purpose of this document is to provide technical and methodological support for the emission information presented in a common template for LRTAP Convention submission and NECD. The report brings sufficiently detailed information that allows a transparent view of the emission preparation process of the Slovak emission inventory.

The structure of the document is in line with general recommendations and presents institutional background information and arrangement, trends of pollutants, the process of the emission inventory preparation, emission factors, sources and references used during the compilations or expert judgements. Then major changes, recalculations and updates, which have been done and reported in the regular template to the European Commission (EC) as well as planned improvements. The national projections and the process of their preparation are also included.

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L2284&from=E**N**

GLOSSARY

Acronyms and Definition

CDR	Central Data Repository
CS	Country-specific
CW	Clinical waste
CWI	Clinical waste incineration
EP and Council	European Parliament and the Council
EC	European Commission
EF	Emission factor
EI	Emission Inventory
EIONET	European Environment Information and Observation Network
EMEP	European Monitoring and Evaluation Programme
EMEP/EEA GB_{2013}	EMEP/EEA air pollutant emission inventory guidebook 2013
EMEP/EEA GB_{2016}	EMEP/EEA air pollutant emission inventory guidebook 2016
EMEP/EEA GB_{2019}	EMEP/EEA air pollutant emission inventory guidebook 2019
EMEP/EEA GB_{2023}	EMEP/EEA air pollutant emission inventory guidebook 2023
ETS	Emission trading system
GHGs	Greenhouse gases
HMs	Heavy metals
IED	Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)
IPCC	Intergovernmental Panel on Climate Change
IPCC 2006 GL	2006 IPCC Guidelines for National Greenhouse Gas Inventories
ISW	Industrial solid waste
IW	Industrial waste
LCP	Large Combustion Plant
LRTAP Convention	Convention on Long-Range Transboundary Air Pollution
MPaRV	Ministerstvo pôdohospodárstva a rozvoja vidieka The Ministry of Agriculture and Rural Development
MSW	Municipal solid waste
MW	Municipal waste
MŽP SR	Ministerstvo životného prostredia Slovenskej republiky The Ministry of Environment of the Slovak Republic
NECD	National Emission Ceilings Directive
NEC Directive	National Emission Ceiling Directive
NIS SR	National Inventory System of the Slovak Republic
NPPC	Národné poľnohospodárske a potravinárske centrum National Agriculture and Food Centre
NPPC - VÚŽV	Národné poľnohospodárske a potravinárske centrum – Výskumý ústav živočíšnej výroby National Agriculture and Food Centre - Research Institute for Animal Production
NEIS	Národný emisný informačný systém National Emission Information System
OEaB	Odbor Emisie a Biopalivá Department emissions and biofuels
PMs	Particulate matter ($PM_{2.5}$, PM_{10}, TSP, BC)
PTaEÚ MV SR	Požiarnotechnický a expertízny ústav Ministerstva vnútra Slovenskej republiky

	Fire Engineering and Expertise Institute of the Ministry of the Interior of the Slovak Republic
POPs	Persistent organic pollutants
REZZO	Register emisií a zdrojov znečistenia ovzdušia Emission and Air Pollution Source Inventory
RDF	Refuse-Derived Fuel
RTI	Rated Thermal Input
SHMÚ	Slovenský hydrometeorologický ústav Slovak Hydrometeorological Institute
SK IIR	Slovak Republic Informative Inventory Report
SK NIR	Slovak Republic National Inventory Report
ŠÚ SR	Štatistický úrad Slovenskej Republiky Statistical Office of the Slovak Republic
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	Environmental Protection Agency (United States)
VÚD	Výskumný ústav dopravný Research Institute of Transport
VÚRUP	Výskumný ústav pôdoznalectva a ochrany pôdy Research Institute of Soil Science and Soil Protection
VÚVH	Výskumný ústav vodného hospodárstva Water Research Institute
WI	Waste incineration

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EXECUTIVE SUMMARY

Last update: 15.3.2024

ES.1 BACKGROUND INFORMATION ON INVENTORY OF AIR POLLUTANTS

Informative Inventory Report of the Slovak Republic (SK IIR) and the complete set of NFR tables represent official submission under the United Nations Economic Commission for Europe (UNECE) Convention on Long-rage Transboundary Air Pollution (LRTAP Convention) and under Directive 2016/2284/EU (NEC Directive).
The SHMÚ, as a single national entity regarding emission inventories, compiles the annual delivery of the Slovak Republic and submits it officially to the Executive Secretary of UNECE as well as to the European Commission.
As a party to the UNECE/LRTAP Convention and under the NEC Directive, the Slovak Republic is required to annually report data on emissions of air pollutants covered in the Convention and its Protocols:

- main pollutants: nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOC), sulphur oxides (SOx) and ammonia (NH_3);
- particulate matter (PM): fine particulate matter ($PM_{2.5}$), coarse particulate matter (PM_{10}) and if available black carbon (BC);
- other pollutants: carbon monoxide (CO);
- heavy metals (HMs): lead (Pb), cadmium (Cd) and mercury (Hg);
- persistent organic pollutants (POPs): polychlorinated dibenzodioxins/dibenzofurans (PCDD/Fs), polycyclic aromatic hydrocarbons (PAHs), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs).

The SK IIR contains information on the inventory of air pollutants of the Slovak Republic for all years from 1990 to 2022, all requested air pollutants in NFR14 reporting format and detailed descriptions of methods, data sources, information on quality assurance and quality control (QA/QC) activities analysis of emission trends.

ES.2 MAJOR GENERAL CHANGES

All changes were done to achieve improvement in the data quality, data completeness and transparency of the results, in line with the legal requirements and with the SK Review 2023 Recommendations.

In the Energy sector, emissions from the category **1A1a** were recalculated as a result of the update of the activity data and as well based on the change in the value of the emission factor for Ni (EMEP/EEA GB_{2023}). In category **1A1b**value of the emission factor changed for PCDD/F (EMEP/EEA GB_{2023}). The recalculations for BC, HMs and POPs were made based on changes in activity data in **1A2c, 1A2d, 1A2f, 1A2gviii** and **1A4ai**. In **1B1a** new emission factors were used for PMs and updated emission factor for NMVOC based on the 2019 IPCC Refinements to the 2006 IPCC Guidelines. In **1B2aiv** new emission factors for heavy metals and PCDD/F were introduced based on the EMEP/EEA GB_{2023}. Activity data of fuel consumption changed in categories **1A4bi** and **1A3dii**.

In the IPPU sector, emissions for the historical years 1990-1999 from category **2C7a** were recalculated due to the correction of the emission factor of Hg, Cr and PCDD/F. In category **2H2**, activity data were updated for NMVOC.

In the Agriculture sector, emissions of NOx and NH_3 in categories **3B3**, **3B1**, **3B4** and **3Da2a** changed as a result of the implementation of the IPCC 2019 Refinement and Implementation of EMEP/EEA GB_{2023}. In category **3B1** emission of NMVOC changed based on recommendation number **SK-3B1-2023-0001**. In category **3B4h** was implemented new methodology based on a Tier 1 method available in the 2023 EMEP/EEA Guidebook.
In the Waste sector, in category **5A,** NMVOC emissions were recalculated following the new EMEP/EEA GB_{2023}. Also, PMs in **5A** were recalculated due to the change of activity data from total waste landfilled to total mineral

waste handled as instructed in the EMEP/EEA GB$_{2023}$. NMVOC in **5B2** were recalculated due to the addition of new types of activity data. In category **5C1biii** correction of activity data and change of abatement technology efficiencies were made based on the new EMEP/EEA GB$_{2023}$.

The document structure of the SK IIR reflects the changes mentioned above and previous endeavours to follow the recommended template to ensure the clarity of the reported data. The individual chapters of categories provide in logical structure:

- general description of the emission trends and key drivers of the changes throughout the years;
- a detailed description of emission trends and key drivers for each category;
- description and more detailed explanation of methodology, level of the method used, activity data and emission factors used in each category;
- the reasoning for notation keys using or explanation for allocated items if needed;
- description of recalculations that have been done covering the time series.

ES.3 STRUCTURAL CHANGES IN INSTITUTIONAL COOPERATION

The Slovak Hydrometeorological Institute (SHMÚ) maintains long-term cooperation with the Statistical Office of the Slovak Republic (ŠÚ SR) in the field of data exchange through an agreement on the mutual cooperation concluded between the Ministry of Environment of the Slovak Republic (MŽP SR) and the ŠÚ SR. The revision of the existing agreement in 2017 has provided a flexible and secure way of exchanging data. The revision was focused on security-enhancing, especially for data transfer of individual and confidential data and their protection. The content extension of received and provided data was re-assessed and it has allowed the enlargement of activity data received from the ŠÚ SR for inventory usage. Moreover, the shift to regular providing of data via FTP server erases the annual administration and paperwork related to official necessary permissions between institutions. Besides, the determination of qualified and authorized persons with direct access improves the effectiveness of this cooperation.

ES.4 OVERVIEW OF THE EMISSION TRENDS

Following ***Figures ES.1*** - ***ES. 4*** show the overall emission trend of Main pollutants (NOx, NMVOC, SOx, NH_3), Particulate matter ($PM_{2.5}$, PM_{10}, BC), Priority heavy metals (Pb, Cd, Hg) and Persistent organic pollutants (PCDD/F, PAHs, HCB, PCBs).

Figure ES.1: *Overall emission trends of main pollutants*

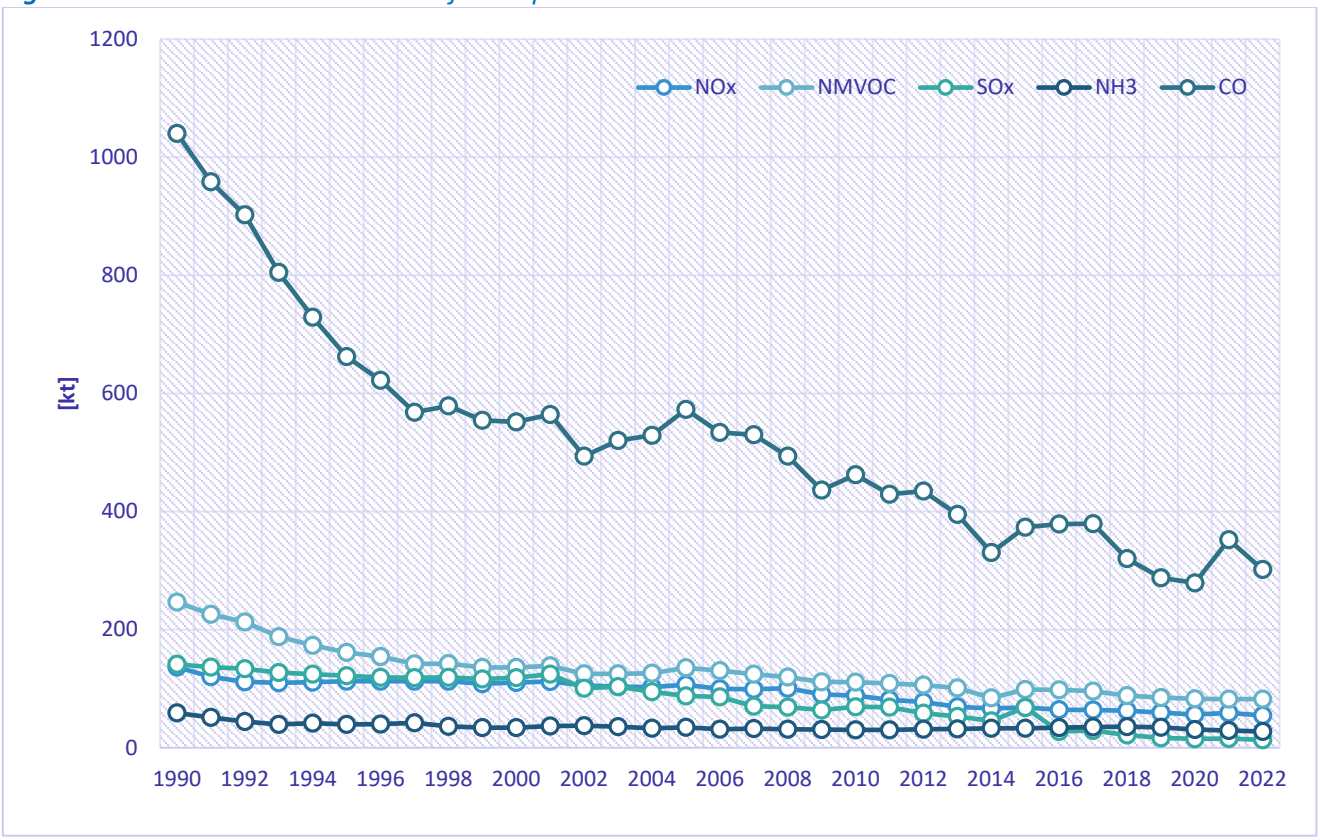


Figure ES.2: *Overall emission trends of the particulate matter*

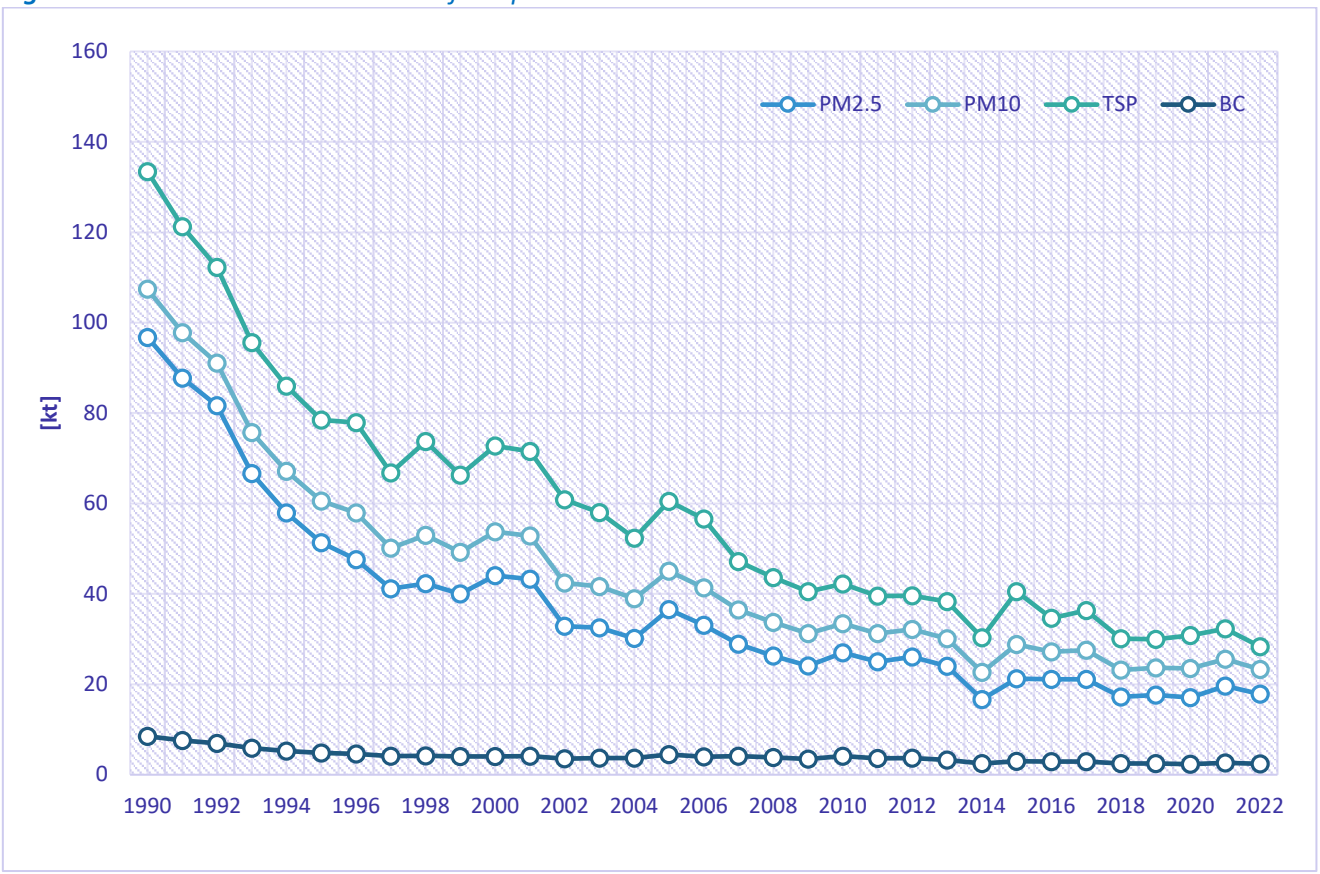


Figure ES.3: *Overall emission trends of the priority heavy metals*

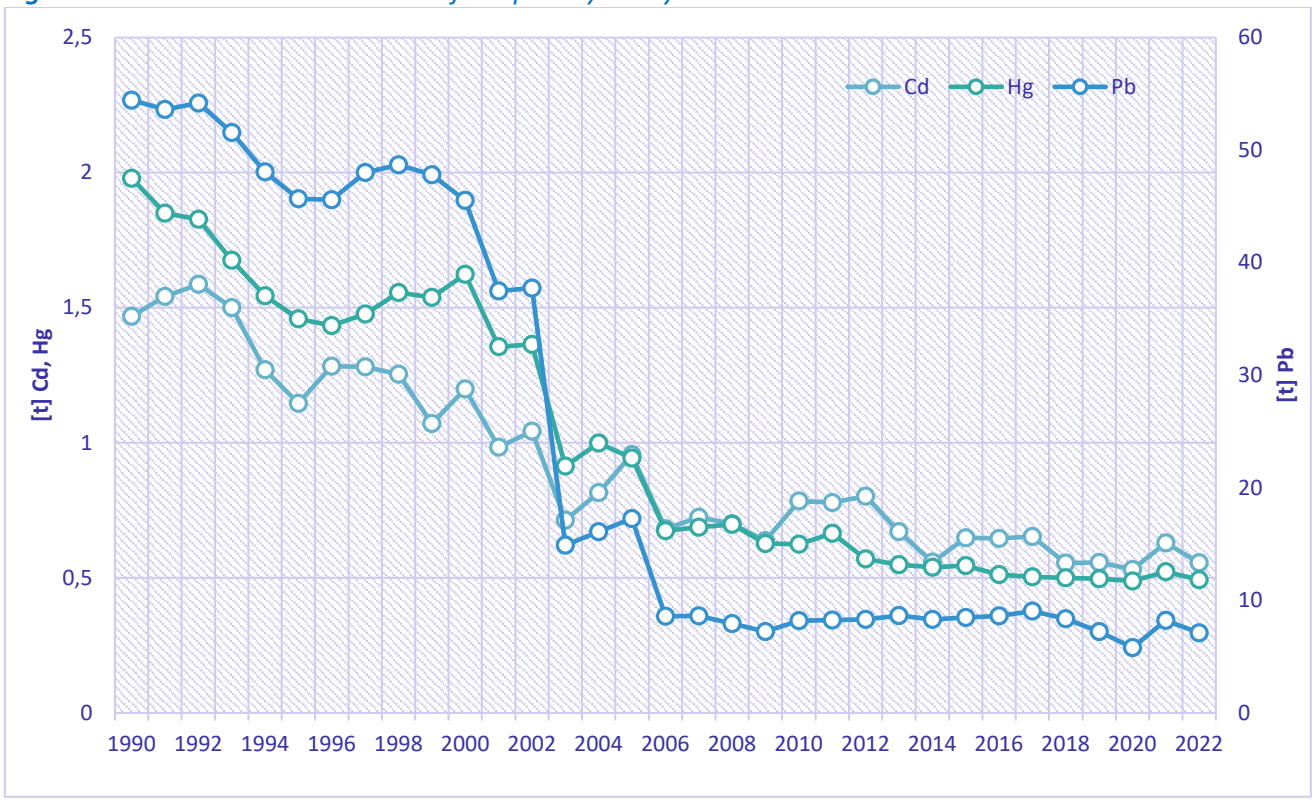
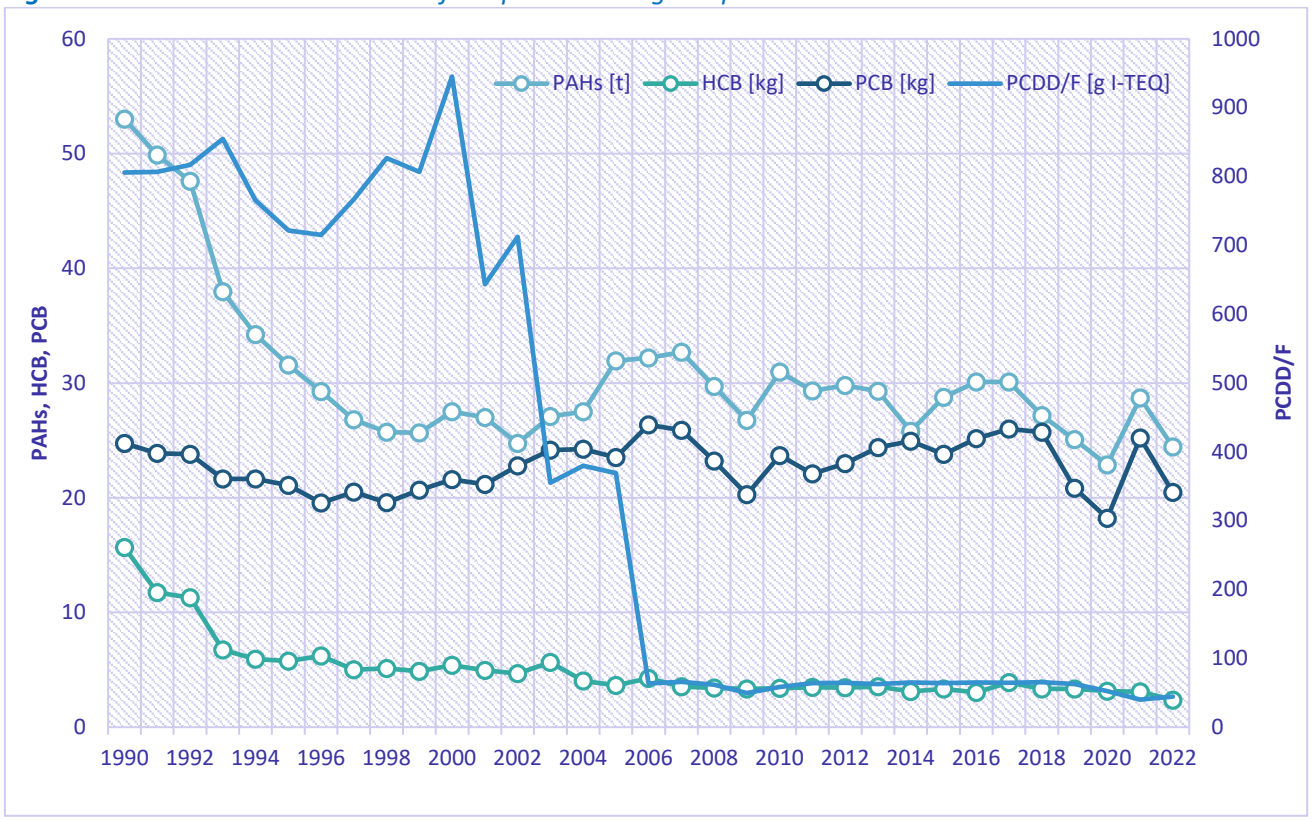


Figure ES.4: *Overall emission trend of the persistent organic pollutants*



ES.5 OVERVIEW OF RECALCULATIONS

Most of the recalculations realized in the 2024 submission were connected with the improvement of activity data and values of emission factors in all sectors, according to the new EMEP/EEA$_{2023}$ Guidebook. In the energy sector improvements were connected with the implementation of 2019 IPCC Refinements to the 2006 IPCC Guidelines emission factors for NMVOC to ensure harmonisation of GHG emissions and air pollutants.
Table ES.1 provides an overview of recalculations in the 2024 submission. More detailed data can be found in the particular chapters of this report.

Table ES.1: *Main recalculations and their explanation, % difference for the years 2019, 2015, 2010, 2005, 2000 and 1990 between the 2023 and 2024 Final Submissions*

POLLUTANT	CHANGE FOR 1990 VALUES	CHANGE FOR 2000 VALUES	CHANGE FOR 2005 VALUES	CHANGE FOR 2010 VALUES	CHANGE FOR 2015 VALUES	CHANGE FOR 2019 VALUES	UNITS	COMMENT/EXPLANATION
NOx (as NO_2)	0%	0%	1%	1%	1%	1%	kt	Minor changes in the period 2012-2020 were caused by activity data recalculation in category 1A4bi, revision of activity data and value of emission factor from EMEP/EEA GB2023 in 1A3dii. Inthe category 3B4h was implemented new methodology based on a Tier 1 method available in the 2023 EMEP/EEA Guidebook.
NMVOC	-3%	-6%	-4%	-5%	-6%	-6%	kt	The decrease were caused as a result of revision of activity data and value of emission factor from EMEP/EEA GB2023 in 1A3dii, 5A and 2H2. Due to changes in methodology in 1B2. By recalculation based on recommendation number SK-3B1-2023-0001 in 3B1.
SOx (as SO_2)	1%	1%	2%	2%	2%	12%	kt	Minor changes were caused as a result of revision of activity data and value of emission factor from EMEP/EEA GB2023 in 1A3di(ii) and 1A3dii.
NH_3	2%	3%	6%	9%	16%	14%	kt	Emissions increased as a result of implementation of the IPCC 2019 Refinement and Implementation of 2023 EMEP/EEA Guideline in 3B3, 3B1, 3B4 and 3Da2a.
$PM_{2.5}$	0%	1%	2%	3%	3%	-1%	kt	A slight changes in emissions in the whole time series was caused by revision of activity data and value of emission factor from EMEP/EEA GB2023 in 1A3dii, by the implemention new methodology in 3B3 based on Tier 1 method available in the 2023 EMEP/EEA Guidebook. Changes in the period 2012-2020 were caused by activity data recalculation in the category 1A4bi. Due to changes in methodology in 1B1a.
PM_{10}	0%	-1%	0%	1%	1%	-2%	kt	A slight decrease in emissions in the whole time series was caused by the implemention new methodology in 3B3 based on a Tier 1 method available in the 2023 EMEP/EEA Guidebook. Changes in the period 2012-2020 were caused by activity data recalculation in the category 1A4bi.
TSP	-2%	-2%	-1%	-1%	-1%	-3%	kt	A slight decrease in emissions in the whole time series was caused by the implemention new methodology in 3B3 based on Tier 1 method available in the 2023 EMEP/EEA Guidebook. Changes in the period 2012-2020 were caused by activity data recalculation in the category 1A4bi.
BC	1%	4%	5%	6%	8%	4%	kt	Emissions increased due to recalculations in 1A1a and 1A3dii based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi.
CO	1%	2%	5%	3%	4%	1%	kt	Emission changed in 1B1b due to introduction additional emissions in charcoal production activities. Changes in the period 2012-2020 were caused by activity data recalculation in the category 1A4bi.

Table ES.1: *Main recalculations and their explanation, % difference for the years 2019, 2015, 2010, 2005, 2000 and 1990 between the 2023 and 2024 Final Submission*

POLLUTANT	CHANGE FOR 1990 VALUES	CHANGE FOR 2000 VALUES	CHANGE FOR 2005 VALUES	CHANGE FOR 2010 VALUES	CHANGE FOR 2015 VALUES	CHANGE FOR 2019 VALUES	UNITS	COMMENT/EXPLANATION
Pb	0%	0%	1%	2%	1%	1%	t	Emissions slightly changed due to recalculations in 1A1a, 1B2aiv,1A3dii based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi, due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB2023 in 5C1biii.
Cd	0%	0%	1%	1%	1%	-4%	t	Emission changed due to recalculations in 1A1a, 1B2aiv based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi, due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB2023 in 5C1biii.
Hg	3%	5%	8%	12%	5%	-2%	t	Emissions changed due to recalculations in 1A1a, 1B2aiv based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi, due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB2023 in 5C1biii. Changes in the period 1990-1990 were caused by emission factor recalcultaion in the category 2C7a.
As	2%	4%	9%	11%	19%	21%	t	Emissions increased due to recalculations in 1A1a, 1B2aiv based on changes in activity data and value of emission factor in EMEP/EEA GB2023.
Cr	1%	-1%	-1%	-1%	-1%	-2%	t	Emissions decreased due to recalculations in 1A1a, 1B2aiv based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi. Changes in the period 1990-1990 were caused by emission factor recalcultaion in the category 2C7a.
Cu	0%	0%	0%	0%	0%	0%	t	Emissions changed due to recalculations in 1A1a, 1B2aiv and 1A3dii based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi, due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB2023 in 5C1biii.
Ni	-1%	-1%	-1%	0%	1%	1%	t	Emissions changed due to recalculations in 1A1a, 1B2aiv and 1A3dii based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi.
Se	0%	0%	0%	0%	3%	1%	t	Emissions changed due to recalculations in 1A1a, 1B2aiv and 1A3dii based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi.
Zn	6%	10%	14%	14%	13%	11%	t	Emissions increased due to recalculations in 1A1a, 1B2aiv based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi.
PCDD/PCDF	5%	4%	3%	5%	-1%	-1%	g I TEQ	Emissions changed due to the recalculations in 1A1b and 1B2aiv based on changes of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi, due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB2023 in 5C1biii. Changes in the period 1990-1990 were caused by emission factor recalcultaion in the category 2C7a.
PAHs	3%	8%	11%	12%	13%	10%	t	Emissions increased due to recalculations in 1A1a based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi.
HCB	3%	8%	4%	3%	3%	1%	kg	Emissions changed due to recalculations in 1A1a based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category 1A4bi and due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB2023 in 5C1biii.
PCBs	0%	0%	0%	0%	0%	0%	kg	Emissions slightly changed due to recalculations in 1A1a and 1A3 di(ii) based on changes in activity data and value of emission factor in EMEP/EEA GB2023, recalculation of the activity data in category 1A4bi and due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB2023 in 5C1biii.

ES.6 IMPROVEMENT AND PRIORITIES

General and sectoral uncertainty analysis is one of our main future goals. Due to the necessity of total approach change in most of the categories in sectors of energy and industry, this cannot be done in the short term.
In 2022, the uncertainty analysis was created for the first time, using the uncertainty tool provided to the MS by CEIP. Also, it was included in the key category analysis for the first time. Last year, additional heavy metals were included in both analyses.
An analysis is planned to be improved for the sectors of agriculture and transport as only default uncertainty for emission factors was used.
Also, sectoral uncertainty analysis is planned for future submissions.
The next important improvement planned for the next period is to develop a new methodology for heavy metals and POPs, with priority to key categories as the uncertainty analysis changed the key categories.
A categorisation of operators is not fully in compliance with GHG inventory at this moment, although major improvements were achieved. cooperation with the GHG inventory experts was initiated, but due to a lack of capacity, a complex solution was not yet achieved.
Another of the key priorities is to widen the participation of the independent experts assigned by the MŽP SR to improve the quality assessment of the inventory and the IIR.

ES.7 OVERVIEW OF SECTORS INCLUDING CONDENSABLE COMPONENT OF $PM_{2.5}$ AND PM_{10}

In sector Industry and subsector Energy production, emissions are mostly measured on stacks, therefore the condensable component is not included. There are three categories in the sector Transport, which include the condensable component into PMs emission factors: Aviation (**1A3a**), Off-road vehicles and other machinery (**1A4cii**) and Other mobile sources (**1A5b**), other categories are estimated using model COPERT and inclusion of condensable compound in EF is unknown. In the sector of Agriculture and Waste, estimations were provided using EMEP/EEA GB_{2023} emission factors, which do not include the condensable component. Detailed information about the methodology used to estimate emissions and inclusion/exclusion of condensable components in PM emission factors of individual categories is described in **ANNEX II** of this report.

CHAPTER 1: INTRODUCTION

Last update: 15.3.2024

1.1 NATIONAL INVENTORY BACKGROUND

The Slovak Republic, as a signatory of several international conventions, is obliged to report air emissions data annually to meet the mandatory requirements arising from the adopted and implemented acts and agreements:

Geneva Protocol[2] on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)

- acceded as Czechoslovakia on 26 November 1986
- succession: the Slovak Republic on 28 May 1993

LRTAP Convention[3] - The Convention on Long-range Transboundary Air Pollution and related protocols

- *Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent (1985)*
    - Signed and approved as Czechoslovakia on 9 July 1985 and 26 November 1986, respectively
    - The Slovak Republic succession on 28 May 1993
- *Sofia Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes (1988)*
    - Signed and approved as Czechoslovakia on 1 November 1988 and 17 August 1990, respectively
    - The Slovak Republic succession on 28 May 1993
- *Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes (1991)*
    - The Slovak Republic's accession on 15 December 1999
- *Oslo Protocol on Further Reduction of Sulphur Emissions (1994)*
    - The Slovak Republic ratification on 1 April 1998
- *Aarhus Protocol on Heavy Metals (1998)*
    - The Slovak Republic accepted on 30 December 2002
- *Aarhus Protocol on Persistent Organic Pollutants (POPs*) (1998)
    - The Slovak Republic accepted on 30 December 2002
- *Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (1999)*
    - The Slovak Republic ratification on 28 April 2005

NEC Directive[4] - Directive (EU) 2016/2284 of the European Parliament and the Council on the reduction of national emissions of certain atmospheric pollutants Ceilings for certain pollutants[5]

This Directive sets national reduction commitments for each country for the five pollutants that cause acidification, eutrophication and ground-level ozone pollution. The new Directive repeals and replaces NEC Directive 2001/81/EC, the National Emission Ceilings Directive (***Table 1.1***).In line with the objective of the Union's air policy to achieve levels of air quality that do not give rise to significant negative impacts on, and risks to, human health and the environment, the new Directive 2016/2284 sets emission reduction commitments for:

- Sulphur dioxides (SOx)
- Non-methane volatile organic compounds (NMVOC)
- Nitrogen oxides (NOx)
- Ammonia (NH_3)
- Fine particulate matter ($PM_{2.5}$)

The objective is to be achieved by setting a percentage reduction in national emissions between 2020 and 2029 and, after 2030, with the base year 2005 (***Table 1.2***).

[2] https://www.unece.org/env/lrtap/emep_h1.html
[3] http://www.unece.org/env/lrtap/status/lrtap_s.html
[4] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1491821672988&uri=CELEX:32016L2284
[5] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001L0081&from=EN

To ensure continuity in improving air quality, the 2001/81/EC emission ceiling to be reached by the Slovak Republic in 2010 is valid until new national emission reduction commitments will be into force in 2020.

Table 1.1: *Emission Ceiling of the Slovak Republic for the year 2010*

	NOx	SOx	VOC	NH_3
Slovak Republic	130	110	140	39
EU-28	8 297	9 003	8 848	4 294

Table 1.2: *Emission Reduction Commitments for the Slovak Republic set in New NECD*

	NOx	SOx	NMVOC	NH_3	$PM_{2.5}$
2020-2029	36%	57%	18%	15%	36%
2030 and onwards	50%	82%	32%	30%	49%

UN context - UN Framework Convention on Climate Change was adopted in 1992 as an instrument to tackle climate change. The objective of the Convention was to stabilize atmospheric concentrations of greenhouse gases at a safe level that enables the adaptation of ecosystems. The UNFCCC covered 195 countries or international communities, including the Slovak Republic, and the EU, which was also the Party to the Convention. The Convention required the adoption of mitigation measures to reduce GHG emissions in developed countries by 25-40% by 2020 compared to 1990. In the Slovak Republic, the Convention came into force on 23rd November 1994. The Slovak Republic accepted all the commitments of the Convention, including the reduction of GHG emissions by 2000 to the 1990 level. In response to the significant increase in GHG emissions since 1992, an urgent need to adopt an additional and efficient instrument that would stimulate mitigation efforts has occurred. In 1997, the Parties of the Convention agreed to adopt the Kyoto Protocol (KP). This protocol defines reduction objectives and means to achieve mitigation goals by the countries included in Annex I to the Convention. The Slovak Republic and the EU Member States ratified the Kyoto Protocol on the 31st of May 2002.

One of the commitments, resulting from the Convention, was the preparation and submission of greenhouse gas emission inventories to the UNFCCC secretariat on an annual basis by the 15th of April each year.

The Paris Agreement (PA) was adopted on December 12, 2015, as a result of the international effort of the 196 parties of the UNFCCC and entered into force on November 4, 2016, as the world's first-ever climate change agreement.

The EU, together with the Heads of State, including the Slovak Republic, signed the Paris Agreement together at the ceremony held on April 22, 2016, in New York. The proposal for the adoption of the Paris Agreement was negotiated by the Government of the Slovak Republic on September 14, 2016, and approved by Resolution No 387/2016. Subsequently, the proposal was submitted by the National Council of the Slovak Republic, which approved the Paris Agreement by Resolution No 215/2016 on September 21, 2016. The SR completed its ratification process on September 28, 2016, signed by the President of the Slovak Republic. The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C. Monitoring, reporting and reducing emissions, including adaptation to climate change, is mandatory for all countries, not just those listed in Annex 1 to the Convention. Emissions reduction action plans, defined as nationally determined contributions (NDCs), set targets for reducing greenhouse gas emissions by 2025 or 2030, along with adaptation to climate change. Countries should review and tighten their NDCs every 5 years to achieve carbon neutrality by 2050.

EU context -

The European Union (EU) considers climate change as one of the four environmental priorities. On November 28, 2018, the European Commission presented its Long-Term Strategy for a prosperous, modern, competitive and climate-neutral economy by 2050. The Low-Carbon Development Strategy of the Slovak Republic until 2030 with a View to 2050 was adopted by the Government of the Slovak Republic by Resolution No 104/2020. The

European Commission launched the European Climate Pact in December 2020, an EU-wide initiative inviting people, communities and organisations to participate in climate action and build a greener Europe. As part of the European Green Deal, the Climate Pact offers a space for everyone to share information, debate and act on the climate crisis, and be part of an ever-growing European climate movement. The Commission's proposal to cut greenhouse gas emissions by at least 55% by 2030 sets Europe on a responsible path to becoming climate neutral by 2050.

Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action

The regulation (EU) 2018/1999 together with Commission implementing regulation EU) 2020/1208 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 integrated rules to ensure planning, monitoring and reporting of progress towards its 2030 climate and energy targets and its international commitments under the Paris Agreement have adopted. The regulation established a governance mechanism for the implementation of strategies and measures designed to meet the objectives and targets of the Energy Union and the EU's long-term greenhouse gas emission commitments under the Paris Agreement, in particular the EU's ambition to achieve climate neutrality by 2030. Slovakia submitted the 2021 – 2030 draft plans under the Regulation on Governance by the end of 2018 and final plans by the end of 2019. The Commission has assessed these both at the EU and Member State levels. The update of the national energy and climate plans is expected by the end of June 2023 in a draft form and by 30 June 2024 in a final to reflect an increased ambition.

1.1.1 Historical background and circumstances

Political changes in the 1990s, as well as the efforts of the Slovak Republic to join the European Union, enabled significant changes in environmental policy. The Slovak Republic expressed interest in being a member of the European Union in 1991. However, the fulfilment of this vision disrupted the division of former Czechoslovakia into Czech and Slovak independent states in 1993. On 4 October 1993, the Slovak Republic signed the agreement in Luxembourg, which was ratified in the year 1995. The integration process, when the necessary political, economic and legislative changes had to be made, culminated in the accession of SR to the EU on 1st May 2004.

In the field of the environment, this effort led to the introduction of strict air protection, which was already in place in 1992 (in legislation - Act No 17/1992 Coll. on Environment). This strict basis was introduced into Slovak law, according to the German model. Therefore, there was no room for the uncontrolled expansion of the industry. The air quality issue (Council Directive 96/62/EC on air protection) has been governed in the legal system of the Slovak Republic in particular by the following legislation:

- Act No 309/1991 Coll. on the Protection of Air from Pollutants (Air Act) as amended[6]
- Act No 134/1992 Coll. on State Administration of Air Protection as amended[7]
- Governmental Ordinance No 92/1996 Coll. through which Act No 309/1991 Coll. on the Protection of Air from Pollutants (Air Act) as amended is implemented[8]
- Decree of Ministry of the Environment of the Slovak Republic No 103/1995 Coll. as amended[9]

Nowadays these acts/decrees were repealed and covered by new acts/decrees.

In 2004, the Slovak Republic became a member of the European Union during the largest enlargement. The integration process has brought the transposition of the earlier EU acquis, which has been fully implemented:

- Air Quality Framework Directive 96/62/EC and its daughter directives (1999/30/EC, 92/72/EEC, 2000/69/EC, 2002/3/EC, 2004/107/EC)

[6] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1991/309/vyhlasene_znenie.html
[7] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1992/134/vyhlasene_znenie.html
[8] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1996/92/vyhlasene_znenie.html
[9] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1995/103/

- Directive 84/360/EEC of the European Parliament and of the Council on combating of air pollution from industrial plants
- Directive 2001/81/EC of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants
- Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants
- Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste
- Council Directive 94/63/EC of the European Parliament and of the Council on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations
- Council Directive 1999/13/EC of the European Parliament and of the Council on the limitation of emission of volatile organic compounds due to the use of organic solvents in certain activities and installations
- Council Directive 1999/32/EC of the European Parliament and of the Council relating to a reduction in the sulphur content of certain liquid fuels
- Council Directive 96/61/EC of the European Parliament and of the Council concerning integrated pollution prevention and control

In May 2000, twinning project SR 98/IB/EN/3: "*Strengthening of the institutions in the air pollution sector*" was launched. As a result of this project, proposals were made to amend the legislation on air protection and transposition into Slovak legislation. The new Clean Air Act and related ministerial decrees were adopted by the end of 2002 and full harmonization was achieved:

- Act No 478/2002 Coll. on air protection[10]
- Decree of the Ministry of Environment of the Slovak Republic No 408/2003 Coll. on monitoring of emissions and air quality monitoring[11]
- Decree No 409/2003 Coll. on emission limits, technical requirements and general operating conditions of certain activities and installations, which use organic solvents[12]
- Decree No 706/2002 Coll. on air pollution sources, on emission limits, on technical requirements and general operational conditions, on the list of pollutants, on the categorization of air pollution sources and on requirements of emission's dispersion as amended[13]
- Decree No 705/2002 Coll. on air quality[14]
- Decree No 704/2002 Coll. on the control of volatile organic compounds emissions resulting from the storage of petrol and its distribution from terminals to service stations[15]
- Decree No60/2003 Coll. on the Specification of a maximum volume of discharged pollutants (emission quotas)[16]
- Decree No 144/2000 Coll. on the Requirements for the quality of fuels[17]

Nowadays are these acts/decrees repealed or it is covered by Act on air protection No 137/2010 Coll.[18] as amended and related regulations.

[10] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/478/vyhlasene_znenie.html
[11] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2003/408/vyhlasene_znenie.html
[12] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2003/409/vyhlasene_znenie.html
[13] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/706/vyhlasene_znenie.html
[14] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/705/vyhlasene_znenie.html
[15] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/704/vyhlasene_znenie.html
[16] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2003/60/vyhlasene_znenie.html
[17] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2000/144/20000601.html
[18] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2010/137/20160101

1.2 INSTITUTIONAL ARRANGEMENTS AND COMPETENCES

The MŽP SR is responsible for the development and implementation of the national environmental policy, including climate change and air protection objectives. The Ministry is responsible for developing strategies and other implementation tools such as acts, regulatory measures, and economic and market instruments to meet the targets cost-effectively. Both conceptual documents and legislative proposals always comment on all ministries and other competent authorities.

After the comments, the proposed acts are discussed at the Governmental Legislative Council approved by the Government, and finally, in the Slovak Parliament. The MŽP SR is the main body to ensure conditions and monitor the progress of the Slovak Republic to meet all commitments and obligations of air protection, climate change and adaptation policy.

Articles 4 and 12 of the UNFCCC require the Parties to UNFCCC to develop, periodically update, publish, and make available to the Conference of the Parties their national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled under the Montreal Protocol. Moreover, the commitments require estimation of emissions and removals as a part of ensuring that Parties comply with emission limits, that they have a national system for estimation of sources and sinks of greenhouse gases, that they submit an inventory annually, and that they formulate national programs to improve the quality of emission factors, activity data, or methods. The obligation of the Slovak Republic to create and maintain the national inventory system (NIS) which enables continual monitoring of greenhouse gases emissions is given by Article 5, paragraph 1 of the Kyoto Protocol.

The National Inventory System of the Slovak Republic (www.oeab.shmu.sk) has been established and officially announced by the Decision of the Ministry of Environment of the Slovak Republic on 1st January 2007 in the official bulletin: Vestnik, Ministry of Environment, XV, 3, 200719. In agreement with paragraph 30(f) of Annex to Decision 19/CMP.1, which gives the definitions of all qualitative parameters for the national inventory systems, the description of quality assurance and quality control plan according to Article 5, paragraph 1 is also required. The revised report of the National Inventory System dated November 2008 was focused on the changes in the institutional arrangement, quality assurance/quality control plan and planned improvements. The regular update of the National Inventory System with all qualitative and quantitative indicators is provided in the National Inventory Reports and in the Seventh National Communication of the SR on Climate Change, published in December 2017.

SHMÚ is delegated by the MŽP for the technical preparation of the national emission inventories and projections. The SHMÚ, as the allowance resort organisation, arranges necessary cooperation with external experts, who are contributors to the preparation process and participate in compilations. The list of internal experts of the Slovak Hydrometeorological Institute and designated external experts involved in the inventory of emissions are in the following ***Table 1.3***.

Table 1.3: *List of internal and external contributors to the Emission Inventory under CLRTAP*

SECTOR/SUBSECTOR	CONTRIBUTOR	INSTITUTION	E-MAIL
CLRTAP coordinator	Petra Kršáková	SHMÚ	petra.krsakova@shmu.sk
Energy	Monika Jalšovská	SHMÚ	monika.jalsovska@shmu.sk
	Michaela Câmpian Ján Horváth	SHMÚ SHMÚ	michaela.campian@shmu.sk jan.horvath@shmu.sk
Transport	Ján Horváth	SHMÚ	jan.horvath@shmu.sk
IPPU	Ivana Bellušová	SHMÚ	ivana.bellusova@shmu.sk
	Vladimír Danielik	STU BA	

[19] Vestnik" (Official Journal of the Ministry of Environment), XV, 3, 2007, page 19: National inventory system of the Slovak Republic for the GHG emissions and sinks under the Article 5, of the Kyoto Protocol

SECTOR/SUBSECTOR	CONTRIBUTOR	INSTITUTION	E-MAIL
Agriculture	Kristína Tonhauzer	SHMÚ	kristina.tonhauzer@shmu.sk
	Zuzana Palkovičová	NPPC	
	Vojtech Brestenský	NPPC	
Waste	Zuzana Jonáček	SHMÚ	zuzana.jonacek@shmu.sk
Projections	Marcel Zemko Kristína Tonhauzer	SHMÚ SHMÚ	marcel.zemko@shmu.sk kristina.tonhauzer@shmu.sk
	Ján Horváth Jiří Balajka	SHMÚ Senior consultant	jan.horvath@shmu.sk
Gridded emissions	Marcel Zemko	SHMÚ	marcel.zemko@shmu.sk
LPS	Monika Jalšovská	SHMÚ	monika.jalsovska@shmu.sk
QA/QC	Alexandra Nadžadyová Petra Kršáková	SHMÚ SHMÚ	alexandra.nadzadyova@shmu.sk petra.krsakova@shmu.sk

Based on the official Agreement between the MŽP SR[20] and the ŠÚ SR, the data are annually exchanged via the FTP server. Data transfer of individual and confidential data and their protection is ensured by the determination of qualified and authorized persons with direct access to the server.

In the emissions inventory of the transport, model COPERT V was used. Activity data for the model were obtained from Transport Research Institute (VÚD) in cooperation with the Ministry of Transport, Construction and Regional Development of the Slovak Republic (MDVRR), and from the ŠÚ SR.

The agricultural sector of emission inventory was performed in cooperation with the Ministry of Agriculture and Rural Development[21] (MPaRV). The responsibility for data and compilations of 3B Manure management was consequently shifted to the allowance organization - the National Agriculture and Food Centre[22] (NPPC).

1.3 INVENTORY PREPARATION PROCESS

The emission inventory is prepared to meet set quality requirements: transparency, consistency, comparability, completeness and accuracy.

The SHMÚ is responsible for the overall LRTAP Convention emission inventory preparation, namely:

- ensure the cooperation with institutions, experts and necessary background studies or papers
- ensure the processing and verification of data in the NEIS database
- ensure the technical preparation and compilation of data
- ensure the processing of data from the Statistical Office
- preparation of the LRTAP Convention reporting template
- annual update of the SK IIR
- submission of the LRTAP Convention reporting template and SK IIR
- cooperation during the review procedure for national emission inventories
- providing data to the Slovak Environmental Agency (Slovenská agentúra životného prostredia – SAŽP)
- providing processed emission data to the ŠÚ SR

The SHMÚ also provides the technical preparation and compilation of data for Air Environmental Accounts - AEA[23] that are processed by inventory first approach for air pollutants and energy first approach for the GHGs.

The NEIS database and emission outputs are used for several international reports:

a) LRTAP Convention and Directive 2016/2284 of the European Parliament and the Council on the reduction of national emissions of certain atmospheric pollutants

[20] Note: Slovak Hydrometeorological Institute is the allowance institution to the Ministry of Environment and thus the Contract is formally between Statistical Office of the Slovak Republic and the Ministry of Environment

[21] http://www.mpsr.sk/

[22] http://www.nppc.sk/index.php/sk/

[23] under the Regulation (EU) No 691/2011 of the EP and of the Council on European environmental economic accounts

b) for verification of E-PRTR

The emission inventory under LRTAP Convention and NEC Directive is prepared consistently with the greenhouse gases (GHG) emission inventory under UNFCCC and the projection requirements of Decision 280/2004/EC. UNFCCC and the projection requirements of Regulation 2018/1999/EU and Implementing regulation 2020/1208/EU.

The National Emissions Inventory is being prepared following EMEP/EEA GB_{2019} and the updated EMEP/EEA GB_{2023} and implements the NFR (reporting nomenclature) and the category. Data are provided between 1990 and 2022[24,25]. Where necessary, the methodology is adapted to the specific circumstances of the country.

1.4 METHODS AND DATA SOURCES

There are several sources of input data among which the most important are the National Emission Information System (NEIS) and activity data from the ŠÚ SR. The basic principles of the NEIS are shown in ***Figure 1.1***.

Activity data from the ŠÚ SR are provided to the SHMÚ based on the long-term cooperation in the field of data exchange through an agreement on the mutual cooperation concluded between the Ministry of Environment of the Slovak Republic (MŽP SR) and the ŠÚ SR. Data are provided via the FTP server to qualified and authorized persons with direct access.

Information System NEIS was established in 1998. The database was developed to fulfil the national legislation in air quality and the requirements for pollutants fees decisions (Act No. 401/1998 on air pollution charges as amended). Since 2000, when the NEIS was set into operation, the emissions are directly collected consistently and verified on more levels. This database replaced an old system REZZO (Inventory of Emissions and Air Pollution Sources).

Annual data is collected from large and medium sources from sector energy and industry. The collection of annual activity data is performed through questionnaires, where specific data is required.

All annual sets of input data involving fuel amounts (according to the types, and quality marks) necessary for the emission balance are obtained from the district offices by means of the NEIS BU module. Activity data collected in the NEIS central database are allocated according to the NFR categorization for solid, liquid, gaseous fuels, biomass and other fuels. The emissions balances of air pollutants in the range from 2000–2022 were processed in the NEIS CU module by the same way of calculation.

Detailed methodology of the NEIS database is available in **ANNEX IV**.

The NEIS remains a major source of data for inventory in the key categories and sectors (Energy, Industry) for the main pollutants. Sectoral experts from research institutes or cooperative external experts provide emission inventory studies or material balance studies that are consequently involved in the compilation process.

The MŽP SR has mandated the SHMÚ to ensure communication with the producers to collect the necessary data, which they are not obliged to provide to the NEIS.

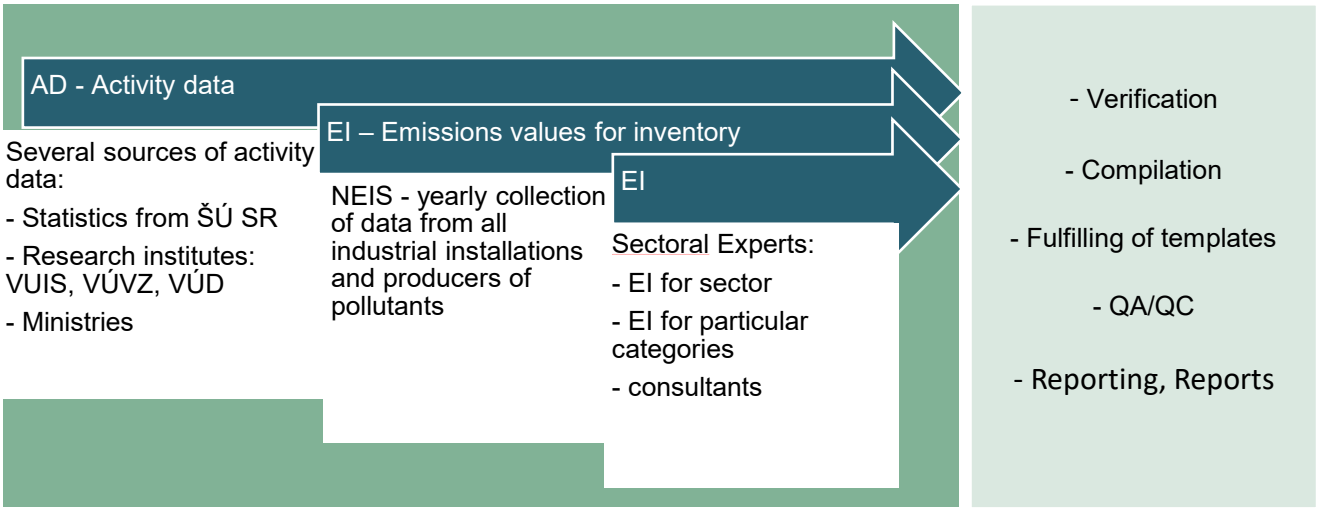
The MŽP SR, the MPaRV SR and some other governmental institutions provided input data into projections.

Data on the quantity of emitted total suspended particulate matter (TSP) were provided directly by operators of individual large and medium sources based on measurements or calculations (under the Slovak Air Protection Act). The PM_{10} and $PM_{2.5}$ emission inventory for the Slovak Republic was compiled according to the EMEP/EEA GB_{2023}, following the requirements of the relevant UNECE Working Group on Inventory of Emissions and the methodology based on the IIASA report[25].

[24] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019
[25] https://www.eea.europa.eu/publications/emep-eea-guidebook-2023
[26] hhttp://www.iiasa.ac.at/web/home/research/researchPrograms/air/ir-02-076.pdf

The NEIS database contains a special program that automatically calculates emissions of PM_{10} and $PM_{2.5}$. The outputs from the NEIS database are verified and performed in excel sheets. ***Figure 1.1*** shows the general principle of how inventory compiling works.

Figure 1.1: *Scheme of different sources for Emission Inventory of air pollutants and processes performed in SHMÚ*



1.5 KEY CATEGORIES

The identification of key categories is described in the EMEP/EEA GB_{2023}. It stipulates that a key category is one that is prioritised within the national inventory system because it is significantly important for one or a number of air pollutants in a country's national inventory of air pollutants in terms of the absolute level, the trend, or the uncertainty in emissions.

It is good practice for each country to use key category analysis systematically and objectively as a basis for choosing methods of emission calculation. Such a process will lead to improved inventory quality as well as greater confidence in the resulting estimates. This can be achieved by performing a quantitative analysis of the relationship between the magnitude of emissions in any one year (i.e. level) and the change in emissions year to year (i.e. trend) for each category's emissions compared to the total national emissions. The identification includes all NFR categories and all mandatory gases.

Purpose of key category analysis:

- **Regular update**: Making sure the methods, data flows and country-specific emission factors are kept up to date and available for important regular estimate updates.
- **More focussed checking and review**: Making sure that specific QA/QC activities are implemented for *key categories*. It is *good practice* to give additional attention to *key categories* with respect to quality assurance and quality control (QA/QC)
- **Improving the accuracy of estimates and reducing overall uncertainty** using higher-tiered methods. For most sources/sinks, higher Tier methods are suggested for key categories. In some cases, inventory compilers may be unable to adopt a higher tier method due to a lack of resources. This may mean that they are unable to collect the required data for a higher Tier or are unable to determine country-specific emission factors and other data needed for Tier 2 and 3 methods. In these cases, although this is not accommodated in the category-specific decision trees, a Tier 1 approach can be used. It should be clearly documented why the methodological choice was not in line with the sectoral decision tree. Any key categories where the good practice method cannot be used should have priority for future improvements.

A category can be identified as *key* for different reasons. These include:

- **Level**: the absolute level the source category contributes to the total pollutant emissions for a particular year of interest.
- **Trend**: the change of emissions for the source category across a time series. This is particularly important for categories with increasing or decreasing emissions trends over time.
- **Uncertainty**: if the contribution of a source category's uncertainty to total inventory uncertainty in a particular year, or the trend uncertainty is high, then the category should be identified as key.
- In addition to making a quantitative determination of *key categories*, it is *good practice* to consider qualitative criteria for identifying categories that are likely to need prioritised attention (e.g. where significant changes in trends are expected, categories not presently estimated or having a suspected high uncertainty)

The identification includes all NFR categories and all mandatory gases

- Main pollutants and CO: SOx, NOx, NMVOC, NH_3, CO
- PMs: TSP, PM_{10}, $PM_{2.5}$
- HMs: Cd, Hg, Pb, As, Cr, Cu, Ni, Se, Zn
- POP: PAH, PCDD/F, HCB, PCBs

The methodology used for identification of key categories: Approach 1

Approach 1 to identifying key categories assesses the influence of various categories of sources on the level, and, possibly, the trend of the national inventory. When the inventory estimates are available for several years, it is good practice to assess the contribution of each category to both the level and trend of the national inventory.

Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80% of the total level.

Level assessment: The contribution of each source category to the total national inventory level is calculated according to ***Equation 1.1***.

Equation 1.1: *Level assessment*

$$L_{x,t} = E_{x,t} / \sum E_t$$

Where:

$L_{x,t}$ = level assessment for source x in the latest inventory year (year *t*)

$E_{x,t}$ = value of emission estimate of source category *x* in year *t*

ΣE_t = total contribution, which is the sum of the emissions in year *t*, calculated using the aggregation level chosen by the country for key category analysis.

Trend assessment: The purpose of the trend assessment is to identify categories that may not be large enough to be identified by the level assessment, but whose trend contributes significantly to the trend of the overall inventory, and should, therefore, receive particular attention. The trend of a category refers to the change in the source category emissions over time. The trend assessment can be calculated according to ***Equation 1.2*** if more than one year of inventory data is available.

Equation 1.2: *Trend assessment*

$$T_{x,t} = \left| \frac{E_{x,t} - E_{x,0}}{\sum_i E_{x,t} - \sum_i E_{i,0}} \right|$$

Where:

$T_{x,}$ = trend assessment of source category *x* in year *t* as compared to the base year (year 0) or starting year of the inventory

$E_{x,}$ and $E_{x,0}$ = values of estimates of source category *x* in year *t* and 0 respectively

$\Sigma E_{i,}$ and $\Sigma E_{i,0i}$ = sum of emissions across all *n* source categories (*i* = 1, …*x, n*) (total inventory estimates) in years *t* and 0, respectively

The presented key category analysis was performed with data for air emissions of the submission 2023 to the UNECE/LRTAP. For all gases a level assessment for all years 1990 (base year) and 2021 (last year), was prepared.

Final ranking and results of the Level and Trend Assessment (Approach 1)

As the analysis was made for all mandatory pollutants reported to the UNECE and as these pollutants differ in their way of formation, most of the identified categories are key for more than one pollutant (***Table 1.4***). For the first time, uncertainty was taken into account for the identification of key categories. The table bellows represent the key categories, but the detailed analysis is provided in **Chapter ANNEXES** as this table does not show the technology and fuels.

Table 1.4: *Summary of Key Categories of key pollutants with uncertainty– Contributions per pollutant for Level Assessment (LA) and Trend Assessment (TA) in %*

NFR	NOx		SOx		NH_3		NMVOC		$PM_{2.5}$		PM_{10}		TSP		CO		BC		Pb		Cd		Hg		As		Cr		Cu		Ni		Se		Zn		PCDD/F		PAHs		HCB		PCB		Sum of KC
	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	
1A1a		5	11	22						2		2								14		24		14	2	21		8				12	7	33		4					56	51	7	3	170
1A1b			7																																8	6							9
1A1c															2																													36
1A2a			4							1											6	4	11	14	3	2					4	15	11											31
1A2c																																										4	26
1A2d				6																		3	7	6	8	6						3											113
1A2f	2	2	3	2																			25	17	8	5					6	5	7	4			79	75						139
1A2gvii	5	6	2												2		3	3																										6
1A2gviii								2																																				12
1A3bi	11	9						6	3	1					4	9	14	7		29			5	4						8						5								179
1A3bii	4	2															5	2																										20
1A3biii	5	13								1							2	7										2		11						6								38
1A3biv																																				2								98
1A3bv							2																																					14
1A3bvi									3	3	3	3	3	3			2	2	46	21	2				8	6	44	31	91	54	11	9	6	4	17	15							4
1A3bvii									2	1	2	2	2	2																														3
1A3c	3	3																																							8	51	29
1A3di(ii)	2	4																							3	2					36	32											353
1A3dii		5																													12	8											24
1A4ai			2																		26	16			5	3	7	6								4				2			62
1A4bi		2	4	20			10	24	59	69	26	44	15	33	56	57	44	54			26	18			3	9	4	13								3			8	24	13	14			35
1A4bii															8	5																												37
1A4cii	10	16							2							5	6	2																		2								11
1A5a																					3	2																						3
1B1a							10	2	2		6	2	8	2																														45
1B1b									2		2	2	3	3					7		3				9	4	5				7	5	14	7					22	10					103
1B2ai							6	2																																				8

NFR	NOx		SOx		NH_3		NMVOC		$PM_{2.5}$		PM_{10}		TSP		CO		BC		Pb		Cd		Hg		As		Cr		Cu		Ni		Se		Zn		PCDD/F		PAHs		HCB		PCB		Sum of KC
	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	
1B2aiv																					3				4	2																			10
1B2av							26	28																																					53
1B2b							11	2																																					12
2A5b											9	8	16	17																															50
2A6			2	2																																									4
2B10a			7	5																																									12
2C1	2	2	21	13											9	4			25	15	3	1			30	16	5	1		10	10	3	34	23	25	7			55	49	12	9	71	22	478
2C3			13	10																																									23
2C7a																					5					4	18	19																	46
2C7c			4	3																																									6
2D3d							2	1																																						4
2D3i																																			41	34										75
2G																	4	4	6		8	6																								28
2H2							8	9																																						17
2K																							18	12																								29
3B1a					6		3	1	2																																							13
3B1b					6	9	3	3	2		2																																					26
3B3					6	19					2		8	3																																		38
3B4gi											4		11	5																																		20
3B4gii					9	7					4	3	5	5																																		33
3Da1	28	11																																													39
3Da2a	5	2			49	46																																									102
3Da3	4				7																																										11
3Dc									2	2	22	17	10	9																																		61
5C1biii																																												5			5
5C1bv																							16	13																								29
5E									1																																							1

1.6 QA/QC AND VERIFICATION METHODS

The Slovak Hydrometeorological Institute has built and introduced the quality management system (QMS) according to the requirements of EN ISO 9001:2008 standard of conformity. In the frame of introduction of the QMS for the SHMÚ as a global standard, the certification itself proceeds according to the partial processes inside of the SHMÚ structure.

Compiling an inventory is an annual process – the steps of this process are Plan, Do, Check and Act.

Sectoral experts apply the QA/QC methodology according to EMEP/EEA GB_{2023}, collect data from providers and process emission inventory for a given sector – they provide partial reports with information on the quality and reliability of data on activities and emissions and fulfil the QA/QC documents.

The set of templates and checklists consists of these documents:

- QA/QC Plan
- Matrix of Responsibility
- General QC
- Improvement plan
- Recommendation list

Part of the QA procedures is bilateral cooperation with the Czech Republic. The first meeting took place in July 2013 and since then is repeated every year. A team of GHG inventory experts from the SHMÚ and the Czech Hydrometeorological Institute (CHMI) met to exchange information and experience relating to the preparation of GHG inventory. In the last meeting, the experts from Slovakia, the Czech Republic, Poland, Hungary and Austria attended. This last meeting with the Czech Hydrometeorological Institute (NIS CZ) took place in June 2021 online and the next meeting is scheduled for May 2023.

1.6.1 QA/QC Plan

A QA/QC plan is an internal document to organise and implement all activities across all of the emission inventory activities. In these documents, deadlines and responsibilities are described.

The inventory planning stage includes the setting of quality objectives and elaboration of the QA/QC plans for the coming inventory preparation, compilation and reporting work. The setting of quality objectives is based on inventory principles.

The quality objectives regarding all calculation sectors for inventory submissions are the following:

- Timeliness
- Completeness
- Consistency
- Comparability
- Accuracy
- Transparency

The general QC procedures are performed by the experts during inventory calculation and compilation.

General quality control includes routine checks, correctness, completeness of data, identification of errors, deficiencies and documentation and archiving of the inventory material. The sectoral experts must adopt adequate procedures for the development and modification of spreadsheets to minimise emission calculation errors. Checks ensure compliance with the established procedures as well as allow the detection of the remaining errors. Parameters, emission units and conversion factors used for the calculations must be clearly singled out and specified.

Experts fill QC forms during the compilation of inventory; results from QC activities are documented and archived.

1.6.2 Quality assurance (CHECK)

Quality assurance is performed after application QC checks concerning the finalised inventory. QA procedures include reviews and audits to assess the quality of inventory and the inventory preparation and reporting process, determine the conformity of the procedures taken and identify areas where improvements could be made. These procedures are at different levels; include basic reviews of the draft report, external peer review, internal audit and EU/UNECE reviews.

Sectoral experts and the members of the inventory team during the year participate in various seminars, meetings, conferences and sector-specific workshops, where are reported the activities of inventory members and results. The comments received during these processes are reviewed and, as appropriate, incorporated into the IIR or reflected in the inventory estimates.

When checking the quality of data in each sector, the coordinator, quality manager and other stakeholders must conduct the following general activities:

Checking: Check whether the data in the sectoral reports (calculations and documents) for each sector conform both to the general and specific procedures.

Documentation: Write down all verification results by filling out a checklist, including conclusions and irregularities that have to be corrected. Such documentation helps to identify potential ways to improve the inventory as well as store evidence of the material that was checked and of the time when the check was performed.

Follow-up of corrective actions: All corrective actions necessary for documenting the activities carried out and the results achieved must be taken. If such a check does not provide a clear clue concerning the steps to be taken, the quality control, a bilateral discussion between the expert and coordinator will take place.

Data transference: All checked documents (including the final questionnaire and all annexes) shall be put into the project file and copies and shall be forwarded to all sectoral experts. Certain activities, such as verification of the electronic data quality or project documentation for checking whether all documents have been provided, must be carried out every year or at least at set intervals. Some checks may be conducted only once (however, comprehensively) and then only from time to time.

1.6.3 Verification activities

Verification refers to the collection of activities and procedures that can be followed during the planning and development, or after the completion of an inventory, that can help to establish its reliability for the intended applications of that inventory. The used parameters and factors and the consistency of data are checked regularly. Completeness checks are undertaken and new and previous estimates are compared every time. Data entry into the database is checked many times by the sector expert for uncertainty. If possible, activity data from different data sources are compared and thus verified. Comprehensive consistency checks between national energy statistics and IEA time series. Checking the results of the EU's internal review for the EU27, and analysing its relevance for the Slovak Republic.

1.6.4 Inventory improvement (ACT)

The main aim of the QA/QC process is the continuous improvement of the quality of inventory. The outcomes and experiences from the annual reviews are the main sources for the preparation of recommendation lists and improvement plans based on these recommendation lists.

The recommendation and improvement plans are updated annually after the regular UNECE and EU compliance reviews take place.

The prioritisation process is based on problems and recommendations raised during reviews and expert consultations. The results of prioritisation are included in the improvement plans. Detailed recommendation

lists and improvement plans are prepared by sectors and delivered to the sectoral experts for consideration and prioritisation of planned activities for the next inventory cycle.
During the last years, the prioritisation of the improvement plan was focused on the Energy and Industry sector. In this submission, several emissions sources were reallocated and the methodology for the calculation of heavy metals and POPs in these sectors was changed to comply with EMEP/EEA GB_{2023}, however, a methodology for these pollutants needs further development as it is on a sufficient level.

1.7 UNCERTAINTY ASSESSMENT

Uncertainty analysis was provided for the main pollutants (SO_2, NOx, NMVOC, NH_3 and $PM_{2.5}$, CO), priority heavy metals and POPS. Information on the methodology and data sources used is provided in the following sections.

1.7.1 Methodological issues

Uncertainty analysis of the Slovak Republic used Approach 1 for all the mandatory pollutants: SO_2, NOx, NMVOC, NH_3, CO, TSP, $PM_{2.5}$, PM_{10}, Pb, Cd, Hg, PAHs, PCDD/F, HCB, PCB and BC. By using the error propagation method, the uncertainties for a specific source category can be estimated and by combining these uncertainties an overall uncertainty can be calculated.
For the purpose of uncertainty calculation, the Uncertainty Analysis Inventory Tool was used.

1.7.2 Source of data

For the estimation of the overall uncertainty, the uncertainty of activity data and emission factor must be calculated. The uncertainties of activity data on the sectoral level were based on the GHG uncertainty analysis. Uncertainties of emission factors were based on the ratings from the EMEP/EEA GB_{2023}.

1.7.3 Qualitative uncertainty analysis results

A qualitative assessment was performed on a sectoral level for all pollutants. The relevant sectors of each pollutant were classified into different quality groups from A to E (***Table 1.5***) following the EMEP/EEA GB_{2023}.

Table 1.5: *Qualitative uncertainty analysis*

NFR	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	PCDD/F	PAHs	HCB	PCB
1A1a	A	A	A	A	A	A	A	A	A	C	C	D	C	C	C	D
1A1b	A	A	A	A	A	A	A	A	A	C	C	C	E	C	E	
1A1c	A	A	A	A	A	A	A	A	A	D	D	D	D	D		
1A2a	A	A	A	A	A	A	A	A	A	E	E	E	E	E	E	E
1A2b	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C	
1A2c	A	A	A	A	A	A	A	A	A	C	C	C	E	C	E	C
1A2d	A	A	A	A	A	A	A	A	A	E	E	E	E	E	E	E
1A2e	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C	C
1A2f	A	A	A	A	A	A	A	A	A	C	C	C	E	E	D	C
1A2gvii	D	D	B	E	E	E	E	C	C		E			E		
1A2gviii	A	A	A	A	A	A	A	A	A	E	E	E	E	E	E	E
1A3a	B	B	A	C	C	C	C	C	**B**	B	B	B				
1A3b	B	B	A	C	C	C	C	C	B	E	E	E	E	E	E	E
1A3c	C	C	B	C	C	C	C		C		C		E	E	E	E
1A3d	D	D	B	E	C	C	C	C	C	E	E	E	E	E	E	E
1A3ei	A	A	A	A	A	A	A	A	A							
1A4ai	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C	D
1A4aii, bii, cii, 1A5b	D	D	B	E	E	E	E	C	C		E			E		
1A4bi	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
1A4ci	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C	D
1A5a	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C	D
1B1a		E			E	E	E									
1B1b	D	E	D	C	D	D	D	C	D	C	E	C	C	E		
1B2ai		E														
1B2aiv										C	C	C	C			
1B2av		E														
1B2b		E														
2A1					A	A	A	A								
2A2					A	A	A	A								
2A3					A	A	A	A		C	C	E				
2A5a	A	A	A	A	A	A	A	A								

NFR	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	PCDD/F	PAHs	HCB	PCB
2A5b					C	C	C									
2A6	A	A	A	A	A	A	A		A							
2B1	A	A	A	A	A	A	A		A							
2B2	A															
2B5	A	A	A	A	A	A	A		A							
2B10a	A	A	A	A	A	A	A	A	A							
2B10b	A	A	A	A	A	A	A		A							
2C1	A	A	A	A	A	A	A	A	A	C	C	C	C	C	E	C
2C2	A	A	A	A	A	A	A	A	A							
2C3	A	A	A	A	A	A	A	A	A					E		
2C5	A	A	A	A	A	A	A		A	C	C	D	C			C
2C7a	A	A	A	A	A	A	A	A	A	C	C	C	E			C
2C7c	A	A	A	A	A	A	A	A	A							
2D3a		B										C				
2D3b		A			A	A	A	A					E			
2D3c		A			A	A	A	A								
2D3d		A														
2D3e		A														
2D3f		A														
2D3g		A									C			C		
2D3h		A														
2D3i		A	A							E	E	E				
2G	B	C	C	B	C	C	C	C	A	C	E	E	C	C		
2H1					A	A	A	A								
2H2		E														
2H3	A	A	A	A	A	A	A		A							
2I	A	A	A	A	A	A	A		A							
2K												E				D
3B	C	C		C	E	E	E									
3D	C	C		C	E	E	E									
5A		A			D	D	D									
5B1				C												
5B2				A												

NFR	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb	Cd	Hg	PCDD/F	PAHs	HCB	PCB
5C1bi	E	E	E		B	B	B	C	E	C	C	C	B	C	B	
5C1bii	E	E	E		B	B	B	C	E	C	C	C	B	C	B	
5C1biii	B	B	C				C	C	B	C	C	C	C	C	E	E
5C1biv	E	E	B						E	E	E	E	E	E	B	
5C1bv	E	E	E		E	E	E		E	E	E	E	E	E	E	E
5D1	A	C	A	C	A	A	A		A							
5D2	A	C	A	A	A	A	A		A							
5E					C	C	C			C	C	C	C			

1.7.4 Quantitative uncertainty analysis results

The quantitative uncertainty assessment was performed with Approach 1 according to EMEP/EEA GB_{2019} for the air pollutants NOx, NMVOC, SO_2, NH_3, PMs, CO, Pb, Cd, Hg, As, Cr. Cu, Ni, Se, Zn, PAH, PCDD/F, HCB, PCBs and BC in the year 2021 and the respective level and trend uncertainties. The basis for this assessment is the qualitative rating as presented in ***Table 1.5***. The results of the uncertainty analysis are indicated in the following ***Table 1.6***.

Table 1.6: *Results of quantitative uncertainty analysis of mandatory main pollutants, heavy metals and persistent organic pollutants*

POLLUTANT	LEVEL ANALYSIS IN 2021 [%]	TREND ANALYSIS IN 2021 [%]
NOx	21.18	4.98
NMVOC	44.93	12.46
SOx	6.95	0.91
NH_3	89.90	24.56
$PM_{2.5}$	22.01	4.97
PM^{10}	30.88	6.43
TSP	32.97	6.05
BC	26.67	7.69
CO	9.85	5.35
Pb	95.71	21.44
Cd	132.29	54.78
Hg	107.37	26.98
As	43.32	9.77
Cr	78.46	35.69
Cu	612.96	279.17
Ni	129.32	20.59
Se	45.16	8.63
Zn	238.49	109.53
PCDD/F	1267.33	64.15
PAHs	213.54	57.57
HCB	80.75	13.80
PCBs	54.35	30.67

1.8 ARCHIVING, DOCUMENTATION AND REPORTING

The compilation of the emission inventory starts with the collection of activity data. A comprehensive description of the inventory preparation is described in methodologies for individual sectors. The methodologies are updated annually within the improvement plan and recommendation list and they are archived after formal approval.

Collected input data are compared and checked with international statistics (Eurostat, IAE, FAO and others). In some cases, the collected input data are compared with the results from models (e.g. in road transport it is the COPERT model).

Official submissions of the emission inventory and projections are archived electronically at SHMÚ as well as at the MŽP SR.

Data related to the NEIS are all archived and backup is done on a daily basis on the backup serves of SHMÚ. This activity is performed for all data processed in SHMÚ (that covers many different sources – meteorological, hydrological, air quality data and others). In addition, the backup, especially for the NEIS database, is also performed automatically once a week on the remote server of the developer company Spirit-informačné systémy a. s.

The data from the ŠÚ SR are, except the arranged FTP server, archived electronically at SHMÚ as well as the Statistical yearbook published annually by the ŠÚ SR are stored in paper form.
All documents and background materials of the internal expert of SHMÚ and external are archived, too. Printed documents are archived in the central archive of the SHMÚ and at the OEaB. The electronic archive has been created for all electronic documents related to emission inventories.

1.9 GENERAL ASSESSMENT OF COMPLETENESS

Assessment of completeness is one of the elements of quality control procedure in inventory preparation on the general and sectoral levels. The completeness of the emission inventory is improving from year to year and the updates are regularly reported in the national inventory reports. The completeness checks for ensuring time-series consistency are performed and the estimation is completed in recent inventory submission (2024). The list of categories reported by the notation keys NE and IE is provided in ***Table 1.7.***
Several categories are reported as not occurring (NO) due to the not existence of the emission source or the source being out of threshold and measurement range. If the methodology does not exist in the EMEP/EEA GB_{2019}, the notation key not applicable (NA) was used. The lists of notation keys NA and NO are available in ***Table 1.8***.
Several NE key categories have been reported in the 2024 submission for 1990–2022.
Three reasons for not estimated (NE) categories are:

- No methodology is available;
- Insufficient activity data
- Information on the contribution of a particular type of fuel to overall emissions is unavailable.

The geographic coverage is complete; the whole territory of the Slovak Republic is covered by the inventory.

Table 1.7: *List of NFR categories reported with notation key NE or IE*

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
1A1b	B(a)P, B(b)F, B(k)F, I()P	1990-2022	Cr, Cu, Se, Zn	1990-2022
1A2b	HCB, PCBs	1990-2002, 2008-2022		
1A2gvii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2022		
A3ai(i)	NH_3, Pb, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2022		
1A3aii(i)	NH_3, Pb, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2022		
1A3bvi	Hg, PCDD/F, PAHs	1990-2022		
1A3bvii	HMs, POPs	1990-2022		
1A3c	Pb, Hg, As	1990-2022		
1A3di(ii)			All pollutants	1990-2015
1A4aii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2022		
1A4bii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2022		
1A4ci	NH_3	1990-2022		
1A4cii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2022		
1A5b	Cd, Hg, AHMs, POPs	1990-2022	All pollutants	1990-2014
1B1a	BC, HMs	1990-2022		
1B1b	HCB, PCBs	1990-2022		
1B2ai	SOx, PCDD/F	1990-2022		
1B2aiv	BC, PAHs	1990-2022	NH_3	1990-2022
1B2av	SOx, PCDD/F	1990-2022		
1B2b	SOx, PCDD/F	1990-2022		
1B2c	NH_3, POPs	1990-2022	NOx, NMVOC, SOx,, PMs, CO, HMs	1990-2022
2A1			MPs, HMs, POPs	1990-2022
2A2	PHMs	1990-2022	MPs	1990-2022

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
2A3	PCDD/F, PAHs, HCB	1990-2021	MPs	1990-2021
2A5c			$PM_{2.5}$, PM_{10}, TSP	1990-2022
2A6	BC	1990-2022		
2B5	BC, HMs, PCDD/F, PAHs, HCB	1990-2022		
2B10a	HMs, POPs	1990-2022		
2B10b	BC	1990-2022		
2C1	B(a)P, B(b)F, B(k)F, I()P	1990-2022		
2C2	HMs, PCDD/F, PAHS	1990-2022		
2C3	NH_3, HMs, PCDD/F, HCB	1990-2022		
2C5	NH_3, BC, Cr, Cu, Ni, Se, B(a)P, B(b)F, B(k)F, I()P, HCB	2011-2022		
2C6	NOx, NMVOC, NH_3, BC, CO, Cr, Cu, Ni, Se, PAHs, HCB	2012-2014		
2C7a	NH_3, Se, Zn, PAHs, HCB	1990-2022		
2C7c	BC, HMs, POPs	1990-2022		
2C7d			PMs	1990-2022
2D3a	$PM_{2.5}$	1990-2022		
2D3b	NOx, SOx, CO, PAHs, HCB	1990-2022		
2D3c	NOx, CO, PHMs, PCDD/F, PAHs, HCB	1990-2022		
2D3e	$PM_{2.5}$	1990-2022		
2D3f	$PM_{2.5}$	1990-2022		
2D3g	NOx, SOx, NH_3, PMs, CO, Pb, Hg, Cu, Zn, PCDD/F, B(a)P, B(b)F, B(k)F, I()P, HCB, PCB	1990-2022		
	Cd, As, Cr, Ni, Se, PAHs	2015-2022		
2D3h	$PM_{2.5}$, BC	1990-2022		
2D3i	NOx, NH_3, PMs, CO, POPs	1990-2022		
2G	Se, HCB, PCBs	1990-2022		
2H1	NH_3, PAHs, HCB	1990-2022	NOx, NMVOC, SOx, CO	1990-2022
2H2	BC	1990-2022		
2H3	BC	1990-2022		
2I	BC, As, Cu	1990-2022		
2K	Pb, Cd, AHMs, HCB	1990-2022		
3Da2a			NMVOC	1990-2022
3Da3			NMVOC	1990-2022
5A	NH_3, CO, Hg	1990-2022		
5B1	NOx, NMVOC, SOx, PMs, CO	1990-2022		
5B2	NOx, NMVOC, SOx, PMs, CO, PHMs, Cr, Zn, POPs	2001-2022		
5C1bi	NH_3[1], Cr[2], Cu[2], Se[2], Zn[2], B(a)P[1], B(b)F[2], B(k)F[2], I()P[2]	1990-2006[1], 1990-2016[2], 2018-2022[2]		
5C1bii	NH_3, Cr, Cu, Se, Zn, B(a)P, B(b)F, B(k)F, I()P	1990-2022		
5C1biii	NH_3, Se, Zn, PAHs	1990-2022		
5C1bv	BC	1990-2022		
5D1	BC, HMS	1990-2022		
5D2	BC, HMS	1990-2022		
5E	NOx, NMVOC, SOx, BC, CO, Ni, Se, Zn, PAHs, HCB, PCBs	1990-2022		

Main Pollutants: MPs - NOx, NMVOC, SOx, NH_3, CO; **Particulate Matter: PMs** - $PM_{2.5}$, PM_{10}, TSP, BC; **Heavy metals: HMs –Priority Heavy Metals**: **PHMs** - Pb, Cd, Hg; **Additional Heavy metals: AHMs** - As, Cr, Cu, Ni, Se, Zn; **Persistent Organic Pollutants: POPs** - PCDD/F; **Polycyclic Aromatic Hydrocarbons**: **PAHs** - B(a)P, B(b)F, B(k)F, I()P; HCB, PCBs

Table 1.8: *List of NFR categories with notation key NA and NO*

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
1A1a			NH_3	1990-2014, 2018, 2020-2022
1A1b	PCBs	1990-2022		
1A1c	Hg, HCB, PCBs	1990-2022		
1A2a			NH_3	1990-2015, 2017-2022
1A2b			NH_3	1990-2022
1A2c			NH_3	1990-2022
1A2d			NH_3	1990-2006
1A2f			NH_3	1990-1999,2006-2011
1A3ai(i)	HCB, PCBs	1990-2022		
1A3aii(i)	HCB, PCBs	1990-2022		
1A3bv	NOx, SOx, NH_3, PMs, CO, HMs, POPs	1990-2022		
1A3bvi	MPs	1990-2022		
1A3bvii	MPs	1990-2022		
1A3ei	NH_3, HMs, POPs	1990-2022		
1A3eii			All pollutants	1990-2022
1A4ai			NH_3	1990-2013
1A4ciii		1990-2022	All pollutants	1990-2022
1B1a	NOx, SOx, NH_3, CO	1990-2022		
1B1c			All pollutants	1990-2022
1B2ai	NOx, NH_3, PMs, CO, HMs, PAHs, HCB, PCB	1990-2022		
1B2av	NOx, NH_3, CO, HMs, PAHs, HCB, PCB	1990-2022		
1B2b	NOx, NH_3, PMs, CO, HMs, PAHs, HCB, PCB	1990-2022		
1B2d			NOx, SOx, NH_3, PMs, CO, HMs, POPs	1990-2022
2A2	AHMs, POPs	1990-2022		
2A3	PCBs	1990-2022		
2A5a	NH_3, BC, HMs, POPs	1990-2022		
2A5b	MPs, BC, HMs, POPs	1990-2022		
2A5c	MPs, BC, HMs, POPs	1990-2022		
2A6	HMs, POPs	1990-2022		
2B1	BC, HMs, POPs	1990-2022		
2B2	NMVOC, SOx, PMs, HMs, POPs	1990-2022		
2B3			All pollutants	1990-2022
2B5	NH_3, PCB	1992-2022	All pollutants	1990-1991
2B6			All pollutants	1990-2022
2B7			All pollutants	1990-2022
2B10b	HMs, POPs	1990-2022	NH_3	2006-2022
2C2	HCB, PCBs	1990-2022	NH_3	2004-2009
2C3	PCBs	1990-2022		
2C4			All pollutants	1990-2022
2C5			All Pollutants	1990-2010
2C6			All pollutants	1990-2011, 2015-2022
2C7b		1990-2022	All Pollutants	1990-2022

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
2D3a	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, Pb, Cd, AHMs, POPs	1990-2022		
2D3b	NH_3, HMs, PCBs	1990-2022		
2D3c	SOx, NH_3, AHMs, PCBs	1990-2022		
2D3d	NOx, SOx, NH_3, PMs, CO, HMs, POPs	1990-2022		
2D3e	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, HMs, POPs	1990-2022		
2D3f	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, HMs, POPs	1990-2022		
2D3h	NOx, SOx, NH_3, PM_{10}, TSP, CO, HMs, POPs	1990-2022		
2H1	HMs, PCDD/F, PCBs	1990-2022		
2H2	NOx, SOx, NH_3, CO, HMs, POPs	1990-2022		
2H3	HMs, POPs	1990-2022	CO	2017-2022
2I	PHMs, Cr, Ni, Se, Zn, POPs	1990-2022	NH_3	2011-2013
2J			All Pollutants	1990-2022
2K	MPs, PMs, PCDD/F, PAHs	1990-2022		
2L			All Pollutants	1990-2022
3B1a	SOx, BC, CO, HMs, POPs	1990-2022		
3B1b	SOx, BC, CO, HMs, POPs	1990-2022		
3B2	SOx, BC, CO, HMs, POPs	1990-2022		
3B3	SOx, BC, CO, HMs, POPs	1990-2022		
3B4a			All Pollutants	1990-2022
3B4d	SOx, BC, CO, HMs, POPs	1990-2022		
3B4e	SOx, BC, CO, HMs, POPs	1990-2022		
3B4f			All Pollutants	1990-2022
3B4gi	SOx, BC, CO, HMs, POPs	1990-2022		
3B4gii	SOx, BC, CO, HMs, POPs	1990-2022		
3B4giii	SOx, BC, CO, HMs, POPs	1990-2022		
3B4giv	SOx, BC, CO, HMs, POPs	1990-2022		
3B4h	SOx, BC, CO, HMs, POPs	1990-2022		
3Da1	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2022	$PM_{2.5}$, PM_{10}	1990-2022
3Da2a	SOx, PMs, HMs, POPs	1990-2022		
3Da2b	NMVOC, SOx, PMs, CO, HMs, POPs	1990-2022		
3Da2c	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2022		
3Da3	SOx, PMs, CO, HMs, POPs	1990-2022		
3Da4	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2022		
3Db	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2022	NH_3	1990-2022
3Dc	MPs, BC, HMs, POPs	1990-2022		
3Dd	All Pollutants	1990-2022		
3De	NOx, SOx, PMs, HMs, POPs	1990-2022	NH_3	1990-2022
3Df	MPs, PMs, HMs, PCDD/F, PAHs, PCBs	1990-2022		
3F			All Pollutants	1990-2022
3I	All Pollutants	1990-2022		
5A	NOx, SOx, BC, Pb, Cd, AHMs, POPs	1990-2022		
5B1	HMs, POPs	1990-2022		
5B2	As, Cu, Ni, Se	2001-2022	All Pollutants	1990-2000
5C1a			All Pollutants	1990-2022
5C1bi	PCBs	1990-2022	All Pollutants[1], NH_3[2], B(a)P[2], MPs[3], PMs[3], Pb[3], Cd[3], Hg[3], As[3], Ni[3], PCDD/F[3], HCB[3]	2017[1], 2007-2022[2], 2021[3]
5C1bii	PCBs	1990-2022		
5C1biii			Pb	2006-2022
5C1biv			All Pollutants	1990-2022
5C1bv	NH_3	1990-2022		

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
5C1bvi			All Pollutants	1990-2022
5C2	PCBs	1990-2022		
5D1	POPs	1990-2022		
5D2	POPs	1990-2022		
5D3			All Pollutants	1990-2022
5E	NH_3	1990-2022		
6A			All Pollutants	1990-2022

Main Pollutants: MPs - NOx, NMVOC, SOx, NH_3, CO; **Particulate Matter: PMs** - $PM_{2.5}$, PM_{10}, TSP, BC; **Heavy metals: HMs** –**Priority Heavy Metals**: **PHMs** - Pb, Cd, Hg; **Additional Heavy metals: AHMs** - As, Cr, Cu, Ni, Se, Zn; **Persistent Organic Pollutants: POPs** - PCDD/F; **Polycyclic Aromatic Hydrocarbons**: **PAHs** - B(a)P, B(b)F, B(k)F, I()P; HCB, PCBs

CHAPTER 2:KEY TRENDS

Last update: 15.3.2024

This chapter is concerned with the latest emission estimates for selected pollutants and analyses the trends in time series across the main source sectors. The pollutants considered are the NECD pollutants (SOx as SO_2, NOx as NO_2, NMVOC, NH_3 and $PM_{2.5}$), PM_{10}, black carbon (BC), Carbon monoxide (CO), the priority metals (lead, cadmium and mercury), Dioxins & Furans (PCDD/PCDF) and Polyaromatic Hydrocarbons (PAHs), Hexachlorobenzene (HCB) and Polychlorinated biphenyls (PCBs). This chapter discusses each of the air pollutants separately and provides explanations of the main changes in the time series.

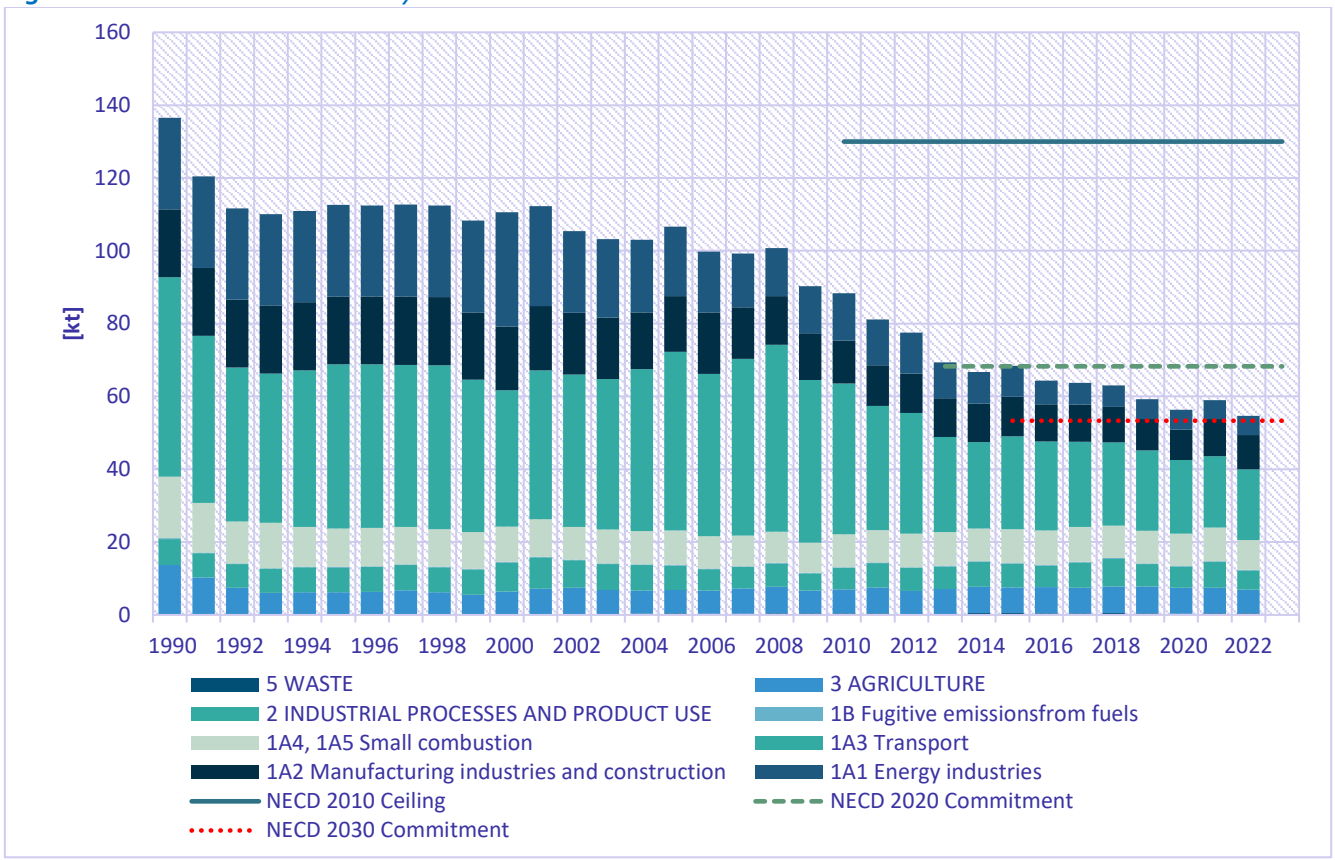
2.1 TRENDS IN EMISSIONS OF NECD POLLUTANTS

In Europe, regional air pollution is regulated by a number of protocols under the CLRTAP (Convention on Long Range Transboundary Air Pollution) under the UNECE (United Nations Economic Commission for Europe). Additionally, there is EU legislation that mostly mirrors the obligations under the CLRTAP.
The Directive 2001/81/EC on National emissions ceilings (NEC Directive) sets limit values of emissions of **sulphur dioxide** (SO_2), **nitrogen oxides** (NOx), **volatile organic compounds** (VOCs) and **ammonia** (NH_3).
This Directive was replaced by The **New NEC Directive** 2284/2016, which sets national emission reduction commitments for the Member States and the EU for five important air pollutants: NOx, NMVOCs, SO_2, NH_3 and for the first time for fine **particulate matter** ($PM_{2.5}$).

2.1.1 Trends in emissions of NOx

In ***Figure 2.1*** can be seen that emissions of NOx have a constantly decreasing trend and do not exceed the emission ceilings set up in **NEC Directive 2001/81/EC** for 2010. Since the year 2005, emissions decreased by 42 which means the Slovak Republic reached its National Commitment for this pollutant, set by **NEC Directive 2016/22848/EU** for the period 2020-2029. Road transport remains the main contributor to this pollutant throughout the whole time-series and emissions in this subsector are decreasing only slowly. **Sofia protocol** of CLRTAP concerning the control of emissions of nitrogen oxides or their transboundary fluxes was fulfilled.

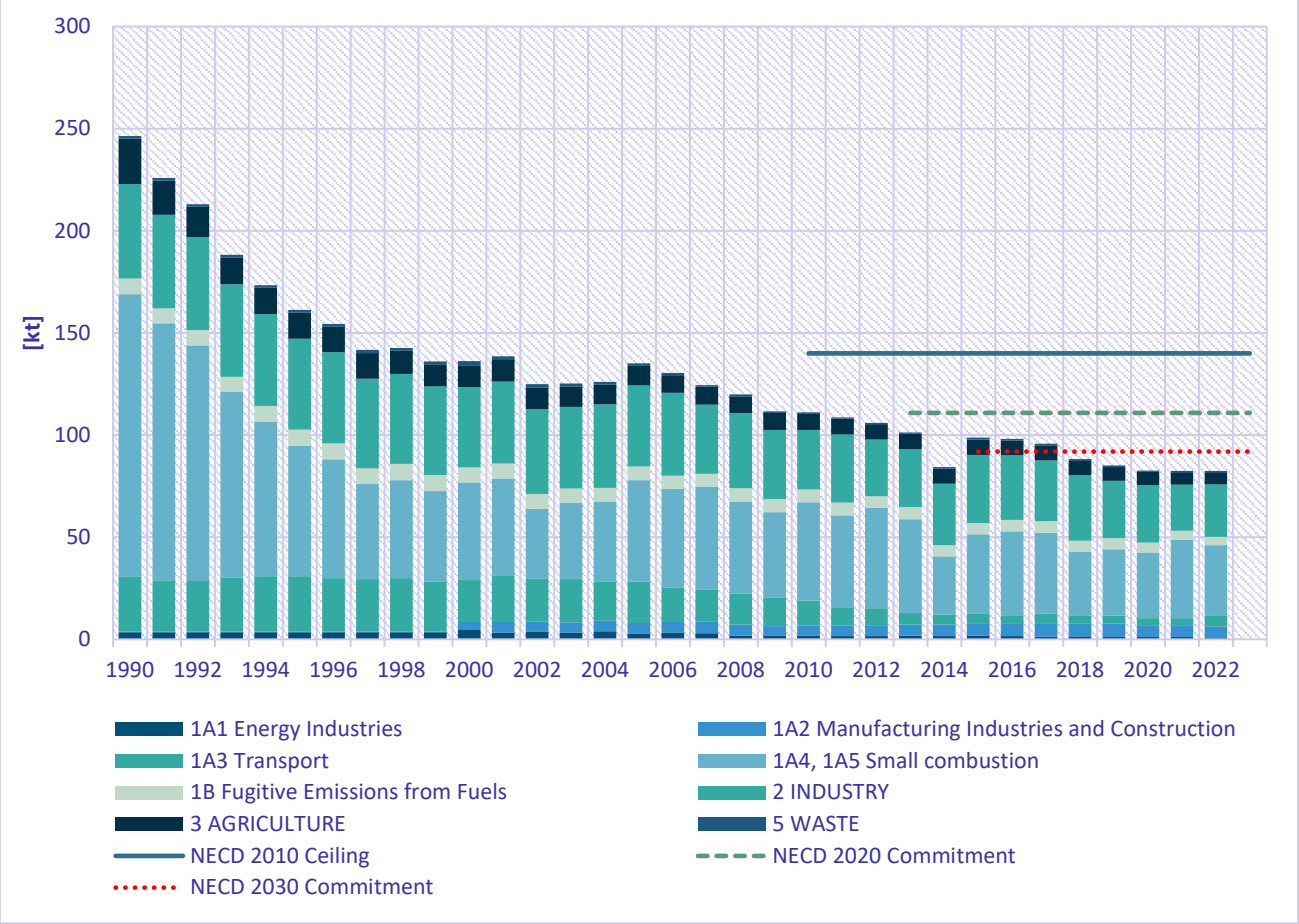
Figure 2.1: *Total NOx emissions by sectors*



2.1.2 Trends in emissions of NMVOC

Emissions of NMVOC have a decreasing trend in the whole time-series although the most significant decrease occurred in the period 1990-2000. The main source of NMVOCs in the Slovak Republic is residential heating sources, which produced 38% of total NMVOCs emissions in 2022. The decrease in the period 1990-2000 was caused primarily by a decrease in energy demand in the households, which reconstructed their houses and also an increase in the energy effectiveness of boilers. National Emission 2010 Ceiling set by **NEC Directive 2001/81/EC**, as well as Commitment set by new **NEC Directive 2016/2284/EU** for the period 2020-2029, were not exceeded (***Figure 2.2***). **Geneva Protocol** of CLRTAP concerning the control of emissions of volatile organic compounds or their transboundary fluxes, which requires a decrease of VOCs by at least 30 % by the year 1999, using 1990 levels as a basis was also fulfilled.

Figure 2.2: *Total NMVOC emissions by sectors*



2.1.3 Trends in emissions of SOx

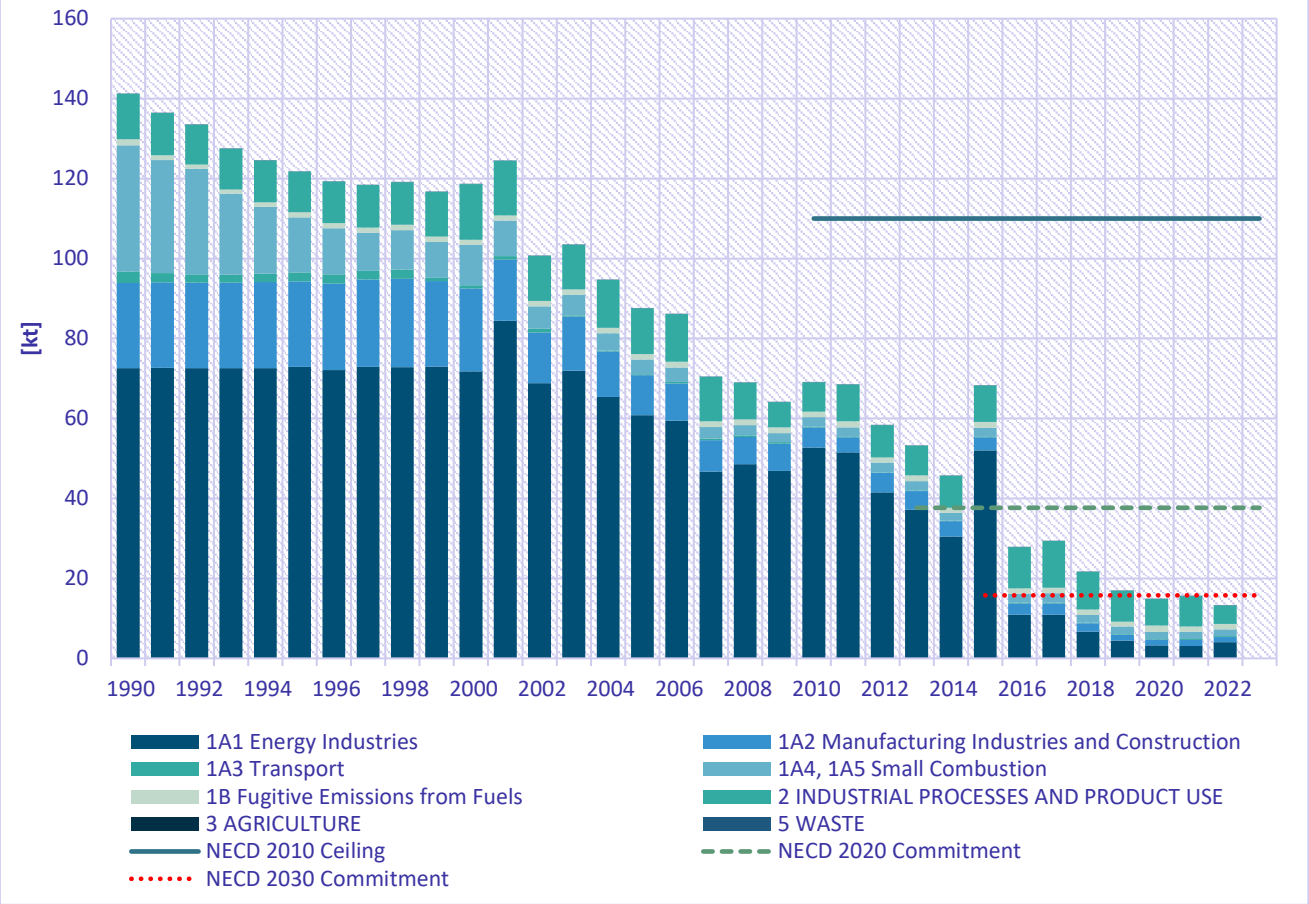
The trends of SOx emissions decreased until 2014 continually. Since 1990 SOx emissions have noticed a significant decrease due to strict air protective legislation. The downward trend relates also to the composition of the fuel used in all sectors and related legislative limitations.

In 2015, a substantial increase was recorded. These emissions originated from the source Slovenské elektrárne (SE). According to records of the NEIS, power plant - ENO 0023 B-block 3 and 4 burned twice the amount of brown coal than in the previous year 2014. Due to the extensive reconstruction of blocks B1 B2 ENO (from a report SE), the ENO and K1, K2 were used, which are not abated granules boilers. Apparently, SE used the last year of special exception (max.20 000 hours of operation from 1.1.2008 to 31.12.2015), for not applying any emission limits and abatement technology. Subsequently, in 2016, emissions dropped significantly.

Although Energy production was the main contributor in the period 1990-2017, in the year 2018 this sector was replaced by Metal production.

Emissions of SOx are in compliance with **NEC Directive** (ceiling for the year 2010, national commitment for the period 2020-2029 and 2030 onwards) so as with **Oslo Protocol** on further reduction of sulphur emissions and **Helsinki Protocol** of CLRTAP on the reduction of sulphur emissions or their transboundary fluxes at least 30 per cent (***Figure 2.3***).

Figure 2.3: *Total SOx emissions by sectors*



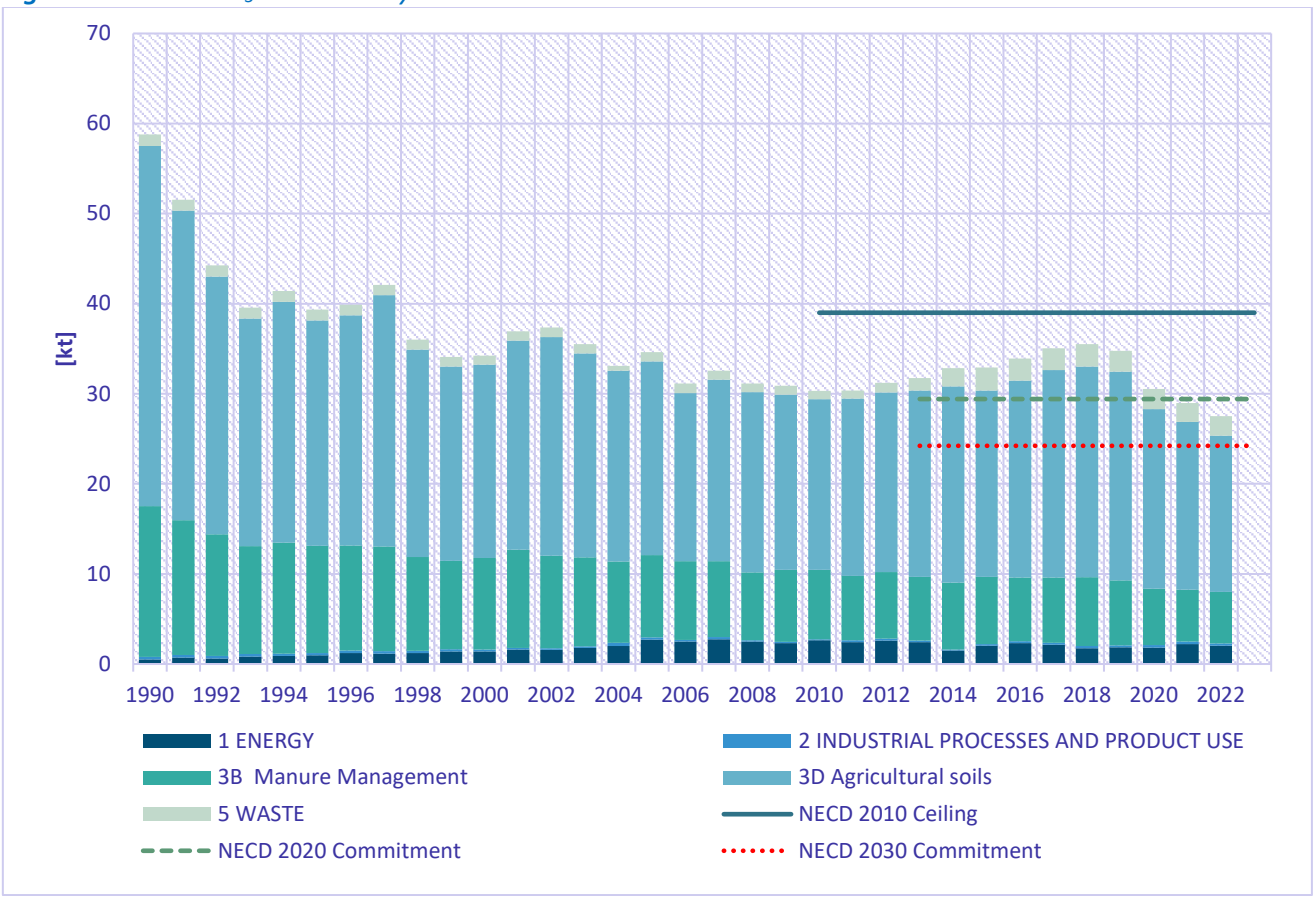
2.1.4 Trends in emissions of NH_3

The overall trend of emission inventory for ammonia (NH_3) from 1990 has a stable decreasing tendency until 2011. The following years until 2015 show a slight increase and the major driver for this change was an increase in the number of animals and application of the inorganic N-fertilized into soils (***Figure 2.4***).

This category is the main polluter of NH_3 in the whole time series.

As shown in ***Figure 2.4***, the Slovak Republic fulfils both the 2010 emission ceiling set by **2001/81/EC Directive** and national commitment to emission reduction for the period 2020-2029 set by **2016/2284/EU Directive.**

Figure 2.4: *Total NH_3 emissions by sectors*



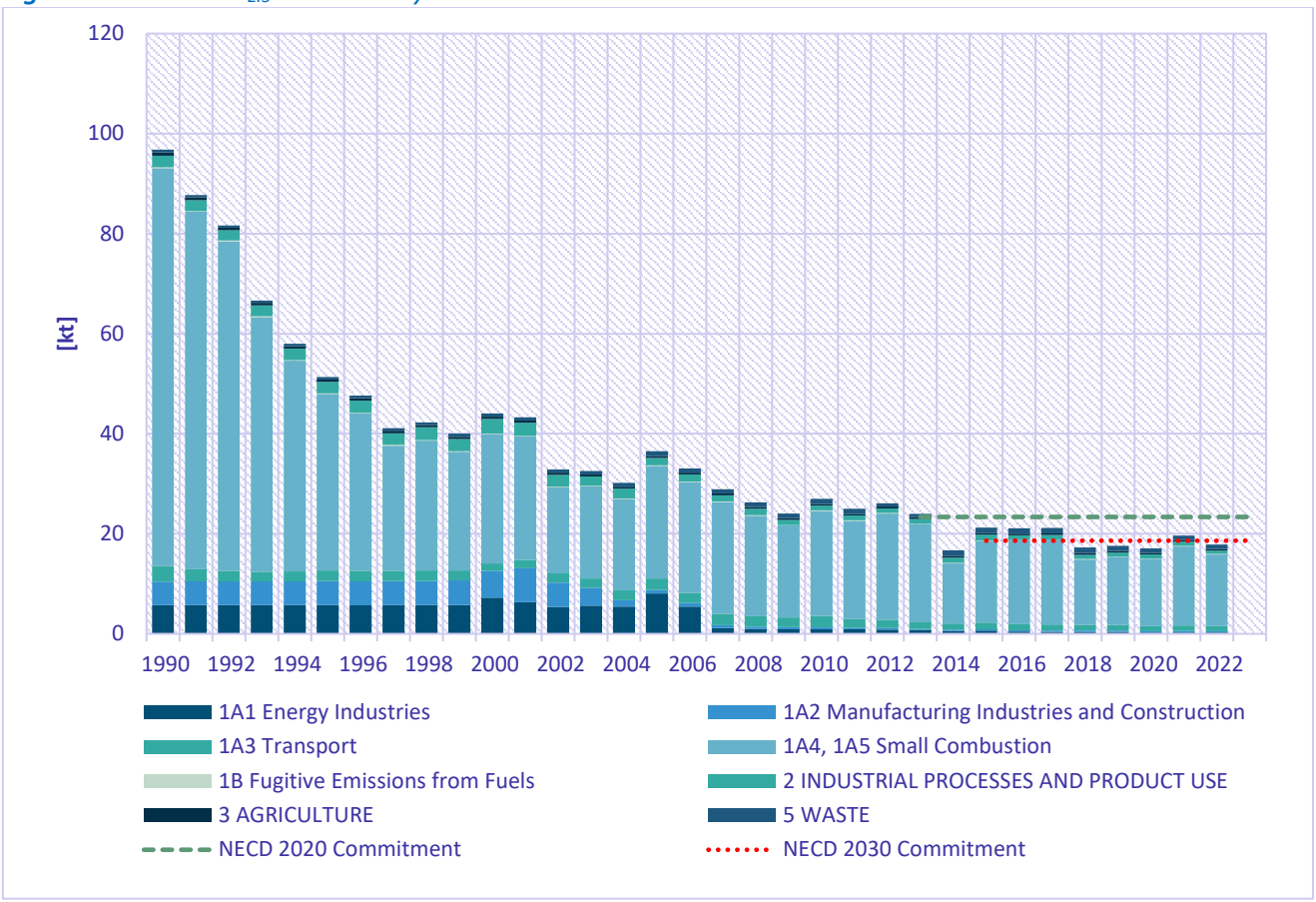
2.1.5 Trends in emissions of $PM_{2.5}$

The emission trend of $PM_{2.5}$ is significantly affected by the emission trend of the category of Residential heating. This category produced 77% of total $PM_{2.5}$ emissions in the Slovak Republic in the year 2022. Emissions in this category are connected to the energy demand of households, which is influenced by several conditions, such as climate factors, reconstruction status of buildings etc.

The highest decrease in emissions occurred in the period 1990-2000, since then, emissions are moderately fluctuating according to conditions connected with the heating season and energy demand of households (***Figure 2.5***).

National emission commitments set by the **2016/2284/EU Directive** for the period 2020-2029 and after 2030 have been fulfilled.

Figure 2.5: *Total $PM_{2.5}$ emissions by sectors*



2.2 TRENDS IN EMISSIONS OF PM_{10}, BC AND CO

Similarly to $PM_{2.5}$, emissions of PM_{10} are strongly connected to the category of Residential heating, which is the main contributor in the whole time series (***Figure 2.6***).

Emissions of BC decreased significantly in the period 1990-2000, and since then they have fluctuated slightly (***Figure 2.7)***. These emissions originate mostly from Residential heating but are emitted in Road transport considerably, too.

CO emissions have had a stable decreasing trend with slight fluctuation in the last two decades. These emissions come especially from residential heating.

Figure 2.6: *Total PM_{10} emissions by sectors*

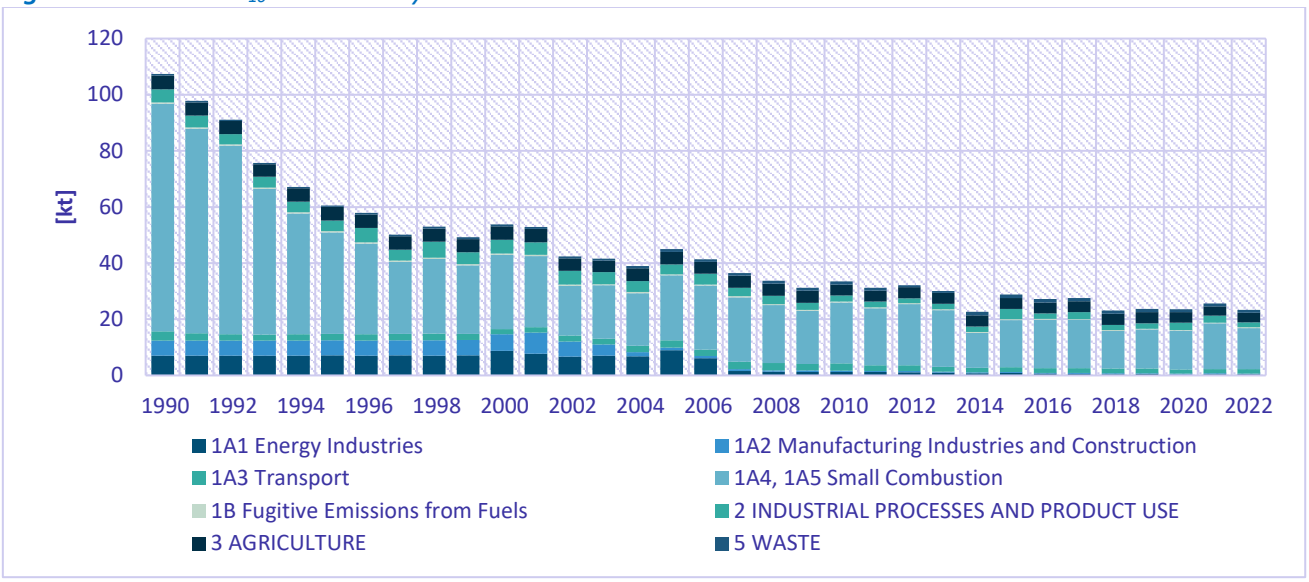


Figure 2.7: *Total BC emissions by sectors*

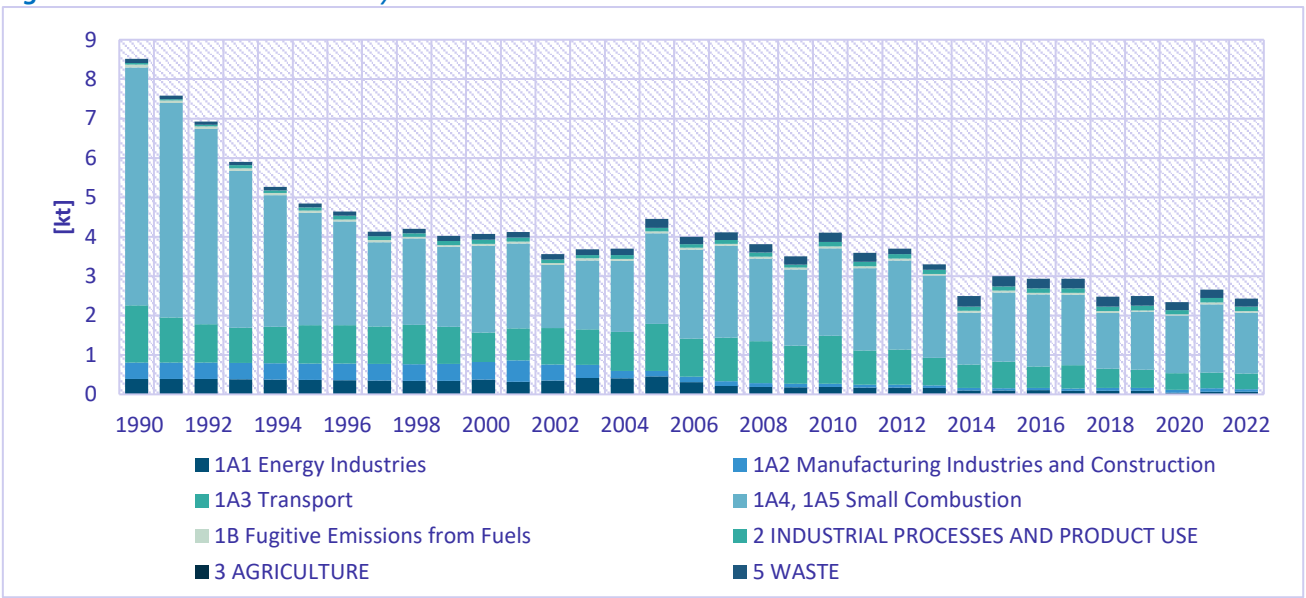
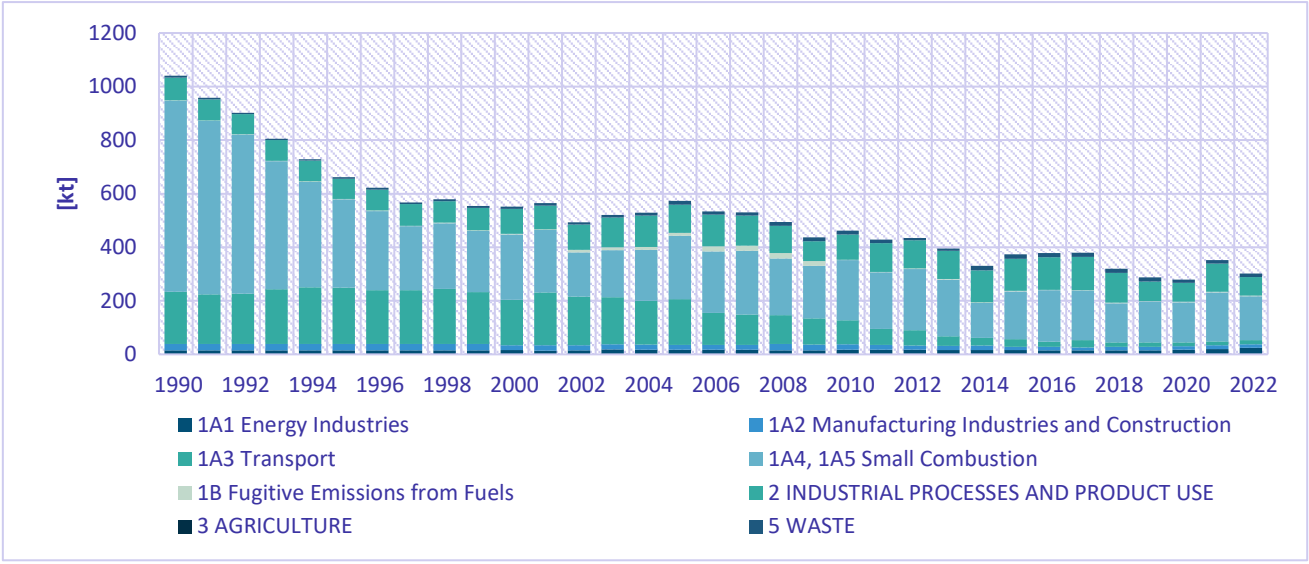


Figure 2.8: *Total CO emissions by sectors*



2.3 TRENDS IN EMISSIONS OF HEAVY METALS

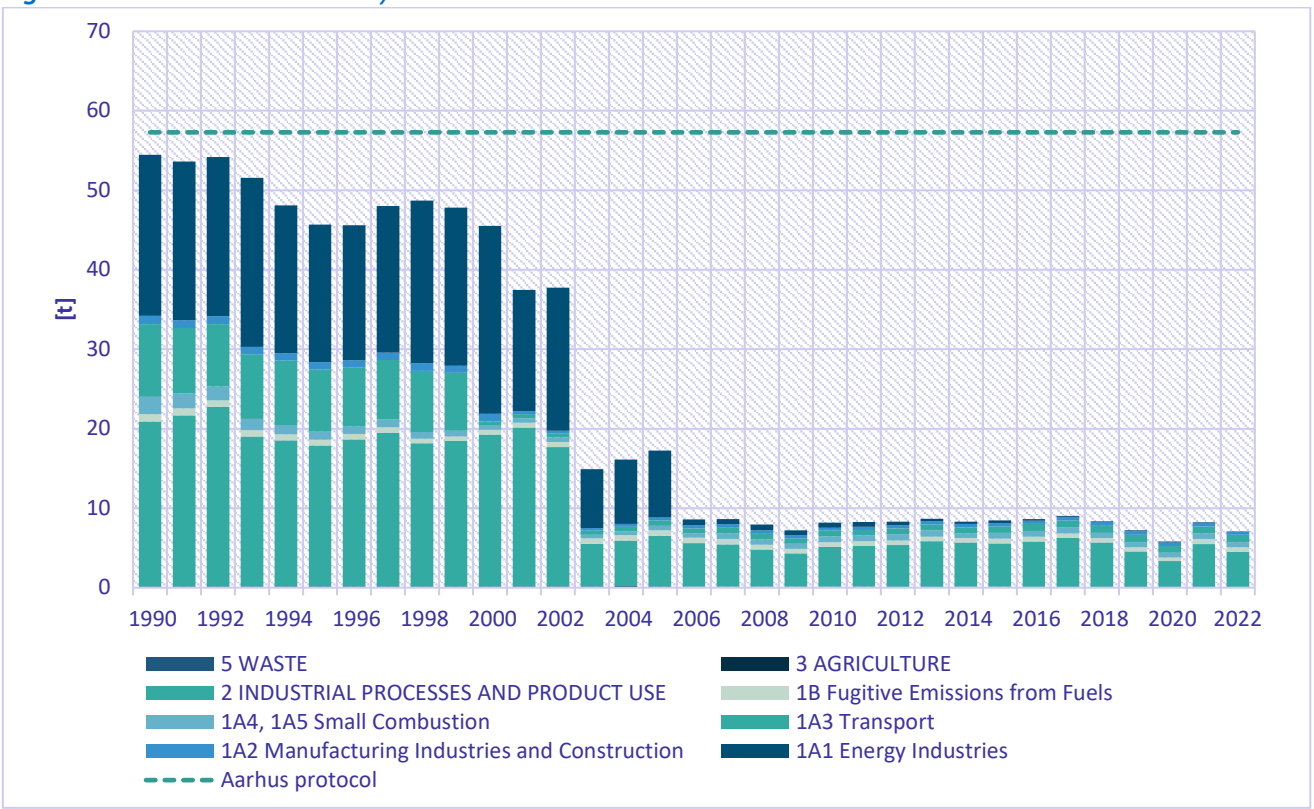
2.3.1 Trends in emissions of Pb

In general, the pollutant has a moderately fluctuating trend. In the year 2001, emissions dropped due to the end of the use of leaded petrol in transport activities. The next significant decrease occurred in 2007 due to stricter legislation and emission limits for large sources. The next decrease was recorded in 2009, which is connected to the economic crisis.

The main contributor to Pb emissions since 2001 is Iron and Steel production, previously it was Energy production.

Aarhus Protocol of CLRTAP on heavy metals requires that parties do not exceed their base year (1990) level of emitted heavy metals. The Slovak Republic's emissions did not exceed this level.

Figure 2.9: *Total Pb emissions by sectors*

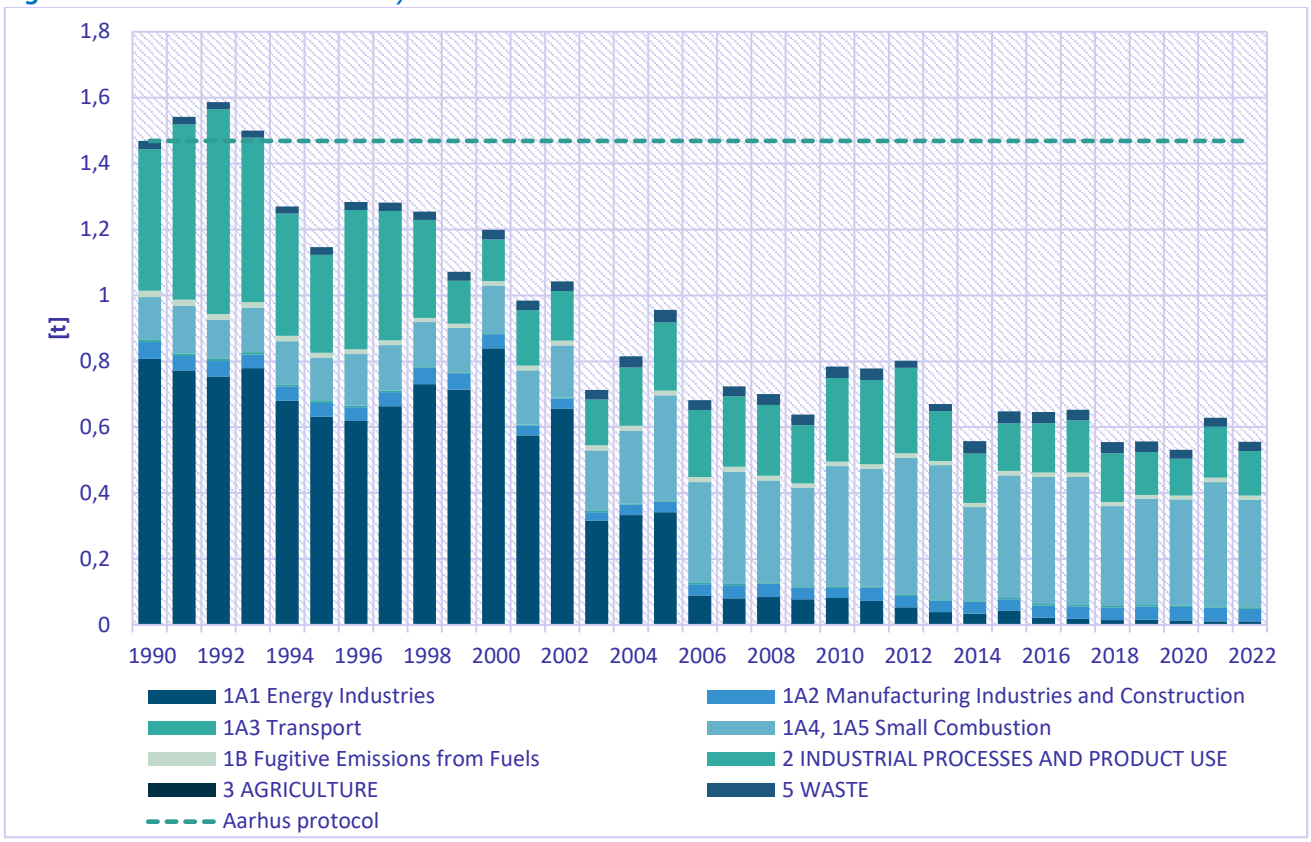


2.3.2 Trends in emissions of Cd

As shown in ***Figure 2.10*** emissions of Cd have had a decreasing trend since 1992. The largest decline occurred in 2003 when municipal waste incineration facilities installed abatement technologies. Since 2004 the main contributing categories are households heating and the production of paper and pulp, which both are characteristic of the wide use of biomass as fuel.

There were no exceedances of Aarhus protocols of CLRTAP after the protocol was signed by the Slovak Republic.

Figure 2.10: *Total Cd emissions by sectors*



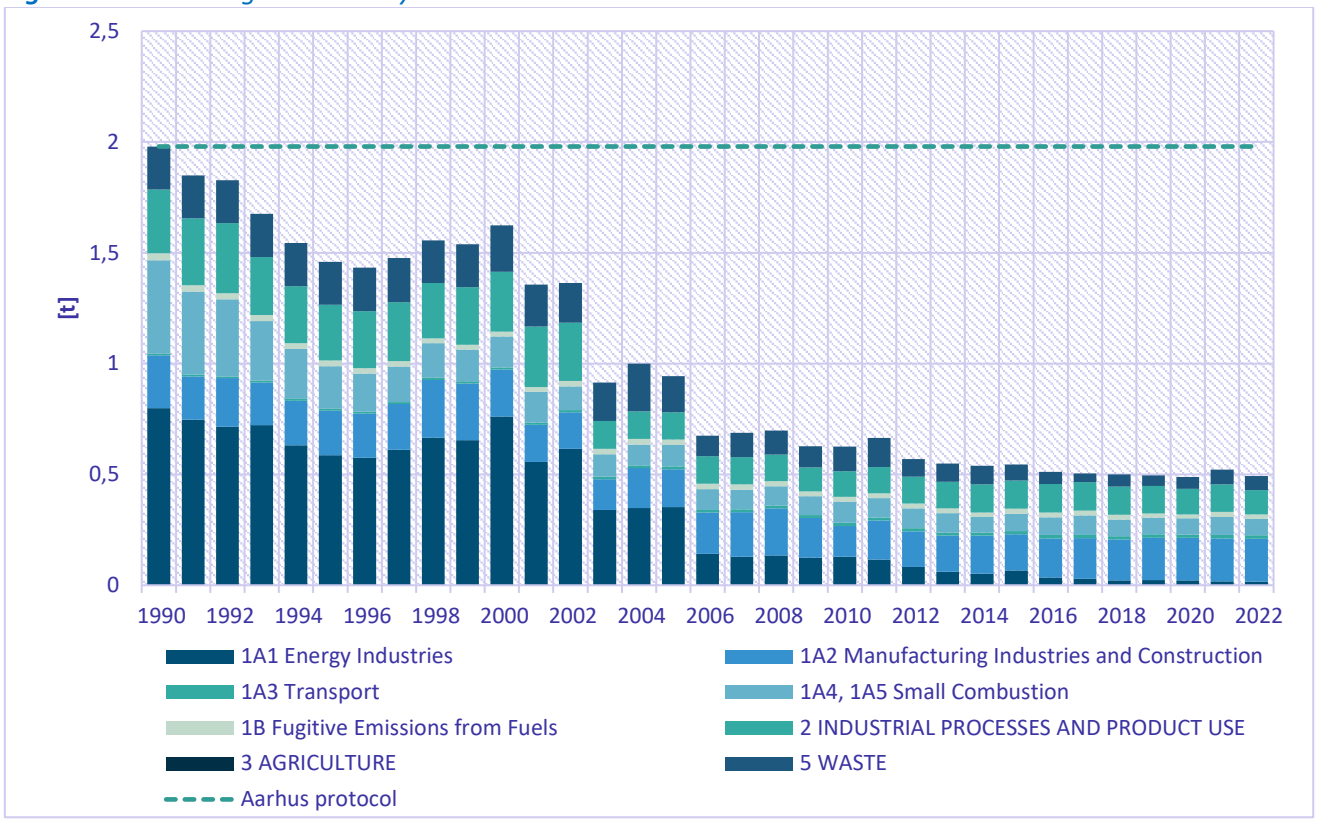
2.3.3 Trends in emissions of Hg

The emissions trend of Hg is decreasing in general (***Figure 2.11***). Since 2009, the emission trend has remained stable.

The main contributor to emissions of Hg was Energy production, mainly municipal waste incineration with energy recovery until 2006. After this year both Slovak MSW incineration plants installed abatement technologies to reduce emissions of this pollutant.

No exceedances of the Aarhus protocol were recorded.

Figure 2.11: *Total Hg emissions by sectors*



2.4 TREND IN EMISSION OF POPS

The emission inventory of POPs (PCB, DIOX, PAHs - benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene and ideno(1,2,3-cd)pyrene) for the Slovak Republic is elaborated according to EMEP/EEA Air Pollution Emission Inventory Guidebook 2019 and in compliance with requirements of the respect of the working group for emission inventory (UNECE Task Force on Emission Inventory).

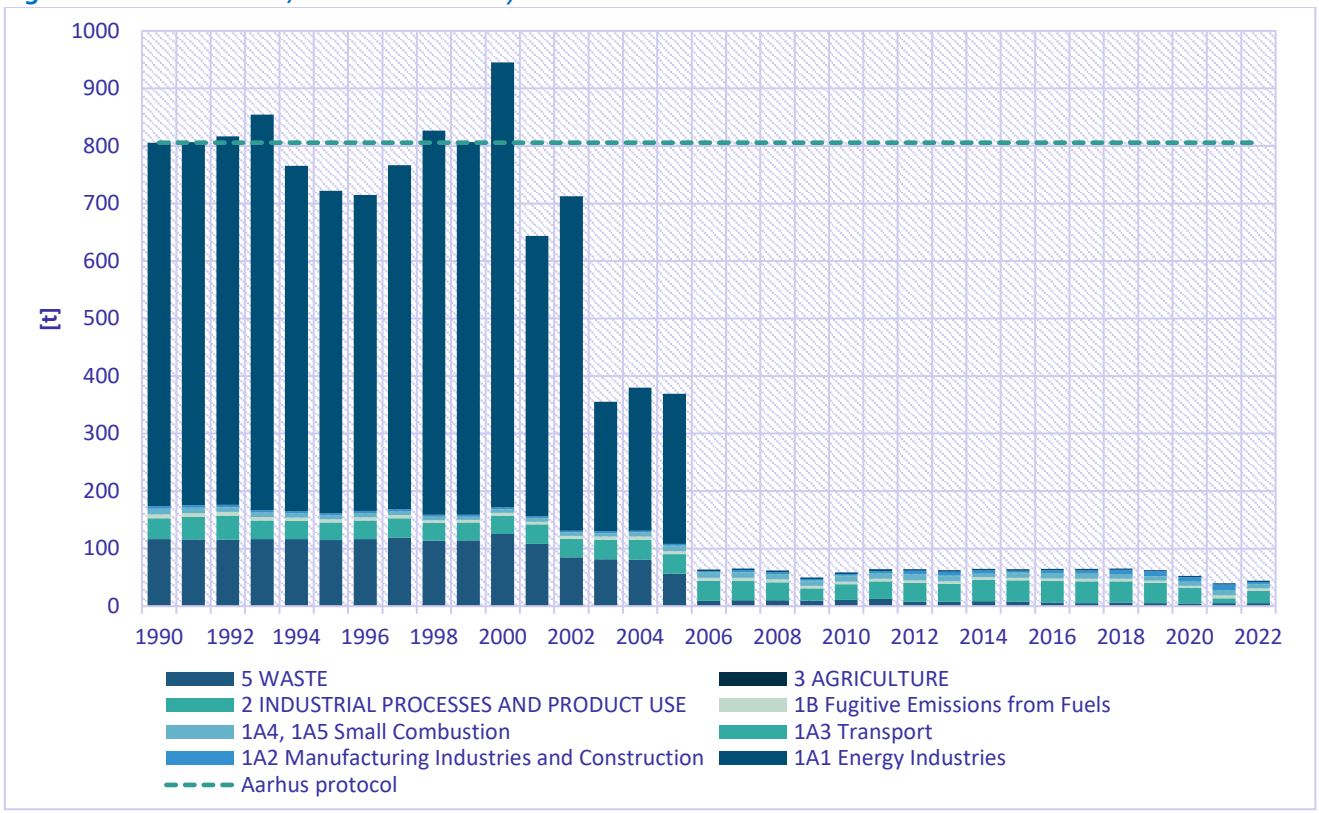
2.4.1 Trends in emissions of PCDD/PCDF

Emissions of PCDD/F dropped in 2003 and 2006 due to technological improvement of facilities that combust municipal waste as a fuel to produce energy (***Figure 2.12***). Since 2006 emissions has shown a slightly increasing trend as a result of waste management politics in the Slovak Republic, which prefers combustion to the landfill of waste.

In 2022, the main contributors are metal production with its share of 49%, and households (15%), then continue with energy production (including incineration of municipal waste with energy recovery) and waste incineration without energy recovery, which includes incineration of industrial and clinical waste.

There were no exceedances of Aarhus protocols of CLRTAP after the protocol was signed by the Slovak Republic.

Figure 2.12: *Total PCDD/PCDF emissions by sectors*



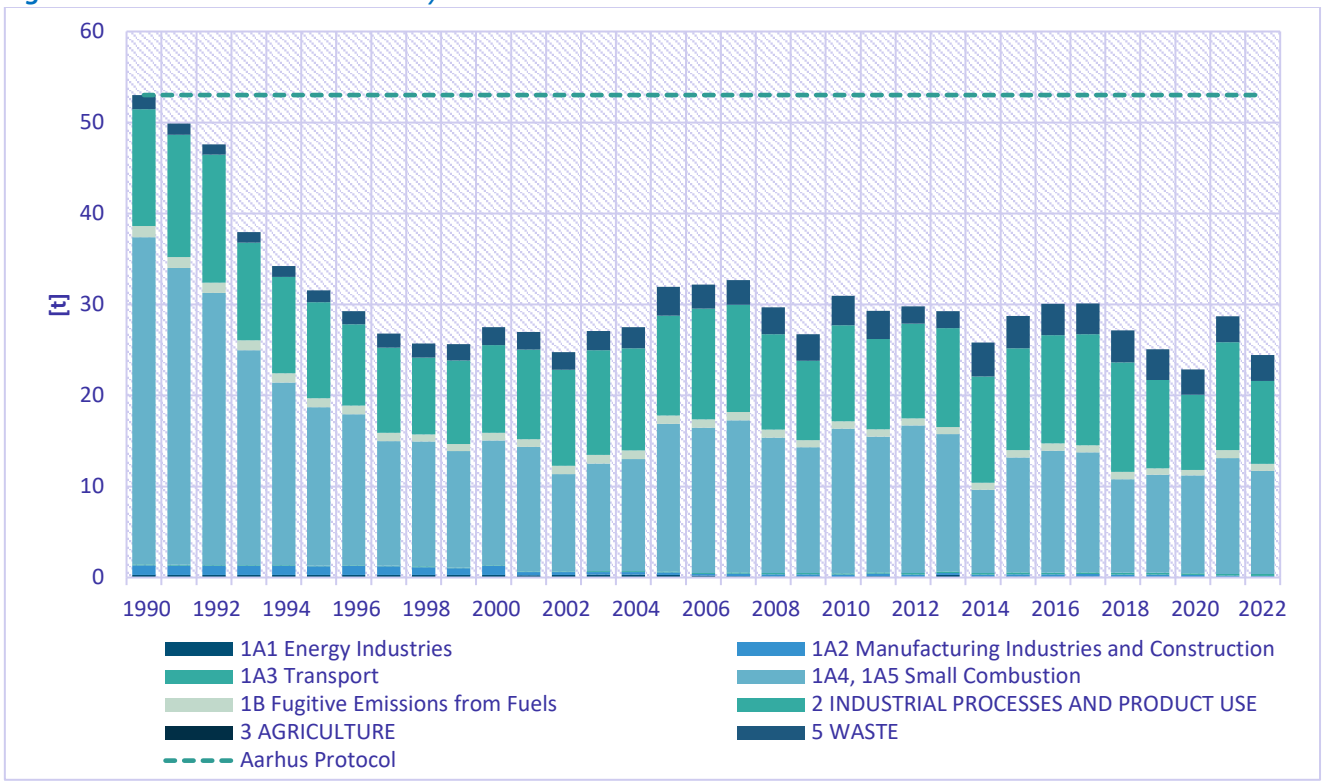
2.4.2 Trends in emissions of PAHs

The decreasing trend of PAHS emission is the most intensive in the period 1990-2000. Since then these emissions fluctuating slightly. (***Figure 2.13***).

The emission of PAHs originated in the sector of households (47%) and metal production (37%) in 2022.

Aarhus Protocol of CLRTAP on persistent organic pollutants requires that parties do not exceed their base year (1990) level of emitted heavy metals. The Slovak Republic's emissions did not exceed this level.

Figure 2.13: *Total PAHs emissions by sectors*

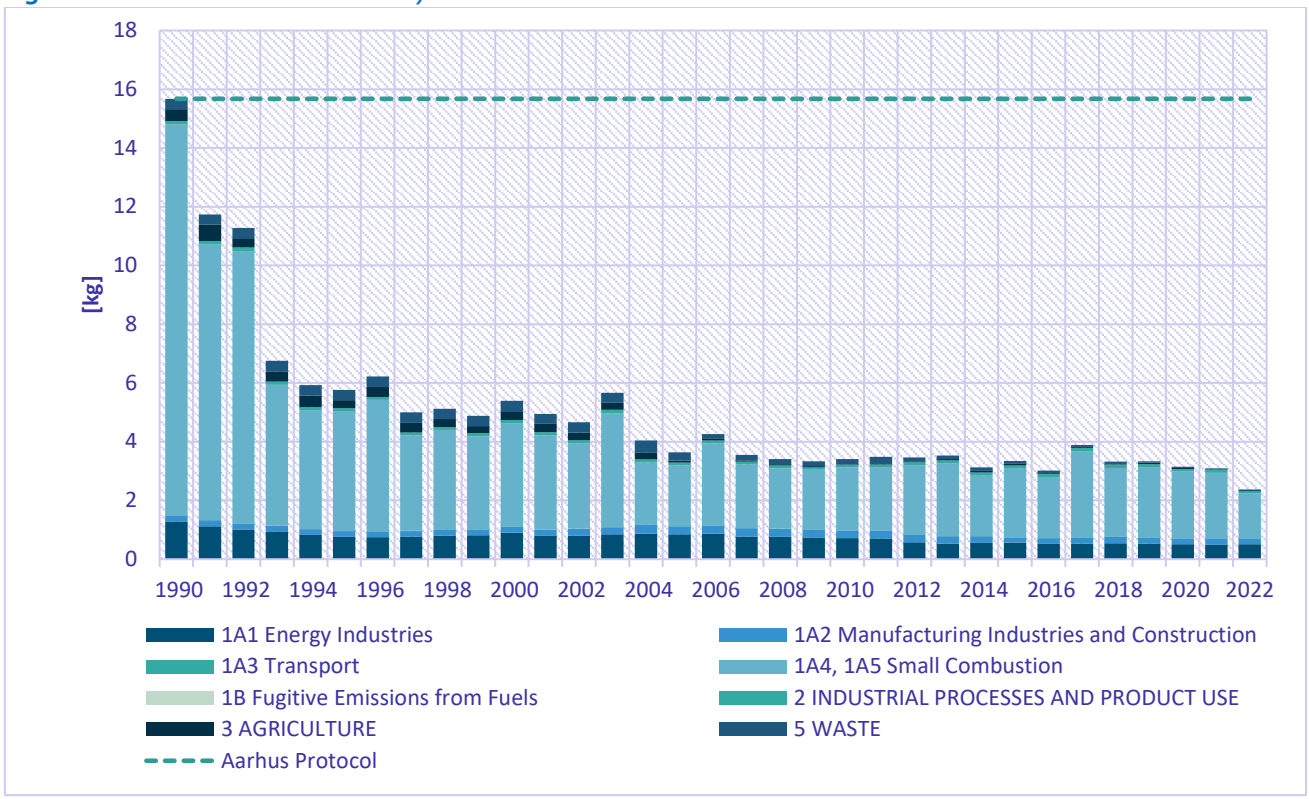


2.4.3 Trends in HCB emissions

Emissions of HCB are connected to households heating. ***Figure 2.14*** shows a general declining trend since 1990, although since 1995 the trend has been rather fluctuating. It is a result of the number of fuels and their quality in the sector of households. The main contributing category to the emissions of this pollutant is MSW incineration with energy recovery in the whole time series.

No exceedances of the Aarhus protocol were recorded.

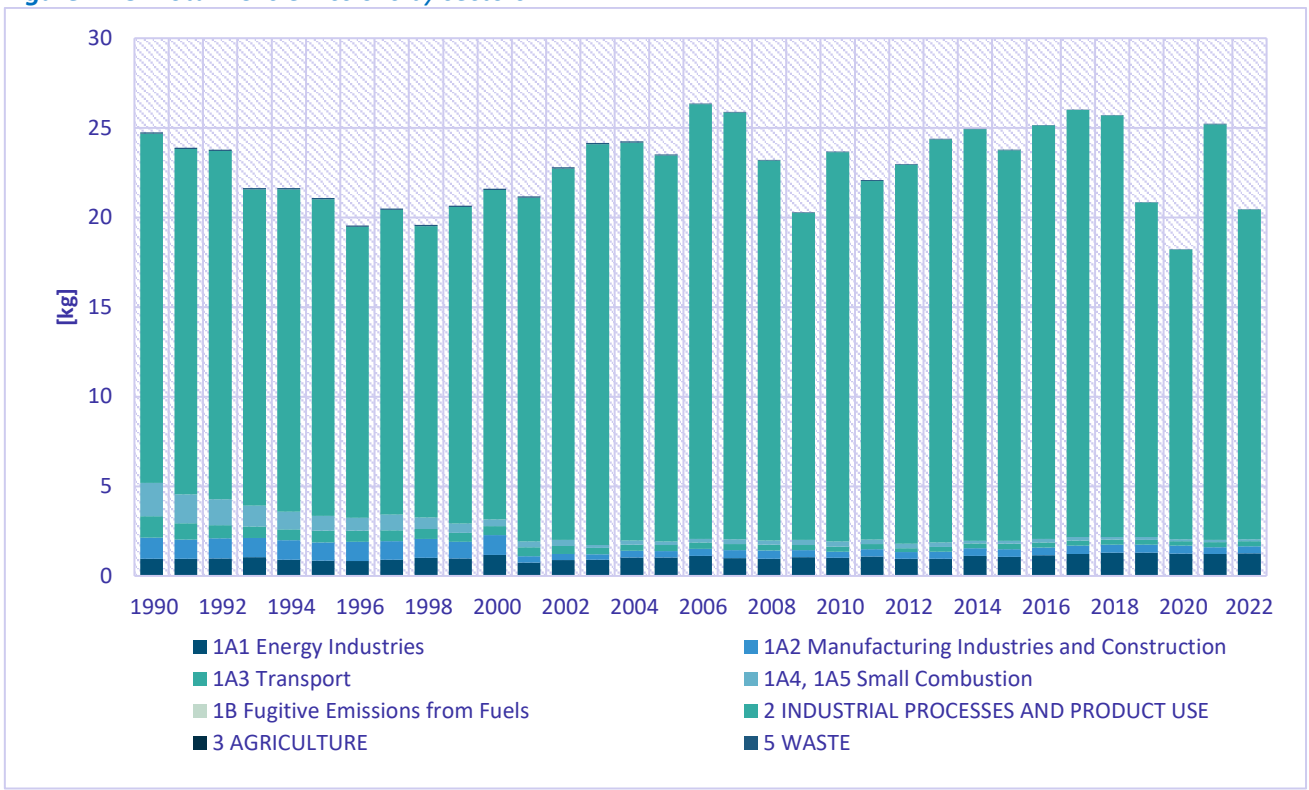
Figure 2.14: *Total HCB emissions by sectors*



2.4.4 Trends in PCBs emissions

Emissions of PCB show fluctuating trend due to changes in the Iron and Steel production industry. This activity is the main contributor to the emission of PCBs and its share of total emissions in 2022 was 87%. (***Figure 2.15***).

Figure 2.15: *Total PCBs emissions by sectors*



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3.1 OVERVIEW OF THE SECTOR ENERGY

The energy sector covers the following subsectors: energy industries (NFR **1A1**), stationary combustion in manufacturing and construction (NFR **1A2**), transport (NFR **1A3**), small combustion (NFR **1A4**), non-road mobile machinery (NFR **1A5**) and fugitive emissions (NFR **1B**). The emissions covered by the energy sector originate from fuel combustion (NFR **1A1**, **1A2**, **1A3**, **1A4** and **1A5**) and fugitive emissions (NFR **1B**). These subsectors are further described in the following chapters.

The data sources

a/ NEIS database of stationary large and medium sources providing facility data for nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) sulphur oxides (SO_x), ammonia (NH_3), total suspended particles (TSP, PM_{10} and $PM_{2.5}$ are consequently compiled) and carbon monoxide (CO). All data that comes from the database is considered as T3 methodology. In the year 2022, the system contained 13 826 large and medium sources.

b/ COPERT 5 model - This methodology is balancing fifteen different emissions including greenhouse gases from road transport. All data that comes from the model is considered as T3 methodology. A detailed description is provided in ***Chapter 3.6.4 Road Transport***.

c/ Estimations based on statistical data and emission factors for air pollutants, heavy metals (HM) and persistent organic pollutants (POPs). Reported emissions that use this type of activity data are considered T2 or T1. The overview of categories according to NFR structure and tier level of inventory is presented in the following ***Table 3.1***.

The inventory of air pollutants except for heavy metals and persistent organic pollutants is performed by the National emission information system - NEIS. It is a national system of data collection from air pollution sources and released emissions. The reporting duties are bonded to the national legislative obligations for air pollution sources to report their annual balances of fuels, emissions and all auxiliary data necessary for the compilation of final emissions.

The energy subsectors **1A1a**, **1A1b**, **1A1c**, **1A2a**, **1A2b**, **1A2c**, **1A2d**, **1A2e**, **1A2f**, **1A2gviii**, **1A3e**, **1A4ai**, **1A4bi**, **1A4ci**, **1A4cii** covers large and medium energy stationary sources of air pollution in the Slovak Republic.

Table 3.1: *Overview of reported categories, tier or notation key used in the energy sector*

NFR		METHODOLOGY/TIER					
	LONGNAME OF CATEGORY	NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TSP	BC	HM	POPs
ENERGY INDUSTRIES							
1A1a	Public electricity and heat production	T3	T3, NK	T3	T3	T2	T2
1A1b	Petroleum refining	T3	T3	T3	T1	T1, NK	T1, NK
1A1c	Manufacture of solid fuels and other energy industries	T3	T3	T3	T1	T2, NK	T2, NK
STATIONARY COMBUSTION IN MANUFACTURING AND CONSTRUCTION							
1A2a	Iron and steel	T3	T3, NK	T3	T3	T2	T2
1A2b	Non-ferrous metals	T3	NK	T3	T3	T1	T1, NK
1A2c	Chemicals	T3	NK	T3	T3	T1	T1
1A2d	Pulp, Paper and Print	T3	T3, NK	T3	T3	T2	T2
1A2e	Food processing, beverages and tobacco	T3	T3	T3	T3	T1	T1
1A2f	Non-metallic minerals	T3	T3, NK	T3	T3	T1, T2	T1, T2
1A2gvii	Mobile Combustion	T1	T1	T1	T1	T1, NK	T1, NK
1A2gviii	Other	T3	T3	T3	T3	T2	T2
TRANSPORT							

NFR		METHODOLOGY/TIER					
	LONGNAME OF CATEGORY	NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TSP	BC	HM	POPs
1A3ai(i)	International aviation LTO (civil)	T3	T3	T3	T3	T1, NK	NK
1A3aii(i)	Domestic aviation LTO (civil)	T3	T3	T3	T3	T1, NK	NK
1A3bi	Road transport: Passenger cars	T3	T3	T3	T3	T3	T3
1A3bii	Road transport: Light-duty vehicles	T3	T3	T3	T3	T3, NK	T3
1A3biii	Road transport: Heavy-duty vehicles and buses	T3	T3	T3	T3	T3, NK	T3
1A3biv	Road transport: Mopeds & motorcycles	T3	T3	T3	T3	T3, NK	T3
1A3bv	Road transport: Gasoline evaporation	T3, NK	NK	NK	NK	NK	NK
1A3bvi	Road transport: Automobile tyre and brake wear	NK	NK	T3	T3	T3	NK
1A3bvii	Road transport: Automobile road abrasion	NK	NK	T3	NK	T3	NK
1A3c	Railways	T1, T2	T2	T2	T2	T1	T1
1A3di(ii)	International inland waterways	T1	T1	T1	T1	T1	T1
1A3dii	National navigation (shipping)	T1	T1	T1	T1	T1	T1
1A3ei	Pipeline transport	T3	NK	T3	T3	NK	NK
1A3eii	Other	NK	NK	NK	NK	NK	NK
SMALL COMBUSTION							
1A4ai	Commercial/institutional: Stationary	T3	T3, NK	T3	T3	T2	T2
1A4aii	Commercial/institutional: Mobile	T1	T1	T1	T1	T1, NK	T1, NK
1A4bi	Residential: Stationary	T2	T2	T2	T2	T2	T2
1A4bii	Residential: Household and gardening	T1	T1	T1	T1	T1, NK	T1, NK
1A4ci	Agri./Forest./Fish.: Stationary	T3	NK	T3	T3	T2	T2
1A4cii	Agri./Forest./Fish.: Off-road vehicles and other machinery	T1	T1	T1	T1	T1, NK	T1, NK
1A4ciii	Agri./Forest./Fish.: National fishing	NK	NK	NK	NK	NK	NK
NON-ROAD MOBILE MACHINERY							
1A5a	Other stationary (including military)	T3	T3	T3	T3	T2	T2
1A5b	Other, Mobile	T1	T1	T1	T1	T1, NK	NK
FUGITIVE EMISSIONS							
1B1a	from solid fuels: Coal mining and handling	T1, NK	NK	T1	NK	NK	NK
1B1b	from solid fuels: Solid fuel transformation	T1	T1	T1	T1	T1	T1, NK
1B1c	Other fugitive emissions from solid fuels	NK	NK	NK	NK	NK	NK
1B2ai	from oil: Exploration, production, transport	T1, NK	NK	NK	NK	NK	NK
1B2aiv	from oil: Refining/storage	T1	NK	T1	NK	T1	T1, NK
1B2av	Distribution of oil products	T1, NK	NK	NK	NK	NK	NK
1B2b	from natural gas	T1, NK	NK	NK	NK	NK	NK
1B2c	Venting and flaring	NK	NK	NK	NK	NK	NK
1B2d	Other fugitive emissions from energy production	T1, NK	NK	NK	NK	NK	NK

3.2 TRENDS IN THE SECTOR ENERGY

In ***Table 3.2*** below is visible an overall decreasing trend of emissions of the main pollutants since 1990 due to the strict air protection legislation. This, together with the advancements and progress of abatement systems led to the reduction of air pollutants as a result of the transposition of European legislation, continual improvement in the national legislation and the endeavour of the industry to implement BAT technologies (if the investments are available).

The categories of energy sector are key categories for most of the main pollutants, heavy metals and POPs. The most significant categories are **1A1a**, which is the key category for NOx, SOx, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As,

Ni, Se, PCDD/F, HCB and **1A4bi** is the key category for NOx, SOx, NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Hg, As, Cr, Ni, Zn, PCDD/F, PAHs, HCB and PCBs.

Table 3.2: *Overview of emissions in the energy sector*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	115.6727	176.6566	129.8216	0.5142	93.2685	97.2641	110.1931	8.3698	948.3718
1995	99.6967	102.6380	111.5983	0.9613	48.0856	51.3773	59.6255	4.6642	580.7745
2000	96.2390	84.1203	104.7127	1.4108	40.0306	43.4299	51.1402	3.8210	449.5143
2005	93.0990	84.7257	76.1295	2.6938	33.6840	36.0141	43.5510	4.1385	454.2198
2010	75.4381	73.4252	61.7060	2.6201	24.6892	26.2869	29.2605	3.7535	353.4246
2011	66.8720	66.9332	59.2693	2.4218	22.7076	24.2347	27.0489	3.2515	307.9713
2012	64.6386	70.1506	50.2629	2.5897	24.1647	25.7627	28.6504	3.4440	320.7436
2013	56.0897	64.7566	45.7888	2.4329	22.0210	23.5499	26.3543	3.0588	281.3074
2014	52.1656	46.1202	37.6724	1.4969	14.1871	15.4363	17.6669	2.1208	193.7922
2015	54.3971	56.9937	59.1472	2.0393	18.6299	20.0289	22.5383	2.6315	237.2732
2016	50.8074	58.5017	17.5247	2.3051	18.7623	20.1466	22.5784	2.5791	241.2408
2017	49.3999	57.9066	17.6587	2.1390	18.7721	20.0885	22.5025	2.5737	239.7197
2018	47.5967	48.3461	12.2324	1.7580	14.9512	16.1925	18.3879	2.1117	192.5757
2019	45.3307	49.5367	9.2028	1.8559	15.4323	16.6617	18.8419	2.1337	199.0267
2020	43.1475	47.3816	8.1955	1.8227	15.0382	16.1314	18.0556	2.0359	196.1378
2021	44.4281	53.2064	7.9859	2.2000	17.5924	18.8488	21.0781	2.3313	233.3552
2022	42.4378	50.2427	8.5832	2.0326	15.9859	17.1807	19.2608	2.1156	219.0082
1990/2022	**-63%**	**-72%**	**-93%**	**295%**	**-83%**	**-82%**	**-83%**	**-75%**	**-77%**
2021/2022	**-4%**	**-6%**	**7%**	**-8%**	**-9%**	**-9%**	**-9%**	**-9%**	**-6%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	33.5226	1.0140	1.4979	2.7104	4.5367	8.8833	6.0226	5.3703	20.6587
1995	27.8104	0.8257	1.0140	1.4453	2.4915	5.9354	2.7361	2.7899	12.1919
2000	26.2900	1.0437	1.1446	1.4830	2.1198	4.7813	1.4447	2.8569	10.7850
2005	10.7203	0.7112	0.6568	1.0637	2.2793	6.6878	1.3244	2.8728	13.7359
2010	3.0753	0.4952	0.3985	0.7960	2.1944	6.9467	1.5175	2.2539	14.1659
2011	3.0166	0.4874	0.4151	0.7405	2.1222	6.6000	1.4110	2.0318	14.3429
2012	2.9328	0.5202	0.3682	0.5755	2.1495	6.9167	1.1046	1.5632	15.7721
2013	2.8051	0.4978	0.3466	0.4716	2.0256	6.8065	1.0201	1.2230	15.5730
2014	2.6029	0.3699	0.3284	0.4170	1.6368	6.8157	0.9549	1.0572	13.3752
2015	2.9256	0.4669	0.3450	0.4952	1.9812	7.4919	1.1725	1.2707	15.7818
2016	2.8204	0.4623	0.3285	0.3429	1.9306	7.9030	1.0022	0.7513	15.4806
2017	2.7981	0.4625	0.3364	0.3217	1.9127	7.6869	0.9508	0.6673	16.0052
2018	2.6733	0.3733	0.3182	0.2753	1.6929	8.1647	0.8125	0.5982	13.8634
2019	2.6608	0.3948	0.3240	0.2829	1.7249	8.3041	0.8699	0.5928	14.4528
2020	2.4469	0.3920	0.3191	0.2689	1.6411	7.4812	0.8301	0.5480	13.9387
2021	2.7158	0.4473	0.3311	0.2657	1.8898	8.0106	0.9278	0.4991	15.3079
2022	2.5786	0.3926	0.3199	0.2536	1.7638	8.3990	0.8791	0.4638	14.0142
1990/2022	**-92%**	**-61%**	**-79%**	**-91%**	**-61%**	**-5%**	**-85%**	**-91%**	**-32%**
2021/2022	**-5%**	**-12%**	**-3%**	**-5%**	**-7%**	**5%**	**-5%**	**-7%**	**-8%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	653.0553	14.1114	10.6093	6.1048	7.3761	38.6372	14.8026	5.1860
1995	576.1708	7.0774	5.4135	3.0950	3.6809	19.6887	5.0480	3.3486
2000	787.6897	5.6809	4.4269	2.4457	2.9535	15.9060	4.6291	3.1525
2005	278.8661	6.4595	4.8971	2.6885	3.3806	17.8134	3.1896	1.9143

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2010	20.6181	6.2789	4.8293	2.6117	3.2946	17.1785	3.1234	1.9188
2011	20.9070	5.8987	4.5841	2.4559	3.1012	16.2828	3.1413	2.0284
2012	23.7692	6.3553	4.9522	2.6400	3.3493	17.4732	3.2066	1.8032
2013	23.9182	5.9081	4.6859	2.4642	3.1255	16.5310	3.2698	1.8585
2014	18.9787	3.6584	3.0887	1.5739	1.9443	10.4172	2.8418	1.9630
2015	19.4807	4.9876	4.0853	2.1128	2.6626	14.0101	3.0826	1.9646
2016	21.3179	5.2506	4.2817	2.2410	2.8176	14.7496	2.7993	2.0567
2017	21.4218	5.1073	4.2825	2.1737	2.7877	14.5350	3.6745	2.1649
2018	22.2674	4.0245	3.4625	1.7464	2.2205	11.5996	3.1098	2.1761
2019	22.1258	4.1766	3.5755	1.8043	2.3198	12.0058	3.1358	2.1636
2020	20.5358	4.1206	3.5029	1.7651	2.3048	11.8087	2.9944	2.0540
2021	26.3314	4.9291	4.1246	2.1206	2.7375	13.9998	2.9411	2.0068
2022	18.1242	4.3597	3.6667	1.8946	2.4498	12.4720	2.2486	2.0411
1990/2022	**-97%**	**-69%**	**-65%**	**-69%**	**-67%**	**-68%**	**-85%**	**-61%**
2021/2022	**-31%**	**-12%**	**-11%**	**-11%**	**-11%**	**-11%**	**-24%**	**2%**

The share of the categories of emissions of the particular pollutants in the energy sector is shown in ***Figure 3.1*** below.

Transport categories are the main contributor to NOx emissions, especially category **1A3bi** (Passenger cars) with a share of 23% of emissions in the energy sector in 2022 (***Figure 3.1***). Emissions in these categories decrease slowly.

Emissions of NMVOC are emitted mostly by the category **1A4bi** (Residential: Stationary). In 2022, it was 63% of all NMVOC emissions in the energy sector and almost 38% of the total emissions of this pollutant (***Figure 3.1***). Emission is relatively stable, with only slight fluctuation since 2005.

SOx emissions are mainly emitted by category **1A1a** (22% in 2022) in the energy sector (***Figure 3.1***). This category shows an overall decreasing trend except for the year 2015. The increase in 2015 and the drop in 2016 were caused by one source of Slovak power plants (***Table 3.2***). This increase was in ENO A K1, K2 – granulated boiler: higher deployment of not abated ENO B3.4 blocks during the extensive reconstruction of ENO B1.2 blocks (from the SE annual report). The source according to the NEIS database burned double the amount of brown coal as in the previous year 2014.

Residential heating is the main contributor to emissions of $PM_{2.5}$, PM_{10} and TSP. From ***Table 3.2*** is clear that emissions of $PM_{2.5}$ (the trend for PM_{10} and TSP is very similar) show a decreasing trend since 1990 although since 2005 emissions in this category are relatively stable. In 2022 this category contributed almost 87% of total emissions of $PM_{2.5}$ (***Figure 3.1***).

CO emissions are emitted mostly by residential heating and road transport (***Figure 3.1***).

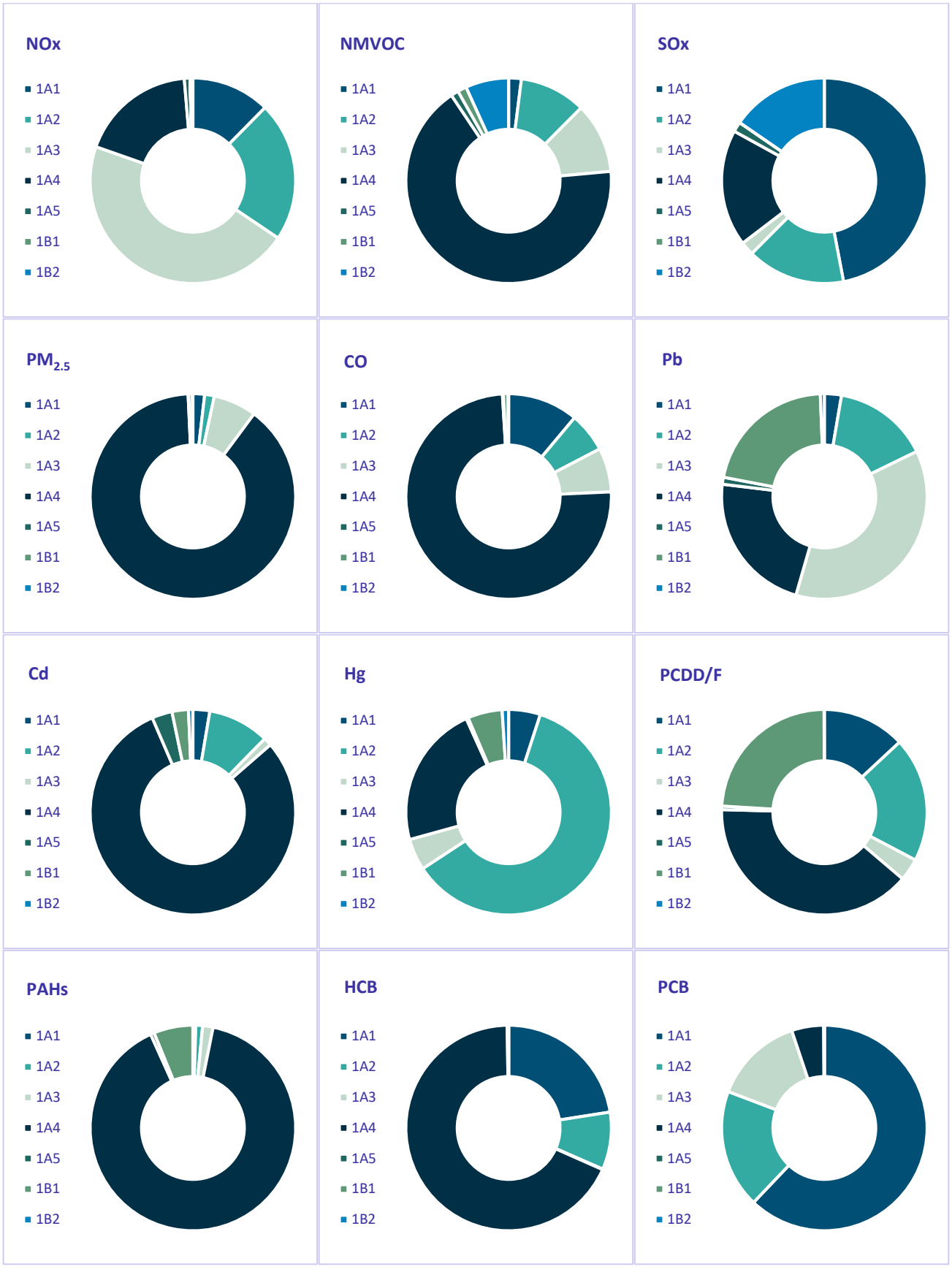
Until 2005, the main contributor to emissions of Pb was the incineration of municipal waste with energy recovery allocated in category 1A1a. Reconstruction of both MSW incineration plants led to a significant decrease in emissions. The decrease in Pb emission from road transport in 2000 was caused by the ban on lead addition to fuels. Since 2006 the main contributor to these emissions is category **1A2a**.

Emissions of Cd decreased only slightly in this sector since 1990. Similar to Pb emissions, MSW incineration plants contributed significantly to its emissions until 2005 (***Table 3.2***). Since then, combustion activities in iron and steel production and households heating have become important.

The amount of emissions of PCDD/F emitted into the air in the Slovak Republic is affected mostly by MSW incineration plants. Since reconstruction, both plants reduced emissions of this pollutant significantly. Category **1A1a** is the main contributor to emissions of PCBs in the whole time series (***Figure 3.1***). In 2022, 62% of emissions of PCB were emitted by this category in the energy sector.

PAHs and HCB emissions are emitted mostly by residential heating. The emission trend of these pollutants is slightly decreasing in the energy sector since 2005 (***Figure 3.1***).

Figure 3.1: *Share of the categories of emissions of the particular pollutants in the energy sector in 2022*



3.3 RECALCULATIONS, IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

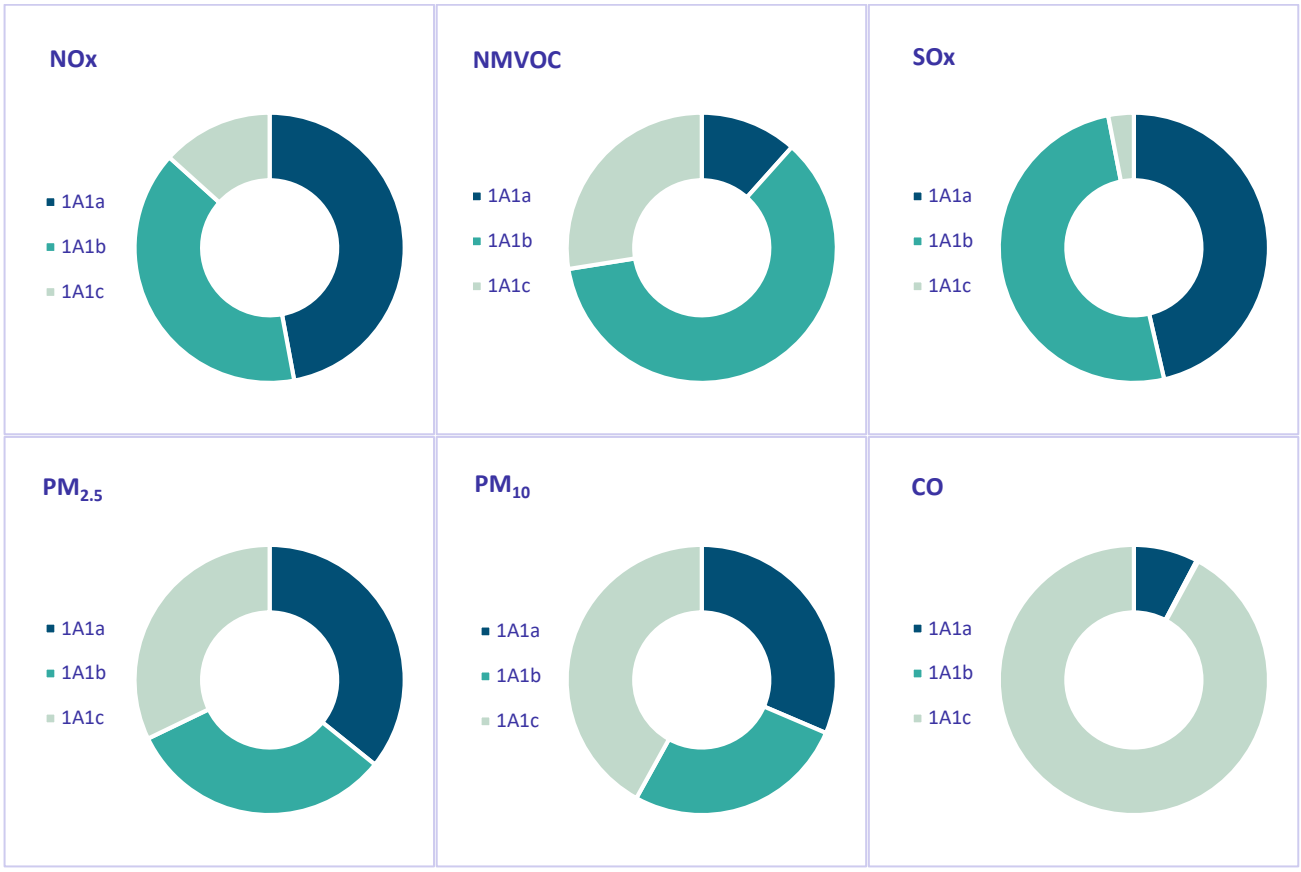
The energy sector undertakes continuing improvements. In submission 2024, the calculations for energy sector, especially the calculations of transport and fugitive emissions are based on the updated EMEP/EEA Guidebooks in 2023, implementation of 2019 IPCC Refinements to the 2006 IPCC Guidelines emission factors for NMVOC to ensure harmonisation of GHG emissions and air pollutnats. Also fuel consumption for the categories **1A3di(ii)** and **1A3dii** were revised and the notation key IE was removed and two whole time-series were introduced.
The detailed analysis of the allocation of sources to the NFR categories across the whole NEIS database is planned for the next period, as it was identified that some sources might be allocated incorrectly within the database.

3.4 ENERGY INDUSTRIES (NFR 1A1)

3.4.1 Overview

The category energy industries **1A1** covers the following subcategories: Public Electricity and Heat Production (**1A1a**), Petroleum Refining (**1A1b**) and Manufacture of Solid Fuels and Other Energy Industries (**1A1c**). These subcategories are further described in the following chapters.
Energy industries are a substantial contributor to most air pollutants. The category **1A1a**, which includes also municipal waste incineration with energy utilization contributes to most main pollutants, heavy metals and POPs. Shares of emissions of main pollutants in particular subcategories are shown in ***Figure 3.2***.

Figure 3.2: *Share of emissions of the main pollutants in 1A1 in 2022*



3.4.2 Public electricity and heat production (NFR 1A1a)

3.4.2.1 Overview

This activity covers emissions from combustion plants as point sources. The emissions considered in this activity are released by a controlled combustion process (boiler emissions, furnace emissions, emissions from gas turbines or stationary engines) and are mainly characterised by the types of fuels used. Activities listed within this category are shown in ***Table 3.3***.

This category includes the power installations for the production of electricity and heat and the combined heat-power installations (CHP). The emissions from the combustion of municipal waste are included because of the energy recovery from the combustion process.

Table 3.3: *Activities according to national categorization included in 1A1a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE S., NACE: 35.1; 35.2; 35.3
5.1. Waste incineration plants (with the specification for MWI) *a) combustion of hazardous waste with a projected capacity in tonnes /day* *b) combustion of non-hazardous waste with a capacity in tonnes /hour*	combustion

This category is key for emissions of NOx, SOx, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Ni, Se, PCDD/F and HCB. From emission data is a visible increase in 2015 and a drop in 2016, the most significant in SOx. This annual fluctuation is caused by one source of Slovak power plants. This increase was in ENO A K1, K2 – granulated boiler: higher deployment of not abated ENO B3.4 blocks during the extensive reconstruction of ENO B1.2 blocks (from the SE annual report). The source according to the NEIS database burned double the amount of brown coal as in the previous year 2014.

The source took advantage of the last year of the special survival regime (maximum 20 000 hours of operation from 1.1.2008 to 31.12.2015) during which they did not apply any Emission Limits. From 1.1.2016, such devices can only be operated if they are applied to new equipment to comply with national legislation, so the expected significant reduction in SO_X emissions was visible in 2016 emissions. The decline was continuing during 2022.

Emission of heavy metals and POPs decreased most significantly after the year 2005. This decrease is connected mainly to the reconstruction of MSW incineration plants which use waste to produce electricity and heat for households and other companies using the CHP system.

The emission data of air pollutants is presented in ***Table 3.4***. The emissions originating from MSW incineration with energy utilisation are described in ***Chapter 6.6.2***.

Table 3.4: *Overview of emissions in the category 1A1a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	20.8652	0.1699	60.6572	NO	5.0981	6.1196	8.1175	0.1475	2.6616
1995	20.9769	0.1708	60.9819	NO	5.1254	6.1524	8.1609	0.1233	2.6759
2000	26.3778	0.1559	58.8624	NO	6.3197	7.5860	10.0625	0.1169	2.6729
2005	15.2963	0.1529	51.9931	NO	7.2630	7.8104	11.7351	0.1381	2.3064
2010	9.5278	0.1612	43.1548	NO	0.4317	0.5171	0.6571	0.0117	1.6932
2011	9.7997	0.1676	45.1935	NO	0.5053	0.5963	0.7224	0.0140	1.6207
2012	8.9735	0.1799	39.3491	NO	0.4601	0.5735	0.7016	0.0134	1.7577
2013	7.8687	0.1766	36.1728	NO	0.3722	0.4683	0.6452	0.0110	1.8626
2014	7.0565	0.1678	29.2536	NO	0.3507	0.4282	0.5545	0.0105	1.6862
2015	6.5387	0.1702	50.8989	0.0148	0.4611	0.5645	0.7051	0.0138	1.6742
2016	4.2010	0.1530	9.2366	0.0202	0.2072	0.2494	0.3018	0.0062	2.1715
2017	3.8701	0.1504	8.6485	0.0194	0.1494	0.1796	0.2277	0.0044	1.7777
2018	3.6499	0.1438	4.4968	NO	0.1168	0.1363	0.1675	0.0035	1.5783

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2019	3.3581	0.1324	2.3546	0.0000	0.1388	0.1499	0.1774	0.0042	1.4240
2020	2.8764	0.1157	1.8447	NO	0.1375	0.1541	0.1861	0.0042	1.4527
2021	2.6306	0.1145	1.8073	NO	0.1312	0.1412	0.1586	0.0041	1.8778
2022	2.4764	0.1167	1.8718	NO	0.1051	0.1194	0.1476	0.0033	1.8739
1990/2022	**-88%**	**-31%**	**-97%**	**-**	**-98%**	**-98%**	**-98%**	**-98%**	**-30%**
2021/2022	**-6%**	**2%**	**4%**	**-**	**-20%**	**-15%**	**-7%**	**-20%**	**0%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	20.2308	0.8059	0.7990	1.8705	0.9764	0.7217	3.7156	4.6039	6.4931
1995	17.2865	0.6301	0.5856	1.0289	0.4646	0.3315	1.1271	2.1503	2.8932
2000	23.6357	0.8378	0.7613	1.1790	0.4880	0.3381	0.6123	2.2343	2.8658
2005	8.3952	0.3409	0.3521	0.8600	0.4595	0.3456	0.5813	2.2147	3.0403
2010	0.6701	0.0816	0.1290	0.6125	0.3975	0.2142	0.5591	1.8528	1.6637
2011	0.5983	0.0729	0.1152	0.5418	0.3530	0.1894	0.4903	1.6231	1.4352
2012	0.4359	0.0530	0.0827	0.3865	0.2545	0.1580	0.3758	1.1359	1.2137
2013	0.3172	0.0389	0.0602	0.2759	0.1836	0.1176	0.2536	0.8004	0.8665
2014	0.2746	0.0341	0.0524	0.2346	0.1578	0.1080	0.2079	0.6735	0.8071
2015	0.3555	0.0432	0.0662	0.3051	0.2044	0.1293	0.2678	0.8744	1.0136
2016	0.1722	0.0224	0.0347	0.1453	0.0986	0.0664	0.1373	0.4175	0.5255
2017	0.1347	0.0184	0.0287	0.1129	0.0771	0.0547	0.0993	0.3265	0.4427
2018	0.0974	0.0142	0.0222	0.0786	0.0550	0.0441	0.0728	0.2236	0.3695
2019	0.1056	0.0150	0.0235	0.0850	0.0594	0.0432	0.0793	0.2379	0.3487
2020	0.0956	0.0137	0.0216	0.0757	0.0533	0.0368	0.0708	0.2074	0.2935
2021	0.0724	0.0109	0.0170	0.0539	0.0394	0.0371	0.0541	0.1400	0.3183
2022	0.0650	0.0102	0.0159	0.0479	0.0354	0.0307	0.0511	0.1265	0.2631
1990/2022	**-100%**	**-99%**	**-98%**	**-97%**	**-96%**	**-96%**	**-99%**	**-97%**	**-96%**
2021/2022	**-10%**	**-6%**	**-7%**	**-11%**	**-10%**	**-17%**	**-6%**	**-10%**	**-17%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	629.9992	0.0009	0.0056	0.0045	0.0004	0.0114	1.2587	0.9524
1995	558.3479	0.0007	0.0029	0.0024	0.0002	0.0062	0.7397	0.8447
2000	771.4119	0.0010	0.0032	0.0026	0.0002	0.0070	0.8788	1.1673
2005	258.9175	0.0009	0.0031	0.0025	0.0002	0.0067	0.8285	1.0241
2010	1.2776	0.0009	0.0024	0.0020	0.0002	0.0055	0.7183	1.0174
2011	1.2656	0.0009	0.0022	0.0019	0.0002	0.0052	0.7002	1.0820
2012	1.0606	0.0008	0.0017	0.0014	0.0001	0.0041	0.5723	0.9570
2013	0.9548	0.0008	0.0014	0.0012	0.0001	0.0034	0.5128	0.9621
2014	1.0256	0.0009	0.0013	0.0012	0.0001	0.0035	0.5518	1.1231
2015	1.0680	0.0009	0.0015	0.0013	0.0001	0.0037	0.5635	1.0641
2016	0.9288	0.0009	0.0011	0.0010	0.0000	0.0030	0.5112	1.1477
2017	0.9418	0.0010	0.0011	0.0010	0.0000	0.0031	0.5255	1.2291
2018	0.9549	0.0010	0.0010	0.0009	0.0000	0.0030	0.5346	1.3018
2019	0.9555	0.0010	0.0010	0.0009	0.0000	0.0030	0.5307	1.2882
2020	0.9168	0.0010	0.0009	0.0009	0.0000	0.0028	0.5069	1.2429
2021	0.8886	0.0010	0.0009	0.0008	0.0000	0.0027	0.4899	1.2228
2022	0.9038	0.0010	0.0009	0.0008	0.0000	0.0028	0.5027	1.2675
1990/2022	**-100%**	**12%**	**-84%**	**-82%**	**-94%**	**-76%**	**-60%**	**33%**
2021/2022	**2%**	**3%**	**1%**	**1%**	**-12%**	**2%**	**3%**	**4%**

An overview of activity data (energy consumption) for this source category is in ***Table 3.5*** below. Incineration of MSW is included in biomass (biomass fraction) or other fuels (non-biomass fraction).

Table 3.5: *Overview of activity data in the category 1A1a*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	386.37	67 039.83	36 381.46	NO	NO
1995	368.67	67 608.67	36 386.08	NO	NO
2000	443.21	65 432.41	34 459.25	NO	1 096.91
2005	393.28	65 937.71	25 852.54	77.70	1 700.25
2010	471.08	48 138.63	20 379.21	2 385.24	1 693.49
2011	430.75	46 672.38	25 678.60	2 869.79	1 833.47
2012	522.43	44 238.33	23 100.57	3 841.03	1 619.98
2013	343.39	41 156.77	19 585.56	4 388.67	1 900.12
2014	210.28	37 326.16	12 489.39	4 567.79	2 243.08
2015	225.52	38 769.06	13 854.96	4 995.70	2 096.86
2016	291.55	36 753.64	13 274.54	4 271.98	2 244.23
2017	132.43	37 815.53	13 709.93	3 875.10	2 391.67
2018	112.58	35 175.81	14 600.15	4 138.96	2 504.49
2019	114.58	28 330.00	21 959.76	3 999.56	2 315.87
2020	72.16	21 365.92	26 783.40	3 722.41	2 241.11
2021	56.82	20 398.62	32 704.33	4 797.22	2 191.11
2022	99.11	18 141.84	18 109.02	4 460.94	2 268.80
1990/2022	**-74%**	**-73%**	**-50%**	-	-
2021/2022	**74%**	**-11%**	**-45%**	**-7%**	**4%**

3.4.2.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.6***).

Emissions of NH_3 are recorded only for the last four years. Emission presence is linked with the usage of DENOX abatements technologies.

Table 3.6: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	201	1.64	584.32	78.2	63%	75%	25.64

The emissions of heavy metals and POPs are calculated at the Tier 2 level. The activity data (fuels, types of combustion plants and other specific information) is compiled in the NEIS database, therefore these detailed methodologies could be used focused on the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of heavy metals and POPs are default EF from EMEP/EEA $GB_{2019/2023}$ (***Table 3.7***).

The annual emission is determined by activity data and an emission factor:

$$E_{pollutant} = \sum EF_{technology/pollutant} \times A_{production/technology}$$

Where:

$E_{pollutant}$ = annual emission of pollutant,

$EF_{technology/pollutant}$ = technology-specific emission factor

$A_{production/technology}$ = activity data (country's fuel usage and installed combustion technology).

Table 3.7: *Emission factors for heavy metals and POPs in the category 1A1a*

TYPE OF FUEL		HEAVY FUEL OIL	LIGHT FUEL OIL		HARD COAL	
T2	UNIT	DRY BOTTOM BOILER	GAS TURBINES	STATIONARY ENGINES	DRY BOTTOM BOILER	FLUID BED BOILER
Pb	[mg/GJ]	4.56	0.0069	4.07	7.3	7.3
Cd	[mg/GJ]	1.2	0.0012	1.36	0.9	0.9
Hg	[mg/GJ]	0.341	0.053	1.36	1.4	1.4
As	[mg/GJ]	3.98	0.0023	1.81	7.1	7.1
Cr	[mg/GJ]	2.55	0.28	1.36	4.5	4.5
Cu	[mg/GJ]	5.31	0.17	2.72	7.8	9
Ni	[mg/GJ]	255	0.0023	1.36	4.9	4.9
Se	[mg/GJ]	2.06	0.0023	6.79	23	23
Zn	[mg/GJ]	87.8	0.44	1.81	19	90
PCDD/F	[ng I-TEQ/GJ]	2.5	NE	0.99	10	10
B(a)P	[µg/GJ]	NE	NE	0.116	0.7	0.7
B(b)F	[µg/GJ]	4.5	NE	0.502	37	37
B(k)F	[µg/GJ]	4.5	NE	0.0987	29	29
I()P	[µg/GJ]	6.92	NE	0.187	1.1	1.1
PAHs	[µg/GJ]	15.92	NE	0.9037	67.8	67.8
HCB	[µg/GJ]	NE	NE	0.22	6.7	6.7
PCBs	[ng/GJ]	NE	NE	0.13	3.3	3.3

TYPE OF FUEL		BROWN COAL		GASEOUS FUELS			BIOMASS
T2	UNIT	DRY BOTTOM BOILER	FLUID BED BOILER	DRY BOTTOM BOILER	GAS TURBINES	STATIONARY ENGINES	DRY BOTTOM BOILER
Pb	[mg/GJ]	15	15	0.0015	0.0015	0.04	20.6
Cd	[mg/GJ]	1.8	1.8	0.00025	0.00025	0.003	1.76
Hg	[mg/GJ]	2.9	2.9	0.1	0.1	0.1	1.51
As	[mg/GJ]	14.3	14.3	0.12	0.12	0.05	9.46
Cr	[mg/GJ]	9.1	9.1	0.00076	0.00076	0.05	9.03
Cu	[mg/GJ]	1	1	0.000076	0.000076	0.01	21.1
Ni	[mg/GJ]	9.7	9.7	0.00051	0.0051	0.05	14.2
Se	[mg/GJ]	45	45	0.0112	0.0112	0.2	1.2
Zn	[mg/GJ]	8.8	8.8	0.0015	0.0015	2.91	181
PCDD/F	[ng I-TEQ/GJ]	10	10	0.5	NE	0.57	50
B(a)P	[µg/GJ]	1.3	1.3	0.56	0.56	1.2	1.12
B(b)F	[µg/GJ]	37	37	0.84	1.58	9	0.043
B(k)F	[µg/GJ]	29	29	0.84	1.11	1.7	0.0155
I()P	[µg/GJ]	2.1	2.1	0.84	8.36	1.8	0.0374
PAHs	[µg/GJ]	69.4	69.4	3.08	11.61	13.7	1.2159
HCB	[µg/GJ]	6.7	6.7	NE	NE	NE	5
PCBs	[ng/GJ]	3.3	3.3	NE	NE	NE	3.5

BC emissions were estimated in this submission based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.8***). The calculated BC emission values are presented in ***Table 3.4***.

Table 3.8: *Emission factors for calculation of BC emissions*

EF	UNIT	HEAVY FUEL OIL	GAS OIL	HARD COAL	BROWN COAL	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	35	7	11	11	1	172

EF	UNIT	HEAVY FUEL OIL	GAS OIL	HARD COAL	BROWN COAL	GASEOUS FUELS	BIOMASS
PM_{10}	[g/GJ]	25	3	8	8	1	155
$PM_{2.5}$	[g/GJ]	19	1	3	3	1	133
BC	[% of $PM_{2.5}$]	6%	34%	2%	1%	3%	3%

3.4.2.3 Completeness

Emissions are well covered. Ammonia emissions in this category do not occur until 2014 and then in 2018 and 2022.

3.4.2.4 Source-specific recalculations

The recalculations were made based on changes in activity data (supplemented activity values) and as well based on change of value of emission factor for Ni (EMEP/EEA GB_{2023}). The results of the recalculations are in ***Table 3.9***.

Table 3.9: *Previous and revised emissions in the category 1A1a*

YEAR	BC [kt]			Pb [t]			Cd [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.1458	0.1475	1%	20.2283	20.2308	0.01%	0.8051	0.8059	0.10%
1991	0.1439	0.1456	1%	19.9526	19.9545	0.01%	0.7703	0.7709	0.08%
1992	0.1404	0.1420	1%	20.0126	20.0142	0.01%	0.7520	0.7525	0.07%
1993	0.1355	0.1370	1%	21.2544	21.2556	0.01%	0.7774	0.7778	0.05%
1994	0.1291	0.1305	1%	18.5536	18.5544	0.00%	0.6783	0.6786	0.04%
1995	0.1221	0.1233	1%	17.2859	17.2865	0.00%	0.6299	0.6301	0.03%
1996	0.1118	0.1127	1%	16.9573	16.9577	0.00%	0.6175	0.6176	0.02%
1997	0.1062	0.1068	1%	18.3912	18.3915	0.00%	0.6620	0.6621	0.01%
1998	0.1002	0.1007	0.43%	20.4373	20.4375	0.00%	0.7285	0.7285	0.01%
1999	0.0964	0.0967	0.30%	19.8746	19.8747	0.00%	0.7121	0.7121	0.01%
2000	0.1167	0.1169	0.24%	23.6356	23.6357	0.00%	0.8378	0.8378	0.00%
2001	0.1000	0.1001	0.08%	15.2543	15.2543	0.00%	0.5741	0.5741	0.00%
2002	0.0817	0.0817	0.03%	17.9653	17.9653	0.00%	0.6554	0.6554	0.00%
2003	0.0880	0.0879	-0.02%	7.4008	7.4008	0.00%	0.3150	0.3150	0.00%
2004	0.0863	0.0863	0.01%	8.0494	8.0494	0.00%	0.3319	0.3319	0.00%
2005	0.1376	0.1381	0.40%	8.3951	8.3952	0.00%	0.3408	0.3409	0.01%
2006	0.0988	0.0989	0.08%	0.7050	0.7051	0.01%	0.0881	0.0881	0.01%
2007	0.0142	0.0142	0.08%	0.6435	0.6435	0.01%	0.0800	0.0800	0.01%
2008	0.0121	0.0121	0.02%	0.6853	0.6853	0.00%	0.0845	0.0845	0.00%
2009	0.0112	0.0112	0.02%	0.6258	0.6258	0.00%	0.0773	0.0773	0.00%
2010	0.0117	0.0117	0.01%	0.6700	0.6701	0.01%	0.0816	0.0816	0.00%
2011	0.0140	0.0140	0.01%	0.4660	0.5983	28%	0.0573	0.0729	27%
2012	0.0134	0.0134	0.00%	0.3876	0.4359	12%	0.0474	0.0530	12%
2013	0.0110	0.0110	0.00%	0.3284	0.3172	-3%	0.0402	0.0389	-3%
2014	0.0105	0.0105	0.01%	0.2664	0.2746	3%	0.0332	0.0341	3%
2015	0.0138	0.0138	0.01%	0.3366	0.3555	6%	0.0410	0.0432	5%
2016	0.0062	0.0062	0.01%	0.1531	0.1722	12%	0.0202	0.0224	11%
2017	0.0044	0.0044	0.00%	0.1247	0.1347	8%	0.0172	0.0184	7%
2018	0.0035	0.0035	0.01%	0.0883	0.0974	10%	0.0131	0.0142	8%
2019	0.0042	0.0042	0.11%	0.0878	0.1056	20%	0.0130	0.0150	16%
2020	0.0042	0.0042	0.04%	0.0851	0.0956	12%	0.0125	0.0137	9%
2021	0.0041	0.0041	0.00%	0.0645	0.0724	12%	0.0100	0.0109	9%

YEAR	Hg [t]			As [t]			Cr [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.7982	0.7990	0.10%	1.8694	1.8705	0.06%	0.9755	0.9764	0.09%
1991	0.7461	0.7468	0.09%	1.6057	1.6065	0.05%	0.8079	0.8086	0.08%
1992	0.7134	0.7139	0.07%	1.4065	1.4071	0.05%	0.6780	0.6785	0.07%
1993	0.7213	0.7217	0.05%	1.2824	1.2829	0.04%	0.5832	0.5835	0.07%
1994	0.6305	0.6308	0.04%	1.1214	1.1217	0.03%	0.5101	0.5104	0.05%
1995	0.5854	0.5856	0.03%	1.0287	1.0289	0.03%	0.4644	0.4646	0.04%
1996	0.5749	0.5751	0.02%	1.0104	1.0105	0.02%	0.4562	0.4564	0.03%
1997	0.6102	0.6103	0.02%	1.0190	1.0191	0.01%	0.4452	0.4453	0.02%
1998	0.6652	0.6653	0.01%	1.0596	1.0597	0.01%	0.4478	0.4479	0.01%
1999	0.6544	0.6544	0.01%	1.0714	1.0714	0.01%	0.4619	0.4619	0.01%
2000	0.7612	0.7613	0.00%	1.1790	1.1790	0.00%	0.4879	0.4880	0.01%
2001	0.5557	0.5557	0.00%	1.1180	1.1181	0.00%	0.5452	0.5452	0.00%
2002	0.6147	0.6147	0.00%	1.0959	1.0959	0.00%	0.4998	0.4998	0.00%
2003	0.3385	0.3385	0.00%	0.9123	0.9123	0.00%	0.5040	0.5040	0.00%
2004	0.3478	0.3478	0.00%	0.8777	0.8777	0.00%	0.4745	0.4745	0.00%
2005	0.3521	0.3521	0.01%	0.8599	0.8600	0.01%	0.4594	0.4595	0.01%
2006	0.1413	0.1413	0.00%	0.6704	0.6704	0.00%	0.4276	0.4276	0.01%
2007	0.1284	0.1284	0.00%	0.6094	0.6094	0.00%	0.3894	0.3894	0.01%
2008	0.1351	0.1351	0.00%	0.6443	0.6443	0.00%	0.4130	0.4130	0.00%
2009	0.1237	0.1237	0.00%	0.5839	0.5839	0.00%	0.3755	0.3755	0.00%
2010	0.1290	0.1290	0.00%	0.6125	0.6125	0.00%	0.3975	0.3975	0.00%
2011	0.0906	0.1152	27%	0.4206	0.5418	29%	0.2746	0.3530	29%
2012	0.0739	0.0827	12%	0.3430	0.3865	13%	0.2262	0.2545	13%
2013	0.0622	0.0602	-3%	0.2859	0.2759	-3%	0.1901	0.1836	-3%
2014	0.0510	0.0524	3%	0.2274	0.2346	3%	0.1530	0.1578	3%
2015	0.0629	0.0662	5%	0.2886	0.3051	6%	0.1935	0.2044	6%
2016	0.0314	0.0347	11%	0.1285	0.1453	13%	0.0875	0.0986	13%
2017	0.0269	0.0287	7%	0.1040	0.1129	9%	0.0713	0.0771	8%
2018	0.0206	0.0222	8%	0.0706	0.0786	11%	0.0498	0.0550	11%
2019	0.0204	0.0235	15%	0.0696	0.0850	22%	0.0492	0.0594	21%
2020	0.0197	0.0216	9%	0.0667	0.0757	13%	0.0473	0.0533	13%
2021	0.0157	0.0170	8%	0.0474	0.0539	14%	0.0350	0.0394	13%

YEAR	Cu [t]			Ni [t]			Se [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.7200	0.7217	0.23%	3.7652	3.7156	-1%	4.5997	4.6039	0.09%
1991	0.5936	0.5949	0.22%	3.0029	2.9621	-1%	3.7860	3.7893	0.09%
1992	0.4950	0.4960	0.20%	2.3731	2.3391	-1%	3.1547	3.1572	0.08%
1993	0.4218	0.4226	0.18%	1.8645	1.8355	-2%	2.6850	2.6869	0.07%
1994	0.3666	0.3672	0.15%	1.4590	1.4334	-2%	2.3563	2.3577	0.06%
1995	0.3311	0.3315	0.12%	1.1505	1.1271	-2%	2.1493	2.1503	0.05%
1996	0.3227	0.3230	0.09%	0.9434	0.9202	-2%	2.1196	2.1203	0.03%
1997	0.3123	0.3125	0.06%	0.7836	0.7611	-3%	2.0577	2.0582	0.02%
1998	0.3120	0.3122	0.04%	0.6834	0.6608	-3%	2.0572	2.0575	0.01%
1999	0.3213	0.3214	0.03%	0.6352	0.6117	-4%	2.1356	2.1358	0.01%
2000	0.3380	0.3381	0.02%	0.6368	0.6123	-4%	2.2341	2.2343	0.01%
2001	0.3398	0.3398	0.01%	0.6627	0.6454	-3%	2.5923	2.5924	0.00%
2002	0.3190	0.3190	0.00%	0.5876	0.5669	-4%	2.3433	2.3434	0.00%
2003	0.3540	0.3540	0.00%	0.6772	0.6574	-3%	2.4480	2.4480	0.00%

YEAR	Cu [t]			Ni [t]			Se [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2004	0.3384	0.3384	0.00%	0.6282	0.6088	-3%	2.2920	2.2920	0.00%
2005	0.3455	0.3456	0.02%	0.6014	0.5813	-3%	2.2145	2.2147	0.01%
2006	0.3476	0.3476	0.02%	0.6036	0.5817	-4%	2.1105	2.1105	0.00%
2007	0.2910	0.2911	0.02%	0.5142	0.4910	-5%	1.9130	1.9130	0.00%
2008	0.2783	0.2783	0.01%	0.5419	0.5201	-4%	2.0082	2.0082	0.00%
2009	0.2062	0.2062	0.01%	0.5205	0.5004	-4%	1.8044	1.8044	0.00%
2010	0.2142	0.2142	0.02%	0.5787	0.5591	-3%	1.8528	1.8528	0.00%
2011	0.1480	0.1894	28%	0.3964	0.4903	24%	1.2593	1.6231	29%
2012	0.1406	0.1580	12%	0.3468	0.3758	8%	1.0079	1.1359	13%
2013	0.1217	0.1176	-3%	0.2749	0.2536	-8%	0.8293	0.8004	-3%
2014	0.1048	0.1080	3%	0.2116	0.2079	-2%	0.6527	0.6735	3%
2015	0.1225	0.1293	6%	0.2624	0.2678	2%	0.8270	0.8744	6%
2016	0.0593	0.0664	12%	0.1266	0.1373	8%	0.3688	0.4175	13%
2017	0.0508	0.0547	8%	0.0956	0.0993	4%	0.3005	0.3265	9%
2018	0.0402	0.0441	10%	0.0685	0.0728	6%	0.2006	0.2236	11%
2019	0.0363	0.0432	19%	0.0688	0.0793	15%	0.1946	0.2379	22%
2020	0.0328	0.0368	12%	0.0654	0.0708	8%	0.1825	0.2074	14%
2021	0.0333	0.0371	12%	0.0497	0.0541	9%	0.1229	0.1400	14%

YEAR	Zn [t]			PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	6.4920	6.4931	0.02%	629.9986	629.9992	0.00%	0.0114	0.0114	0.00%
1991	5.3381	5.3390	0.02%	629.7553	629.7558	0.00%	0.0097	0.0097	0.00%
1992	4.4323	4.4329	0.02%	638.8078	638.8082	0.00%	0.0085	0.0085	0.00%
1993	3.7546	3.7551	0.01%	685.8520	685.8522	0.00%	0.0077	0.0077	0.00%
1994	3.2347	3.2351	0.01%	598.6529	598.6531	0.00%	0.0067	0.0067	0.00%
1995	2.8929	2.8932	0.01%	558.3478	558.3479	0.00%	0.0062	0.0062	0.00%
1996	2.7881	2.7883	0.01%	547.7076	547.7077	0.00%	0.0061	0.0061	0.00%
1997	2.6781	2.6782	0.00%	596.7063	596.7064	0.00%	0.0061	0.0061	0.00%
1998	2.6605	2.6606	0.00%	665.6251	665.6251	0.00%	0.0063	0.0063	0.00%
1999	2.7262	2.7262	0.00%	645.8775	645.8776	0.00%	0.0064	0.0064	0.00%
2000	2.8657	2.8658	0.00%	771.4119	771.4119	0.00%	0.0070	0.0070	0.00%
2001	3.0135	3.0135	0.00%	485.4141	485.4141	0.00%	0.0067	0.0067	0.00%
2002	2.7415	2.7415	0.00%	579.3721	579.3721	0.00%	0.0065	0.0065	0.00%
2003	3.1371	3.1370	0.00%	222.9144	222.9144	0.00%	0.0069	0.0069	0.00%
2004	2.9828	2.9828	0.00%	246.4338	246.4338	0.00%	0.0069	0.0069	0.00%
2005	3.0403	3.0403	0.00%	258.9174	258.9175	0.00%	0.0067	0.0067	0.00%
2006	3.0243	3.0248	0.02%	1.3950	1.3951	0.01%	0.0067	0.0067	0.00%
2007	2.4234	2.4239	0.02%	1.2471	1.2472	0.01%	0.0060	0.0060	0.00%
2008	2.3046	2.3048	0.01%	1.2527	1.2527	0.00%	0.0060	0.0060	0.00%
2009	1.6126	1.6128	0.01%	1.2353	1.2354	0.00%	0.0056	0.0056	0.00%
2010	1.6634	1.6637	0.02%	1.2775	1.2776	0.01%	0.0055	0.0055	0.00%
2011	1.1252	1.4352	28%	1.1418	1.2656	11%	0.0045	0.0052	15%
2012	1.0820	1.2137	12%	1.0121	1.0606	5%	0.0038	0.0041	6%
2013	0.8960	0.8665	-3%	0.9664	0.9548	-1%	0.0035	0.0034	-2%
2014	0.7836	0.8071	3%	1.0167	1.0256	1%	0.0034	0.0035	1%
2015	0.9611	1.0136	5%	1.0480	1.0680	2%	0.0036	0.0037	2%
2016	0.4705	0.5255	12%	0.9087	0.9288	2%	0.0030	0.0030	3%
2017	0.4123	0.4427	7%	0.9314	0.9418	1%	0.0030	0.0031	2%

YEAR	Zn [t]			PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2018	0.3379	0.3695	9%	0.9450	0.9549	1%	0.0030	0.0030	2%
2019	0.2949	0.3487	18%	0.9357	0.9555	2%	0.0029	0.0030	3%
2020	0.2624	0.2935	12%	0.9048	0.9168	1%	0.0028	0.0028	2%
2021	0.2864	0.3183	11%	0.8785	0.8886	1%	0.0027	0.0027	1%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	1.2586	1.2587	0.01%	0.9524	0.9524	0.00%
1991	1.0996	1.0997	0.01%	0.9523	0.9523	0.00%
1992	0.9815	0.9816	0.01%	0.9662	0.9662	0.00%
1993	0.9168	0.9168	0.01%	1.0376	1.0376	0.00%
1994	0.8030	0.8030	0.01%	0.9057	0.9057	0.00%
1995	0.7397	0.7397	0.00%	0.8447	0.8447	0.00%
1996	0.7281	0.7281	0.00%	0.8286	0.8286	0.00%
1997	0.7442	0.7442	0.00%	0.9029	0.9029	0.00%
1998	0.7836	0.7836	0.00%	1.0072	1.0072	0.00%
1999	0.7878	0.7878	0.00%	0.9773	0.9773	0.00%
2000	0.8788	0.8788	0.00%	1.1673	1.1673	0.00%
2001	0.7685	0.7685	0.00%	0.7342	0.7342	0.00%
2002	0.7791	0.7791	0.00%	0.8765	0.8765	0.00%
2003	0.8220	0.8220	0.00%	0.9102	0.9102	0.00%
2004	0.8393	0.8393	0.00%	1.0311	1.0311	0.00%
2005	0.8285	0.8285	0.00%	1.0241	1.0241	0.00%
2006	0.8514	0.8515	0.00%	1.1184	1.1184	0.00%
2007	0.7565	0.7565	0.00%	0.9971	0.9971	0.00%
2008	0.7497	0.7497	0.00%	0.9614	0.9614	0.00%
2009	0.7263	0.7263	0.00%	1.0523	1.0523	0.00%
2010	0.7183	0.7183	0.00%	1.0174	1.0174	0.00%
2011	0.6347	0.7002	10%	1.0820	1.0820	0.00%
2012	0.5484	0.5723	4%	0.9570	0.9570	0.00%
2013	0.5182	0.5128	-1%	0.9621	0.9621	0.00%
2014	0.5478	0.5518	1%	1.1231	1.1231	0.00%
2015	0.5547	0.5635	2%	1.0641	1.0641	0.00%
2016	0.5020	0.5112	2%	1.1477	1.1477	0.00%
2017	0.5206	0.5255	1%	1.2291	1.2291	0.00%
2018	0.5301	0.5346	1%	1.3018	1.3018	0.00%
2019	0.5225	0.5307	2%	1.2882	1.2882	0.00%
2020	0.5022	0.5069	1%	1.2429	1.2429	0.00%
2021	0.4864	0.4899	1%	1.2228	1.2228	0.00%

3.4.3 Petroleum refining (NFR 1A1b)

3.4.3.1 Overview

The emissions from the refineries are allocated in category **1A1b**. Refineries process crude oil into a variety of hydrocarbon products. The biggest refinery SLOVNAFT Plc is the only petroleum refining company operating in Slovakia, processing approximately 5.7 million tons of crude oil a year. The company is the most important supplier of petrol and diesel fuels in Slovakia. Emissions from petroleum refining, classified by code **1A1b**, concern all combustion activities required to support the refining of petroleum products. A decrease in

emissions of SO_x after 2010 was caused by the economic situation of Slovak's biggest refinery Slovnaft. This activity covers emissions released from production and combustion processes within a refinery.
The combustion processes include the heating of crude and petroleum products without contact between flame and products and also industrial waste incineration. Activities listed within this category are shown in ***Table 3.10***.

Table 3.10: *Activities according to national categorization included in 1A1b*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE S., NACE: 19
5.1. Industrial waste incineration	combustion

The overview of emissions in this category is shown in ***Table 3.11***. Increasing in emissions of NH_3 in 2022 is related to the increase in emitted emissions of ammonia from one source of the biggest refinery SLOVNAFT.

Table 3.11: *Overview of emissions in the category 1A1b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.7968	1.9928	11.2358	0.0231	0.2306	0.2518	0.2529	0.0424	0.4963
1995	3.8022	1.9956	11.2517	0.0232	0.2309	0.2522	0.2532	0.0425	0.4970
2000	4.6652	2.5278	12.2614	0.0245	0.5848	0.6387	0.6414	0.1076	0.7964
2005	3.1916	1.5070	8.1885	0.0127	0.2439	0.2629	0.2911	0.0449	0.2913
2010	2.8144	1.3846	9.0583	0.0013	0.1499	0.1595	0.1600	0.0276	0.1756
2011	2.0950	1.1533	6.0985	0.0028	0.1043	0.1104	0.1107	0.0192	0.1797
2012	1.7081	1.1991	1.9754	0.0006	0.0814	0.0882	0.0886	0.0150	0.1053
2013	1.3770	1.2277	0.6966	0.0053	0.0834	0.0907	0.0912	0.0153	0.1104
2014	1.1687	1.0975	1.0279	0.0023	0.0456	0.0494	0.0497	0.0084	0.1074
2015	1.3197	1.2988	0.8994	0.0014	0.0445	0.0488	0.0490	0.0082	0.1149
2016	1.6853	0.9778	1.4934	0.0152	0.0690	0.0746	0.0749	0.0127	0.0646
2017	1.6510	0.7354	2.1356	0.0165	0.0810	0.0880	0.0884	0.0149	0.0633
2018	1.6297	0.9479	1.9923	0.0013	0.0914	0.0978	0.0982	0.0168	0.0562
2019	1.4300	0.7329	1.9337	0.0070	0.0824	0.0873	0.0876	0.0152	0.0515
2020	1.7207	0.7663	1.2027	0.0010	0.0664	0.0726	0.0730	0.0122	0.0487
2021	1.8186	0.6868	1.1806	0.0010	0.0723	0.0778	0.0781	0.0133	0.0392
2022	2.0828	0.6111	2.0391	0.0061	0.0943	0.1012	0.1015	0.0173	0.0513
1990/2022	**-45%**	**-69%**	**-82%**	**-74%**	**-59%**	**-60%**	**-60%**	**-59%**	**-90%**
2021/2022	**15%**	**-11%**	**73%**	**500%**	**30%**	**30%**	**30%**	**30%**	**31%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0169	0.0013	0.0007	0.0002	IE	IE	0.0018	IE	IE
1995	0.0169	0.0013	0.0007	0.0002	IE	IE	0.0018	IE	IE
2000	0.0169	0.0013	0.0007	0.0002	IE	IE	0.0018	IE	IE
2005	0.0156	0.0012	0.0007	0.0002	IE	IE	0.0017	IE	IE
2010	0.0001	0.0000	0.0001	0.0000	IE	IE	0.0001	IE	IE
2011	0.0002	0.0001	0.0003	0.0001	IE	IE	0.0002	IE	IE
2012	0.0002	0.0001	0.0002	0.0000	IE	IE	0.0001	IE	IE
2013	0.0006	0.0002	0.0007	0.0001	IE	IE	0.0006	IE	IE
2014	0.0002	0.0001	0.0002	0.0000	IE	IE	0.0002	IE	IE
2015	0.0002	0.0001	0.0002	0.0000	IE	IE	0.0002	IE	IE
2016	0.0002	0.0001	0.0002	0.0000	IE	IE	0.0001	IE	IE
2017	0.0002	0.0001	0.0002	0.0000	IE	IE	0.0002	IE	IE
2018	0.0001	0.0000	0.0001	0.0000	IE	IE	0.0001	IE	IE
2019	0.0001	0.0000	0.0001	0.0000	IE	IE	0.0001	IE	IE
2020	0.0001	0.0000	0.0001	0.0000	IE	IE	0.0001	IE	IE

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2021	0.0001	0.0000	0.0001	0.0000	IE	IE	0.0001	IE	IE
2022	0.0001	0.0000	0.0001	0.0000	IE	IE	0.0001	IE	IE
1990/2022	**-99%**	**-98%**	**-86%**	**-90%**	-	-	**-95%**	-	-
2021/2022	**25%**	**25%**	**25%**	**25%**	-	-	**25%**	-	-

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [g]	PCBs [kg]
1990	0.1300	NE	NE	NE	NE	0.2601	0.0260	NA
1995	0.1302	NE	NE	NE	NE	0.2605	0.0260	NA
2000	0.1301	NE	NE	NE	NE	0.2602	0.0260	NA
2005	0.1198	NE	NE	NE	NE	0.2397	0.0240	NA
2010	0.0295	NE	NE	NE	NE	0.0295	0.0029	NA
2011	0.1078	NE	NE	NE	NE	0.1078	0.0108	NA
2012	0.0666	NE	NE	NE	NE	0.0666	0.0067	NA
2013	0.2502	NE	NE	NE	NE	0.2502	0.0250	NA
2014	0.0747	NE	NE	NE	NE	0.0747	0.0075	NA
2015	0.0709	NE	NE	NE	NE	0.0709	0.0071	NA
2016	0.0650	NE	NE	NE	NE	0.0650	0.0065	NA
2017	0.0767	NE	NE	NE	NE	0.0767	0.0077	NA
2018	0.0433	NE	NE	NE	NE	0.0433	0.0043	NA
2019	0.0478	NE	NE	NE	NE	0.0478	0.0048	NA
2020	0.0302	NE	NE	NE	NE	0.0302	0.0030	NA
2021	0.0296	NE	NE	NE	NE	0.0296	0.0030	NA
2022	0.0370	NE	NE	NE	NE	0.0370	0.0037	NA
1990/2022	**-72%**	-	-	-	-	**-86%**	**-86%**	-
2021/2022	**25%**	-	-	-	-	**25%**	**25%**	-

An overview of activity data (energy consumption) for this source category is in ***Table 3.12*** below.

Table 3.12: *Overview of activity data in the category 1A1b*

YEAR	WASTE INCINERATED [kt]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	13.00	29 694.17	1 069.06	10 467.17	NO	NO
1995	13.02	29 952.97	1 106.24	10 229.82	NO	NO
2000	13.01	30 828.03	1 197.97	8 842.78	NO	183.83
2005	11.98	29 601.35	1 958.62	6 438.24	NO	103.43
2010	1.47	31 575.66	1 282.94	5 749.07	NO	NO
2011	5.39	25 692.53	1 551.69	4 321.68	NO	10.05
2012	3.33	23 398.09	1 483.57	4 198.31	NO	NO
2013	12.51	19 474.46	1 833.24	5 752.59	NO	54.35
2014	3.73	15 698.77	1 278.42	5 209.24	NO	NO
2015	3.55	19 621.47	1 893.66	5 005.96	NO	NO
2016	3.25	20 417.54	1 727.90	4 960.58	NO	13.77
2017	3.84	19 465.74	1 925.76	5 171.72	NO	16.15
2018	2.16	19 948.10	1 776.06	4 579.83	NO	9.55
2019	2.39	18 868.78	1 225.26	4 425.81	0.00	0.00
2020	1.51	19 565.52	1 608.55	4 692.13	0.00	0.00
2021	1.48	19 428.73	1 754.03	4 857.35	NO	6.44
2022	1.85	20 629.80	1 880.53	4 113.09	NO	8.37
1990/2022	**-86%**	**-31%**	**76%**	**-61%**	-	-
2021/2022	**25%**	**6%**	**7%**	**-15%**	-	**30%**

3.4.3.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.13***).

Table 3.13: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/tGJ]
EF	92.09	48.33	272.51	0.56	6.13	91.2%	99.6%	18.4%	12.04

*T1 EMEP/EEA GB_{2019} EF

HMs and POPs emissions from the category **1A1b** were allocated to category **1B2aiv** because if using of Tier 1 approach is adopted for the process emissions, the combustion emissions are already covered and should not be reported again in Chapter **1A1b** since this would lead to double counting. Only industrial waste incineration emissions for HMs and POPs are allocated in this category and were calculated using Tier 1 emission factors from EMEP/EEA GB_{2023} (***Table 3.14***).

Table 3.14: *Emission factors for HMs and POPs in 1A1b*

T1	UNIT	EF
Pb	[g/t]	1.3
Cd	[g/t]	0.1
Hg	[g/t]	0.056
As	[g/t]	0.016
Ni	[g/t]	0.14
PCDD/F	[µg/t I-TEQ]	10
PAHs	[g/t]	0.02
HCB	[g/t]	0.002

3.4.3.3 Completeness

Emissions are well covered.

3.4.3.4 Source-specific recalculations

The recalculations were made based on change of value of emission factor for PCDD/F (EMEP/EEA GB_{2023}). The results of the recalculations are in ***Table 3.15***.

Table 3.15: *Previous and revised emissions in the category 1A1b*

YEAR	PCDD/F [g I-TEQ]		
	PREVIOUS	REVISED	CHANGE
1990	4.5512	0.1300	-97%
1991	4.5553	0.1302	-97%
1992	4.5497	0.1300	-97%
1993	4.5493	0.1300	-97%
1994	4.5611	0.1303	-97%
1995	4.5586	0.1302	-97%
1996	4.5324	0.1295	-97%
1997	4.5803	0.1309	-97%
1998	4.5865	0.1310	-97%
1999	4.5154	0.1290	-97%

YEAR	PCDD/F [g I-TEQ]		
	PREVIOUS	REVISED	CHANGE
2000	4.5539	0.1301	-97%
2001	3.9221	0.1121	-97%
2002	4.2473	0.1214	-97%
2003	4.8026	0.1372	-97%
2004	4.8927	0.1398	-97%
2005	4.1941	0.1198	-97%
2006	2.9797	0.0851	-97%
2007	2.0903	0.0597	-97%
2008	2.7215	0.0778	-97%
2009	2.8124	0.0804	-97%
2010	1.0323	0.0295	-97%
2011	3.7737	0.1078	-97%
2012	2.3316	0.0666	-97%
2013	8.7569	0.2502	-97%
2014	2.6129	0.0747	-97%
2015	2.4826	0.0709	-97%
2016	2.2741	0.0650	-97%
2017	2.6853	0.0767	-97%
2018	1.5152	0.0433	-97%
2019	1.6741	0.0478	-97%
2020	1.0560	0.0302	-97%
2021	1.0360	0.0296	-97%

3.4.4 Manufacture of solid fuels and other energy industries (NFR 1A1c)

3.4.4.1 Overview

The activity covers coke production and emissions associated with combustion in the coke oven. Activities listed within this category are shown in ***Table 3.16***.

Table 3.16: *Activities according to national categorization included in 1A1c*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
1.2. Sorting and treatment of coal, briquette production with projected output in t/h
1.3. Production of Coke

The overview of emissions in this category is shown in ***Table 3.17***.

Table 3.17: *Overview of emissions in the category 1A1c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.4307	1.2510	0.6901	0.0887	0.4264	0.7176	1.0773	0.2047	12.2804
1995	0.4279	1.2428	0.6855	0.0881	0.4236	0.7129	1.0702	0.2033	12.1997
2000	0.3519	1.8925	0.6866	0.1067	0.3097	0.5213	0.7825	0.1487	12.3868
2005	0.6081	1.0227	0.6376	0.0645	0.5719	0.9610	1.4396	0.2745	15.2868
2010	0.6990	0.3721	0.5342	0.0310	0.3124	0.5255	0.7884	0.1500	15.4326
2011	0.6540	0.3178	0.1996	0.0325	0.2953	0.4965	0.7443	0.1418	15.0236
2012	0.5827	0.2740	0.2144	0.0270	0.3002	0.5047	0.7567	0.1441	14.9857
2013	0.5846	0.3343	0.3310	0.0314	0.2936	0.4940	0.7413	0.1409	14.0761
2014	0.5514	0.3273	0.2054	0.0312	0.1703	0.2875	0.4331	0.0818	14.5471
2015	0.6271	0.3609	0.2393	0.0311	0.1623	0.2739	0.4126	0.0779	14.4584
2016	0.5759	0.4290	0.2129	0.0323	0.1754	0.2957	0.4449	0.0842	13.2027
2017	0.5214	0.4100	0.1786	0.0308	0.1450	0.2446	0.3681	0.0696	12.6232
2018	0.6125	0.3708	0.2032	0.0296	0.1484	0.2499	0.3755	0.0712	12.9564

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2019	0.6880	0.3231	0.1529	0.0256	0.1572	0.2646	0.3974	0.0755	13.6313
2020	0.8756	0.3051	0.1731	0.0167	0.0620	0.1048	0.1584	0.0297	15.7335
2021	0.6962	0.3153	0.1404	0.0296	0.0964	0.1625	0.2443	0.0463	17.7035
2022	0.7007	0.2762	0.1234	0.0242	0.0945	0.1594	0.2401	0.0453	22.3741
1990/2022	**63%**	**-78%**	**-82%**	**-73%**	**-78%**	**-78%**	**-78%**	**-78%**	**82%**
2021/2022	**1%**	**-12%**	**-12%**	**-18%**	**-2%**	**-2%**	**-2%**	**-2%**	**26%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0050	0.0002	NA	0.0036	0.0081	0.0038	0.0020	0.0041	0.0172
1995	0.0050	0.0002	NA	0.0036	0.0081	0.0038	0.0020	0.0041	0.0172
2000	0.0052	0.0002	NA	0.0038	0.0085	0.0040	0.0021	0.0042	0.0179
2005	0.0054	0.0002	NA	0.0040	0.0089	0.0042	0.0022	0.0044	0.0188
2010	0.0039	0.0002	NA	0.0028	0.0064	0.0030	0.0016	0.0032	0.0135
2011	0.0046	0.0002	NA	0.0033	0.0075	0.0035	0.0019	0.0037	0.0158
2012	0.0044	0.0002	NA	0.0032	0.0073	0.0034	0.0018	0.0036	0.0153
2013	0.0044	0.0002	NA	0.0032	0.0071	0.0034	0.0018	0.0036	0.0151
2014	0.0045	0.0002	NA	0.0032	0.0073	0.0034	0.0018	0.0036	0.0154
2015	0.0047	0.0002	NA	0.0034	0.0077	0.0036	0.0019	0.0038	0.0162
2016	0.0047	0.0002	NA	0.0034	0.0077	0.0036	0.0019	0.0038	0.0162
2017	0.0045	0.0002	NA	0.0033	0.0074	0.0035	0.0018	0.0037	0.0156
2018	0.0046	0.0002	NA	0.0033	0.0075	0.0035	0.0019	0.0037	0.0158
2019	0.0040	0.0002	NA	0.0029	0.0065	0.0031	0.0016	0.0033	0.0138
2020	0.0034	0.0002	NA	0.0024	0.0055	0.0026	0.0014	0.0028	0.0116
2021	0.0047	0.0002	NA	0.0034	0.0076	0.0036	0.0019	0.0038	0.0161
2022	0.0043	0.0002	NA	0.0031	0.0070	0.0033	0.0017	0.0035	0.0147
1990/2022	**-14%**	**-14%**	**-**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**
2021/2022	**-9%**	**-9%**	**-**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	1.6671	0.0185	0.0002	0.0001	4.52E-05	0.0189
1995	1.6693	0.0185	0.0002	0.0001	4.52E-05	0.0189
2000	1.7411	0.0193	0.0002	0.0001	4.72E-05	0.0197
2005	1.8243	0.0203	0.0002	0.0001	4.94E-05	0.0206
2010	1.3114	0.0146	0.0002	0.0001	3.55E-05	0.0148
2011	1.5365	0.0171	0.0002	0.0001	4.16E-05	0.0174
2012	1.4893	0.0165	0.0002	0.0001	4.04E-05	0.0169
2013	1.4642	0.0163	0.0002	0.0001	3.97E-05	0.0166
2014	1.4959	0.0166	0.0002	0.0001	4.05E-05	0.0169
2015	1.5727	0.0175	0.0002	0.0001	4.26E-05	0.0178
2016	1.5734	0.0175	0.0002	0.0001	4.26E-05	0.0178
2017	1.5144	0.0168	0.0002	0.0001	4.10E-05	0.0171
2018	1.5328	0.0170	0.0002	0.0001	4.15E-05	0.0173
2019	1.3402	0.0149	0.0002	0.0001	3.63E-05	0.0152
2020	1.1291	0.0125	0.0002	0.0000	3.06E-05	0.0128
2021	1.5623	0.0174	0.0002	0.0001	4.23E-05	0.0177
2022	1.4266	0.0159	0.0002	0.0001	3.87E-05	0.0161
1990/2022	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**
2021/2022	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**

An overview of activity data (energy consumption) for this source category is in ***Table 3.18*** below.

Table 3.18: *Overview of activity data in the category 1A1c*

YEAR	COAL TRANSFORMED [kt]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	2 258.95	NO	7 109.30	NO	NO	NO
1995	2 261.97	NO	7 061.99	NO	NO	NO
2000	2 359.26	NO	7 431.88	0.93	NO	NO
2005	2 471.97	NO	7 231.65	1.85	NO	NO
2010	1 777.00	0.09	6 491.11	3.43	NO	NO
2011	2 082.00	0.08	6 187.55	1.76	NO	NO
2012	2 018.00	0.10	6 211.97	2.46	NO	NO
2013	1 984.00	0.07	6 130.61	2.48	NO	NO
2014	2 027.00	0.09	6 209.12	1.29	NO	NO
2015	2 131.00	0.10	6 456.99	1.23	NO	NO
2016	2 132.00	0.13	6 471.44	1.33	NO	NO
2017	2 052.00	0.05	5 934.80	6.83	NO	NO
2018	2 077.00	0.10	6 087.14	6.82	NO	NO
2019	1 816.00	0.08	5 585.03	7.02	NO	NO
2020	1 530.00	0.05	5 056.88	4.93	NO	NO
2021	2 117.00	0.12	6 038.13	6.37	NO	NO
2022	1 933.00	0.16	6 001.56	4.63	NO	NO
1990/2022	**-14%**	-	**-16%**	-	-	-
2021/2022	**-9%**	**41%**	**-1%**	**-27%**	-	-

3.4.4.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.19***).

Table 3.19: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/tGJ]
EF	60.68	176.23	97.21	12.50	151.76	40%	67%	48%	1730.01

*T1 EMEP/EEA GB_{2019} EF

HMs and POPs emissions were calculated using Tier 2 emission factors with by-product recovery from EMEP/EEA GB_{2019} (***Table 3.20***).

Table 3.20: *Emission factors for heavy metals and POPs in the category 1A1c*

T2	UNIT	COAL
Pb	[mg/GJ]	2.2
Cd	[mg/GJ]	0.1
Hg	[mg/GJ]	NA
As	[mg/GJ]	1.6
Cr	[mg/GJ]	3.6
Cu	[mg/GJ]	1.7
Ni	[mg/GJ]	0.9
Se	[mg/GJ]	1.8
Zn	[mg/GJ]	7.6

PCDD/F	[ng I-TEQ/GJ]	738
B(a)P	[µg/GJ]	8.2
B(b)F	[µg/GJ]	0.1
B(k)F	[µg/GJ]	0.03
I()P	[µg/GJ]	0.02
PAHs	[µg/GJ]	8.35

3.4.4.3 Completeness

Emissions are well covered.

3.4.4.3 Source-specific recalculations

The recalculations for the year 2021 were made based on the correction of incorrect value of activity data (coal transformed). The results of the recalculations are in ***Table 3.21***.

Table 3.21: *Previous and revised emissions in the category 1A1c*

YEAR	COAL TRANSFORMED [kt]			Pb [t]			Cd [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	2 719.00	2 117.00	-22%	0.0044	0.0034	-22%	0.0044	0.0034	-22%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	0.0044	0.0034	-22%	0.0098	0.0076	-22%	0.0046	0.0036	-22%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	0.0024	0.0019	-22%	0.0049	0.0038	-22%	0.0207	0.0161	-22%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	2.0066	1.5623	-22%	0.0227	0.0177	-22%

3.5 MANUFACTURING INDUSTRIES AND CONSTRUCTION (NFR 1A2)

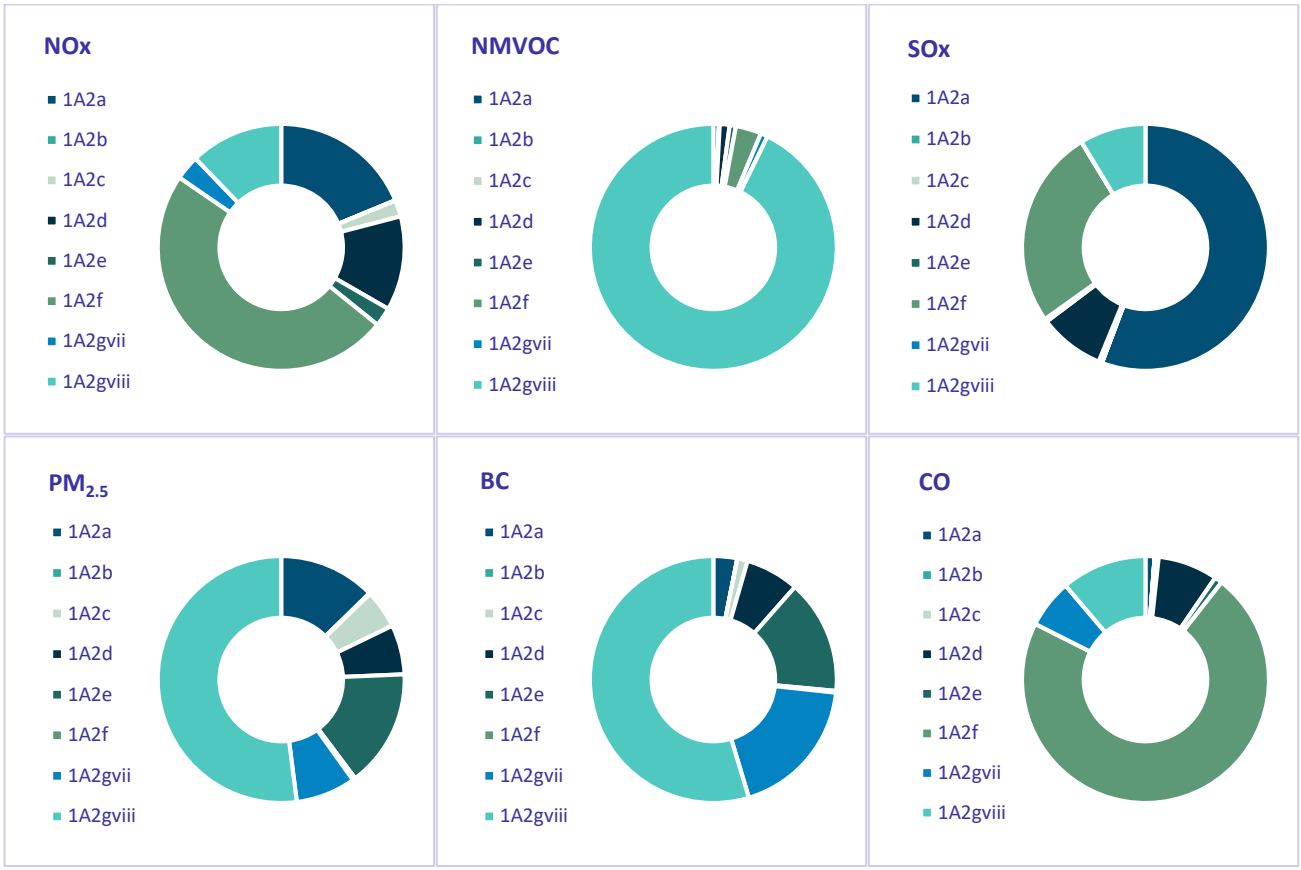
3.5.1 Overview

The category manufacturing industries and construction **1A2** is focused on the following combustion subcategories: Iron and steel (**1A2a**); Non-ferrous metals (**1A2b**); Chemicals (**1A2c**); Pulp, paper, and print (**1A2d**); Food processing, beverages, and tobacco (**1A2e**); Non-metallic minerals (**1A2f**); and Other (**1A2g**).

The emissions depend on fuel and process activity. Relevant pollutants are generally as described for combustion: SO_2, NO_x, CO, NMVOC, particulate matter (TSP, PM_{10}, $PM_{2.5}$), black carbon (BC), heavy metals (HM), polycyclic aromatic hydrocarbons (PAH), polychlorinated dibenzo-dioxin and polychlorinated dibenzo-furans (PCDD/F) and, for some activities, polychlorinated biphenyls (PCB) and hexachlorobenzene (HCB). NH_3 emissions from solid biomass combustion are reported as 'NO' because measurements show that NH_3 is not relevant (***Recommendation No 1A2-SK-2022-0001***).

Manufacturing industries and construction are substantial contributors to most air pollutants. Category **1A2a**, **1A2d**, **1A2f** and **1A2gviii** are the key categories for various air pollutants (***Figure 3.3***).

Figure 3.3: *Share of emissions of the main pollutants in 1A2 in 2022*



3.5.2 Stationary combustion in manufacturing industries and construction: Iron and steel (NFR 1A2a)

3.5.2.1 Overview

The iron and steel industry is one of the most energy-intensive industrial branches in the Slovak Republic and it is represented by one biggest iron and steel companies in the Slovak Republic (U.S. Steel). The total volume of fuels allocated in **1A2a** expressed in energy units represented almost 19 400 TJ in 2022. Emissions of main pollutants are calculated using the Tier 3 method – facility data from the operator. Emissions have an overall decreasing trend except for SOx in 2000 when a single operator used to duel with a higher share of sulphur. Activities listed within this category are shown in ***Table 3.22***.

Table 3.22: *Activities according to national categorization included in 1A2a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE/MEDIUM S.: NACE 24.1-24.3; 24.51-24.52
2.99. Other industrial production and metal processing if: *a) the combustion of fuel with nominated thermal input in MW is a part of technology* *b) the share of mass flow of emissions before the separator and mass flow of air pollutants is defined in annex 3 in national legislation (carcinogenic effect, organic gases and other compounds)*	LARGE/MEDIUM S.: NACE 24.1-24.3; 24.51-24.53

The overview of emissions in this category is shown in ***Table 3.23***.

Table 3.23: *Overview of emissions in the category 1A2a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	5.1282	0.0362	4.3832	NO	3.6566	3.9214	4.5386	0.2336	0.4202
1995	5.2063	0.0368	4.4499	NO	3.7123	3.9811	4.6077	0.2372	0.4266
2000	6.0894	0.0367	9.7871	NO	4.5250	4.8526	5.6164	0.2890	0.7581
2005	5.7510	0.0287	4.8804	NO	0.2555	0.2589	0.2870	0.0163	0.4317
2010	3.8203	0.0509	3.9807	NO	0.1790	0.1836	0.2007	0.0114	0.6545

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2011	2.8316	0.0487	2.8248	NO	0.1209	0.1235	0.1360	0.0077	0.5703
2012	3.3872	0.0570	3.8774	NO	0.0642	0.0784	0.0979	0.0041	0.7353
2013	3.2981	0.0560	3.6654	NO	0.0503	0.0595	0.0746	0.0032	0.8143
2014	3.0680	0.0612	2.7901	NO	0.0616	0.0725	0.0890	0.0039	0.5220
2015	3.0669	0.0424	2.3135	NO	0.0418	0.0517	0.0728	0.0027	0.5840
2016	2.5749	0.0381	1.9776	0.0000	0.0377	0.0448	0.0539	0.0024	0.3735
2017	2.1911	0.0339	1.5720	NO	0.0299	0.0360	0.0481	0.0019	0.3239
2018	2.5348	0.0474	1.3473	NO	0.0347	0.0401	0.0545	0.0022	0.3129
2019	0.9780	0.0373	0.5527	NO	0.0328	0.0362	0.0387	0.0021	0.1024
2020	0.9744	0.0375	0.6027	NO	0.0206	0.0234	0.0254	0.0013	0.0991
2021	2.0873	0.0538	0.7029	NO	0.0366	0.0402	0.0424	0.0023	0.1848
2022	1.7550	0.0386	0.7405	NO	0.0308	0.0339	0.0357	0.0020	0.1628
1990/2022	**-66%**	**6%**	**-83%**	**-**	**-99%**	**-99%**	**-99%**	**-99%**	**-61%**
2021/2022	**-16%**	**-28%**	**5%**	**-**	**-16%**	**-16%**	**-16%**	**-16%**	**-12%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0325	0.0085	0.0190	0.0092	0.0494	0.0858	0.0571	0.2350	0.1975
1995	0.0334	0.0087	0.0195	0.0094	0.0507	0.0880	0.0585	0.2410	0.2026
2000	0.0344	0.0090	0.0202	0.0098	0.0523	0.0909	0.0603	0.2489	0.2091
2005	0.0425	0.0042	0.0118	0.0069	0.0702	0.1215	0.0709	0.3586	0.2968
2010	0.0283	0.0028	0.0085	0.0054	0.0468	0.0810	0.0472	0.2388	0.1977
2011	0.0285	0.0028	0.0086	0.0054	0.0470	0.0814	0.0477	0.2402	0.1989
2012	0.0314	0.0031	0.0092	0.0058	0.0519	0.0898	0.0563	0.2648	0.2204
2013	0.0310	0.0031	0.0091	0.0056	0.0512	0.0887	0.0517	0.2617	0.2165
2014	0.0280	0.0028	0.0084	0.0054	0.0462	0.0800	0.0466	0.2361	0.1952
2015	0.0276	0.0027	0.0083	0.0052	0.0456	0.0790	0.0460	0.2330	0.1926
2016	0.0194	0.0019	0.0063	0.0042	0.0320	0.0555	0.0323	0.1636	0.1354
2017	0.0197	0.0020	0.0063	0.0042	0.0326	0.0564	0.0335	0.1665	0.1380
2018	0.0252	0.0025	0.0078	0.0051	0.0416	0.0720	0.0421	0.2124	0.1757
2019	0.0225	0.0022	0.0066	0.0042	0.0370	0.0642	0.0404	0.1891	0.1575
2020	0.0214	0.0022	0.0063	0.0040	0.0352	0.0606	0.0370	0.1785	0.1528
2021	0.0216	0.0022	0.0067	0.0046	0.0353	0.0610	0.0421	0.1793	0.1551
2022	0.0199	0.0020	0.0061	0.0039	0.0327	0.0565	0.0329	0.1665	0.1407
1990/2022	**-39%**	**-76%**	**-68%**	**-57%**	**-34%**	**-34%**	**-42%**	**-29%**	**-29%**
2021/2022	**-8%**	**-10%**	**-10%**	**-14%**	**-7%**	**-7%**	**-22%**	**-7%**	**-9%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0288	0.0001	0.0001	0.0001	0.0001	0.0003	0.0689	0.0045
1995	0.0295	0.0001	0.0001	0.0001	0.0001	0.0003	0.0707	0.0046
2000	0.0307	0.0001	0.0001	0.0001	0.0001	0.0003	0.0730	0.0048
2005	0.0270	0.0001	0.0001	0.0001	0.0001	0.0003	0.1044	0.0184
2010	0.0216	0.0000	0.0001	0.0001	0.0001	0.0002	0.0696	0.0122
2011	0.0216	0.0000	0.0001	0.0001	0.0001	0.0002	0.0700	0.0123
2012	0.0226	0.0000	0.0001	0.0001	0.0001	0.0002	0.0771	0.0136
2013	0.0222	0.0000	0.0001	0.0001	0.0001	0.0002	0.0762	0.0134
2014	0.0212	0.0000	0.0001	0.0001	0.0001	0.0002	0.0688	0.0121
2015	0.0208	0.0000	0.0001	0.0001	0.0000	0.0002	0.0679	0.0119
2016	0.0168	0.0000	0.0001	0.0000	0.0000	0.0002	0.0477	0.0084
2017	0.0168	0.0000	0.0001	0.0000	0.0000	0.0002	0.0485	0.0085
2018	0.0203	0.0000	0.0001	0.0000	0.0000	0.0002	0.0619	0.0109

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2019	0.0165	0.0000	0.0001	0.0000	0.0000	0.0002	0.0551	0.0097
2020	0.0164	0.0001	0.0002	0.0001	0.0001	0.0005	0.0521	0.0092
2021	0.0188	0.0001	0.0002	0.0001	0.0001	0.0005	0.0523	0.0093
2022	0.0162	0.0001	0.0001	0.0001	0.0001	0.0003	0.0485	0.0085
1990/2022	**-44%**	**42%**	**34%**	**-24%**	**-10%**	**10%**	**-30%**	**88%**
2021/2022	**-14%**	**-30%**	**-30%**	**-24%**	**-23%**	**-28%**	**-7%**	**-8%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.24*** below.

Table 3.24: *Overview of activity data in the category 1A2a*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	5.93	18 622.60	1 451.96	NO	NO
1995	5.97	18 979.64	1 400.55	NO	NO
2000	5.50	20 111.83	1 465.23	NO	NO
2005	NO	27 089.95	1 319.92	NO	NO
2010	0.35	24 392.52	1 756.07	NO	NO
2011	2.82	23 921.25	2 160.77	NO	NO
2012	17.10	24 668.61	1 740.10	NO	NO
2013	2.23	23 780.86	2 085.08	NO	NO
2014	1.36	23 837.29	1 849.90	NO	NO
2015	0.60	23 489.52	1 561.83	NO	NO
2016	1.30	20 577.44	1 413.57	NO	NO
2017	4.64	20 294.87	1 446.04	NO	NO
2018	2.89	24 210.47	1 295.23	NO	NO
2019	14.44	18 054.40	1 401.57	NO	NO
2020	9.55	16 955.23	1 424.88	8.72	NO
2021	28.80	21 631.33	1 301.52	8.91	NO
2022	1.53	18 447.22	944.67	5.61	NO
1990/2022	**-74%**	**-1%**	**-35%**	**-**	**-**
2021/2022	**-95%**	**-15%**	**-27%**	**-37%**	**-**

3.5.2.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.25***).

Table 3.25: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	255.38	1.80	218.28	226.02	81%	86%	20.93

The emissions of heavy metals and POPs are calculated at the Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore these detailed methodologies could be used focused on the combinations of the main installation types/fuels used in our country. Emission factors used for the

calculation of emissions of heavy metals and POPs are default EF from EMEP/EEA GB$_{2019}$, expert estimation and special source[1] (***Table 3.26***).

The annual emission is determined by activity data and an emission factor:

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

Where:

E_i = annual emission of pollutant *i*,

$EF_{i,j,k}$ = default emission factor of pollutant *i* for source type *j* and fuel *k*,

$A_{j,k}$ = annual consumption of fuel *k* in source type *j*.

Table 3.26: *Emission factors for heavy metals and POPs in the category 1A2a*

TYPE OF FUEL		LIQUID FUELS				HARD COAL		
T2	**UNIT**	**ALL TYPES OF BOILERS** (≤ 5 MWth)	**ALL TYPES OF BOILERS** (5 – 50 MWth)	**ALL TYPES OF BOILERS** (> 100 MWth)	**STATIONARY ENGINES**	**FIXED BED BOILER** (≤ 5 MWth)	**FIXED BED BOILER** (> 100 MWth)	**PULVERIZED COAL-FIRED BOILERS** (> 100 MWth)
Pb	[mg/GJ]	4.56	4.56	4.56	4.07	13.687	2.656	2.722
Cd	[mg/GJ]	1.2	1.2	1.2	1.36	2.456	0.823	0.268
Hg	[mg/GJ]	0.341	0.341	0.341	1.36	9.051	1.744	0.668
As	[mg/GJ]	3.98	3.98	3.98	1.81	9.402	0.243	0.339
Cr	[mg/GJ]	2.55	2.55	2.55	1.36	15	4.5	4.5
Cu	[mg/GJ]	5.31	5.31	5.31	2.72	10	7.8	7.8
Ni	[mg/GJ]	255	255	255	1.36	10	4.9	4.537
Se	[mg/GJ]	2.06	2.06	2.06	6.79	2	23	23
Zn	[mg/GJ]	87.8	87.8	87.8	1.81	150	19	19
PCDD/F	[ng I-TEQ/GJ]	2.5	2.5	2.5	0.99	14.657	2.299	1.314
B(a)P	[mg/GJ]	3.678	3.678	3.678	116	10.975	2.4	2.844
B(b)F	[mg/GJ]	12.673	12.673	12.673	502	18.54	4.768	5.433
B(k)F	[mg/GJ]	3.968	3.968	3.968	98.7	10.966	3.085	3.786
I()P	[mg/GJ]	6.484	6.484	6.484	187	5.956	2.08	3.662
PAHs	[mg/GJ]	26.803	26.803	26.803	903.7	46.437	12.33	15.725
HCB	[µg/GJ]	-	-	-	0.22	6.7	6.7	6.7
PCBs	[µg/GJ]	3.334	3.334	3.334	0.00013	8.073	0.395	1.176

TYPE OF FUEL		BROWN COAL		GASEOUS FUELS				BIOMASS
T2	**UNIT**	**FIXED BED BOILER** (≤ 5 MWTH)	**FIXED BED BOILER** (5–50 MWTH)	**ALL TYPES OF BOILERS** (≤ 5 MWTH)	**ALL TYPES OF BOILERS** (5–50 MWTH)	**ALL TYPES OF BOILERS** (> 100 MWTH)	**GAS TURBINES**	**FIXED BED BOILER** (≤ 5 MWTH)
Pb	[mg/GJ]	59.471	6.67	0.0015	0.0015	0.0015	0.0015	27
Cd	[mg/GJ]	1.294	0.495	0.00025	0.00025	0.00025	0.00025	13
Hg	[mg/GJ]	2.382	1.924	0.1	0.1	0.1	0.1	0.56
As	[mg/GJ]	60.967	2.102	0.12	0.12	0.12	0.12	0.19
Cr	[mg/GJ]	38.383	9.1	0.00076	0.00076	0.00076	0.00076	23
Cu	[mg/GJ]	69.545	1	0.000076	0.000076	0.000076	0.000076	6
Ni	[mg/GJ]	62.104	27.67	0.00051	0.00051	0.00051	0.00051	2
Se	[mg/GJ]	5.192	45	0.0112	0.0112	0.0112	0.0112	0.5
Zn	[mg/GJ]	30.756	8.8	0.0015	0.0015	0.0015	0.0015	512
PCDD/F	[ng I-TEQ/GJ]	4.986	7.68	0.5	0.5	0.5	0.5	100
B(a)P	[µg/GJ]	320.061	3.147	0.56	0.56	0.56	0.56	10000
B(b)F	[µg/GJ]	518.482	7.973	0.84	0.84	0.84	0.84	16000

[1] MODLÍK, M., 2017. Emission factors of heavy metals and POPs from combustion processes. Available at: http://portal.chmi.cz/files/portal/docs/uoco/oez/embil/EmisniFaktoryTKaPOPs.pdf

TYPE OF FUEL		BROWN COAL		GASEOUS FUELS				BIOMASS
T2	UNIT	FIXED BED BOILER (≤ 5 MWTH)	FIXED BED BOILER (5–50 MWTH)	ALL TYPES OF BOILERS (≤ 5 MWTH)	ALL TYPES OF BOILERS (5–50 MWTH)	ALL TYPES OF BOILERS (> 100 MWTH)	GAS TURBINES	FIXED BED BOILER (≤ 5 MWTH)
B(k)F	[µg/GJ]	518.482	4.047	0.84	0.84	0.84	0.84	5000
I()P	[µg/GJ]	400.322	4.203	0.84	0.84	0.84	0.84	4000
PAHs	[µg/GJ]	1757.347	19.37	3.08	3.08	3.08	3.08	35000
HCB	[µg/GJ]	6.7	6.7	0.00308	0.00308	0.00308	0.00308	5
PCBs	[ng/GJ]	5.059	0.757	-	-	-	-	0.007

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.27***). The calculated BC emission values are presented in ***Table 3.23***.

Table 3.27: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.5.2.3 Completeness

Emissions are well covered.

3.5.2.4 Source-specific recalculations

No recalculation n this submission.

3.5.3 Stationary combustion in manufacturing industries and construction: Non-ferrous metals (NFR 1A2b)

3.5.3.1 Overview

The category is focused on combustion processes in the production of non-ferrous metals. Activities listed within this category are shown in ***Table 3.28***.

Table 3.28: *Activities according to national categorization included in 1A2b*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE/MEDIUM S.: NACE 24.4-24.3; 24.53-24.54
2.99. Other industrial production and metal processing if: *a) the combustion of fuel with nominated thermal input in MW is a part of technology* *b) the share of mass flow of emissions before the separator and mass flow of air pollutants defined in annex 3 in national legislation (carcinogenic effect, organic gases and other compounds)*	LARGE/MEDIUM S.: NACE 24.4-24.3; 24.53-24.54

The overview of emissions in this category is shown in ***Table 3.29***.

Table 3.29: *Overview of emissions in the category 1A2b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0040	0.0001	0.0002	NO	0.0002	0.0002	0.0003	0.0000	0.0014
1995	0.0044	0.0001	0.0002	NO	0.0002	0.0003	0.0003	0.0000	0.0016
2000	0.0011	0.0001	0.0000	NO	0.0000	0.0000	0.0001	0.0000	0.0004
2005	0.0036	0.0001	0.0004	NO	0.0002	0.0002	0.0006	0.0000	0.0015
2010	0.0033	0.0002	0.0000	NO	0.0002	0.0002	0.0002	0.0000	0.0013
2011	0.0035	0.0002	0.0000	NO	0.0001	0.0002	0.0002	0.0000	0.0016

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2012	0.0036	0.0002	0.0000	NO	0.0002	0.0002	0.0002	0.0000	0.0014
2013	0.0035	0.0002	0.0000	NO	0.0002	0.0002	0.0002	0.0000	0.0014
2014	0.0039	0.0002	0.0000	NO	0.0002	0.0002	0.0002	0.0000	0.0016
2015	0.0041	0.0002	0.0000	NO	0.0002	0.0002	0.0002	0.0000	0.0017
2016	0.0042	0.0003	0.0000	NO	0.0002	0.0002	0.0002	0.0000	0.0017
2017	0.0050	0.0003	0.0000	NO	0.0002	0.0002	0.0003	0.0000	0.0020
2018	0.0053	0.0003	0.0000	NO	0.0002	0.0003	0.0003	0.0000	0.0021
2019	0.0050	0.0003	0.0000	NO	0.0002	0.0002	0.0003	0.0000	0.0020
2020	0.0057	0.0004	0.0000	NO	0.0002	0.0003	0.0003	0.0000	0.0023
2021	0.0062	0.0004	0.0000	NO	0.0003	0.0003	0.0003	0.0000	0.0025
2022	0.0055	0.0003	0.0000	NO	0.0003	0.0003	0.0003	0.0000	0.0022
1990/2022	**40%**	**361%**	**-78%**	**-**	**21%**	**25%**	**12%**	**23%**	**60%**
2021/2022	**-10%**	**-10%**	**-13%**	**-**	**-3%**	**-2%**	**-1%**	**-6%**	**-10%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
1995	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2005	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
2010	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2011	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2013	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2015	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2016	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2017	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2018	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2019	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2020	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2021	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2022	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
1990/2022	**59%**	**59%**	**59%**	**59%**	**59%**	**60%**	**59%**	**59%**	**59%**
2021/2022	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0000	0.0001	0.0002	0.0001	0.0001	0.0005	NE	NE
1995	0.0000	0.0001	0.0003	0.0001	0.0001	0.0005	NE	NE
2000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0003	NE	NE
2005	0.0001	0.0001	0.0002	0.0001	0.0001	0.0005	0.0000	0.0001
2010	0.0000	0.0001	0.0002	0.0001	0.0001	0.0004	NE	NE
2011	0.0000	0.0001	0.0002	0.0001	0.0001	0.0005	NE	NE
2012	0.0000	0.0001	0.0002	0.0001	0.0001	0.0005	NE	NE
2013	0.0001	0.0001	0.0003	0.0001	0.0001	0.0006	NE	NE
2014	0.0000	0.0000	0.0002	0.0001	0.0001	0.0004	NE	NE
2015	0.0001	0.0001	0.0003	0.0001	0.0001	0.0006	NE	NE
2016	0.0001	0.0001	0.0003	0.0001	0.0001	0.0006	NE	NE
2017	0.0001	0.0001	0.0003	0.0001	0.0001	0.0007	NE	NE
2018	0.0001	0.0001	0.0004	0.0001	0.0001	0.0007	NE	NE

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2019	0.0001	0.0001	0.0003	0.0001	0.0001	0.0007	NE	NE
2020	0.0001	0.0001	0.0004	0.0001	0.0001	0.0008	NE	NE
2021	0.0001	0.0001	0.0004	0.0002	0.0002	0.0008	NE	NE
2022	0.0001	0.0001	0.0004	0.0001	0.0001	0.0008	NE	NE
1990/2022	**59%**	**59%**	**59%**	**59%**	**59%**	**59%**	**-**	**-**
2021/2022	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-**	**-**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.30*** below.

Table 3.30: *Overview of activity data in the category 1A2b*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	NO	NO	82.27	NO	NO
1995	NO	NO	92.15	NO	NO
2000	NO	NO	50.36	NO	NO
2005	NO	0.48	74.88	NO	NO
2010	NO	NO	76.40	NO	NO
2011	NO	NO	81.65	NO	NO
2012	NO	NO	83.09	NO	NO
2013	0.01	NO	102.13	NO	NO
2014	0.01	NO	61.46	NO	NO
2015	0.01	NO	97.30	NO	NO
2016	0.01	NO	99.67	NO	NO
2017	0.01	NO	116.37	NO	NO
2018	0.01	NO	123.28	NO	NO
2019	0.01	NO	117.47	NO	NO
2020	0.01	NO	134.22	NO	NO
2021	0.02	NO	144.64	NO	NO
2022	0.01	NO	130.80	NO	NO
1990/2022	**-**	**-**	**59%**	**-**	**-**
2021/2022	**-69%**	**-**	**-10%**	**-**	**-**

3.5.3.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.31***).

Table 3.31: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	48.12	0.90	1.92	3.41	78%	85%	16.93

HMs and POPs emissions were calculated using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.32***).

Table 3.32: *Emission factors for heavy metals and POPs in the category 1A2b*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.08	134	0.011	27

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Cd	[mg/GJ]	0.006	1.8	0.0009	13
Hg	[mg/GJ]	0.12	7.9	0.54	0.56
As	[mg/GJ]	0.03	4	0.1	0.19
Cr	[mg/GJ]	0.2	13.5	0.013	23
Cu	[mg/GJ]	0.22	17.5	0.002600	6
Ni	[mg/GJ]	0.008	13	0.013	2
Se	[mg/GJ]	0.11	1.8	0.058	0.5
Zn	[mg/GJ]	29	200	0.73	512
PCDD/F	[ng I-TEQ/GJ]	1.4	203	0.52	100
B(a)P	[mg/GJ]	1.9	45.5	0.72	10
B(b)F	[mg/GJ]	15	58.9	2.9	16
B(k)F	[mg/GJ]	1.7	23.7	1.1	5
I()P	[mg/GJ]	1.5	18.5	1.08	4
PAHs	[mg/GJ]	20.1	146.6	5.8	35
HCB	[µg/GJ]	-	0.62	-	5
PCBs	[µg/GJ]	-	170	-	0.06

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.33***). The calculated BC emission values are presented in ***Table 3.29***.

Table 3.33: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.5.3.3 Completeness

POPs (HCB and PCB) are reported as NE except in the years 2003-2007, as only in this period solid fuels were used. For other used fuels, the emission factors are not available.

3.5.3.4 Source-specific recalculations

No recalculations in this submission.

3.5.4 Stationary combustion in manufacturing industries and construction: Chemicals (NFR 1A2c)

3.5.4.1 Overview

Combustion in the chemicals sector ranges from conventional fuels in boiler plants and recovery of process by-products using thermal oxidisers to process-specific combustion activities. The category includes emissions from fuel combustion in the chemical industry. The production in the chemical industry is very wide and all sources with mixed emissions were allocated into **2B10a**.

Activities listed within this category are shown in ***Table 3.34***. The emissions from the combustion of industrial waste are included in this category because of the energy recovery from the combustion process.

Table 3.34: *Activities according to national categorization included in 1A2c*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE/MEDIUM S.: NACE 20-22; 24-25

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
5.1. Industrial waste incineration	combustion

The overview of emissions in this category is shown in ***Table 3.35***.

Table 3.35: *Overview of emissions in the category 1A2c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.7208	0.0375	0.4394	NO	0.0311	0.0462	0.0687	0.0023	0.1880
1995	0.6853	0.0357	0.4178	NO	0.0296	0.0439	0.0653	0.0022	0.1787
2000	0.3992	0.0207	0.2715	NO	0.0232	0.0345	0.0513	0.0018	0.1221
2005	0.2958	0.0057	0.0595	NO	0.0165	0.0169	0.0206	0.0067	0.0472
2010	0.2064	0.0050	0.0092	NO	0.0108	0.0120	0.0153	0.0008	0.0606
2011	0.2299	0.0056	0.0128	NO	0.0119	0.0128	0.0162	0.0009	0.0649
2012	0.2375	0.0050	0.0119	NO	0.0120	0.0130	0.0162	0.0009	0.0667
2013	0.2275	0.0059	0.0120	NO	0.0116	0.0125	0.0151	0.0009	0.0655
2014	0.2301	0.0054	0.0125	NO	0.0100	0.0104	0.0107	0.0007	0.0651
2015	0.2402	0.0060	0.0145	NO	0.0107	0.0109	0.0112	0.0006	0.0807
2016	0.2368	0.0059	0.0150	NO	0.0117	0.0122	0.0127	0.0011	0.0787
2017	0.2372	0.0058	0.0274	NO	0.0121	0.0127	0.0133	0.0009	0.0741
2018	0.2534	0.0057	0.0197	NO	0.0113	0.0117	0.0121	0.0008	0.0708
2019	0.2343	0.0057	0.0209	NO	0.0106	0.0109	0.0116	0.0006	0.0685
2020	0.2105	0.0053	0.0068	NO	0.0101	0.0104	0.0108	0.0014	0.0675
2021	0.2121	0.0052	0.0033	NO	0.0124	0.0128	0.0132	0.0007	0.0614
2022	0.1994	0.0047	0.0060	NO	0.0122	0.0127	0.0132	0.0009	0.0705
1990/2022	**-72%**	**-87%**	**-99%**	**-**	**-61%**	**-73%**	**-81%**	**-63%**	**-63%**
2021/2022	**-6%**	**-9%**	**82%**	**-**	**-1%**	**-1%**	**-1%**	**14%**	**15%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.6213	0.0091	0.0408	0.0192	0.0616	0.0798	0.0605	0.0087	0.9311
1995	0.5526	0.0081	0.0367	0.0171	0.0548	0.0709	0.0538	0.0078	0.8296
2000	0.6193	0.0089	0.0403	0.0191	0.0617	0.0798	0.0603	0.0087	0.9339
2005	0.0102	0.0008	0.0026	0.0005	0.0002	0.0002	0.0011	0.0003	0.0155
2010	0.0096	0.0007	0.0025	0.0005	0.0002	0.0001	0.0011	0.0002	0.0060
2011	0.0095	0.0007	0.0027	0.0006	0.0002	0.0001	0.0011	0.0003	0.0060
2012	0.0078	0.0006	0.0027	0.0005	0.0002	0.0001	0.0009	0.0003	0.0060
2013	0.0069	0.0006	0.0027	0.0005	0.0002	0.0001	0.0008	0.0003	0.0063
2014	0.0052	0.0001	0.0027	0.0005	0.0001	0.0000	0.0006	0.0003	0.0051
2015	0.0061	0.0001	0.0030	0.0006	0.0001	0.0000	0.0007	0.0003	0.0051
2016	0.0064	0.0002	0.0029	0.0006	0.0002	0.0001	0.0007	0.0003	0.0075
2017	0.0072	0.0001	0.0029	0.0006	0.0002	0.0000	0.0008	0.0003	0.0060
2018	0.0068	0.0001	0.0029	0.0006	0.0001	0.0000	0.0008	0.0003	0.0050
2019	0.0054	0.0001	0.0041	0.0008	0.0001	0.0000	0.0007	0.0004	0.0063
2020	0.0060	0.0003	0.0026	0.0005	0.0004	0.0001	0.0007	0.0003	0.0112
2021	0.0039	0.0001	0.0026	0.0005	0.0001	0.0000	0.0005	0.0003	0.0044
2022	0.0043	0.0001	0.0022	0.0004	0.0001	0.0000	0.0005	0.0002	0.0040
1990/2022	**-99%**	**-99%**	**-95%**	**-98%**	**-100%**	**-100%**	**-99%**	**-98%**	**-100%**
2021/2022	**11%**	**8%**	**-15%**	**-14%**	**-5%**	**-3%**	**8%**	**-17%**	**-10%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	4.0019	0.2138	0.2989	0.1175	0.0935	0.8992	0.0204	0.7736
1995	3.6495	0.1906	0.2686	0.1053	0.0840	0.8099	0.0186	0.6876

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2000	3.3577	0.2136	0.2985	0.1169	0.0930	0.8607	0.0167	0.7741
2005	2.5939	0.0037	0.0175	0.0050	0.0048	0.1791	0.0148	0.0007
2010	2.3575	0.0031	0.0117	0.0045	0.0043	0.1581	0.0135	0.0009
2011	2.3660	0.0033	0.0128	0.0048	0.0047	0.1607	0.0135	0.0008
2012	1.9210	0.0034	0.0131	0.0050	0.0049	0.1359	0.0110	0.0007
2013	1.6988	0.0034	0.0133	0.0050	0.0049	0.1236	0.0097	0.0006
2014	0.0028	0.0033	0.0132	0.0050	0.0049	0.1035	0.0077	0.0001
2015	0.0030	0.0037	0.0146	0.0055	0.0054	0.1200	0.0091	0.0000
2016	0.0034	0.0036	0.0145	0.0055	0.0054	0.1224	0.0094	0.0000
2017	0.0031	0.0036	0.0141	0.0054	0.0053	0.1351	0.0107	0.0001
2018	0.0029	0.0035	0.0139	0.0053	0.0052	0.1298	0.0102	0.0000
2019	0.0040	0.0052	0.0207	0.0078	0.0077	0.1228	0.0082	0.0000
2020	0.0038	0.0033	0.0127	0.0048	0.0047	0.1103	0.0086	0.0000
2021	0.0026	0.0032	0.0129	0.0049	0.0048	0.0836	0.0058	0.0000
2022	0.0022	0.0027	0.0108	0.0041	0.0040	0.0857	0.0064	0.0000
1990/2022	**-100%**	**-99%**	**-96%**	**-97%**	**-96%**	**-90%**	**-68%**	**-100%**
2021/2022	**-14%**	**-16%**	**-16%**	**-17%**	**-17%**	**3%**	**11%**	**6%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.36*** below.

Table 3.36: *Overview of activity data in the category 1A2c*

YEAR	WASTE INCINERATED [kt]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	8.78	522.62	4 550.61	7 926.22	NO	NO
1995	8.07	516.75	4 044.80	7 796.65	NO	NO
2000	6.94	617.35	4 553.46	7 244.47	NO	564.77
2005	7.40	413.42	4.01	3 821.97	4.70	192.44
2010	6.73	1.20	5.58	3 887.23	23.81	161.41
2011	6.75	1.16	4.55	4 269.22	21.95	162.00
2012	5.48	14.03	4.30	4 372.33	21.09	131.48
2013	4.84	13.99	3.53	4 372.89	111.40	115.27
2014	3.85	14.45	0.58	4 295.01	219.22	91.42
2015	4.54	7.26	0.28	4 750.59	264.49	108.35
2016	4.67	3.18	0.24	4 625.45	320.25	108.42
2017	5.34	0.98	0.42	4 535.95	311.32	127.46
2018	5.10	3.48	0.17	4 490.38	271.79	122.38
2019	4.07	3.40	0.07	6 874.85	245.09	107.45
2020	4.24	8.97	0.00	4 133.26	170.60	106.90
2021	2.89	3.39	NO	4 280.55	154.65	72.12
2022	3.21	8.98	NO	3 484.55	205.14	80.22
1990/2022	**-63%**	**-98%**	**-**	**-56%**	**-**	**-**
2021/2022	**11%**	**165%**	**-**	**-19%**	**33%**	**11%**

3.5.4.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.37***).

Table 3.37: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	55.45	2.89	33.80	5.29	45%	67%	14.46

HMs and POPs emissions were calculated using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.38***).

Table 3.38: *Emission factors for heavy metals and POPs in the category 1A2c*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.08	134	0.011	27
Cd	[mg/GJ]	0.006	1.8	0.0009	13
Hg	[mg/GJ]	0.12	7.9	0.54	0.56
As	[mg/GJ]	0.03	4	0.1	0.19
Cr	[mg/GJ]	0.2	13.5	0.013	23
Cu	[mg/GJ]	0.22	17.5	0.002600	6
Ni	[mg/GJ]	0.008	13	0.013	2
Se	[mg/GJ]	0.11	1.8	0.058	0.5
Zn	[mg/GJ]	29	200	0.73	512
PCDD/F	[ng I-TEQ/GJ]	1.4	203	0.52	100
B(a)P	[mg/GJ]	1.9	45.5	0.72	10
B(b)F	[mg/GJ]	15	58.9	2.9	16
B(k)F	[mg/GJ]	1.7	23.7	1.1	5
I()P	[mg/GJ]	1.5	18.5	1.08	4
PAHs	[mg/GJ]	20.1	146.6	5.8	35
HCB	[µg/GJ]	-	0.62	-	5
PCBs	[µg/GJ]	-	170	-	0.06

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.39***). The calculated BC emission values are presented in ***Table 3.35***.

Table 3.39: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.5.4.3 Completeness

Emissions are well covered.

3.5.4.4 Source-specific recalculations

The recalculations for BC, HM and POPs were made based on changes in activity data (corrections in categorization of fuels for the year 2019-2021). The results of the recalculations are in ***Table 3.40***.

Table 3.40: *Previous and revised emissions in the category 1A2c*

YEAR	BC [kt]			Pb [t]			Cd [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	0.0007	0.0006	-15%	0.0055	0.0054	-1%	0.0001	0.0001	-22%
2020	0.0014	0.0014	-2%	0.0060	0.0060	-0.43%	0.0003	0.0003	-5%

YEAR	BC [kt]			Pb [t]			Cd [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	0.0010	0.0007	-22%	0.0039	0.0039	-2%	0.0001	0.0001	-31%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	0.0002	0.0001	-22%	0.0000	0.0000	-25%	0.0007	0.0007	-1%
2020	0.0004	0.0004	-5%	0.0001	0.0001	-5%	0.0007	0.0007	-0.28%
2021	0.0002	0.0001	-32%	0.0000	0.0000	-35%	0.0005	0.0005	-1%

YEAR	Zn [t]			PCDD/F [g I-TEQ]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	0.0073	0.0063	-13%	0.0042	0.0040	-4%	0.0000	0.0000	-1%
2020	0.0116	0.0112	-4%	0.0039	0.0038	-2%	0.0000	0.0000	-6%
2021	0.0056	0.0044	-21%	0.0028	0.0026	-8%	0.0000	0.0000	-50%

3.5.5 Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print (NFR 1A2d)

3.5.5.1 Overview

The production of pulp and paper requires considerable amounts of steam and power. Most pulp and paper mills produce their own steam in one or more industrial boilers or combined heat and power (CHP) units which burn fossil fuels and/or wood residues.

Activities listed within this category are shown in ***Table 3.41***.

Table 3.41: *Activities according to national categorization included in 1A2d*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE/MEDIUM S.: NACE 17-18; 24-25
4.18. Manufacture of pulp and derivatives thereof, including the treatment of waste to products of this manufacture	
4.36. Production and refinement of paper, cardboard with projected output in t/d	

The category includes emissions from fuel combustion in the paper industry. The trends in emissions of pollutants, for which is this category key, are provided in the following figures. A decrease in 2004 and an increase in 2015 in emissions of HMs and POPs was caused by a single source which used almost 3x more biomass fuel in 2004 and in 2015, the same source used 2x less biomass fuel. A decrease in emissions of PCBs in 2010 is connected with a significant reduction in the use of solid fuels in this category. An overview of the emissions is shown in ***Table 3.42***.

Table 3.42: *Overview of emissions in the category 1A2d*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.3048	0.0321	12.6102	NO	0.1983	0.2240	0.2985	0.0403	5.5380
1995	3.3055	0.0321	12.6132	NO	0.1983	0.2240	0.2986	0.0407	5.5393
2000	1.9772	0.1984	7.3805	NO	0.1261	0.1425	0.1899	0.0280	3.0044
2005	2.1433	0.1611	3.3816	NO	0.0748	0.0887	0.1205	0.0187	2.1215
2010	1.2829	0.0725	0.2672	0.0039	0.0245	0.0279	0.0424	0.0068	1.8493
2011	1.2395	0.0679	0.2202	0.0038	0.0281	0.0315	0.0472	0.0079	2.0261
2012	1.1296	0.0707	0.1503	0.0029	0.0253	0.0292	0.0487	0.0071	1.7745
2013	1.0277	0.0253	0.1800	0.0029	0.0220	0.0254	0.0411	0.0062	1.8270
2014	0.9283	0.0264	0.2292	0.0026	0.0164	0.0164	0.0164	0.0046	1.6509
2015	1.0847	0.0364	0.1637	0.0002	0.0127	0.0134	0.0148	0.0036	0.9662
2016	1.1150	0.0462	0.0969	0.0031	0.0181	0.0181	0.0181	0.0051	1.9663

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2017	1.0995	0.0749	0.2004	0.0072	0.0120	0.0121	0.0122	0.0033	0.4761
2018	0.9907	0.0763	0.0596	0.0079	0.0142	0.0142	0.0142	0.0040	0.2665
2019	1.0505	0.0494	0.1221	0.0033	0.0167	0.0169	0.0170	0.0047	0.3509
2020	1.1573	0.0770	0.1401	0.0105	0.0145	0.0147	0.0148	0.0041	0.6176
2021	1.3143	0.0521	0.0998	0.0030	0.0174	0.0174	0.0174	0.0049	1.1397
2022	1.1550	0.0681	0.1137	0.0080	0.0158	0.0158	0.0158	0.0044	1.0733
1990/2022	**-65%**	**112%**	**-99%**	**-**	**-92%**	**-93%**	**-95%**	**-89%**	**-81%**
2021/2022	**-12%**	**31%**	**14%**	**162%**	**-9%**	**-9%**	**-9%**	**-9%**	**-6%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0361	0.0041	0.0231	0.0127	0.0431	0.0296	0.1347	0.2115	0.1384
1995	0.0362	0.0041	0.0232	0.0128	0.0425	0.0293	0.1341	0.2087	0.1377
2000	0.0419	0.0047	0.0280	0.0159	0.0422	0.0292	0.1208	0.2078	0.1401
2005	0.0446	0.0044	0.0315	0.0193	0.0272	0.0213	0.0308	0.1370	0.1006
2010	0.0417	0.0044	0.0324	0.0226	0.0033	0.0064	0.0170	0.0180	0.0627
2011	0.0395	0.0042	0.0315	0.0219	0.0008	0.0027	0.0057	0.0057	0.0501
2012	0.0377	0.0040	0.0300	0.0209	0.0008	0.0026	0.0096	0.0057	0.0491
2013	0.0395	0.0042	0.0312	0.0216	0.0008	0.0027	0.0064	0.0057	0.0508
2014	0.0361	0.0038	0.0285	0.0197	0.0007	0.0025	0.0073	0.0048	0.0481
2015	0.0177	0.0019	0.0140	0.0099	0.0005	0.0013	0.0087	0.0024	0.0264
2016	0.0332	0.0036	0.0262	0.0182	0.0007	0.0024	0.0134	0.0044	0.0464
2017	0.0336	0.0036	0.0265	0.0184	0.0008	0.0024	0.0102	0.0045	0.0467
2018	0.0331	0.0036	0.0261	0.0182	0.0007	0.0024	0.0103	0.0044	0.0459
2019	0.0309	0.0033	0.0244	0.0170	0.0007	0.0022	0.0097	0.0041	0.0425
2020	0.0340	0.0036	0.0268	0.0186	0.0008	0.0024	0.0101	0.0045	0.0470
2021	0.0369	0.0039	0.0291	0.0202	0.0008	0.0026	0.0096	0.0049	0.0500
2022	0.0337	0.0036	0.0266	0.0184	0.0006	0.0024	0.0091	0.0045	0.0441
1990/2022	**-7%**	**-13%**	**15%**	**45%**	**-99%**	**-92%**	**-93%**	**-98%**	**-68%**
2021/2022	**-9%**	**-10%**	**-9%**	**-9%**	**-18%**	**-9%**	**-6%**	**-9%**	**-12%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.1077	0.0004	0.0012	0.0006	0.0003	0.0026	0.0822	0.0244
1995	0.1102	0.0004	0.0013	0.0006	0.0003	0.0026	0.0829	0.0249
2000	0.1533	0.0006	0.0018	0.0009	0.0004	0.0037	0.1016	0.0332
2005	0.2257	0.0009	0.0028	0.0013	0.0007	0.0057	0.1231	0.0467
2010	0.2855	0.0012	0.0036	0.0017	0.0008	0.0073	0.1279	0.0563
2011	0.2804	0.0011	0.0035	0.0017	0.0008	0.0072	0.1228	0.0548
2012	0.2668	0.0011	0.0034	0.0016	0.0008	0.0068	0.1169	0.0522
2013	0.2789	0.0012	0.0036	0.0017	0.0008	0.0072	0.1225	0.0547
2014	0.2546	0.0011	0.0033	0.0015	0.0008	0.0066	0.1117	0.0499
2015	0.1250	0.0005	0.0016	0.0008	0.0004	0.0033	0.0543	0.0243
2016	0.2336	0.0010	0.0030	0.0014	0.0007	0.0061	0.1024	0.0459
2017	0.2369	0.0010	0.0031	0.0014	0.0007	0.0062	0.1038	0.0465
2018	0.2335	0.0010	0.0030	0.0014	0.0007	0.0061	0.1023	0.0458
2019	0.2182	0.0009	0.0028	0.0013	0.0006	0.0057	0.0955	0.0428
2020	0.2394	0.0010	0.0031	0.0014	0.0007	0.0063	0.1049	0.0469
2021	0.2602	0.0011	0.0034	0.0016	0.0008	0.0068	0.1141	0.0510
2022	0.2377	0.0010	0.0030	0.0014	0.0007	0.0061	0.1045	0.0467
1990/2022	**121%**	**134%**	**143%**	**139%**	**125%**	**138%**	**27%**	**91%**
2021/2022	**-9%**	**-12%**	**-10%**	**-10%**	**-10%**	**-10%**	**-8%**	**-8%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.43*** below.

Table 3.43: *Overview of activity data in the category 1A2d*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	427.07	6 103.22	3 755.85	8 262.26	NO
1995	426.01	6 021.67	3 598.35	8 506.75	NO
2000	373.34	5 972.66	3 699.16	12 318.58	NO
2005	50.66	4 026.33	1 791.17	19 253.13	NO
2010	49.14	491.85	3 811.88	24 913.19	NO
2011	13.17	9.27	3 677.97	24 536.73	NO
2012	28.40	14.06	3 274.23	23 350.60	NO
2013	15.83	10.93	1 720.44	24 477.14	NO
2014	21.25	NO	1 630.09	22 333.75	34.71
2015	30.36	NO	2 800.74	10 852.98	34.56
2016	45.65	NO	1 818.05	20 471.67	NO
2017	33.17	NO	1 513.20	20 765.72	19.78
2018	35.04	NO	1 609.60	20 468.21	23.75
2019	31.82	NO	2 020.11	19 081.44	22.69
2020	1.73	NO	1 843.13	20 943.86	29.79
2021	1.72	NO	1 870.16	22 778.01	31.44
2022	15.59	NO	1 117.16	20 869.41	25.35
1990/2022	**-96%**	-	**-70%**	**153%**	-
2021/2022	**805%**	-	**-40%**	**-8%**	**-19%**

3.5.5.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.44***).

Table 3.44: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	178.17	1.73	679.85	16.09	66%	75%	298.57

The emissions of heavy metals and POPs are calculated at the Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore these detailed methodologies could be used focused on the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of emissions of heavy metals and POPs are default EF from EMEP/EEA GB_{2019}, expert estimation and special source (***Table 3.45***).

The annual emission is determined by activity data and an emission factor:

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

Where:

E_i = annual emission of pollutant *i*,

$EF_{i,j,k}$ = default emission factor of pollutant *i* for source type *j* and fuel *k*,

$A_{j,k}$ = annual consumption of fuel *k* in source type *j*.

Table 3.45: *Emission factors for heavy metals and POPs in the category 1A2d*

TYPE OF FUEL		LIQUID FUELS				HARD COAL	
T2	**UNIT**	**ALL TYPES OF BOILERS** (≤ 5 MWth)	**ALL TYPES OF BOILERS** (5–50 MWth)	**ALL TYPES OF BOILERS** (> 100 MWth)	**STATIONARY ENGINES**	**FIXED BED BOILER** (> 100 MWth)	**PULVERIZED COAL-FIRED BOILERS** (> 100 MWth)
Pb	[mg/GJ]	4.56	4.56	4.56	4.07	2.656	2.722
Cd	[mg/GJ]	1.2	1.2	1.2	1.36	0.823	0.268
Hg	[mg/GJ]	0.341	0.341	0.341	1.36	1.744	0.668
As	[mg/GJ]	3.98	3.98	3.98	1.81	0.243	0.339
Cr	[mg/GJ]	2.55	2.55	2.55	1.36	4.5	4.5
Cu	[mg/GJ]	5.31	5.31	5.31	2.72	7.8	7.8
Ni	[mg/GJ]	255	255	255	1.36	4.9	4.537
Se	[mg/GJ]	2.06	2.06	2.06	6.79	23	23
Zn	[mg/GJ]	87.8	87.8	87.8	1.81	19	19
PCDD/F	[ng I-TEQ/GJ]	2.5	2.5	2.5	0.99	2.299	1.314
B(a)P	[mg/GJ]	3.678	3.678	3.678	116	2.4	2.844
B(b)F	[mg/GJ]	12.673	12.673	12.673	502	4.768	5.433
B(k)F	[mg/GJ]	3.968	3.968	3.968	98.7	3.085	3.786
I()P	[mg/GJ]	6.484	6.484	6.484	187	2.08	3.662
PAHs	[mg/GJ]	26.803	26.803	26.803	903.7	12.33	15.725
HCB	[µg/GJ]	-	-	-	0.22	6.7	6.7
PCBs	[µg/GJ]	3.334	3.334	3.334	0.00013	0.395	1.176

TYPE OF FUEL		BROWN COAL		GASEOUS FUELS				
T2	**UNIT**	**FIXED BED BOILER** (> 100 MWth)	**PULVERIZED COAL-FIRED BOILERS** (> 100 MWth)	**ALL TYPES OF BOILERS** (≤ 5 MWth)	**ALL TYPES OF BOILERS** (5–50 MWth)	**ALL TYPES OF BOILERS** (50–100 MWth)	**ALL TYPES OF BOILERS** (> 100 MWth)	**GAS TURBINES**
Pb	[mg/GJ]	6.67	4.071	0.0015	0.0015	0.0015	0.0015	0.0015
Cd	[mg/GJ]	0.495	0.292	0.00025	0.00025	0.00025	0.00025	0.00025
Hg	[mg/GJ]	1.924	2.965	0.1	0.1	0.1	0.1	0.1
As	[mg/GJ]	2.102	0.76	0.12	0.12	0.12	0.12	0.12
Cr	[mg/GJ]	9.1	9.1	0.00076	0.00076	0.00076	0.00076	0.00076
Cu	[mg/GJ]	1	1	0.000076	0.000076	0.000076	0.000076	0.000076
Ni	[mg/GJ]	27.67	3.374	0.00051	0.00051	0.00051	0.00051	0.00051
Se	[mg/GJ]	45	45	0.0112	0.0112	0.0112	0.0112	0.0112
Zn	[mg/GJ]	8.8	8.8	0.0015	0.0015	0.0015	0.0015	0.0015
PCDD/F	[ng I-TEQ/GJ]	7.68	1.925	0.5	0.5	0.5	0.5	0.5
B(a)P	[µg/GJ]	3.147	4.653	0.56	0.56	0.56	0.56	0.56
B(b)F	[µg/GJ]	7.973	6.187	0.84	0.84	0.84	0.84	0.84
B(k)F	[µg/GJ]	4.047	4.915	0.84	0.84	0.84	0.84	0.84
I()P	[µg/GJ]	4.203	5.664	0.84	0.84	0.84	0.84	0.84
PAHs	[µg/GJ]	19.37	21.419	3.08	3.08	3.08	3.08	3.08
HCB	[µg/GJ]	6.7	6.7	0.00308	0.00308	0.00308	0.00308	0.00308
PCBs	[ng/GJ]	0.757	0.547	-	-	-	-	-

TYPE OF FUEL		BIOMASS					
T2	**UNIT**	**FIXED BED BOILER** (≤ 5 MWth)	**FIXED BED BOILER** (5 – 50 MWth)	**FIXED BED BOILER** (> 100 MWth)	**FLUIDIZED BED BOILER** (50 – 100 MWth)	**FLUIDIZED BED BOILER** (> 100 MWth)	**PULVERIZED COAL-FIRED BOILERS** (> 100 MWth)
Pb	[mg/GJ]	27	1.606	4.56	1.606	1.606	1.606
Cd	[mg/GJ]	13	0.169	1.2	0.169	0.169	0.169
Hg	[mg/GJ]	0.56	1.268	0.341	1.268	1.268	1.268

TYPE OF FUEL		BIOMASS					
T2	UNIT	FIXED BED BOILER (≤ 5 MWth)	FIXED BED BOILER (5 – 50 MWth)	FIXED BED BOILER (> 100 MWth)	FLUIDIZED BED BOILER (50 – 100 MWth)	FLUIDIZED BED BOILER (> 100 MWth)	PULVERIZED COAL-FIRED BOILERS (> 100 MWth)
As	[mg/GJ]	0.19	0.871	3.98	0.871	0.871	0.871
Cr	[mg/GJ]	23	0.027	2.55	0.027	0.027	0.027
Cu	[mg/GJ]	6	0.106	5.31	0.106	0.106	0.106
Ni	[mg/GJ]	2	0.085	255	0.085	0.085	0.085
Se	[mg/GJ]	0.5	0.211	2.06	0.211	0.211	0.211
Zn	[mg/GJ]	512	1.991	87.8	1.991	1.991	1.991
PCDD/F	[ng I-TEQ/GJ]	100	11.348	2.5	11.348	11.348	11.348
B(a)P	[mg/GJ]	10000	46.462	3.678	46.462	46.462	46.462
B(b)F	[mg/GJ]	16000	144.329	12.673	144.329	144.329	144.329
B(k)F	[mg/GJ]	5000	67.897	3.968	67.897	67.897	67.897
I()P	[mg/GJ]	4000	33.073	6.484	33.073	33.073	33.073
PAHs	[mg/GJ]	35000	291.761	26.803	291.761	291.761	291.761
HCB	[µg/GJ]	5	5	-	5	5	5
PCBs	[µg/GJ]	0.007	2.233	3.334	2.233	2.233	2.233

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.46***). The calculated BC emission values are presented in ***Table 3.42***.

Table 3.46: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.5.5.3 Completeness

Emissions are well covered.

3.5.5.4 Source-specific recalculations

The recalculations for BC, HM and POPs were made based on changes in activity data (supplemented activity values for the year 2010-2021) due to the corrections in categorization of one source. The results of the recalculations are in ***Table 3.47***.

Table 3.47: *Previous and revised emissions in the category 1A2d*

YEAR	BC [kt]			Pb [t]			Cd [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2010	0.0068	0.0068	0.11%	0.0380	0.0417	10%	0.0040	0.0044	10%
2011	0.0079	0.0079	0.01%	0.0355	0.0395	11%	0.0037	0.0042	12%
2012	0.0071	0.0071	0.01%	0.0335	0.0377	13%	0.0035	0.0040	13%
2013	0.0062	0.0062	0.01%	0.0351	0.0395	12%	0.0037	0.0042	13%
2014	0.0046	0.0046	0.00%	0.0316	0.0361	14%	0.0034	0.0038	15%
2015	0.0036	0.0036	0.03%	0.0132	0.0177	34%	0.0014	0.0019	34%
2016	0.0051	0.0051	0.00%	0.0294	0.0332	13%	0.0031	0.0036	14%
2017	0.0033	0.0033	0.00%	0.0289	0.0336	16%	0.0031	0.0036	17%
2018	0.0040	0.0040	0.00%	0.0282	0.0331	18%	0.0030	0.0036	18%
2019	0.0047	0.0047	0.01%	0.0257	0.0309	20%	0.0027	0.0033	21%
2020	0.0041	0.0041	0.00%	0.0339	0.0340	0.28%	0.0036	0.0036	1%

YEAR	BC [kt]			Pb [t]			Cd [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	0.0049	0.0049	0.01%	0.0316	0.0369	17%	0.0034	0.0039	17%

YEAR	Hg [t]			As [t]			Cr [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2010	0.0297	0.0324	9%	0.0205	0.0226	10%	0.0031	0.0033	6%
2011	0.0284	0.0315	11%	0.0197	0.0219	11%	0.0007	0.0008	15%
2012	0.0268	0.0300	12%	0.0186	0.0209	12%	0.0007	0.0008	20%
2013	0.0278	0.0312	12%	0.0192	0.0216	13%	0.0007	0.0008	16%
2014	0.0250	0.0285	14%	0.0173	0.0197	14%	0.0006	0.0007	21%
2015	0.0106	0.0140	32%	0.0074	0.0099	33%	0.0003	0.0005	47%
2016	0.0233	0.0262	12%	0.0161	0.0182	13%	0.0006	0.0007	31%
2017	0.0228	0.0265	16%	0.0158	0.0184	17%	0.0006	0.0008	27%
2018	0.0223	0.0261	17%	0.0154	0.0182	18%	0.0006	0.0007	29%
2019	0.0204	0.0244	20%	0.0141	0.0170	21%	0.0005	0.0007	33%
2020	0.0268	0.0268	0%	0.0185	0.0186	1%	0.0007	0.0008	12%
2021	0.0251	0.0291	16%	0.0173	0.0202	17%	0.0006	0.0008	26%

YEAR	Cu [t]			Ni [t]			Se [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2010	0.0059	0.0064	8%	0.0044	0.0170	283%	0.0174	0.0180	3%
2011	0.0023	0.0027	14%	0.0021	0.0057	167%	0.0051	0.0057	11%
2012	0.0022	0.0026	19%	0.0022	0.0096	341%	0.0051	0.0057	12%
2013	0.0023	0.0027	16%	0.0022	0.0064	198%	0.0051	0.0057	12%
2014	0.0021	0.0025	19%	0.0017	0.0073	338%	0.0042	0.0048	15%
2015	0.0009	0.0013	50%	0.0007	0.0087	1135%	0.0018	0.0024	36%
2016	0.0020	0.0024	25%	0.0016	0.0134	760%	0.0039	0.0044	15%
2017	0.0019	0.0024	25%	0.0015	0.0102	568%	0.0038	0.0045	18%
2018	0.0019	0.0024	26%	0.0015	0.0103	590%	0.0037	0.0044	19%
2019	0.0017	0.0022	30%	0.0014	0.0097	610%	0.0034	0.0041	22%
2020	0.0023	0.0024	8%	0.0018	0.0101	463%	0.0045	0.0045	1%
2021	0.0021	0.0026	24%	0.0017	0.0096	474%	0.0042	0.0049	18%

YEAR	Zn [t]			PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2010	0.0542	0.0627	16%	0.2612	0.2855	9%	0.0067	0.0073	9%
2011	0.0440	0.0501	14%	0.2522	0.2804	11%	0.0064	0.0072	11%
2012	0.0416	0.0491	18%	0.2380	0.2668	12%	0.0061	0.0068	12%
2013	0.0441	0.0508	15%	0.2484	0.2789	12%	0.0064	0.0072	12%
2014	0.0407	0.0481	18%	0.2234	0.2546	14%	0.0058	0.0066	14%
2015	0.0184	0.0264	44%	0.0942	0.1250	33%	0.0025	0.0033	31%
2016	0.0379	0.0464	22%	0.2080	0.2336	12%	0.0054	0.0061	12%
2017	0.0381	0.0467	23%	0.2043	0.2369	16%	0.0054	0.0062	16%
2018	0.0370	0.0459	24%	0.1995	0.2335	17%	0.0053	0.0061	17%
2019	0.0334	0.0425	27%	0.1820	0.2182	20%	0.0048	0.0057	19%
2020	0.0442	0.0470	6%	0.2397	0.2394	-0.12%	0.0063	0.0063	-0.14%
2021	0.0410	0.0500	22%	0.2238	0.2602	16%	0.0059	0.0068	16%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2010	0.1172	0.1279	9%	0.0514	0.0563	10%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2011	0.1103	0.1228	11%	0.0493	0.0548	11%
2012	0.1042	0.1169	12%	0.0465	0.0522	12%
2013	0.1090	0.1225	12%	0.0487	0.0547	12%
2014	0.0980	0.1117	14%	0.0437	0.0499	14%
2015	0.0407	0.0543	33%	0.0182	0.0243	34%
2016	0.0911	0.1024	12%	0.0407	0.0459	13%
2017	0.0895	0.1038	16%	0.0400	0.0465	16%
2018	0.0874	0.1023	17%	0.0390	0.0458	17%
2019	0.0796	0.0955	20%	0.0356	0.0428	20%
2020	0.1050	0.1049	-0.16%	0.0469	0.0469	0.07%
2021	0.0981	0.1141	16%	0.0438	0.0510	17%

3.5.6 Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco (NFR 1A2e)

3.5.6.1 Overview

Food processing can require considerable amounts of heat, steam and power. Many foods and beverage processes produce their own steam in one or more industrial boilers which burn fossil fuel and/or biomass. The NFR category **1A2e** covers more activities in the Slovak Republic. Emission from activities of the food industry was clearly identified as combustion emissions. Therefore the industrial categories of national classification according to the following ***Table 3.48*** were included here.

Table 3.48: *Activities according to national categorization included in 1A2e*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE/MEDIUM S.: NACE 10-12
6.13. Slaughterhouses with a projected capacity of live weight in t/d in the monthly average	combustion
a) poultry, lagomorphs	
b) domestic ungulates	
c) Others (e.g. fish)	
6.14. Sugar refineries with a projected production capacity of sugar t/h	combustion
6.15. Canneries and other food manufacturing with projected production capacity t/d:	combustion
a) meat products	
b) plant products (average per quarter)	
6.16. Distilleries with a projected production capacity of 100 per cent alcohol in t/y	combustion
6.17. Breweries with a projected production v hl/y	combustion
6.18. Food mills with a projected output in t/h	combustion
6.19. Production of industrial feed and organic fertilizer with a projected output in t/h	combustion
6.21. Roasting plants with a projected capacity in kg/h	combustion
a) coffee, coffee substitutes	
b) cocoa beans or nuts	
6.22. Smoking devices food products with a projected capacity of smoking in kg/week	combustion

An overview of the emissions is shown in ***Table 3.49***. Emissions of main pollutants in this category show an overall decreasing trend, especially emissions of SOx, heavy metals and POPs are decreasing due to the decrease of using solid fuels within this category (one source of Slovenské cukrovary is out of operation).

Table 3.49: *Overview of emissions in the category 1A2e*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.7790	0.0520	0.8731	0.0075	0.0651	0.1039	0.1734	0.0093	0.4200
1995	0.7739	0.0516	0.8674	0.0075	0.0646	0.1032	0.1723	0.0094	0.4173
2000	0.7063	0.0230	0.9341	0.0001	0.0649	0.1036	0.1729	0.0099	0.3813
2005	0.5258	0.0259	0.5047	0.0075	0.0755	0.0829	0.0958	0.0143	0.2446
2010	0.3418	0.0600	0.1481	0.0094	0.0154	0.0244	0.0406	0.0014	0.3559
2011	0.3358	0.0602	0.1785	0.0037	0.0138	0.0227	0.0385	0.0009	0.3644
2012	0.2992	0.0572	0.1815	0.0039	0.0127	0.0208	0.0355	0.0008	0.2884
2013	0.2949	0.0605	0.2061	0.0040	0.0152	0.0257	0.0414	0.0010	0.2416
2014	0.2987	0.0577	0.2037	0.0040	0.0155	0.0270	0.0434	0.0010	0.2626
2015	0.3406	0.0596	0.2015	0.0040	0.0182	0.0309	0.0472	0.0012	0.2730
2016	0.2989	0.0407	0.1783	0.0039	0.0353	0.0445	0.0569	0.0024	0.2577
2017	0.3289	0.0425	0.2551	0.0096	0.0362	0.0462	0.0597	0.0024	0.2766
2018	0.3095	0.0414	0.1979	0.0117	0.0371	0.0472	0.0601	0.0025	0.2651
2019	0.3240	0.0464	0.1549	0.0115	0.0361	0.0403	0.0639	0.0045	0.2486
2020	0.3174	0.0482	0.1357	0.0131	0.0444	0.0548	0.0678	0.0056	0.1602
2021	0.2372	0.0432	0.0196	0.0123	0.0351	0.0391	0.0457	0.0073	0.1510
2022	0.2320	0.0428	0.0050	0.0134	0.0376	0.0417	0.0487	0.0094	0.1389
1990/2022	**-70%**	**-18%**	**-99%**	**79%**	**-42%**	**-60%**	**-72%**	**1%**	**-67%**
2021/2022	**-2%**	**-1%**	**-74%**	**9%**	**7%**	**7%**	**7%**	**29%**	**-8%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0611	0.0012	0.0086	0.0027	0.0070	0.0082	0.0060	0.0014	0.1261
1995	0.0609	0.0012	0.0086	0.0027	0.0070	0.0081	0.0060	0.0014	0.1262
2000	0.0526	0.0011	0.0079	0.0024	0.0061	0.0071	0.0052	0.0013	0.1131
2005	0.0448	0.0013	0.0059	0.0019	0.0057	0.0061	0.0044	0.0010	0.1128
2010	0.0630	0.0015	0.0059	0.0023	0.0074	0.0084	0.0061	0.0011	0.1206
2011	0.0667	0.0010	0.0061	0.0024	0.0069	0.0087	0.0065	0.0011	0.1056
2012	0.0557	0.0008	0.0053	0.0020	0.0057	0.0073	0.0055	0.0010	0.0875
2013	0.0617	0.0008	0.0055	0.0022	0.0063	0.0081	0.0060	0.0010	0.0957
2014	0.0734	0.0010	0.0062	0.0025	0.0075	0.0096	0.0072	0.0012	0.1136
2015	0.0967	0.0013	0.0076	0.0032	0.0098	0.0126	0.0094	0.0015	0.1483
2016	0.0739	0.0010	0.0063	0.0026	0.0075	0.0097	0.0072	0.0012	0.1145
2017	0.0882	0.0012	0.0071	0.0030	0.0090	0.0115	0.0086	0.0014	0.1364
2018	0.0792	0.0011	0.0066	0.0027	0.0081	0.0104	0.0077	0.0013	0.1227
2019	0.0728	0.0030	0.0059	0.0024	0.0106	0.0099	0.0070	0.0012	0.1866
2020	0.0679	0.0029	0.0057	0.0023	0.0100	0.0093	0.0065	0.0011	0.1769
2021	0.0104	0.0018	0.0025	0.0006	0.0037	0.0017	0.0010	0.0004	0.0789
2022	0.0042	0.0020	0.0020	0.0004	0.0035	0.0009	0.0004	0.0003	0.0794
1990/2022	**-93%**	**60%**	**-77%**	**-86%**	**-50%**	**-89%**	**-94%**	**-80%**	**-37%**
2021/2022	**-60%**	**10%**	**-20%**	**-36%**	**-5%**	**-45%**	**-64%**	**-25%**	**1%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0996	0.0283	0.0610	0.0218	0.0191	0.1302	0.0004	0.0762
1995	0.0993	0.0282	0.0609	0.0217	0.0191	0.1298	0.0004	0.0760
2000	0.0865	0.0251	0.0559	0.0198	0.0175	0.1182	0.0004	0.0655
2005	0.0747	0.0207	0.0465	0.0156	0.0137	0.0966	0.0005	0.0549
2010	0.1005	0.0244	0.0397	0.0156	0.0131	0.0928	0.0005	0.0782
2011	0.1035	0.0255	0.0410	0.0162	0.0136	0.0964	0.0003	0.0843
2012	0.0865	0.0216	0.0355	0.0140	0.0117	0.0828	0.0003	0.0706

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2013	0.0952	0.0234	0.0373	0.0147	0.0122	0.0875	0.0003	0.0782
2014	0.1132	0.0275	0.0426	0.0169	0.0140	0.1009	0.0004	0.0930
2015	0.1484	0.0354	0.0531	0.0211	0.0172	0.1268	0.0005	0.1225
2016	0.1139	0.0277	0.0430	0.0170	0.0141	0.1018	0.0004	0.0936
2017	0.1357	0.0326	0.0496	0.0196	0.0161	0.1179	0.0004	0.1118
2018	0.1220	0.0295	0.0454	0.0179	0.0147	0.1075	0.0004	0.1004
2019	0.1214	0.0272	0.0423	0.0166	0.0137	0.0998	0.0011	0.0868
2020	0.1138	0.0256	0.0403	0.0157	0.0131	0.0947	0.0011	0.0808
2021	0.0252	0.0064	0.0161	0.0061	0.0056	0.0342	0.0007	0.0087
2022	0.0169	0.0041	0.0128	0.0047	0.0045	0.0261	0.0007	0.0001
1990/2022	**-83%**	**-85%**	**-79%**	**-78%**	**-77%**	**-80%**	**74%**	**-100%**
2021/2022	**-33%**	**-35%**	**-21%**	**-22%**	**-20%**	**-24%**	**11%**	**-99%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.50*** below.

Table 3.50: *Overview of activity data in the category 1A2e*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	486.58	448.38	9 248.51	40.84	NO
1995	498.01	447.23	9 171.20	40.84	NO
2000	488.85	385.14	8 774.43	40.84	NO
2005	604.59	323.08	6 093.54	53.97	NO
2010	0.80	459.72	4 066.54	68.66	NO
2011	1.23	496.14	4 024.59	18.37	NO
2012	12.95	415.15	3 717.15	17.44	NO
2013	29.59	459.88	3 343.55	20.63	NO
2014	6.00	547.16	3 517.81	21.56	NO
2015	11.92	720.47	3 570.57	31.39	NO
2016	27.23	550.43	3 520.30	25.33	NO
2017	30.26	657.52	3 547.82	51.78	NO
2018	42.21	590.46	3 382.68	97.01	NO
2019	13.97	510.69	3 281.77	189.35	NO
2020	11.21	475.44	3 334.02	179.71	NO
2021	13.51	51.08	3 784.04	151.98	NO
2022	16.14	0.57	3 544.39	171.91	NO
1990/2022	**-97%**	**-100%**	**-62%**	**321%**	**-**
2021/2022	**19%**	**-99%**	**-6%**	**13%**	**-**

3.5.6.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.51***).

Table 3.51: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/GJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	76.18	5.08	85.39	0.73	16.96	38%	60%	41.08

HMs and POPs emissions were calculated using Tier 1 emission factors from EMEP/EEA GB$_{2019}$ (***Table 3.52***).

Table 3.52: *Emission factors for heavy metals and POPs in the category 1A2e*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.08	134	0.011	27
Cd	[mg/GJ]	0.006	1.8	0.0009	13
Hg	[mg/GJ]	0.12	7.9	0.54	0.56
As	[mg/GJ]	0.03	4	0.1	0.19
Cr	[mg/GJ]	0.2	13.5	0.013	23
Cu	[mg/GJ]	0.22	17.5	0.002600	6
Ni	[mg/GJ]	0.008	13	0.013	2
Se	[mg/GJ]	0.11	1.8	0.058	0.5
Zn	[mg/GJ]	29	200	0.73	512
PCDD/F	[ng I-TEQ/GJ]	1.4	203	0.52	100
B(a)P	[mg/GJ]	1.9	45.5	0.72	10
B(b)F	[mg/GJ]	15	58.9	2.9	16
B(k)F	[mg/GJ]	1.7	23.7	1.1	5
I()P	[mg/GJ]	1.5	18.5	1.08	4
PAHs	[mg/GJ]	20.1	146.6	5.8	35
HCB	[µg/GJ]	-	0.62	-	5
PCBs	[µg/GJ]	-	170	-	0.06

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB$_{2019}$) (***Table 3.53***). The calculated BC emission values are presented in ***Table 3.49***.

Table 3.53: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.5.6.3 Completeness

Emissions are well covered.

3.5.6.4 Source-specific recalculations

No recalculations in this submission.

3.5.7 Stationary combustion in manufacturing industries and construction: Non-metallic minerals (NFR 1A2f)

3.5.7.1 Overview

Emissions in this category include combustion processes within the cement, lime, glass and glass wool production in the Slovak Republic. The emissions depend on fuel and process activity. Relevant pollutants are generally described for combustion: SOx, NOx, CO, NMVOC, particulate matter (TSP, PM_{10}, $PM_{2.5}$), black carbon (BC), heavy metals (HM), polycyclic aromatic hydrocarbons (PAH), polychlorinated dibenzo-dioxin and polychlorinated dibenzo-furans (PCDD/F) and, for some activities, polychlorinated biphenyls (PCB) and hexachlorobenzene (HCB). This category is key for emissions of NOx.

Sources within this category are a combination of combustion and process sources, therefore, emissions of particulate matter from the cement, lime and glass production are reported under the particular IPPU categories and combustion emissions from those categories are reported in **1A2f**. Particular matter emissions

included in this category originate only from sources allocated by national law to category 1.1 and NACE division 23. Activities listed within this category are shown in ***Table 3.54***.

Table 3.54: *Activities according to national categorization included in 1A2f*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE/MEDIUM S.: NACE 23
3.2. Manufacture of cement with a projected production capacity in t/d	
3.3. Manufacture of lime with a designed production capacity of cement clinker in t/d	
3.7. Manufacture of glass, glass products, including glass fibre with projected melting capacity in t/d	

The overview of the emissions is shown in ***Table 3.55***.

Table 3.55: *Overview of emissions in the category 1A2f*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	5.6738	0.0741	0.6594	NO	0.0245	0.0345	0.0386	0.0019	11.3766
1995	5.6543	0.0739	0.6571	NO	0.0244	0.0344	0.0385	0.0019	11.3375
2000	5.3727	0.0741	0.7341	0.0031	0.0285	0.0401	0.0449	0.0022	9.0429
2005	5.0294	0.0662	0.4997	0.0000	0.0044	0.0063	0.0162	0.0004	10.2890
2010	4.5594	0.1898	0.3220	NO	0.0029	0.0045	0.0124	0.0003	12.8343
2011	4.8866	0.2473	0.3462	NO	0.0022	0.0033	0.0088	0.0002	11.3292
2012	4.2019	0.1520	0.4290	0.0000	0.0030	0.0040	0.0074	0.0003	9.3928
2013	4.3940	0.1198	0.3624	0.0006	0.0027	0.0036	0.0074	0.0003	7.9731
2014	4.4765	0.1498	0.3841	0.0006	0.0024	0.0032	0.0067	0.0003	9.7134
2015	4.6022	0.1757	0.3421	0.0240	0.0024	0.0031	0.0059	0.0003	7.6889
2016	4.4955	0.1665	0.3008	0.0428	0.0023	0.0026	0.0031	0.0003	7.8489
2017	4.3187	0.1655	0.2779	0.0439	0.0018	0.0019	0.0020	0.0002	8.8505
2018	3.7363	0.1677	0.2133	0.0384	0.0017	0.0019	0.0022	0.0002	10.9896
2019	4.3699	0.1439	0.2975	0.0383	0.0017	0.0019	0.0022	0.0002	9.3890
2020	4.2351	0.1845	0.2994	0.0415	0.0014	0.0015	0.0015	0.0002	9.9209
2021	4.2879	0.1525	0.4194	0.0484	0.0013	0.0014	0.0014	0.0002	10.5219
2022	4.5632	0.1769	0.3478	0.0587	0.0009	0.0009	0.0009	0.0001	9.8394
1990/2022	**-20%**	**139%**	**-47%**	**-**	**-96%**	**-97%**	**-98%**	**-93%**	**-14%**
2021/2022	**6%**	**16%**	**-17%**	**21%**	**-33%**	**-34%**	**-35%**	**-14%**	**-6%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.2779	0.0227	0.1390	0.0751	0.1163	0.1835	0.1390	0.0717	1.2024
1995	0.2191	0.0179	0.1096	0.0592	0.0917	0.1447	0.1096	0.0566	0.9480
2000	0.2267	0.0185	0.1134	0.0613	0.0949	0.1497	0.1134	0.0585	0.9810
2005	0.2306	0.0188	0.1153	0.0623	0.0965	0.1522	0.1153	0.0595	0.9975
2010	0.1621	0.0132	0.0810	0.0438	0.0678	0.1070	0.0810	0.0418	0.7011
2011	0.2414	0.0197	0.1194	0.0645	0.0998	0.1575	0.1196	0.0616	1.0320
2012	0.2219	0.0180	0.1048	0.0565	0.0872	0.1376	0.1056	0.0538	0.9015
2013	0.2290	0.0186	0.1066	0.0575	0.0886	0.1398	0.1078	0.0547	0.9164
2014	0.2550	0.0207	0.1191	0.0642	0.0990	0.1563	0.1203	0.0611	1.0241
2015	0.2566	0.0209	0.1233	0.0665	0.1028	0.1621	0.1240	0.0634	1.0626
2016	0.2712	0.0221	0.1281	0.0691	0.1066	0.1682	0.1291	0.0658	1.1021
2017	0.2823	0.0230	0.1330	0.0717	0.1107	0.1746	0.1342	0.0683	1.1443
2018	0.2917	0.0237	0.1333	0.0718	0.1105	0.1744	0.1351	0.0682	1.1430
2019	0.3082	0.0250	0.1411	0.0760	0.1170	0.1847	0.1429	0.0722	1.2104
2020	0.3147	0.0256	0.1454	0.0784	0.1207	0.1905	0.1471	0.0745	1.2487
2021	0.3242	0.0263	0.1455	0.0783	0.1204	0.1901	0.1479	0.0743	1.2456

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2022	0.3099	0.0252	0.1495	0.0807	0.1247	0.1968	0.1503	0.0769	1.2895
1990/2022	**11%**	**11%**	**8%**	**7%**	**7%**	**7%**	**8%**	**7%**	**7%**
2021/2022	**-4%**	**-4%**	**3%**	**3%**	**4%**	**4%**	**2%**	**4%**	**4%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0116	0.0000	0.0008	0.0002	0.0001	0.0012	0.0130	0.2921
1995	0.0092	0.0000	0.0006	0.0002	0.0001	0.0009	0.0103	0.2303
2000	0.0095	0.0000	0.0006	0.0002	0.0001	0.0009	0.0106	0.2383
2005	0.0096	0.0000	0.0007	0.0002	0.0001	0.0010	0.0108	0.2423
2010	0.0068	0.0000	0.0005	0.0001	0.0001	0.0007	0.0076	0.1703
2011	0.7947	0.0000	0.0007	0.0002	0.0001	0.0010	0.0112	0.2507
2012	3.6462	0.0000	0.0006	0.0002	0.0001	0.0011	0.0098	0.2190
2013	4.6273	0.0000	0.0006	0.0002	0.0001	0.0011	0.0100	0.2226
2014	4.9267	0.0000	0.0007	0.0002	0.0001	0.0013	0.0111	0.2488
2015	2.9831	0.0000	0.0007	0.0002	0.0001	0.0012	0.0115	0.2581
2016	4.4538	0.0000	0.0007	0.0002	0.0001	0.0013	0.0120	0.2677
2017	4.8012	0.0000	0.0008	0.0002	0.0001	0.0014	0.0124	0.2780
2018	7.4282	0.0000	0.0008	0.0002	0.0001	0.0015	0.0124	0.2777
2019	7.6730	0.0000	0.0008	0.0002	0.0001	0.0016	0.0132	0.2940
2020	7.0438	0.0000	0.0008	0.0002	0.0001	0.0016	0.0136	0.3033
2021	9.7928	0.0000	0.0008	0.0002	0.0001	0.0018	0.0136	0.3026
2022	3.1910	0.0000	0.0009	0.0002	0.0001	0.0014	0.0140	0.3133
1990/2022	**27 346%**	**7%**	**7%**	**7%**	**7%**	**23%**	**7%**	**7%**
2021/2022	**-67%**	**4%**	**4%**	**4%**	**4%**	**-19%**	**3%**	**4%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.56*** below.

Table 3.56: *Overview of activity data in the category 1A2f*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	582.03	6 388.61	10 817.05	95.99	17.10
1995	520.34	6 454.60	10 751.21	95.99	17.11
2000	638.78	6 842.71	9 544.20	95.99	20.25
2005	259.17	10 026.78	7 170.93	506.78	792.00
2010	276.51	6 590.37	4 520.81	655.05	3 439.86
2011	296.85	6 565.93	4 512.34	658.54	3 378.13
2012	88.98	6 057.41	3 663.32	617.42	3 675.01
2013	1 332.87	4 158.81	4 246.25	395.71	4 316.48
2014	1 450.24	4 264.56	4 048.12	277.21	5 221.75
2015	2 361.15	4 444.44	3 776.08	308.63	4 982.50
2016	2 407.44	4 115.03	4 661.18	483.15	5 223.98
2017	2 462.64	4 390.73	4 841.37	481.78	7 003.06
2018	2 219.04	4 159.07	4 673.82	623.07	4 974.97
2019	2 358.09	3 635.78	4 720.09	590.78	5 967.80
2020	2 409.22	3 776.24	4 401.23	1.35	6 359.26
2021	2 595.59	3 155.22	4 906.93	5.04	7 270.81
2022	2 704.33	2 056.11	4 695.25	85.10	5 138.24
1990/2022	**365%**	**-68%**	**-57%**	**-11%**	**29 956%**
2021/2022	**4%**	**-35%**	**-4%**	**1 589%**	**-29%**

3.5.7.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.57***).

Table 3.57: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/GJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	316.96	4.14	36.83	0.17	2.16	63%	89%	635.54

HMs and POPs emissions from the categories **2A1** (Cement production), **2A2** (Lime production) and **2A3** (Glass production) were allocated in this category because most of these emissions originate during the combustion processes.

Tier 2 EMEP/EEA GB_{2019} emission factors for the manufacture of cement (**2A1**) and Tier 1 EMEP/EEA GB_{2019} emission factors for industrial waste incineration (**2A2**) were used for the calculation of HMs and POPs emissions (***Table 3.58***).

Table 3.58: *Emission factors for heavy metals and POPs in the category 1A2f*

T2/T1	UNIT	MANUFACTURE OF CEMENT	INDUSTRIAL WASTE INCINERATION
Pb	[mg/GJ]	0.098	1.3
Cd	[mg/GJ]	0.008	0.1
Hg	[mg/GJ]	0.049	0.056
As	[mg/GJ]	0.0265	0.016
Cr	[mg/GJ]	0.041	-
Cu	[mg/GJ]	0.0647	-
Ni	[mg/GJ]	0.049	0.14
Se	[mg/GJ]	0.0253	-
Zn	[mg/GJ]	0.424	-
PCDD/F	[ng I-TEQ/GJ]	4.1	350
B(a)P	[mg/GJ]	6.5E-06	-
B(b)F	[mg/GJ]	0.00028	-
B(k)F	[mg/GJ]	0.000077	-
I()P	[mg/GJ]	0.000043	-
PAHs	[mg/GJ]	0.000407	0.02
HCB	[µg/GJ]	4.6	0.002
PCBs	[µg/GJ]	103	-

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.59***). The calculated BC emission values are presented in ***Table 3.55***.

Table 3.59: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.5.7.3 Completeness

Emissions are well covered.

3.5.7.4 Source-specific recalculations

The recalculations for BC, HM and POPs were made based on changes in activity data (corrections in categorization of fuels for the years 2019-2021) and as well based on the correction of incorrect value of activity data (clinker produced). The results of the recalculations are in ***Table 3.60***.

Table 3.60: *Previous and revised emissions in the category 1A2f*

YEAR	BC [kt]			Pb [t]			Cd [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	0.0004	0.0002	-37%	0.3082	0.3082	0.00%	0.0250	0.0250	0.00%
2020	0.0003	0.0002	-48%	0.3147	0.3147	0.00%	0.0256	0.0256	0.00%
2021	0.0003	0.0002	-45%	0.3470	0.3242	-7%	0.0282	0.0263	-7%

YEAR	Hg [t]			As [t]			Cr [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	0.1411	0.1411	0.00%	0.0760	0.0760	0.00%	0.1170	0.1170	0.00%
2020	0.1454	0.1454	-0.01%	0.0784	0.0784	-0.01%	0.1208	0.1207	-0.01%
2021	0.1569	0.1455	-7%	0.0845	0.0783	-7%	0.1300	0.1204	-7%

YEAR	Cu [t]			Ni [t]			Se [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	0.1847	0.1847	0.00%	0.1429	0.1429	0.00%	0.0722	0.0722	0.00%
2020	0.1906	0.1905	-0.01%	0.1471	0.1471	-0.01%	0.0745	0.0745	-0.01%
2021	0.2051	0.1901	-7%	0.1593	0.1479	-7%	0.0802	0.0743	-7%

YEAR	Zn [t]			PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	1.2104	1.2104	0.00%	7.6730	7.6730	0.00%	0.0016	0.0016	0.00%
2020	1.2488	1.2487	-0.01%	7.0336	7.0438	0.14%	0.0016	0.0016	0.03%
2021	1.3442	1.2456	-7%	9.7938	9.7928	-0.01%	0.0018	0.0018	-5.12%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2019	0.0132	0.0132	0.00%	0.2940	0.2940	0.00%
2020	0.0136	0.0136	-0.01%	0.3034	0.3033	-0.01%
2021	0.0146	0.0136	-7.31%	0.3265	0.3026	-7.34%

3.5.8 Mobile Combustion in manufacturing industries and Construction (NFR 1A2gvii)

3.5.8.1 Overview

According to ***Recommendations No SK-1A4cii-2018-0001*** and ***SK-1A4cii-2021-0002*** Slovakia after receiving the most necessary data was able to disaggregate all non-road mobile combustion categories (**1A2gvii**, **1A4aii**, **1A4bii** and **1A4cii**). The results of the separation are shown in ***Table 3.61***. In the year 2022 a decrease in energy consumption and emissions was observed.

Table 3.61: *Overview of emissions in the category 1A2gvii*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.5025	0.0852	0.0003	0.0001	0.0318	0.0318	0.0318	0.0196	1.5714
1995	0.4836	0.0872	0.0003	0.0001	0.0306	0.0306	0.0306	0.0188	1.7316

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2000	0.4648	0.0892	0.0003	0.0001	0.0293	0.0293	0.0293	0.0180	1.8917
2005	0.4459	0.0912	0.0003	0.0001	0.0280	0.0280	0.0280	0.0172	2.0519
2010	0.4271	0.0932	0.0003	0.0001	0.0267	0.0267	0.0267	0.0163	2.2121
2011	0.4233	0.0936	0.0003	0.0001	0.0265	0.0265	0.0265	0.0162	2.2441
2012	0.4195	0.0940	0.0003	0.0001	0.0262	0.0262	0.0262	0.0160	2.2762
2013	0.4129	0.0972	0.0003	0.0001	0.0257	0.0257	0.0257	0.0157	2.4404
2014	0.5760	0.1141	0.0004	0.0001	0.0362	0.0362	0.0362	0.0222	2.4943
2015	0.3987	0.0594	0.0003	0.0001	0.0254	0.0254	0.0254	0.0157	0.8997
2016	0.3334	0.0527	0.0002	0.0001	0.0212	0.0212	0.0212	0.0131	0.8781
2017	0.5547	0.0574	0.0003	0.0001	0.0358	0.0358	0.0358	0.0222	0.1832
2018	0.7505	0.0777	0.0005	0.0002	0.0484	0.0484	0.0484	0.0300	0.2478
2019	0.5363	0.0918	0.0004	0.0001	0.0340	0.0340	0.0340	0.0209	1.7131
2020	0.4313	0.0628	0.0003	0.0001	0.0275	0.0275	0.0275	0.0170	0.9104
2021	0.8881	0.1101	0.0006	0.0002	0.0570	0.0570	0.0570	0.0353	1.0613
2022	0.3008	0.0493	0.0002	0.0001	0.0191	0.0191	0.0191	0.0118	0.8673
1990/2022	**-40%**	**-42%**	**-41%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-45%**
2021/2022	**-66%**	**-55%**	**-64%**	**-65%**	**-66%**	**-66%**	**-66%**	**-67%**	**-18%**

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	PAHs [t]
1990	0.0002	0.0008	0.0286	0.0012	0.0002	0.0168	0.0013
1995	0.0002	0.0008	0.0279	0.0011	0.0002	0.0164	0.0013
2000	0.0002	0.0008	0.0272	0.0011	0.0002	0.0160	0.0013
2005	0.0002	0.0008	0.0265	0.0011	0.0002	0.0156	0.0012
2010	0.0002	0.0008	0.0258	0.0011	0.0002	0.0152	0.0012
2011	0.0002	0.0008	0.0257	0.0011	0.0002	0.0151	0.0012
2012	0.0002	0.0008	0.0256	0.0011	0.0002	0.0150	0.0012
2013	0.0002	0.0008	0.0255	0.0011	0.0002	0.0150	0.0012
2014	0.0002	0.0010	0.0340	0.0014	0.0002	0.0200	0.0016
2015	0.0001	0.0007	0.0221	0.0009	0.0001	0.0130	0.0010
2016	0.0001	0.0006	0.0187	0.0008	0.0001	0.0110	0.0009
2017	0.0002	0.0009	0.0289	0.0012	0.0002	0.0170	0.0014
2018	0.0002	0.0012	0.0391	0.0016	0.0002	0.0230	0.0018
2019	0.0002	0.0009	0.0306	0.0013	0.0002	0.0180	0.0014
2020	0.0001	0.0007	0.0238	0.0010	0.0001	0.0140	0.0011
2021	0.0003	0.0014	0.0476	0.0020	0.0003	0.0280	0.0022
2022	0.0001	0.0005	0.0170	0.0007	0.0001	0.0100	0.0008
1990/2022	**-41%**	**-41%**	**-41%**	**-41%**	**-41%**	**-41%**	**-41%**
2021/2022	**-64%**	**-64%**	**-64%**	**-64%**	**-64%**	**-64%**	**-64%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.62*** below.

Table 3.62: *Overview of activity data in the category 1A2gvii*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	716.73	NA	NA	NO	NA
1995	693.64	NA	NA	NO	NA
2000	683.63	NA	NA	NO	NA
2005	662.60	NA	NA	NO	NA
2010	594.54	NA	NA	23.53	NA
2011	583.63	NA	NA	27.40	NA
2012	582.43	NA	NA	26.39	NA

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2013	603.27	NA	NA	28.96	NA
2014	789.97	NA	NA	49.93	NA
2015	511.73	NA	NA	34.88	NA
2016	432.97	NA	NA	29.49	NA
2017	663.78	NA	NA	49.36	NA
2018	903.10	NA	NA	61.73	NA
2019	710.20	NA	NA	46.74	NA
2020	547.48	NA	NA	40.14	NA
2021	1 092.45	NA	NA	81.34	NA
2022	392.67	NA	NA	29.00	NA
1990/2022	**-45%**	-	-	-	-
2021/2022	**-64%**	-	-	**-64%**	-

3.5.8.2 Methodological issues

Slovakia was able to receive statistical data about fuel combustion from the year 2013. The years 1990-2012 were estimated using expert judgment and a linear regression model back to the base year. This model caused the trend to be clearly linear up to 2013. After this year we can observe deviations in fuel consumption, as well as in estimated emissions. For the emission estimation, EMEP/EEA GB_{2019} Tier 1 emission factors were used.

3.5.8.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB_{2019}.

3.5.8.4 Source-specific recalculations

No recalculations in this submission.

3.5.9 Stationary combustion in manufacturing industries and construction: Other (NFR 1A2gviii)

3.5.9.1 Overview

The category covers the sources that cannot be clearly identified to particular activity but generally, it is the combustion process. Activities listed within this category are shown in ***Table 3.63***.

Table 3.63: *Activities according to national categorization included in 1A2gviii*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	LARGE/MEDIUM S.: NACE 01-09; 13-16; 19; 25-33; 36-47; 50-99
2.99. Other industrial production and metal processing if the combustion of fuel with nominated thermal input in MW is a part of technology	combustion
3.99. Other industrial production and processing of non-mineral products if the combustion of fuel with nominated thermal input in MW is a part of technology	combustion
4.99. Other chemical industrial production and processing if the combustion of fuel with nominated thermal input in MW is a part of technology	combustion
6.99. Other industrial technologies, production and processing if the combustion of fuel with nominated thermal input in MW is a part of technology	combustion

The overview of the emissions is shown in ***Table 3.64***. Emissions of PCDD/F and HCB are influenced mostly by the amount of industrial waste incinerated with energy recovery and abatement technology of ISW incineration plants reported within this category. A significant increase in 2005 was caused by the fact that operators of obsolete plants used the last year before the introduction of stricter emission limits associated with the accession of the Slovak Republic to the EU and burned three times higher amount of waste than in the previous

year. Subsequently, in 2006 non-compliance plants ceased their activities. The increase in HMs and PAHs in 2017 correlates with the consumption of solid fuels. The overall trend of these emissions is connected with the trend of biomass fuels used.

Table 3.64: *Overview of emissions in the category 1A2gviii*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	2.5797	0.1227	2.3689	0.0270	0.7010	0.9572	1.4711	0.1060	3.7165
1995	2.5338	0.1205	2.3268	0.0266	0.6885	0.9402	1.4450	0.1050	3.6505
2000	2.4824	3.5369	1.6422	0.0080	0.5623	0.7679	1.1802	0.0989	3.0044
2005	1.1298	4.9561	0.6837	0.0076	0.2662	0.3538	0.6150	0.0633	2.1215
2010	1.0966	4.4405	0.2108	0.0051	0.1490	0.2055	0.3073	0.0404	1.8493
2011	1.1755	4.6571	0.2331	0.0072	0.1360	0.1876	0.2795	0.0360	2.0261
2012	1.1063	4.8403	0.2118	0.0074	0.1529	0.2006	0.2837	0.0415	1.7745
2013	0.9920	5.0664	0.2472	0.0062	0.1183	0.1648	0.2453	0.0318	1.8270
2014	0.9397	5.1977	0.2377	0.0064	0.1141	0.1695	0.2670	0.0303	1.6509
2015	1.1158	5.3408	0.2587	0.0066	0.1190	0.1806	0.2909	0.0318	1.7669
2016	1.1770	5.5870	0.2670	0.0067	0.1271	0.1757	0.2565	0.0346	1.1496
2017	1.4359	5.9146	0.4311	0.0081	0.1362	0.1866	0.2713	0.0315	1.2729
2018	1.1863	6.0538	0.2591	0.0087	0.1310	0.1837	0.2716	0.0356	1.2487
2019	1.1007	6.1370	0.2649	0.0084	0.1345	0.1863	0.2781	0.0364	1.1994
2020	1.0764	5.2788	0.2876	0.0076	0.1328	0.1830	0.2648	0.0360	1.1603
2021	1.1546	5.1439	0.2749	0.0047	0.1390	0.1912	0.2752	0.0377	1.3213
2022	1.1422	4.8782	0.1153	0.0027	0.1265	0.1672	0.2293	0.0345	1.5360
1990/2022	**-56%**	**3876%**	**-95%**	**-90%**	**-82%**	**-83%**	**-84%**	**-67%**	**-59%**
2021/2022	**-1%**	**-5%**	**-58%**	**-44%**	**-9%**	**-13%**	**-17%**	**-9%**	**16%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0193	0.0056	0.0066	0.0098	0.0121	0.0090	0.2765	0.0166	0.2411
1995	0.0064	0.0018	0.0031	0.0043	0.0043	0.0030	0.0855	0.0071	0.0772
2000	0.0028	0.0007	0.0020	0.0029	0.0026	0.0015	0.0357	0.0072	0.0299
2005	0.0086	0.0025	0.0039	0.0040	0.0054	0.0024	0.0364	0.0075	0.0952
2010	0.0215	0.0067	0.0082	0.0066	0.0115	0.0043	0.0339	0.0068	0.2419
2011	0.0313	0.0112	0.0089	0.0068	0.0196	0.0061	0.0219	0.0085	0.4167
2012	0.0238	0.0075	0.0088	0.0071	0.0128	0.0046	0.0215	0.0068	0.2677
2013	0.0219	0.0072	0.0078	0.0059	0.0124	0.0040	0.0142	0.0067	0.2600
2014	0.0225	0.0077	0.0072	0.0054	0.0132	0.0041	0.0110	0.0054	0.2826
2015	0.0207	0.0068	0.0074	0.0056	0.0117	0.0037	0.0175	0.0066	0.2478
2016	0.0211	0.0070	0.0073	0.0055	0.0121	0.0039	0.0202	0.0064	0.2585
2017	0.0227	0.0074	0.0082	0.0063	0.0128	0.0042	0.0159	0.0072	0.2694
2018	0.0207	0.0065	0.0080	0.0062	0.0110	0.0038	0.0200	0.0063	0.2323
2019	0.0205	0.0063	0.0082	0.0062	0.0107	0.0037	0.0161	0.0068	0.2238
2020	0.0166	0.0056	0.0057	0.0043	0.0099	0.0030	0.0102	0.0062	0.2056
2021	0.0206	0.0063	0.0082	0.0064	0.0108	0.0038	0.0158	0.0074	0.2237
2022	0.0175	0.0050	0.0079	0.0059	0.0083	0.0030	0.0146	0.0065	0.1739
1990/2022	**-9%**	**-10%**	**20%**	**-40%**	**-31%**	**-67%**	**-95%**	**-61%**	**-28%**
2021/2022	**-15%**	**-21%**	**-5%**	**-7%**	**-23%**	**-22%**	**-7%**	**-13%**	**-22%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0752	0.0029	0.0049	0.0016	0.0012	0.0105	0.0207	0.0118
1995	0.0292	0.0009	0.0016	0.0005	0.0004	0.0035	0.0070	0.0038
2000	0.0144	0.0003	0.0006	0.0002	0.0002	0.0013	0.0032	0.0016

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2005	0.0435	0.0016	0.0027	0.0009	0.0007	0.0059	0.0116	0.0051
2010	0.1097	0.0045	0.0076	0.0025	0.0019	0.0166	0.0306	0.0130
2011	0.1489	0.0080	0.0133	0.0043	0.0033	0.0289	0.0346	0.0137
2012	0.1203	0.0051	0.0086	0.0028	0.0022	0.0188	0.0331	0.0138
2013	0.1110	0.0050	0.0084	0.0027	0.0021	0.0183	0.0293	0.0120
2014	0.1112	0.0055	0.0091	0.0030	0.0023	0.0198	0.0277	0.0112
2015	0.1052	0.0047	0.0079	0.0026	0.0020	0.0172	0.0279	0.0115
2016	0.1055	0.0049	0.0082	0.0027	0.0020	0.0178	0.0272	0.0112
2017	0.1145	0.0052	0.0086	0.0028	0.0022	0.0188	0.0300	0.0123
2018	0.1071	0.0044	0.0075	0.0025	0.0019	0.0162	0.0299	0.0125
2019	0.1065	0.0043	0.0072	0.0024	0.0018	0.0157	0.0303	0.0127
2020	0.0829	0.0039	0.0066	0.0021	0.0016	0.0143	0.0210	0.0085
2021	0.1066	0.0043	0.0072	0.0024	0.0018	0.0157	0.0303	0.0126
2022	0.0948	0.0033	0.0057	0.0019	0.0014	0.0122	0.0290	0.0123
1990/2022	**26%**	**15%**	**16%**	**18%**	**15%**	**16%**	**40%**	**4%**
2021/2022	**-11%**	**-23%**	**-22%**	**-21%**	**-22%**	**-22%**	**-4%**	**-3%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.65*** below.

Table 3.65: *Overview of activity data in the category 1A2gviii*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	422.68	2 318.63	20 227.45	1 119.73	NO
1995	410.23	2 345.02	19 731.99	1 173.23	NO
2000	489.74	1 859.07	17 487.13	1 415.42	NO
2005	420.07	927.89	9 748.14	2 541.02	11.66
2010	168.73	242.57	7 253.84	3 754.19	9.91
2011	181.78	423.59	7 378.02	4 020.46	NO
2012	197.54	250.28	7 462.88	3 863.99	NO
2013	142.49	252.31	7 496.96	3 002.44	NO
2014	143.18	276.46	6 432.57	2 793.73	NO
2015	216.29	256.39	7 219.92	2 916.27	NO
2016	182.82	175.15	7 831.62	3 388.56	NO
2017	231.51	2 363.12	8 008.58	3 314.50	NO
2018	185.38	173.66	7 756.01	3 273.00	NO
2019	206.92	172.50	7 779.31	3 068.83	NO
2020	217.54	179.94	7 114.92	3 008.66	NO
2021	364.25	192.74	8 067.25	3 018.37	NO
2022	355.02	180.04	7 111.44	2 769.49	NO
1990/2022	**-16%**	**-92%**	**-65%**	**147%**	-
2021/2022	**-3%**	**-7%**	**-12%**	**-8%**	-

3.5.9.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.66***).

Table 3.66: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/GJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	107.09	5.09	98.34	1.12	61.07	48%	65%	154.29

The emissions of heavy metals and POPs are calculated at the Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore these detailed methodologies could be used focused on the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of emissions of heavy metals and POPs are default EF from EMEP/EEA GB_{2019}, expert estimation and special source[1] (***Table 3.67***).

The annual emission is determined by activity data and an emission factor:

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

Where:

E_i = annual emission of pollutant *i*,

$EF_{i,j,k}$ = default emission factor of pollutant *i* for source type *j* and fuel *k*,

$A_{j,k}$ = annual consumption of fuel *k* in source type *j*.

Table 3.67: *Emission factors for heavy metals and POPs in the category 1A2gviii*

TYPE OF FUEL		LIQUID FUELS			HARD COAL	BROWN COAL		
T2	UNIT	ALL TYPES OF BOILERS (≤ 5 MWth)	ALL TYPES OF BOILERS (5–50 MWth)	STATIONARY ENGINES	FIXED BED BOILER (≤ 5 MWth)	FIXED BED BOILER (≤ 5 MWth)	FLUIZED BED BOILER (≤ 5 MWth)	FLUIZED BED BOILER (50–100 MWth)
Pb	[mg/GJ]	4.56	4.56	4.56	13.687	59.471	2.037	2.037
Cd	[mg/GJ]	1.2	1.2	1.2	2.456	1.294	0.282	0.282
Hg	[mg/GJ]	0.341	0.341	0.341	9.051	2.382	1.5	1.5
As	[mg/GJ]	3.98	3.98	3.98	9.402	60.967	0.922	0.922
Cr	[mg/GJ]	2.55	2.55	2.55	15	38.383	9.1	9.1
Cu	[mg/GJ]	5.31	5.31	5.31	10	69.545	1	1
Ni	[mg/GJ]	255	255	255	10	62.104	4.803	4.803
Se	[mg/GJ]	2.06	2.06	2.06	2	5.192	45	45
Zn	[mg/GJ]	87.8	87.8	87.8	150	30.756	8.8	8.8
PCDD/F	[ng I-TEQ/GJ]	2.5	2.5	2.5	14.657	4.986	2.778	2.778
B(a)P	[mg/GJ]	3.678	3.678	3.678	10.975	320.061	5.148	5.148
B(b)F	[mg/GJ]	12.673	12.673	12.673	18.54	518.482	7.621	7.621
B(k)F	[mg/GJ]	3.968	3.968	3.968	10.966	518.482	5.321	5.321
I()P	[mg/GJ]	6.484	6.484	6.484	5.956	400.322	5.559	5.559
PAHs	[mg/GJ]	26.803	26.803	26.803	46.437	1757.347	23.649	23.649
HCB	[µg/GJ]	-	-	-	6.7	6.7	6.7	6.7
PCBs	[µg/GJ]	3.334	3.334	3.334	8.073	5.059	1.449	1.449

TYPE OF FUEL		GASEOUS FUELS				BIOMASS			
T2	UNIT	ALL TYPES OF BOILERS (≤ 5 MWth)	ALL TYPES OF BOILERS (5–50 MWth)	STATIONARY ENGINES	GAS TURBINES	FIXED BED BOILER (≤ 5 MWth)	FIXED BED BOILER (5–50 MWth)	FLUIDIZED BED BOILER (≤ 5 MWth)	FLUIDIZED BED BOILER (5–50 MWth)
Pb	[mg/GJ]	0.0015	0.0015	0.04	0.0015	27	1.606	1.606	1.606
Cd	[mg/GJ]	0.00025	0.00025	0.003	0.00025	13	0.169	0.169	0.169
Hg	[mg/GJ]	0.1	0.1	0.1	0.1	0.56	1.268	1.268	1.268
As	[mg/GJ]	0.12	0.12	0.05	0.12	0.19	0.871	0.871	0.871
Cr	[mg/GJ]	0.00076	0.00076	0.05	0.00076	23	0.027	0.027	0.027
Cu	[mg/GJ]	0.000076	0.000076	0.01	0.000076	6	0.106	0.106	0.106

TYPE OF FUEL		GASEOUS FUELS				BIOMASS			
T2	UNIT	ALL TYPES OF BOILERS (≤ 5 MWth)	ALL TYPES OF BOILERS (5–50 MWth)	STATIONARY ENGINES	GAS TURBINES	FIXED BED BOILER (≤ 5 MWth)	FIXED BED BOILER (5–50 MWth)	FLUIDIZED BED BOILER (≤ 5 MWth)	FLUIDIZED BED BOILER (5–50 MWth)
Ni	[mg/GJ]	0.00051	0.00051	0.05	0.00051	2	0.085	0.085	0.085
Se	[mg/GJ]	0.0112	0.0112	0.2	0.0112	0.5	0.211	0.211	0.211
Zn	[mg/GJ]	0.0015	0.0015	2.91	0.0015	512	1.991	1.991	1.991
PCDD/F	[ng I-TEQ/GJ]	0.5	0.5	0.57	0.5	100	11.348	11.348	11.348
B(a)P	[mg/GJ]	0.56	0.56	1.2	0.56	10000	46.462	46.462	46.462
B(b)F	[mg/GJ]	0.84	0.84	9	0.84	16000	144.329	144.329	144.329
B(k)F	[mg/GJ]	0.84	0.84	1.7	0.84	5000	67.897	67.897	67.897
I()P	[mg/GJ]	0.84	0.84	1.8	0.84	4000	33.073	33.073	33.073
PAHs	[mg/GJ]	3.08	3.08	13.7	3.08	35000	291.761	291.761	291.761
HCB	[µg/GJ]	0.00308	0.00308	-	0.00308	5	5	5	5
PCBs	[µg/GJ]	-	-	-	-	0.007	2.233	2.233	2.233

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.68***). The calculated BC emission values are presented in ***Table 3.64***.

Table 3.68: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.5.9.3 Completeness

Emissions are well covered.

3.5.9.4 Source-specific recalculations

The recalculations for BC were made based on changes in activity data (for the years 2010-2021) due to the corrections in categorization of one source. The recalculations for HM and POPs were made based on changes in activity data (supplemented activity values). The results of the recalculations are in ***Table 3.69***.

Table 3.69: *Previous and revised emissions in the category 1A2gviii*

YEAR	BC [kt]		
	PREVIOUS	REVISED	CHANGE
2010	0.0408	0.0404	-1%
2011	0.0368	0.0360	-2%
2012	0.0420	0.0415	-1%
2013	0.0324	0.0318	-2%
2014	0.0311	0.0303	-3%
2015	0.0325	0.0318	-2%
2016	0.0350	0.0346	-1%
2017	0.0343	0.0315	-8%
2018	0.0361	0.0356	-1%
2019	0.0371	0.0364	-2%
2020	0.0360	0.0360	0.00%
2021	0.0384	0.0377	-2%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2020	0.0166	0.0166	0.00%	0.0056	0.0056	0.00%	0.0057	0.0057	0.41%
2021	0.0204	0.0206	1%	0.0063	0.0063	0.05%	0.0082	0.0082	0.03%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2020	0.0043	0.0043	1%	0.0099	0.0099	0.00%	0.0030	0.0030	0.00%
2021	0.0062	0.0064	3%	0.0107	0.0108	1%	0.0036	0.0038	6%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2020	0.0102	0.0102	0.00%	0.0062	0.0062	0.04%	0.2056	0.2056	0.00%
2021	0.0156	0.0158	1%	0.0075	0.0074	-2%	0.2236	0.2237	0.03%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2020	0.0828	0.0829	0.14%	0.0143	0.0143	0.01%
2021	0.1066	0.1066	0.01%	0.0157	0.0157	0.03%

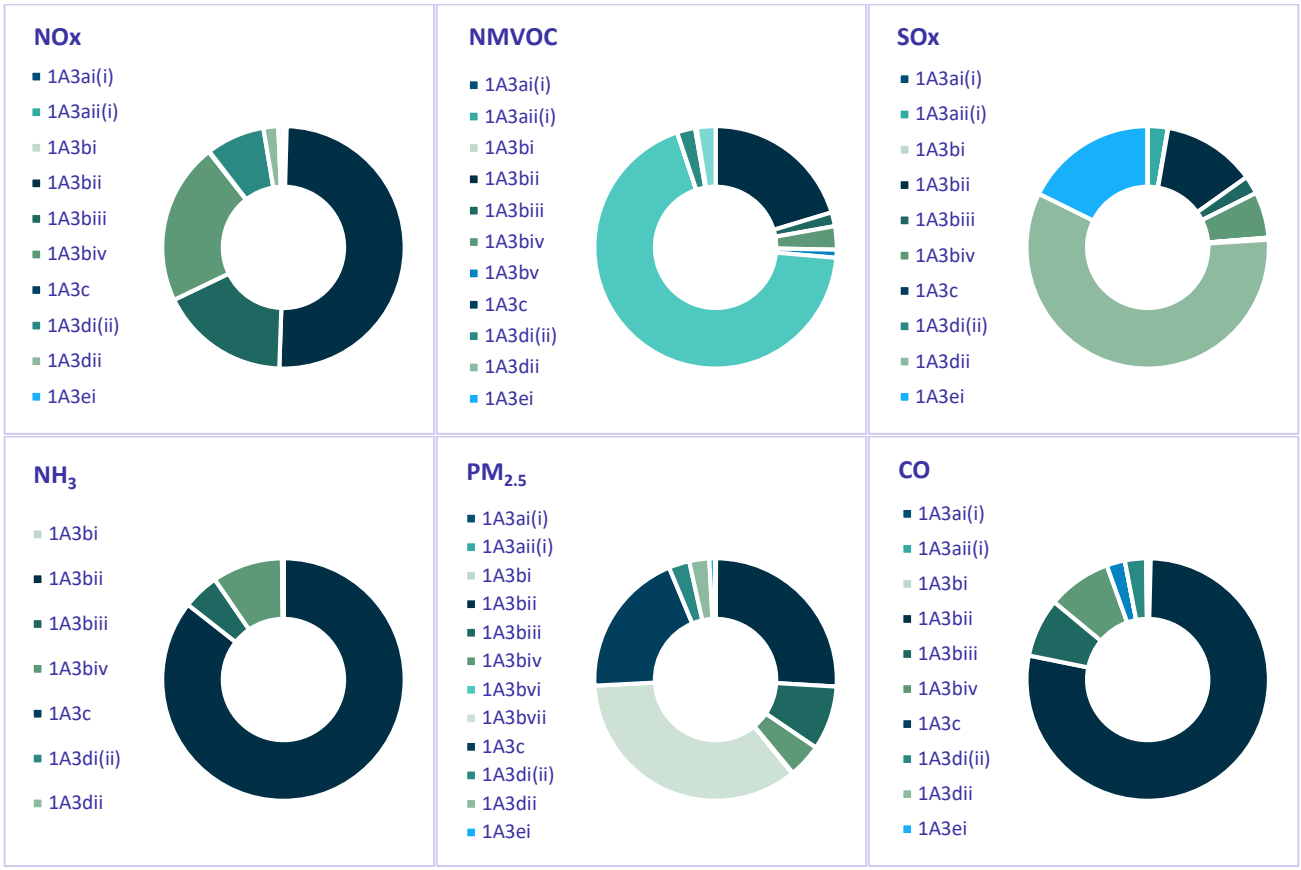
YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2020	0.0210	0.0210	0.00%	0.0085	0.0085	0.00%
2021	0.0303	0.0303	0.00%	0.0126	0.0126	0.09%

3.6 TRANSPORT (NFR 1A3)

3.6.1 Overview

The emissions from the category **1A3** Transport include subcategories Domestic aviation (**1A3a**), Road transportation (**1A3b**), Railways (**1A3c**), Domestic navigation (**1A3d**) and Pipeline transport (**1A3ei**). As mentioned in previous reports there is still observed shift from public transportation to individual passenger cars in Slovakia. After a decrease in fuel consumption and emissions in the pandemic year 2020, there can be observed again a rise. In the road transport the passenger cars category is still declining and the only category to rise are heavy duty vehicles and buses (public transport). Total aggregated pollutants in transport decreased against the base year in the range of 64.12% (NOx) and 93.54% (SOx), although emission of ammonia has increased by 1 254.65% and PAH increased by 102.93%, in comparison with the base year. More information about the current status of emissions is in ***Figure 3.4***. Ammonia mostly comes from road transportation, exactly 99.91% of it and the rest is railways and navigation (0.09%). The emissions from road and non-road transport were calculated by using models, default methodologies and the consistent data series from 1990 to 2021.

Figure 3.4: *Share of emissions of the main pollutants in 1A3 in 2022*



Category-specific QA/QC plan is based on the general QA/QC plan described in **Chapter 1.6.1** of this report. The emissions inventory in the transport categories were prepared by the sectoral expert. Slovakia has been dealing with data inconsistency from several statistical sources in the last years regarding fuel consumption in transport. Therefore, in agreement with our QA/QC Plan, the extensive analyses of the available statistical information in liquid fuels in transport began in 2017. The results were published in the statistical journal[2] in Slovak.

QA/QC procedures for the transport sector follow basic rules and activities of QA/QC as defined in the EMEP/EEA GB_{2023}. The QC checks were done during the NFR and IIR compilation, general QC questionnaire was filled in and is archived.

Due to frequent questions for data consistency between the IEA statistics and the national inventory, the data sources were investigated. Comparison of activity data and their sources is also crucial for the evaluation of consistency in reporting. Gasoline, diesel oil and biofuel consumption are key activity data in the transport sector, thus the comparison was focused on these statistical data across several sources. Datasets for this analysis are the years 2014-2022:

- The Statistical Office of the Slovak Republic (ŠÚ SR) inserts data also from the State Material Reserve of the Slovak Republic;
- Ministry of Economy (MH SR);
- Finance Administration of the Slovak Republic (FR SR);
- Ministry of Environment (MŽP SR) (***Table 3.70***).

Each source has specific forms or questionnaires, CN codes and different reporting rules, methodologies and dates of publication or collection. Different institutions further process these data. The ŠÚ SR used the

[2] Slovak Statistics and Demography: https://slovak.statistics.sk/wps/wcm/connect/fcafaa22-6de1-44ce-bd6b-83fb377d84fc/Slovenska_statistika_a_demografia_1_2021.pdf?MOD=AJPERES&CVID=nvlXiB0

import/export and production data, the FR SR used data from taxes on sales of products of crude oil and taxes on sales of biofuels (***Figure 3.5***).[3, 4]

Table 3.70: *Crude oil and crude oil products data flow and utilisation (final user is the SHMÚ)*

ORIGIN OF DATA	PRIMARY USER	SECONDARY USER
Import-export data (ŠÚ SR - Depart.	Statistical Office of Slovak Republic (Depart. of Energy Statistics)	EUROSTAT
Data regarding production and sales		Slovak Hydrometeorological Institute
Data from taxes on sales of biofuels	Financial Administration of the Slovak Republic	Ministry of Economy
Data from taxes on sales of products		SK - BIO[5]
Confirmation (certificate) of the sustainability	Slovak Hydrometeorological Institute	European Environmental Agency
Data on production and sales (companies)	Slovak State Material Reserves	International Energy Agency (data on crude
		EUROSTAT (natural gas)
Data on fuel sales at gas stations (NEIS)	Ministry of Environment (according to Art. 8)	European Environmental Agency

As shown in ***Table 3.70*** and in ***Figure 3.5***, discrepancies occurred between major data sources – providers. During discussions with the main authorities, information was collected by the sectoral experts, which was further analysed:

- Each authority reports different data in different forms for different institutions or requirements (***Table 3.71*** and **ANNEX VII**);
- The conversion factors (e.g. density) differ throughout all data suppliers not only between authorities and companies but also for each delivered supply has its own characteristics;
- Dates of collection for tax reports and reports to the ŠÚ SR differ.

Table 3.71: *Results of fuels consumption comparison according to different sources*

DATA SOURCE	ŠÚ SR			FR SR		
YEAR	PETROL [kt]	DIESEL OIL [kt]	BIOFUELS [kt]	PETROL [kt]	DIESEL OIL [kt]	BIOFUELS [kt]
2014	529.0	1 315.0	167.0	508.6	1 619.7	–
2015	550.0	1 259.0	182.0	516.6	1 743.0	–
2016	581.0	1 442.0	163.0	533.3	1 841.7	–
2017	620.0	1 905.0	176.0	540.0	1 914.0	–
2018	579.0	1 879.0	174.0	544.6	1 978.2	–
2019	562.0	1 952.0	183.0	546.4	2 003.6	–
2020	531.0	1 796.0	187.0	524.5	1 860.0	–
2021	541.0	1889.0	195.0	541.6	1 958.8	–
2022	570.0	1 969.0	206.0	570.5	2 010.7	–

DATA SOURCE	MH SR			MŽP SR (FQD ART.8)		
YEAR	PETROL [kt]	DIESEL OIL [kt]	BIOFUELS [kt]	PETROL [kt]	DIESEL OIL [kt]	BIOFUELS [kt]
2014	517.2	1 639.0	138.9	664.9	1 507.4	–
2015	521.5	1 854.8	149.9	613.1	1 514.8	–
2016	543.8	1 872.3	147.9	591.0	1 494.6	–
2017	506.0	1 914.0	173.0	715.7	2 037.0	–
2018	532.7	1 841.6	178.0	555.0	2 004.6	–
2019	569.0	2 016.0	184.0	532.0	1 893.0	–
2020	524.0	1 853.5	184.9	524.5	1 865.5	–
2021*	–	–	–	541.7	1 964.1	–
2022*	–	–	–	578.2	2 042.7	–

**Ministry of Economy of the Slovak Republic stopped reporting these data*

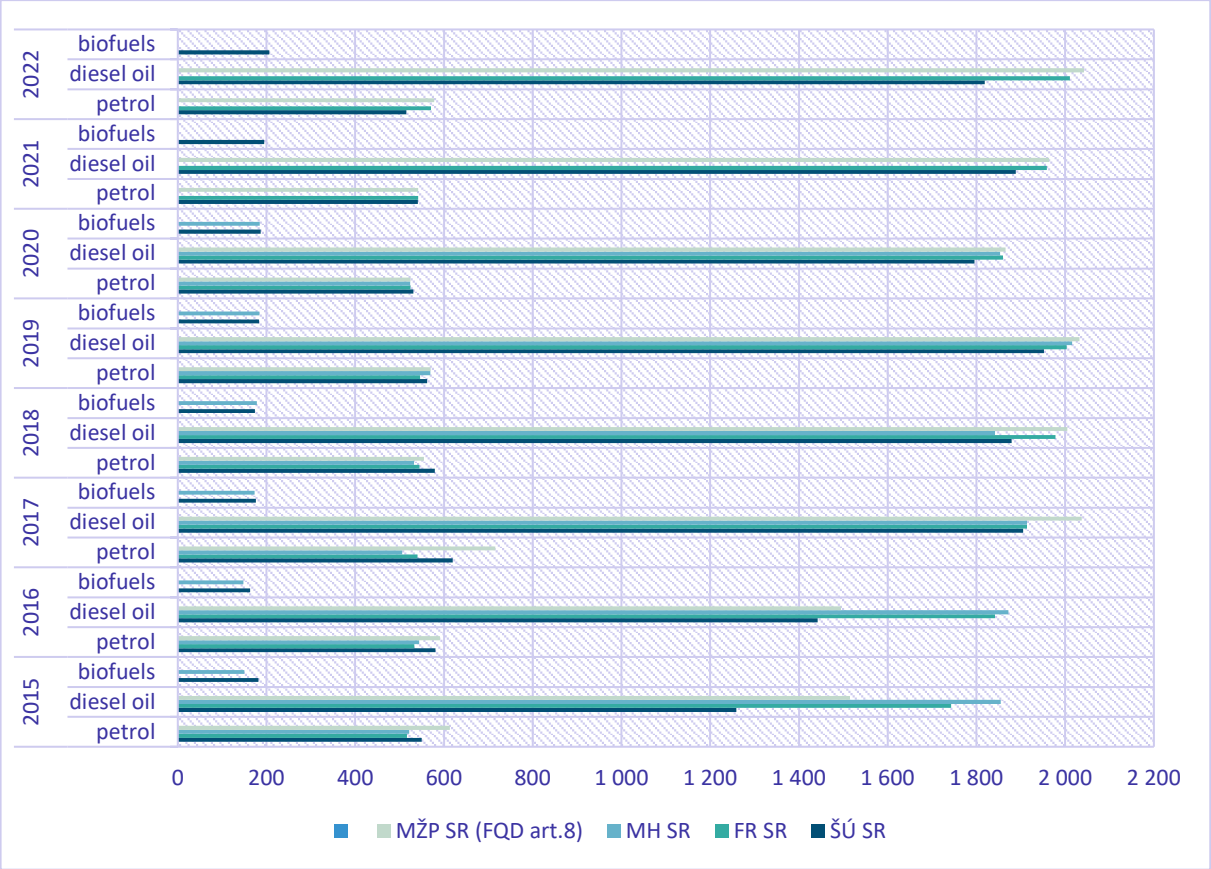
[3] Council Directive (EU) 2015/652 laying down calculation methods and reporting requirements pursuant to Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels

[4] Act 309/2009 Coll. on the Promotion of renewable energy sources and high-efficiency cogeneration and on amendments to certain acts as amended, http://www.minzp.sk/en/areas/renewable-energy-sources/biofuels-bioliquids/

[5] SK-BIO is the national register for biofuels and bioliquids (https://oeab.shmu.sk/en/biofuels-and-bioliquids.html)

The main outcomes of this analysis are harmonisation of fuels consumption in the country on the most possible level and lowering the differences in reporting by different subjects to 2.8% for fossil fuels and 2% for biofuels in 2022. Full consistency of data on the national level is not possible. This is due to different legislation that each authority is required to fulfil (e.g. statistical reporting to EU institutions, tax collection, etc.).[6]

Figure 3.5: *Results of fuels consumption comparison according to different sources (kt)*



3.6.2 International aviation LTO (NFR 1A3ai(i)) and Domestic aviation LTO (NFR 1A3aii(i))

3.6.2.1 Overview

These categories are not key categories. In the absence of national data on the exact numbers of domestic and international LTO cycles (only total numbers of LTO cycles is available), summary information from the EUROCONTROL database was used. The Slovak Management of Airports manages Slovak airports, except for the airport in Žilina, where exercises with light aircrafts of the Žilina University predominate. Other smaller civil airports (Nitra, Prievidza, Ružomberok and Lučenec) are operated by aero-clubs with a predomination of sports flights. Emissions estimation was calculated based on the data directly provided by the individual airports based on LTO cycles and fuel consumption (without fuel type differentiation). The described approach is maintained for a time series from 1990-2004. For the time series 2005-2022, 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 the EUROCONTROL file for LTO and Cruise separately and reported in International (***Table 3.72***) and Domestic aviation LTO cycles (***Table 3.73***). The fuel consumption in category **1A3ai(i)** increased compared to the base year 1990 by 101% (***Table 3.74***). The total consumption of jet kerosene was 252.18 TJ

[6] Regulation (EC) 1099/2008 of the European Parliament and of the Council, Act No. 268/2017, which amend Act No. 98/2004 Coll. on the Excise Duty on mineral oil as amended, which amends Act No. 309/2009 Coll. on the Promotion of renewable energy sources and high-efficiency cogeneration and on amendments to certain acts as amended (only § 14a), https://www.financnasprava.sk/en/businesses/taxes-businesses/excise-duties-businesses#TaxRatesMineralOil

and the consumption of aviation gasoline was 0.14 TJ allocated in the international aviation LTO cycle in 2022. After a decrease in 2020, there can be observed a rise in international aviation as a part of the recovery of the sector after the COVID pandemic. From 2005 until 2019, international aviation emissions were increasing. The increase in fuel consumption and emissions were influenced by the arrival of low-cost airlines (Ryanair – based in Bratislava, WizzAir – based in Košice) and charter flights.

The fuel consumption in category **1A3aii(i)** decreased compared to the base year 1990 by 63%. The total consumption of jet kerosene was 5.35 TJ and the consumption of aviation gasoline was 0.19 TJ in the domestic aviation LTO cycle in 2022 (***Table 3.75***). Since 2005, domestic aviation emissions are decreasing. This decrease and the whole category is influenced by the fact, that the Slovak Republic has no official national airlines as Slovak Airlines are out of business since 2007, SkyEurope since 2009 and close distance of other big international airports in Vienna and Budapest.

Table 3.72: *Overview of emissions from internatinal aviation 1A3ai(i)*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1020	0.0012	0.0271	0.0007	0.0007	0.0007	0.0003	0.0680
1995	0.0677	0.0008	0.0180	0.0005	0.0005	0.0005	0.0002	0.0458
2000	0.0776	0.0009	0.0205	0.0005	0.0005	0.0005	0.0002	0.0510
2005	0.0698	0.0008	0.0051	0.0011	0.0011	0.0011	0.0005	0.0632
2010	0.0771	0.0011	0.0049	0.0008	0.0008	0.0008	0.0004	0.0541
2011	0.0782	0.0010	0.0050	0.0008	0.0008	0.0008	0.0004	0.0557
2012	0.0722	0.0010	0.0046	0.0007	0.0007	0.0007	0.0004	0.0564
2013	0.0686	0.0011	0.0044	0.0008	0.0008	0.0008	0.0004	0.0560
2014	0.0700	0.0012	0.0043	0.0008	0.0008	0.0008	0.0004	0.0531
2015	0.0834	0.0012	0.0051	0.0009	0.0009	0.0009	0.0005	0.0613
2016	0.0917	0.0016	0.0056	0.0010	0.0010	0.0010	0.0005	0.0693
2017	0.0997	0.0015	0.0060	0.0009	0.0009	0.0009	0.0004	0.0676
2018	0.1113	0.0015	0.0068	0.0011	0.0011	0.0011	0.0005	0.0747
2019	0.1127	0.0013	0.0069	0.0011	0.0011	0.0011	0.0005	0.0747
2020	0.0364	0.0006	0.0022	0.0005	0.0005	0.0005	0.0002	0.0291
2021	0.0424	0.0009	0.0026	0.0004	0.0004	0.0004	0.0002	0.0348
2022	0.0827	0.0011	0.0049	0.0007	0.0007	0.0007	0.0003	0.0544
1990/2022	**-19%**	**-9%**	**-82%**	**-4%**	**-4%**	**-4%**	**-4%**	**-20%**
2021/2022	**95%**	**13%**	**89%**	**72%**	**72%**	**72%**	**72%**	**57%**

Table 3.73: *Overview of emissions from domestic aviation 1A3aii(i)*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0809	0.0007	0.0226	0.0004	0.0004	0.0004	0.0002	0.0199
1995	0.0537	0.0004	0.0150	0.0003	0.0003	0.0003	0.0001	0.0132
2000	0.0614	0.0005	0.0172	0.0003	0.0003	0.0003	0.0002	0.0151
2005	0.0079	0.0001	0.0006	0.0002	0.0002	0.0002	0.0001	0.0108
2010	0.0043	0.0002	0.0004	0.0002	0.0002	0.0002	0.0001	0.0121
2011	0.0034	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0112
2012	0.0032	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0127
2013	0.0027	0.0001	0.0002	0.0002	0.0002	0.0002	0.0001	0.0113
2014	0.0030	0.0001	0.0003	0.0002	0.0002	0.0002	0.0001	0.0094
2015	0.0032	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0123
2016	0.0029	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0095
2017	0.0032	0.0001	0.0003	0.0001	0.0001	0.0001	0.0001	0.0097
2018	0.0026	0.0001	0.0002	0.0001	0.0001	0.0001	0.0000	0.0086
2019	0.0017	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0044
2020	0.0007	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0030
2021	0.0012	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0047
2022	0.0012	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0060
1990/2022	**-99%**	**-80%**	**-100%**	**-96%**	**-96%**	**-96%**	**-96%**	**-70%**
2021/2022	**0%**	**30%**	**8%**	**14%**	**14%**	**14%**	**14%**	**27%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.74*** and ***Table 3.75*** below.

Table 3.74: *Overview of activity data from international aviation 1A3ai(i)*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	125.37	NA	NA	NO	NO
1995	89.44	NA	NA	NO	NO
2000	88.48	NA	NA	NO	NO
2005	263.97	NA	NA	NO	NO
2010	251.22	NA	NA	23.53	NO
2011	257.32	NA	NA	27.40	NO
2012	235.74	NA	NA	26.39	NO
2013	226.71	NA	NA	28.96	NO
2014	224.16	NA	NA	49.93	NO
2015	264.49	NA	NA	34.88	NO
2016	289.64	NA	NA	29.49	NO
2017	309.96	NA	NA	49.36	NO
2018	349.00	NA	NA	61.73	NO
2019	354.75	NA	NA	46.74	NO
2020	114.61	NA	NA	40.14	NO
2021	133.53	NA	NA	NO	NO
2022	252.32	NA	NA	NO	NO
1990/2022	**101%**	-	-	-	-
2021/2022	**89%**	-	-	-	-

Table 3.75: *Overview of activity data from domestic aviation 1A3aii(i)*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	14.80	NA	NA	NO	NO
1995	10.51	NA	NA	NO	NO
2000	10.49	NA	NA	NO	NO
2005	31.99	NA	NA	NO	NO
2010	19.26	NA	NA	NO	NO
2011	15.43	NA	NA	NO	NO
2012	14.51	NA	NA	NO	NO
2013	12.58	NA	NA	NO	NO
2014	13.30	NA	NA	NO	NO
2015	14.02	NA	NA	NO	NO
2016	13.06	NA	NA	NO	NO
2017	13.41	NA	NA	NO	NO
2018	11.01	NA	NA	NO	NO
2019	7.21	NA	NA	NO	NO
2020	2.93	NA	NA	NO	NO
2021	5.13	NA	NA	NO	NO
2022	5.54	NA	NA	NO	NO
1990/2022	**-63%**	-	-	-	-
2021/2022	**8%**	-	-	-	-

3.6.2.2 Methodological issues

The airport traffic in Slovakia is determined only by the origin of airlines. It means, that there is no direct information about the number of domestic and international flights in statistics. Tier 1 methodology for

emission estimation in aviation, both for aviation gasoline and jet kerosene was used for time series 1990-2004. Tier 1 methodology is based on fuel sold in the airports. For this period, the only total number of LTO cycles is known, therefore the average disaggregation of activities between national and international aviation was revised. The share for national and international aviation activities for the period 1990-2004 was improved based on the real data used for time series 2005-2017. The share is a constant value. The real share of national and international activities for the period 2005-2022 was taken from the EUROCONTROL database directly. Data regarding disaggregation to LTO and cruise phase for the period 1990-2004 (***Table 3.76***) is taken from EUROCONTROL and the share is based on the real data used for time series 2005-2017 (in line with observation and ***Recommendation No SK-1A3aii(ii)-2017-0002***).

Table 3.76: *The share of fuel consumption in domestic and international aviation for the period 1990-2004*

FUELS	DOMESTIC AVIATION	INTERNATIONAL AVIATION
	1990-2004	
Aviation gasoline	30%	70%
Jet kerosene	5%	95%

The implied emission factors for jet kerosene applied in these submissions for the years 1990-2004 were calculated as average EFs from available EUROCONTROL data for 2005-2017. These average emission factors (***Table 3.77***) for all pollutants were used for the years 1990-2004 in national and international aviation. Emission factors applied for aviation gasoline, for the period 1990-2004, were from EMEP/EEA GB$_{2019}$.

Activity data for the years 1990-1993 are not available and were estimated as expert judgment according to real LTO cycles in this period. For the period 1994-2004, activity data were directly provided by the airports on annual basis.

From the year 2005 onwards, Slovakia decided to use the EUROCONTROL data. The decision is based on the analysis of the national data and the data obtained from the EUROCONTROL. Results showed that the EUROCONTROL data are more consistent and accurate in line with the QA/QC rules. The Ministry of Transport of the Slovak Republic thereafter approved these results. EUROCONTROL data used tier 3 methodology applying the Advanced Emissions Model (AEM). The following data were taken from the EUROCONTROL data published in 2020 into the 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.

Slovakia made in the year 2020 analysis of jet kerosene and aviation gasoline for heavy metals and according to this analysis was able to define a new emission factor for lead (Pb) for this inventory (***Table 3.77***).

Table 3.77: *Average emission factors for the pollutants in civil aviation according to EUROCONTROL*

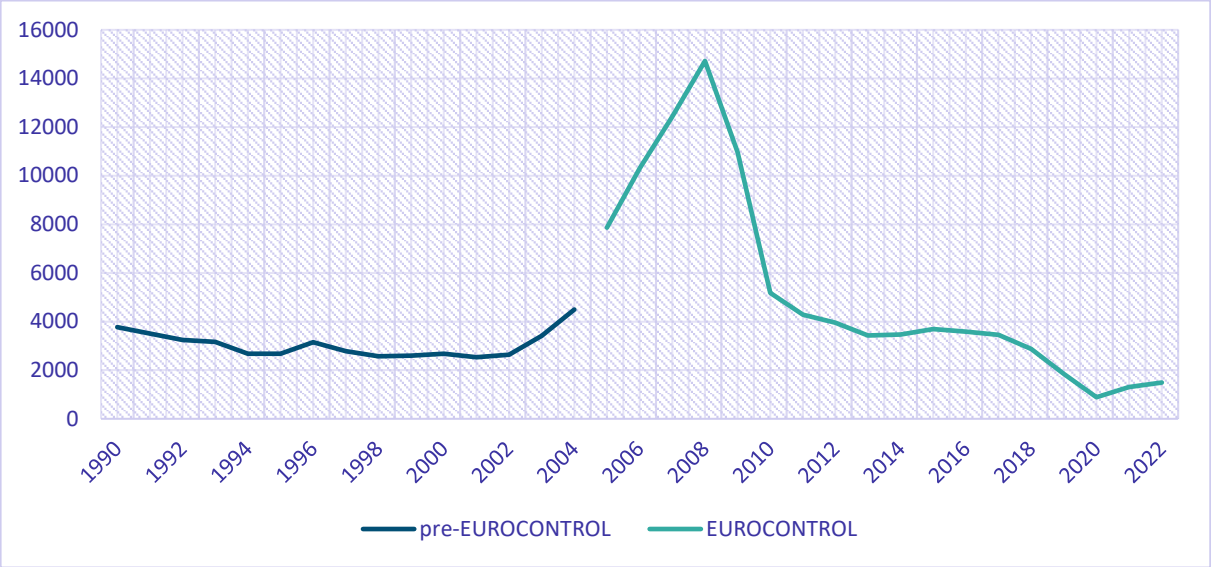
FUEL TYPE		EMISSION FACTORS						
		NOx	NMVOC	SOx	TSP	CO	BC	Pb
		[kg/t]						[g/t]
Aviation gasoline	national	4.00	19.00	1.00	0.03	1200.00	0.48	0.56
	international	4.00	19.00	1.00	0.03	1200.00	0.48	0.56
Jet kerosene	national	14.38	0.08	0.84	0.08	6.26	0.48	0
	international	13.66	0.04	0.84	0.16	3.08	0.48	0

3.6.2.3 Completeness

Since 2011, the agreement of the European Commission (the EC) and the EUROCONTROL is in place. Based on this agreement, an annual comparison of aviation fuel consumption and the emissions data with AEM model calculations is prepared. The individual EU Member State provides the comparison of the EUROCONTROL and

the UNFCCC reporting data in aviation. The information and data provided in this evaluation are intended to be used for QA/QC activities regarding emissions from aviation. The EC works towards making data from the EUROCONTROL available to the EU MS regularly, for quality check, however, this information is not possible to make publicly available. Consistency of the time-series (***Figure 3.6***) is maintained by using calculated average EFs from EUROCONTROL. The methodology is explained in **Chapter 3.6.2.1**.

Figure 3.6: *Demonstration of time-series consistency between pre-EUROCONTROL methodology and EUROCONTROL methodology (in TJ)*



The verification process is also based on cross-checking of the input data from the Slovak airports by sectoral experts and the comparison with the sectoral statistical indicators from the Ministry of Transport, Construction and Regional Development of the Slovak Republic. The sectoral experts in the central archiving system at the SHMÚ archive the background documents.

3.6.2.4 Source-specific recalculations

A recalculation in the category **1A3aii(i)** (domestic aviation) was made due to incorrect input for PM_{10} and TSP for the year 1994. The results of recalculations are in ***Table 3.78***.

Table 3.78: *Previous and revised emissions in domestic aviation – 1A3aii(i)*

YEAR	PM_{10} [kt]				TSP [kt]		
	PREVIOUS	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1994	0.0005	0.0005	0.0005	3 %	0.0005	0.0005	3%

3.6.3 Road Transportation (NFR 1A3b)

3.6.3.1 Overview

Short distance passenger transport is an important part of road transportation. It is the most exploited type of transport in the Slovak Republic due to the high density and quality of the road network and interconnection of all municipalities. In recent years, road transport has expanded significantly in the transport of goods and persons. In 2022, the transport network included 545 km of highways, 317 km of motorways and 3 337 km of the category 1st class roads. Total roads network represented 18 156 km of roads in the Slovak Republic[7] in 2022. Road transportation is the most important and key category with the highest share of emissions and continually increasing trend in fuels consumption within transport. There is a huge increase in emission of ammonia compared to base year – 1 410% (***Table 3.79***). This is caused by the expansion of light commercial

[7] Slovak Road Database 2022

vehicles in category EURO 5 and onwards, which have higher EFs than vehicles in category EURO 2, 3 and 4.

Table 3.79: *Overview of emissions in road transport in the years 1990-2022*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	BC [kt]	CO [kt]	Priority HMs [t]	PAHs [t]
1990	43.8129	26.0657	2.4180	0.0249	2.8064	3.0529	1.3470	193.0129	9.1513	0.0860
1995	37.2257	26.6181	1.9042	0.0874	1.9271	2.1443	0.9119	209.2321	7.8600	0.0707
2000	31.5863	20.1830	0.6929	0.3490	1.4436	1.6694	0.7016	168.3104	0.4447	0.0687
2005	43.2728	19.8301	0.1934	0.5261	2.2405	2.5892	1.1622	170.1213	0.6860	0.1121
2010	36.8401	11.7866	0.0285	0.4700	2.1781	2.5618	1.1963	89.2107	0.7471	0.1428
2011	29.5004	8.1419	0.0267	0.4110	1.6056	1.9666	0.8453	58.4767	0.7025	0.1386
2012	30.9457	7.9975	0.0283	0.4179	1.6633	2.0481	0.8758	56.2936	0.7460	0.1500
2013	23.5803	5.3607	0.0274	0.4292	1.2617	1.6455	0.6725	35.5857	0.7387	0.1520
2014	21.6445	4.5491	0.0294	0.3701	1.1361	1.5265	0.5696	29.0237	0.7504	0.1602
2015	22.8935	4.7221	0.0307	0.3458	1.2700	1.6961	0.6497	28.2203	0.8237	0.1817
2016	21.8079	3.6215	0.0314	0.4037	1.1557	1.6166	0.5262	19.0520	0.8847	0.1936
2017	20.8402	4.5952	0.0351	0.3573	1.1858	1.6342	0.5659	26.8405	0.8588	0.1894
2018	20.6112	3.6114	0.0337	0.3852	1.1019	1.5856	0.4651	16.4659	0.9253	0.2039
2019	19.7557	3.6159	0.0361	0.3888	1.0831	1.5772	0.4403	15.8927	0.9435	0.2057
2020	18.2303	3.1477	0.0340	0.3391	0.9807	1.4143	0.4117	13.6974	0.8448	0.1881
2021	17.4287	3.3031	0.0368	0.3505	0.9940	1.4676	0.3863	14.3917	0.9003	0.1943
2022	17.3711	5.2776	0.0386	0.3764	1.0166	1.5207	0.3778	14.6796	0.9607	0.2018
1990/2022	**-60%**	**-80%**	**-98%**	**1410%**	**-64%**	**-50%**	**-72%**	**-92%**	**-90%**	**135%**
2021/2022	**-0.3%**	**59.8%**	**4.8%**	**7.4%**	**2.3%**	**3.6%**	**-2.2%**	**2.0%**	**6.7%**	**3.9%**

The major share of emissions belongs to passenger cars (***Table 3.80***). Most of the priority HMs (Pb, Cd and Hg) comes from tyre and brake wear abrasion. The majority of NOx, NMVOC and CO emission is emitted in the cities (***Table 3.81***).

Table 3.80: *Overview of total emissions according to the type of vehicles in 2022*

VEHICLE CATEGORY	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	TSP [kt]	CO [kt]	Priority HMs [t]	PAHs [t]
Passenger cars	9.7708	1.1307	0.0228	0.3224	0.2807	0.2807	0.0117	0.1198
Light duty vehicles	3.3783	0.1032	0.0044	0.0183	0.0929	0.0929	0.0018	0.0237
Heavy duty vehicles and buses	4.2032	0.1731	0.0112	0.0353	0.0490	0.0490	0.0043	0.0581
Mopeds & motorcycles	0.0188	0.0597	0.0001	0.0004	0.0013	0.0013	0.0001	0.0003
Gasoline evaporation	NA	3.8110	NA	NA	NA	NA	NA	NE
Automobile tyre and brake wear abrasion	NA	NA	NA	NA	0.9334	NA	0.9428	NE
Automobile road abrasion	NA	NA	NA	NA	0.7855	NA	NE	NE

Table 3.81: *Results from COPERT in the distribution for agglomeration mode in 2022*

	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	CO [kt]
Urban	8.2513	4.1900	0.0254	0.1007	0.4519	10.1410
Rural	6.2744	0.6338	0.0261	0.1800	0.4069	2.8860
Highway	2.8455	0.4538	0.0104	0.0957	0.1578	1.6526

3.6.3.2 Methodological issues

COPERT model 5 (v5.5) was used for the estimation of road transport emissions. The model distinguishes vehicle categories and emission factors reflecting the recent development and research. These data are not available before 2000. The methodology is often referred to the name of the program (methodology "COPERT"). Calculation in model COPERT 5 is based on EMEP/EEA GB_{2019} methodology. This methodology is

balancing fifteen different emissions including greenhouse gases from road transport. Preparation of basic pollutants inventory is based on the sequence calculation for each vehicle category and summing. Emission factors are set by the model and they differ for all types of fuel, different vehicle categories and different technological levels. Statistically recorded fuel consumption and fuel consumption calculated through COPERT 5 model are equal, except for fossil petrol. There is a statistically insignificant difference on the level up to 2%. The COPERT 5 defined new vehicle categories for the calculation of pollutants, with the disaggregation into 5 base categories and 375 subcategories. Further disaggregation was applied according to the operation of road vehicles in the agglomeration, road and highway traffic mode. In COPERT 5, buses were divided into 8 sub-districts and 2 subgroups (urban and coaches). Heavy duty vehicles are divided into 2 basic groups (rigid and articulated). Rigid vehicles are further divided by weight into 8 subgroups and articulated into 6 subgroups. This methodology uses technical parameters of different vehicle types and country characteristics, such as the composition of the car fleet, the age of the cars, the parameters of operation and fuels or climate conditions.
The estimation is provided for the main 6 groups of input data:

- Total fuel consumption;
- Composition of vehicles fleet;
- Driving mode;
- Driving speed;
- Emission factors;
- Annual mileage.

Based on these input parameters the emissions can be estimated. Information about the vehicle fleet is based on the database operated by the Police Presidium of the Slovak Republic. The SHMÚ has access to the database and can download the necessary information directly from the IS EVO (Information System for Vehicle Evidence) website[8].
Exhaust emissions from road transport are divided into two types:

- so-called "cold emissions", which are additional emissions with the start of a cold motor;
- so-called "hot emissions", which are produced by the engine of a vehicle warmed at the operating temperature.

The EFs values for air pollutants in COPERT are defined separately for the different types of fuels, types of vehicles and the different technological levels of vehicles. The emission factors for pollutants such as SO_x, NOx, NH_3, PMs and partially CH_4 can be obtained by the simple formula of driving mode and consumed fuel. Emission factors are then calculated automatically by the model based on the input parameters such as the average speed, the quality of fuels, the age of vehicles, the weight of vehicles and the volume of cylinders.
Accurate and actual data on distance-based values and parameters are necessary to run the COPERT 5 model (***Table 3.82***). Particularly kilometres (km) travelled are not available in Slovakia. Therefore, new input data on mileages were requested from TID (odometers) and NCR (from the Police). As the unique key for binding data from these two registries, the VIN number (vehicle identification number) was used. Using MS Access, the average number of mileages was produced. Further data needed were: first registration of the vehicle, VIN, vehicle type, engine volume, weight of the vehicle, emission category and data from the odometer. At least that many years as are between two technical controls are needed. The mileages in those years can be calculated and if the mileages are divided by the number of years, the average annual mileages can be obtained. To distribute the number of vehicles to their appropriate COPERT category, the data on mileages were used from the estimation mentioned above. The recommendations provided within the framework of the COPERT 5 model, including consistency with fuel consumption, were used in addition. The main source of activity data such as intensity on urban, rural and highways is the Traffic Census of Slovakia, conducted every five years (2000, 2005, 2010 and 2015[9]).

[8] http://www.minv.sk/?celkovy-pocet-evidovanych-vozidiel-v-sr
[9] Traffic Census of Slovakia 2015, http://www.ssc.sk/sk/cinnosti/rozvoj-cestnej-siete/dopravne-inzinierstvo.ssc

Table 3.82: *Overview of input data used in COPERT 5 model in 2022*

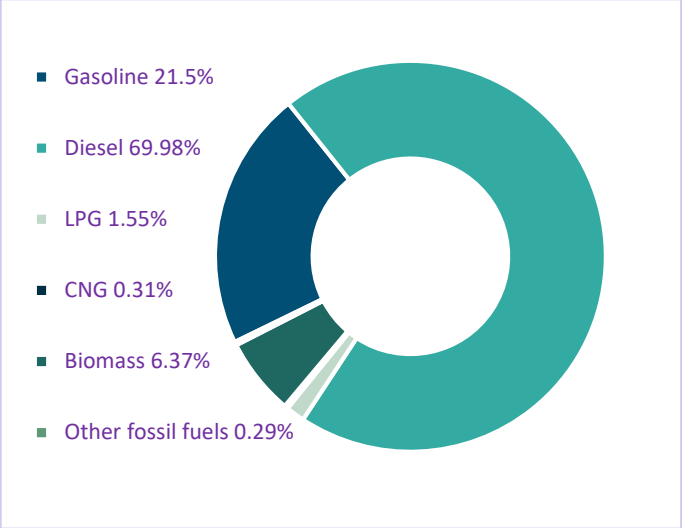
CATEGORY OF ROAD VEHICLE	ACTIVITY DATA		CATEGORY OF ROAD VEHICLE	ACTIVITY DATA	
	NUMBER OF VEHICLES	AVERAGE MILEAGE [KM/VEH]		NUMBER OF VEHICLES	AVERAGE MILEAGE [KM/VEH]
Passenger Cars	**2 523 199**	**1 564 173**	Diesel N1-II	74 057	133 311
Petrol Mini	155	1 076	Diesel N1-III	145 177	123 351
Petrol Small	7 318	23 590	**Heavy Duty Trucks**	**77 034**	**1 693 908**
Petrol Medium	822 316	51 625	Petrol >3,5 t	108	346
Petrol Large-SUV-Executive	396 600	71 866	Rigid <=7,5 t	24 645	161 758
Petrol 2-Stroke	47 161	68 106	Rigid 7,5 - 12 t	14 014	204 115
Petrol Hybrid Mini	50	22 952	Rigid 12 - 14 t	3 823	143 335
Petrol Hybrid Small	6 835	49 234	Rigid 14 - 20 t	5 293	125 528
Petrol Hybrid Medium	27 450	60 548	Rigid 20 - 26 t	1 235	64 843
Petrol Hybrid Large-SUV-Executive	9 233	65 219	Rigid 26 - 28 t	58	159 652
Petrol PHEV Small	873	26 505	Rigid 28 - 32 t	211	107 467
Petrol PHEV Medium	2 081	41 793	Rigid >32 t	165	109 942
Petrol PHEV Large-SUV-Executive	977	40 670	Articulated 14 - 20 t	27 462	444 216
Diesel Mini	394	13 006	Articulated 20 - 28 t	20	172 706
Diesel Small	25 347	71 636	**Buses**	**8 159**	**1 390 237**
Diesel Medium	919 254	160 646	Urban Buses Midi <=15 t	736	206 538
Diesel Large-SUV-Executive	207 248	116 224	Urban Buses Standard 15 - 18 t	392	226 720
Diesel PHEV Large-SUV-Executive	72	44 902	Urban Buses Articulated >18 t	41	164 467
LPG Mini	21	9 989	Coaches Articulated >18 t	36	377 011
LPG Small	23 560	161 987	Coaches Standard <=18 t	6 668	259 162
LPG Medium	19 646	161 184	Diesel Hybrid	16	51 345
LPG Large-SUV-Executive	4 989	146 381	Urban CNG Buses	270	104 994
CNG Mini	14	10 651	**L-Category**	**165 156**	**43 875**
CNG Small	1 060	58 350	Mopeds 2-stroke <50 cm^3	1 071	3 819
CNG Medium	489	64 496	Mopeds 4-stroke <50 cm^3	27 275	3 920
CNG Large-SUV-Executive	56	21 538	Motorcycles 2-stroke >50 cm^3	2 633	5 732
Light Commercial Vehicles	**272 527**	**574 153**	Motorcycles 4-stroke <250 cm^3	47 667	4 898
Petrol N1-I	24 607	66 245	Motorcycles 4-stroke 250 - 750 cm^3	48 000	8 073
Petrol N1-II	9 152	72 557	Motorcycles 4-stroke >750 cm^3	38 377	11 403
Petrol N1-III	1 971	62 073	Quad & ATVs	59	1 293
Diesel N1-I	17 563	116 616	Micro-car	74	4 737

Input parameters for the CNG buses are known only since 2000. Before the year 2000, CNG consumption in transport was negligible (close to zero). The consumption of the CNG as a fuel can neither be used for a diesel engine nor for a gasoline engine without modifications. The CNG buses have completely different combustion and after-treatment technology despite using the same fuel as the passenger cars for CNG. The CNG buses need to fulfil a specific emission standard (Euro II, Euro III, etc.) because their emissions performance may vary significantly. Due to the low NOx and PM emissions compared to diesel oil, an additional emission standard has been set for the CNG vehicles, known as the standard for Enhanced Environmental Vehicles (EEV). The emission limits imposed for EEV are even below Euro V and usually EEVs benefit from tax exemptions and free entrance to low emission zones. New stoichiometry buses are able to fulfil the EEV requirements, while older buses were usually registered as Euro II, Euro III, Euro IV or Euro V.

The statistical consumptions of petrol, diesel oil and biofuels were received from data reported under the Fuel Quality Directive art. 7a by SHMU and cross-checked according to data received from the Ministry of Economy (MH SR). According to the latest QA/QC these consumptions are the most accurate (for more see **Chapter 3.6.4.2** Data about LPG distribution and sales were obtained from the Slovak Association of Petrochemical

Industry (SAPPO). CNG consumption was obtained directly from transport companies for the city and regional bus transportation that operate CNG fuelled vehicles. All documents available are in the Slovak language and they are official. Share of diesel oil represents 69.98%, followed by gasoline with 21.50% share, then LPG (1.55%), CNG (0.31%), biomass (6.37%) and other fossil fuels (fossil part of biofuels) (0.29%) in 2022 (***Figure 3.7)***.

Figure 3.7: *Fuels balance in road transportation in 2022*



The blending of biomass in liquid fuels was considered and the bio-emissions are calculated since 2007 (the first year of using blended fuels in the transport in Slovakia). The information about fuels quality is provided by the Ministry of Economy of the Slovak Republic in terms of implementing Directive No 2009/29/EC and Directive No 2009/30/EC on the replacement of fossil fuels with bio-component. The share of biomass in liquid fuels in transport was calculated as a bio-component percentage (***Table 3.83***).

Table 3.83: *Estimated activity data and share of biomass for the time series 2007-2022*

YEAR	GASOLINE		DIESEL OIL	
	BIOMASS SHARE % (energy)	BIOMASS [TJ]	BIOMASS SHARE % (energy)	BIOMASS [TJ]
2007	2.30%	652.26	4.09%	2 677.29
2008	1.23%	358.17	4.77%	2 795.75
2009	2.58%	706.72	5.14%	3 090.30
2010	2.95%	779.13	5.28%	3 577.88
2011	2.97%	715.87	6.05%	3 741.68
2012	2.94%	710.56	5.79%	3 846.12
2013	3.21%	726.60	6.43%	4 107.36
2014	3.88%	859.33	5.65%	3 766.08
2015	3.33%	747.87	5.74%	4 342.97
2016	3.10%	725.62	6.68%	5 158.95
2017	4.06%	943.49	6.92%	5 464.18
2018	4.52%	1 018.32	6.97%	5 697.80
2019	4.46%	1042.07	6.45%	5 371.36
2020	6.20%	1390.40	7.27%	5 401.90
2021	6.20%	1 419.47	6.96%	5 617.89
2022	6.04%	1 645.29	6.95%	5 779.55

In ETBE as bio-component is considered only 37% by mass in the calculation of total bio-components in fuel. From the biomass (biodiesel) is also subtracted the 5.33% fossil methanol part and all emissions from the bio-parts of biofuels are reported as biomass emissions, and the fossil part (ETBE, FAME) is reported in its associated

fossil fuel (ETBE – petrol; FAME – diesel). The fossil part of FAME was calculated as the national average according to data from the report under Fuel Quality Directive art. 7a (***Table 3.84***).

Table 3.84: *National fossil carbon content in FAME in 2022*

FEEDSTOCK	VOLUME [m³]	C FOSSIL PART	CARBON CONTENT	g FOSSIL CO_2/g FAME
Rapeseed	76 757.10	5.30%	75.50%	0.147
Palm oil	188.72	5.50%	71.80%	0.145
Sunflower seed	10 291.44	5.30%	77.20%	0.150
Used cooking oil[10]	52 278.82	5.40%	74.40%	0.147
National average	-	5.34%	75.21%	0.147

Requirements for the quality of motor fuels containing bio-component must be at the level of the specifications listed in the STN EN 228:2004 and STN EN 590:2004, respectively. The quality of blending in bio-liquid fuels must meet the requirements specified in the STN EN 14 214, STN EN 15 376.

According to ***Recommendation No SK-1A3b-2018-0001***, Slovakia managed to distinguish lube oil consumption in 2-stroke vehicles and 4-stroke vehicles (***Table 3.85***). The emissions from lube oil are allocated according to EMEP/EEA GB_{2019} and recommendations:

- from 2-stroke vehicles accordingly in the **1A3b** categories;
- from 4-stroke vehicles in the **2D3i** category.

Table 3.85: *Overview of lube oil consumption in particular years*

YEAR	2-STROKE LUBE OIL [t]	4-STROKE [t]
1990	128.7	1999.9
1995	65.7	1 887.9
2000	25.6	1 999.7
2005	26.5	2 979.8
2010	14.8	3 616.1
2011	14.8	3 451.6
2012	14.4	3 712.7
2013	0.7	3 763.0
2014	0.7	3 848.7
2015	0.8	4 379.5
2016	0.8	4 726.2
2017	0.8	4 554.6
2018	0.8	4 931.1
2019	0.8	5 103.3
2020	0.9	4 995.6
2021	1.1	4 914.6
2022	1.4	5 221.1

Lube oil composition, including HMs was analysed and used for emission estimation for the years 2000-2022 (more info in **Chapter 3.6.4.3**). For the years 1990-1999 were used reconstructed data for fuel composition (***Table 3.86***), vehicle fleet and estimations in line with ***Recommendations No SK-1A3b-2018-0003***, ***SK-1A3b-2018-0004*** and ***SK-1A3b-2018-0005***.

The emissions of all heavy metals are dependent on content level (***Table 3.86***) and fuel consumption, thus all irregularities are caused by a change in content and statistical fuel consumption in the appropriate vehicle category.

The emission factors for lead (Pb) after 2000 are estimated as the maximum allowed content (natural lead) in the FQD[11] (Fuel Quality directive) and reported under article 8 (***Recommendation No SK-1A3b-2018-0002***). Lead emissions are allocated according to the previous paragraph.

[10] For Used cooking oil are no available data of carbon content, thus data for lard were used

[11] Directive 2009/30/EC of the European Parliament and of the Council amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the

Table 3.86: *Overview of HMs and sulphur content in the time series 1990-1999*

YEAR	S [ppm]		Pb [ppm]		Cd [ppm]		Cu [ppm]		Cr [ppm]	
	PETROL	DIESEL	PETROL	DIESEL	PETROL	DIESEL	PETROL	DIESEL	PETROL	DIESEL
1990	324.00	1080.00	20.00	0.0005	0.010	0.0001	1.70	1.70	0.05	0.05
1991	324.00	1080.00	18.40	0.0005	0.009	0.0001	1.53	1.53	0.05	0.05
1992	324.00	1080.00	16.96	0.0005	0.008	0.0001	1.36	1.36	0.04	0.04
1993	324.00	1080.00	15.66	0.0005	0.007	0.0001	1.19	1.19	0.04	0.04
1994	324.00	1080.00	14.50	0.0005	0.006	0.0001	1.02	1.02	0.03	0.03
1995	324.00	1080.00	13.45	0.0005	0.005	0.0001	0.85	0.85	0.03	0.03
1996	324.00	1080.00	12.50	0.0005	0.004	0.0001	0.68	0.68	0.02	0.03
1997	324.00	1080.00	11.65	0.0005	0.003	0.0001	0.51	0.51	0.02	0.02
1998	324.00	1080.00	10.89	0.0005	0.002	0.0001	0.34	0.34	0.02	0.02
1999	120.00	400.00	10.20	0.0005	0.001	0.0001	0.17	0.18	0.01	0.01

YEAR	Ni [ppm]		Se [ppm]		Zn [ppm]		Hg [ppm]		As [ppm]	
	PETROL	DIESEL	PETROL	DIESEL	PETROL	DIESEL	PETROL	DIESEL	PETROL	DIESEL
1990	0.07	0.07	0.0002	0.0001	1.00	1.00	0.009	0.005	0.0003	0.0001
1991	0.06	0.06	0.0002	0.0001	0.90	0.90	0.009	0.005	0.0003	0.0001
1992	0.06	0.06	0.0002	0.0001	0.81	0.80	0.009	0.005	0.0003	0.0001
1993	0.05	0.05	0.0002	0.0001	0.71	0.71	0.009	0.005	0.0003	0.0001
1994	0.04	0.04	0.0002	0.0001	0.61	0.61	0.009	0.005	0.0003	0.0001
1995	0.04	0.04	0.0002	0.0001	0.52	0.51	0.009	0.005	0.0003	0.0001
1996	0.03	0.03	0.0002	0.0001	0.42	0.41	0.009	0.005	0.0003	0.0001
1997	0.02	0.02	0.0002	0.0001	0.32	0.31	0.009	0.005	0.0003	0.0001
1998	0.02	0.01	0.0002	0.0001	0.23	0.21	0.009	0.005	0.0003	0.0001
1999	0.01	0.01	0.0002	0.0001	0.13	0.12	0.009	0.005	0.0003	0.0001

3.6.3.3 Completeness

QC activities ensuring the quality standards for the preparation of the emissions inventory in road transportation are based on the cooperation of several experts and institutions. The activity data and the input parameters provided from the different data sources are collected and then checked for the basic quality criteria (consistency, transparency, etc.) and archived by the sectoral experts. The Transport Research Institute in Žilina is responsible for the data collection from different subjects in transport. Transport sectoral expert is responsible for the verification of these input parameters and the emissions calculation by the COPERT model. The QA verification process includes the exercise of statistical and calculated data on fuel consumption. The Statistical Office of the Slovak Republic provides statistical data on fuel consumption. The calculated data on fuel consumption is a direct outcome of the COPERT model.

The process of verification is based on cross-checking input data from the Statistical Office of the Slovak Republic and the comparison with the fuel balance from the COPERT. The background documents are archived by sectoral experts and in the central archiving system of SNE at SHMÚ.

Analysis of fuels and lube oils composition

Slovakia is analysing the composition of fuels on regular basis. Delivering actual and the most recent data on the composition of fuels is crucial for the correct calculation and estimation of country-specific emission factors. The last data update on fuel composition was made in 2020. In this update, the subject of analysis was not only the most used fuels but also the most used lube oils. This analysis is also a part of the implementation of ***Recommendations No SK-1A3b-2018-0001***, ***SK-1A3b-2018-0002*** and ***SK-1A3b-2018-0003***.

specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC (https://eur-lex.europa.eu/legal-content/SK/TXT/PDF/?uri=CELEX:32009L0030&from=EN)

In ***Table 3.87*** are presented the fuels from the three greatest sellers in Slovakia. These sellers also represent different refineries that affect the Slovak market.

Table 3.87: *Composition of diesel oil and petrol needed for estimation of country-specific emission factors*

SUPPLIER	DIESEL OIL	PETROL			
	PCS % vol	AROMATICS % vol	OLEFINS % vol	H:C RATIO	O:C RATIO
Slovnaft	3.7	32.9	13.6	1.878	0.027
OMV	1.9	33.0	10.0	1.861	0.027
Unipetrol	3.1	33.4	11.4	1.871	0.030
Average	2.9	33.1	11.7	1.870	0.028

As it was mentioned above, lube oil is more important for the estimation of air pollutants, especially for HMs and sulphur oxides. Lube oils are the biggest source of HMs and sulphur oxides by brake wear and engine abrasions. The results of most sold lube oil brands are displayed in ***Table 3.88***. These data were used to estimate heavy metal emissions.

Table 3.88: *Composition of lube oil needed for estimation of country-specific emission factors*

LUBE OIL BRANDS	[ppm/wt]										
	Pb	Cd	Cu	Cr	Ni	Se	Zn	Hg	As	S	H:C RATIO
Shell helix	0.098	0.039	0.063	0.069	0.065	0.037	1 523	0.097	0.126	2166	2.069
Shell rimula	0.100	0.039	0.101	0.083	0.087	0.037	1 503	0.026	0.156	2353	2.095
Castrol edge	0.017	0.298	0.010	0.044	0.030	0.037	1 149	0.021	0.159	2198	2.066
Average	0.072	0.125	0.058	0.065	0.061	0.037	1 392	0.048	0.147	2239	2.077

Time-series consistency - Scrapping Subsidy Program (SSP)

In 2009, a Scrap Subsidy Program was launched in Slovakia to support the exchange of old passenger cars (PC) for new cars – at that time (EURO 4). During two phases of this program, 44 200 vehicles were handed over for scrapping and 39 275 of EURO 4 vehicles were bought. This caused a decrease in the number of passenger cars in all categories in the frame of the SSP (4 475 cars older than 10 years). After the analyses made by the SHMÚ, it can be seen (***Table 3.89***), that most of the deregistered cars were in EURO 1 emission category or older categories.

Table 3.89: *Number of scrapped passenger cars by age (according to the Automotive Industry Association statistics) in 2009*

AGE OF SCRAPPED CARS	EMISSION CATEGORY	TOTAL NUMBER	SHARE OF SCRAPPED VEHICLES
10-15 years	EURO 1 and EURO 2	7 366	
15-20 years	ECE 1504 and EURO 1	9 684	55.8%
20-25 years	ECE 1503 and ECE 1504	17 310	54.6%
>25 years	pre-ECE till ECE 1503	9 840	23.8%
New registrations	EURO 4	39 275	

Through deeper analysis (***Table 3.90***) it was discovered, that reduction of registered cars wasn´t present in all emission categories (EURO). Despite the rules of the SSP, it supported only new vehicles and purchases of 10 years old cars and older (outside of this program) occurred. This concerns two categories:

1. Conventional diesel passenger cars;
2. EURO 2 passenger cars (petrol and diesel oil).

An inter-annual increase of 14 365 passenger cars in the category of conventional diesel PC was recorded (instead of degreasing). A similar situation was recorded also in the category EURO 2 PC (diesel and petrol), where the number of passenger cars rose by 16 653. These anomalies potentially reduce the potential positive impact of the SSP on emissions reduction by 80%. The insufficient rules and control of the SSP started up and accelerated the annual rise of new registration of passenger cars with a small positive impact on air quality and climate change in Slovakia.

On the other hand, the SSP was possibly one of the factors causing a decrease in fuel consumption (FC) in the year 2009. The exact effect cannot be calculated as exact data from the SSP are missing. However, a small positive effect on GHG emissions and air pollutants is visible. The main positive outcomes of the SSP are:

- The SSP caused fuel consumption decrease;
- The SSP has a moderate effect on air quality.
- On the other hand, negative outcomes are also important:
- The SSP failed in intention to decrease the number of pre-EURO 4 vehicles;
- The SSP accelerate registration of additional vehicles (not only new or modern ones);
- The SSP has no significant effect on GHG emissions.

Table 3.90: *Yearly change (2008-2009) in the number of passenger cars by emission category (according to the Police statistics)*

TOTAL NUMBER OF PC IN 2008		TOTAL NUMBER	DIFFERENCE	AVERAGE	AVERAGE	DIFFERENCE
Conventional	38 908	53 273	14 365	10 240.11	8 024.19	-2 215.92
PRE ECE	86 778	73 350	-13 428	3 415.64	3 300.58	-115.05
ECE 15/00-01	93 514	79 725	-13 789	3 080.74	2 976.97	-103.77
ECE 15/02	94 546	80 701	-13 845	4 312.89	4 167.62	-145.27
ECE 15/03	110 107	95 425	-14 682	5 028.18	4 858.81	-169.37
ECE 15/04	153 137	136 141	-16 996	6 087.41	5 882.36	-205.05
Euro 1	195 607	195 263	-344	9 660.12	8 227.15	-1 432.97
Euro 2	321 717	338 370	16 653	11 555.38	9 811.85	-1 743.52
Average			**-5 258**			**-766.37**

NMVOC time-series inconsistency

Non-methane volatile organic compounds are in road transportation originate from petrol evaporation. Evaporative emissions of VOCs come from the fuel systems (tanks, injection systems and fuel lines) of petrol vehicles. NMVOCs from diesel vehicles are considered negligible due to the presence of heavier hydrocarbons with a lower vapour pressure of diesel fuel.

According to the EMEP/EEA GB_{2019}, emissions from petrol evaporation are the most important sources:

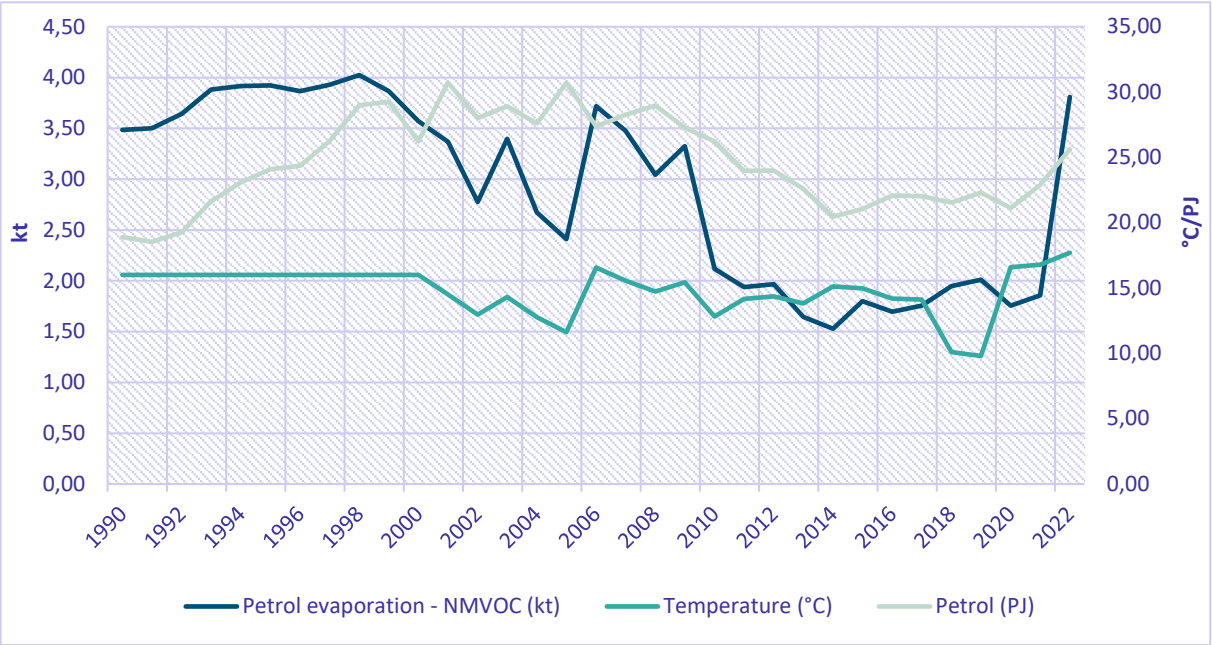
- Breathing losses through the tank vent. Breathing losses are due to the evaporation of fuel in the tank during driving and parking, as a result of normal diurnal temperature variation;
- Fuel permeation/leakage. Various studies (e.g. CRC, 2004; Reuter et al., 1994) indicate that liquid fuel seepage and permeation through plastic and rubber components of the fuel and vapour control system contribute significantly to the total evaporative emissions.

Also, three separate mechanisms are considered:

- diurnal emissions;
- running losses;
- hot-soak emissions.

All three mechanisms are directly connected and dependent on temperature (ambient and vehicle). The dependence is possible to lower with newer technologies that recirculate the petrol vapour and minimalize its emissions. All inconsistencies in category **1A3bv** can be explained by ambient temperature (***Figure 3.8***) (according to ***Recommendation No SK-1A3bv-2018-0001***).

Figure 3.8: *Ambient air temperature and evaporation emissions correlation*



3.6.3.4 Source-specific recalculations

In the IIR 2024 there were no source-specific recalculations made.

3.6.4 Railways (NFR 1A3c)

3.6.4.1 Overview

Railways are the second most important source of emissions in transport (except for pipeline transport), despite the decreasing character of this transport mode. Railways and rail transport are modernised with the support of EU funds. Improved quality and ecology of rail transport and the increase in passengers' number are the results of this modernisation. Modernisation of rail infrastructure results in an increase in operational speed to 160 km/h and an increase in safety. According to the Annual Report of Slovak Railways[12] in 2022, the length of managed railways was 3 626 km. The length of the electric railways was 1 585 km. Total NO_x emissions from railways transport increased by 0.1% compared to the previous year and by 75% compared to the base year (***Table 3.91***).

The increase in fuel consumption was a recovery from the COVID pandemic.

Table 3.91: *Overview of emissions in railways in the years 1990-2022*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	CO [kt]	PRIORITY HMs [t]	PAHs [t]
1990	6.1928	0.5496	0.0024	0.0008	0.1619	0.1702	1.2646	0.0012	0.0095
1995	3.3542	0.2977	0.0013	0.0004	0.0877	0.0922	0.6849	0.0006	0.0051
2000	2.5600	0.2272	0.0010	0.0003	0.0669	0.0704	0.5228	0.0005	0.0039
2005	1.7520	0.1555	0.0007	0.0002	0.0458	0.0481	0.3578	0.0003	0.0027
2010	1.4432	0.1281	0.0006	0.0002	0.0377	0.0397	0.2947	0.0003	0.0022
2011	1.3928	0.1236	0.0005	0.0002	0.0364	0.0383	0.2844	0.0003	0.0021
2012	1.1791	0.1046	0.0005	0.0002	0.0308	0.0324	0.2408	0.0002	0.0018
2013	1.4511	0.1288	0.0006	0.0002	0.0379	0.0399	0.2963	0.0003	0.0022
2014	1.3789	0.1224	0.0005	0.0002	0.0361	0.0379	0.2816	0.0003	0.0021
2015	1.6565	0.1383	0.0006	0.0003	0.0311	0.0340	0.4689	0.0003	0.0023
2016	1.6936	0.1417	0.0004	0.0003	0.0319	0.0349	0.4793	0.0003	0.0024

[12] Annual Report of Slovak Railway 2022, p. 14

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	CO [kt]	PRIORITY HMs [t]	PAHs [t]
2017	1.6500	0.1385	0.0004	0.0003	0.0312	0.0341	0.4668	0.0003	0.0023
2018	1.6123	0.1357	0.0004	0.0003	0.0305	0.0333	0.4560	0.0003	0.0022
2019	1.5251	0.1328	0.0004	0.0003	0.0297	0.0325	0.4297	0.0003	0.0022
2020	1.3603	0.1190	0.0003	0.0002	0.0266	0.0291	0.3831	0.0002	0.0020
2021	1.5212	0.1342	0.0004	0.0003	0.0299	0.0327	0.3161	0.0003	0.0023
2022	1.5223	0.1349	0.0004	0.0003	0.0300	0.0329	0.4281	0.0003	0.0023
1990/2022	**-75%**	**-75%**	**-83%**	**-66%**	**-81%**	**-81%**	**-66%**	**-76%**	**-76%**
2021/2022	**0%**	**1%**	**1%**	**1%**	**0%**	**0%**	**35%**	**1%**	**1%**

3.6.4.2 Methodological issues

Railways transport represents the operation of diesel traction using Tier 2 methodology according to the EMEP/EEA GB_{2019} Higher tier methodology is introduced in 2015 as there are no older data available and as a result of ***Recommendation No SK-1A3c-2020-0001***.

The consumption of each powertrain according to Tier 2 was obtained directly from companies operating these or from calculations based on data provided in the EMEP/EEA GB_{2019}. The consumption of rail cars operated by one of the companies had to be calculated based on data provided by the guidebook and as a result of a field survey. The field survey focused on the average speed of rail cars. Based on the total mileage of rail cars, average consumption (kg/h) and average speed was the total consumption estimated. This estimation was adjusted afterwards according to the total consumption provided by companies (***Table 3.92***).

Table 3.92: *Consumption of each powertrain in particular years (2015-2022) in tonnes*

YEAR	LINE-HAUL LOCOMOTIVES	SHUNTING LOCOMOTIVES	RAIL CARS	TOTAL
2015	21 697.3363	0.0000	7 258.2891	28 955.6254
2016	22 036.8815	0.0000	7 650.5740	29 687.4554
2017	21 303.0055	0.0000	7 717.2538	29 020.2593
2018	20 698.2496	0.0000	7 727.5098	28 425.7594
2019	17 866.4060	0.0000	10 012.9750	27 879.3810
2020	15 717.4992	0.0000	9 276.1755	24 993.6746
2021	17 164.2711	0.0000	11 022.7835	28 187.0546
2022	16 928.0450	0.0000	11 423.7128	28 351.7578

The emissions of the pollutants are calculated from the consumed fuels according to the powertrain and multiplied by the appropriate emission factor. The consumption of diesel oil for the motor traction in the Slovak Republic was obtained from the railways' companies for all years in time-series and the years 2015-2022 also for each powertrain.

Slovakia has also a small amount of hard coal consumption in steam locomotives, which are rather low and thus Slovakia is not reporting this fuel and emissions from it. These emissions are under threshold as it can be seen in ***Table 3.93***. Also there is no whole time-series of activity data available.

Table 3.93: *Emissions from solid fuels and comparison to national totals*

EMISSION	UNIT	2018	2019	2020	2021	2022
Solid Fuels	TJ	0.6752	0.8170	0.6587	0.7421	0.7589
NOx	kt	0.0001	0.0001	0.0001	0.0001	0.0001
NMVOC	kt	0.0001	0.0002	0.0001	0.0001	0.0002
SOx	kt	0.0006	0.0007	0.0006	0.0007	0.0007
NH_3	kt	NE	NE	NE	NE	NE
$PM_{2.5}$	kt	0.0001	0.0001	0.0001	0.0001	0.0001
PM_{10}	kt	0.0001	0.0002	0.0001	0.0001	0.0001
TSP	kt	0.0001	0.0002	0.0001	0.0001	0.0002
BC	kt	4.32E-06	5.23E-06	4.22E-06	4.75E-06	4.86E-06

EMISSION	UNIT	2018	2019	2020	2021	2022
CO	kt	0.0014	0.0016	0.0013	0.0015	0.0015
Pb	t	0.0001	0.0002	0.0001	0.0001	0.0002
Cd	t	2.03E-06	2.45E-06	1.98E-06	2.23E-06	2.28E-06
Hg	t	4.73E-06	5.72E-06	4.61E-06	5.19E-06	5.31E-06
As	t	3.38E-06	4.08E-06	3.29E-06	3.71E-06	3.79E-06
Cr	t	1.01E-05	1.23E-05	9.88E-06	1.11E-05	1.14E-05
Cu	t	2.03E-05	2.45E-05	1.98E-05	2.23E-05	2.28E-05
Ni	t	1.35E-06	1.63E-06	1.32E-06	1.48E-06	1.52E-06
Se	t	1.35E-06	1.63E-06	1.32E-06	1.48E-06	1.52E-06
Zn	t	0.0002	0.0002	0.0002	0.0002	0.0002
PCDD/ PCDF	g I-TEQ	0.0003	0.0003	0.0003	0.0003	0.0003
(dioxins/ furans)	t	0.0001	0.0001	0.0001	0.0001	0.0001
benzo(a) pyrene	t	0.0001	0.0001	0.0001	0.0001	0.0001
benzo(b) fluoranthene	t	3.38E-05	4.08E-05	3.29E-05	3.71E-05	3.79E-05
benzo(k) fluoranthene	t	2.70E-05	3.27E-05	2.63E-05	2.97E-05	3.04E-05
Indeno (1,2,3-cd) pyrene	t	0.0002	0.0003	0.0002	0.0002	0.0002
Total 1-4	t	4.19E-07	5.07E-07	4.08E-07	4.60E-07	4.70E-07
HCB	kg	0.0001	0.0001	0.0001	0.0001	0.0001
PCBs	kg	0.6752	0.8170	0.6587	0.7421	0.7589

EMISSION	UNIT	2018	2019	2020	2021	2022
Solid Fuels	TJ	-	-	-	-	-
NOx	kt	63.10	59.39	56.50	58.93	54.65
NMVOC	kt	90.06	87.48	84.94	81.69	82.32
SOx	kt	21.67	16.96	14.88	15.58	13.30
NH_3	kt	35.62	34.90	30.67	28.94	27.51
$PM_{2.5}$	kt	18.03	18.58	18.02	19.30	17.83
PM_{10}	kt	23.94	24.61	24.50	25.21	23.28
TSP	kt	30.78	30.86	31.68	31.80	28.18
BC	kt	2.57	2.61	2.44	2.62	2.43
CO	kt	329.69	299.24	290.46	348.37	301.80
Pb	t	8.36	7.24	5.82	8.18	7.09
Cd	t	0.57	0.58	0.55	0.62	0.55
Hg	t	0.48	0.48	0.47	0.50	0.47
As	t	0.93	0.83	0.71	0.90	0.77
Cr	t	3.44	3.61	3.38	3.76	2.88
Cu	t	9.10	9.17	8.02	8.73	9.13
Ni	t	1.08	1.10	1.01	1.18	1.11
Se	t	0.95	0.89	0.91	0.89	0.87
Zn	t	34.09	31.53	28.34	32.63	29.98
PCDD/ PCDF	g I-TEQ	63.63	60.84	51.15	37.91	42.50
(dioxins/ furans)	t	5.05	5.22	5.03	5.45	4.97
benzo(a) pyrene	t	4.88	4.98	4.70	5.05	4.65
benzo(b) fluoranthene	t	3.40	3.40	3.11	3.33	3.13
benzo(k) fluoranthene	t	2.36	2.49	2.47	2.68	2.45
Indeno (1,2,3-cd) pyrene	t	27.84	25.90	23.67	28.43	24.44
Total 1-4	t	3.34	3.34	3.14	3.08	2.36
HCB	kg	25.72	20.85	18.22	25.21	20.46
PCBs	kg	63.10	59.39	56.50	58.93	54.65

EMISSION	2018	2019	2020	2021	2022
Solid Fuels	-	-	-	-	-
NOx	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%
NMVOC	0.0001%	0.0002%	0.0002%	0.0002%	0.0002%
SOx	0.0028%	0.0043%	0.0040%	0.0043%	0.0051%
NH_3	NE	NE	NE	NE	NE
$PM_{2.5}$	0.0006%	0.0007%	0.0006%	0.0007%	0.0007%
PM_{10}	0.0005%	0.0006%	0.0005%	0.0006%	0.0006%
TSP	0.0004%	0.0005%	0.0004%	0.0005%	0.0005%
BC	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%
CO	0.0004%	0.0005%	0.0005%	0.0004%	0.0005%
Pb	0.0016%	0.0023%	0.0023%	0.0018%	0.0021%
Cd	0.0004%	0.0004%	0.0004%	0.0004%	0.0004%
Hg	0.0010%	0.0012%	0.0010%	0.0010%	0.0011%
As	0.0004%	0.0005%	0.0005%	0.0004%	0.0005%
Cr	0.0003%	0.0003%	0.0003%	0.0003%	0.0004%
Cu	0.0002%	0.0003%	0.0002%	0.0003%	0.0002%
Ni	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%
Se	0.0001%	0.0002%	0.0001%	0.0002%	0.0002%
Zn	0.0006%	0.0008%	0.0007%	0.0007%	0.0008%
PCDD/ PCDF	0.0004%	0.0005%	0.0005%	0.0008%	0.0007%
(dioxins/ furans)	0.0013%	0.0016%	0.0013%	0.0014%	0.0015%
benzo(a) pyrene	0.0018%	0.0021%	0.0018%	0.0019%	0.0021%
benzo(b) fluoranthene	0.0010%	0.0012%	0.0011%	0.0011%	0.0012%
benzo(k) fluoranthene	0.0011%	0.0013%	0.0011%	0.0011%	0.0012%
Indeno (1,2,3-cd) pyrene	0.0008%	0.0010%	0.0009%	0.0008%	0.0010%
Total 1-4	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
HCB	0.0004%	0.0007%	0.0006%	0.0005%	0.0006%
PCBs	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%

3.6.4.3 Completeness

The verification process is based on cross-checking of the input data on fuel consumption from the Railways Company, Ltd. and the Statistical Office of the Slovak Republic. The preliminary results of the emissions inventory are sent to other subjects (Ministry of the Environment of the Slovak Republic, Ministry of Transport and Construction of the Slovak Republic) for valuation and QA activities. The QC verification process includes the comparison of statistical and calculated data on fuel consumption. Notation key NE is used for solid fuels as the emissions from steam locomotives are under the threshold.

3.6.4.4 Source-specific recalculations

In the IIR 2024, there were no source-specific recalculations made.

3.6.5 International inland waterways (NFR 1A3di(ii)) and National navigation (NFR 1A3dii)

3.6.5.1 Overview

The major share of emissions from inland shipping in Slovakia is realized as transit on the Danube River. Due to a lack of data, these two categories were reported together as national emissions until 2016. Based on the information from the State Navigation Administration (the SNA), there are movements realized between the Gabčíkovo and Komárno ports on the Slovak territory (national transport). Due to the international character of shipping transportation on the Danube River, the ships do not stop their operation on the Slovak territory, but the transit continues to Austria or Hungary. The experts from the Slovak Shipping and Ports Company

confirmed that before 2005, a negligible number of movements were between the Slovak ports registered. Inland shipping transportation on small lakes for tourist purposes was also estimated and added to the total emissions in this category.

Decreasing trends of emission of air pollutants were recognized compared to the previous years and compared to the base year (***Table 3.94***), despite an increase in touristic activities in Slovakia. The emissions for the years 2000 and 2005 were estimated to be negligible, because of the increasing prices of diesel oil in the Slovak Republic and decreasing prices of fuels in the neighbouring countries (market discrepancies).

Table 3.94: *Overview of emissions in navigation (international 1A3di(ii) and national 1A3dii) in particular years*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	CO [kt]	PRIORITY HMs [t]	PAHs [t]
1990	1.4170	0.0342	0.3937	0.0001	0.1066	0.1066	0.0753	0.0045	0.0022
1995	1.2488	0.0302	0.3470	0.0001	0.0940	0.0940	0.0663	0.0040	0.0020
2000	0.0005	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2005	0.0155	0.0004	0.0043	0.0000	0.0012	0.0012	0.0008	0.0000	0.0000
2010	0.7293	0.0176	0.2027	0.0001	0.0549	0.0549	0.0387	0.0023	0.0012
2011	0.6472	0.0156	0.1798	0.0001	0.0487	0.0487	0.0344	0.0021	0.0010
2012	0.2257	0.0055	0.0627	0.0000	0.0170	0.0170	0.0120	0.0007	0.0004
2013	0.3554	0.0086	0.0987	0.0000	0.0267	0.0267	0.0189	0.0011	0.0006
2014	0.4132	0.0100	0.1148	0.0000	0.0311	0.0311	0.0219	0.0013	0.0007
2015	0.6218	0.0150	0.1728	0.0001	0.0468	0.0468	0.0330	0.0020	0.0010
2016	0.5202	0.0126	0.1446	0.0001	0.0391	0.0391	0.0276	0.0017	0.0008
2017	0.5126	0.0124	0.1424	0.0001	0.0386	0.0386	0.0272	0.0016	0.0008
2018	0.2972	0.0072	0.0826	0.0000	0.0224	0.0224	0.0158	0.0009	0.0005
2019	0.4425	0.0107	0.1229	0.0000	0.0333	0.0333	0.0235	0.0014	0.0007
2020	0.4476	0.0108	0.1244	0.0000	0.0337	0.0337	0.0238	0.0014	0.0007
2021	0.5056	0.0122	0.1405	0.0001	0.0380	0.0380	0.0269	0.0016	0.0008
2022	0.5012	0.0121	0.1393	0.0001	0.0377	0.0377	0.0266	0.0016	0.0008
1990/2022	**-65%**	**-65%**	**-65%**	**-65%**	**-65%**	**-65%**	**-65%**	**-65%**	**-65%**
2021/2022	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**

3.6.5.2 Methodological issues

These subcategories include all emissions from national and international shipping between the ports on the Danube River on the Slovak territory and domestic shipping on lakes and dams for touristic purposes.

Shipping between the Slovak ports on the Danube River: The Slovak Shipping and Ports Company is providing detailed information on diesel oil consumption on the Danube River. The consumption is allocated between national and international companies. It was assumed that total fuel sold to international companies is reported in the international inland waterways (**1A3di(ii)**) and total fuel sold to national companies (Slovak Water Management Enterprise) is reported in the national navigation (**1A3dii**). This activity represents the movements of ships between Slovak ports (Bratislava, Devin and Komárno). This approach was introduced in IIR 2018 first time.

Shipping on lakes: The State Navigation Administration was officially requested to check the availability of information about the shipping activity in the Slovak Republic except for the Danube River movements. The expert was informed that they register a total number of ships and boats operated except the Danube River but without information about their activity or fuel consumption. Based on expert research, three other relevant shipping routes, except the shipping routes on the Danube River, occur in Slovakia, however to a limited extent. The three shipping routes are:

- River – basin of the Váh (Pieštany, Trenčín, Liptovská Mara dam);
- The tributary River of the Váh (Oravská priehrada dam);
- River – basin of the Bodrog (Zemplínska Šírava dam).

While the public and tourist shipping activities in the Slovak Republic are not very frequent and have expanded only in recent years (due to the increase in tourism), it was necessary to propose an appropriate methodological approach for emissions estimation. Chosen activity data were:

- The number of trips per year:

The number of trips per year is limited by the daily schedule of trips mostly in the summer months (May-October).

- The duration of trips (in hours):

The duration can differ according to the type of trip (mostly short or long tours).

- The technical parameters of the most populated ships:

The technical parameters of vessels can be found on the webpage. The engines are mostly with 100 kilowatts of power, which is a common type of engine used in non-road mechanisms, or in agricultural machinery (type Zetor). The engines run on diesel oil.

- The average consumption of diesel oil in litres per hour:

The average consumption based on the technical description of the engines is 12 litres of diesel oil per hour of work. The consumption of diesel oil in tons was calculated using the average density of diesel oil is **0.84 kg/dm^3**. The emissions are calculated from the consumed fuel by diesel motor boats multiplied by the emission factor. The emission factors are taken from the EMEP/EEA GB$_{2019}$. Activity data for domestic navigation are shown in ***Table 3.95***.

Table 3.95: *The amount of diesel oil sold by shipping companies and allocation to the categories 1A3di(ii) and 1A3dii in selected years 2005-2022*

YEAR	SHIPPING COMPANIES	SALE OF DIESEL OIL [t]		
		NATIONAL	INTERNATIONAL	TOTAL
		1A3d	1D1b	1A3d + 1D1b
2005	Slovak Shipping and Ports (Danube)	1.3	128.7	130.0
	International shipping companies	0.0	84.0	84.0
	Total	**1.3**	**212.7**	**214.0**
2010	Slovak Shipping and Ports (Danube)	91.8	9 087.2	9 179.0
	International shipping companies	0.0	1 363.0	1 363.0
	Total	**91.8**	**10 450.2**	**10 542.0**
2011	Slovak Shipping and Ports (Danube)	79.7	7 895.3	7 975.0
	Slovak Water Management Enterprise	175.0	0.0	175.0
	Other Companies	1.0	102.0	103.0
	International shipping companies	0.0	1 104.0	1 104.0
	Total	**255.8**	**9 101.2**	**9 357.0**
2012	Slovak Shipping and Ports (Danube)	21.0	2 080.0	2 101.00
	Slovak Water Management Enterprise	321.0	0.0	321.0
	Other companies	0.7	69.3	70.0
	International shipping companies	0.0	764.0	764.0
	Total	**342.7**	**2 913.3**	**3 256.0**
2013	Slovak Shipping and Ports (Danube)	1 083.1	3 249.3	4 332.4
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	0.0	0.0	0.0
	International shipping companies	0.0	801.0	801.0
	Total	**1 083.1**	**4 050.3**	**5 133.4**
2014	Slovak Shipping and Ports (Danube)	1 244.0	3 732.0	4 976.0
	Slovak Water Management Enterprise	149.0	0.0	149.0
	Other companies	0.0	0.0	0.0
	International shipping companies	0.0	844.0	844.0
	Total	**1 393.0**	**4 576.0**	**5 969.0**
	Slovak Shipping and Ports (Danube)	1 981.8	5 945.4	7 927.2

YEAR	SHIPPING COMPANIES	SALE OF DIESEL OIL [t]		
		NATIONAL	INTERNATIONAL	TOTAL
		1A3d	1D1b	1A3d + 1D1b
2015	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	0.5	47.5	48.0
	International shipping companies	0.0	1 016.0	1 016.0
	Total	**1 982.3**	**7 008.9**	**8 991.2**
2016	Slovak Shipping and Ports (Danube)	1 515.1	4 545.4	6 060.5
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	2.0	189.0	191.0
	International shipping companies	0.0	1 272.0	1 272.0
	Total	**1 517.0**	**6 006.5**	**7 523.5**
2017	Slovak Shipping and Ports (Danube)	1 492.9	4 478.7	5 971.6
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	2.4	236.6	239.0
	Morsevo (Komárno)	0.0	1034.0	1034.0
	International shipping companies	0.0	168.5	168.5
	Total	**1 495.3**	**5 917.8**	**7 413.1**
2018	Slovak Shipping and Ports (Danube)	3 239.00	809.75	2 429.25
	Slovak Water Management Enterprise	0.00	0.00	0.00
	Other companies	232.00	2.32	229.68
	Morsevo (Komárno)	824.00	0.00	824.00
	International shipping companies	0.00	0.00	0.00
	Total	**4 295.00**	**812.07**	**3 482.93**
2019	Slovak Shipping and Ports (Danube)	1 327.00	3 981.00	5 308.00
	Slovak Water Management Enterprise	0.00	0.00	0.00
	Other companies	3.26	322.74	326.00
	Morsevo (Komárno)	0.00	760.00	760.00
	International shipping companies	0.00	0.00	0.00
	Total	**1 330.26**	**5 063.74**	**6 394.00**
2020	Slovak Shipping and Ports (Danube)	6 223.00	1 555.75	4 667.25
	Slovak Water Management Enterprise	0.00	0.00	0.00
	Other companies	161.00	161.00	0.00
	Morsevo (Komárno)	94.00	0.00	94.00
	International shipping companies	0.00	0.00	0.00
	Total	**6 478.00**	**1 716.75**	**4 761.25**
2021	Slovak Shipping and Ports (Danube)	1 764.25	5 292.75	7 057.00
	Slovak Water Management Enterprise	0.00	0.00	0.00
	Other companies	95.00	0.00	95.00
	T a M Terminal[13] (Komárno)	0.00	0.00	0.00
	International shipping companies	0.00	165.00	165.00
	Total	**1 859.25**	**5 457.75**	**7 317.00**
2022	Slovak Shipping and Ports (Danube)	1 569.25	4 707.75	6 277.00
	Slovak Water Management Enterprise	0	0	0
	Other companies	120	0	120
	T a M Terminal[14] (Komárno)	0	855	855
	International shipping companies	0	0	0
	Total	**1 689.25**	**5 562.75**	**7 252.00**

In 2020 there did not occur shipping on lakes as a result of the COVID pandemic.

3.6.5.3 Completeness

Verification of the activity data on fuels sold for shipping activities was performed by the sectoral expert and compared with the statistical information from requested institutions and companies as mentioned in this

[13] Previous name Morsevo
[14] Previous name Morsevo

chapter above.

3.6.5.4 Source-specific recalculations

Recalculation of the time-series was made based on revision of AD and new EF from EMEP/EEA GB$_{2023}$ (***Table 3.96*** and ***Table 3.97***).

Table 3.96: *Previous and revised emissions in the category 1A3di(ii) International inland waterways*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	1.4166	-	IE	0.0342	-	IE	0.3936	-
1991	IE	1.2438	-	IE	0.0301	-	IE	0.3456	-
1992	IE	1.1747	-	IE	0.0284	-	IE	0.3264	-
1993	IE	0.9674	-	IE	0.0234	-	IE	0.2688	-
1994	IE	0.9250	-	IE	0.0224	-	IE	0.2570	-
1995	IE	1.2484	-	IE	0.0302	-	IE	0.3469	-
1996	IE	1.0634	-	IE	0.0257	-	IE	0.2955	-
1997	IE	0.6334	-	IE	0.0153	-	IE	0.1760	-
1998	IE	0.8854	-	IE	0.0214	-	IE	0.2460	-
1999	IE	0.1866	-	IE	0.0045	-	IE	0.0519	-
2000	IE	NO	-	IE	NO	-	IE	NO	-
2001	IE	0.5781	-	IE	0.0140	-	IE	0.1606	-
2002	IE	0.6238	-	IE	0.0151	-	IE	0.1733	-
2003	IE	0.4724	-	IE	0.0114	-	IE	0.1313	-
2004	IE	0.1839	-	IE	0.0044	-	IE	0.0511	-
2005	IE	0.0147	-	IE	0.0004	-	IE	0.0041	-
2006	IE	0.6549	-	IE	0.0158	-	IE	0.1820	-
2007	IE	0.7004	-	IE	0.0169	-	IE	0.1946	-
2008	IE	0.7479	-	IE	0.0181	-	IE	0.2078	-
2009	IE	0.6853	-	IE	0.0166	-	IE	0.1904	-
2010	IE	0.7221	-	IE	0.0175	-	IE	0.2006	-
2011	IE	0.6289	-	IE	0.0152	-	IE	0.1747	-
2012	IE	0.2013	-	IE	0.0049	-	IE	0.0559	-
2013	IE	0.2799	-	IE	0.0068	-	IE	0.0778	-
2014	IE	0.3162	-	IE	0.0076	-	IE	0.0879	-
2015	IE	0.4843	-	IE	0.0117	-	IE	0.1346	-
2016	0.4763	0.4150	-13%	0.0162	0.0100	-38%	0.1201	0.1153	-4%
2017	0.4693	0.4089	-13%	0.0160	0.0099	-38%	0.1184	0.1136	-4%
2018	0.2762	0.2407	-13%	0.0094	0.0058	-38%	0.0697	0.0669	-4%
2019	0.4016	0.3499	-13%	0.0137	0.0085	-38%	0.1013	0.0972	-4%
2020	0.3776	0.3290	-13%	0.0129	0.0080	-38%	0.0952	0.0914	-4%
2021	0.4328	0.3771	-13%	0.0147	0.0091	-38%	0.1092	0.1048	-4%

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	1.4E-04	-	IE	0.1066	-	IE	0.1066	-
1991	IE	1.3E-04	-	IE	0.0936	-	IE	0.0936	-
1992	IE	1.2E-04	-	IE	0.0884	-	IE	0.0884	-
1993	IE	9.8E-05	-	IE	0.0728	-	IE	0.0728	-
1994	IE	9.4E-05	-	IE	0.0696	-	IE	0.0696	-
1995	IE	1.3E-04	-	IE	0.0939	-	IE	0.0939	-
1996	IE	1.1E-04	-	IE	0.0800	-	IE	0.0800	-
1997	IE	6.4E-05	-	IE	0.0477	-	IE	0.0477	-

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1998	IE	9.0E-05	-	IE	0.0666	-	IE	0.0666	-
1999	IE	1.9E-05	-	IE	0.0140	-	IE	0.0140	-
2000	IE	NO	-	IE	NO	-	IE	NO	-
2001	IE	5.9E-05	-	IE	0.0435	-	IE	0.0435	-
2002	IE	6.3E-05	-	IE	0.0469	-	IE	0.0469	-
2003	IE	4.8E-05	-	IE	0.0355	-	IE	0.0355	-
2004	IE	1.9E-05	-	IE	0.0138	-	IE	0.0138	-
2005	IE	1.5E-06	-	IE	0.0011	-	IE	0.0011	-
2006	IE	6.6E-05	-	IE	0.0493	-	IE	0.0493	-
2007	IE	7.1E-05	-	IE	0.0527	-	IE	0.0527	-
2008	IE	7.6E-05	-	IE	0.0563	-	IE	0.0563	-
2009	IE	6.9E-05	-	IE	0.0516	-	IE	0.0516	-
2010	IE	7.3E-05	-	IE	0.0543	-	IE	0.0543	-
2011	IE	6.4E-05	-	IE	0.0473	-	IE	0.0473	-
2012	IE	2.0E-05	-	IE	0.0151	-	IE	0.0151	-
2013	IE	2.8E-05	-	IE	0.0211	-	IE	0.0211	-
2014	IE	3.2E-05	-	IE	0.0238	-	IE	0.0238	-
2015	IE	4.9E-05	-	IE	0.0364	-	IE	0.0364	-
2016	4.2E-05	4.2E-05	0%	0.0336	0.0312	-7%	0.0372	0.0312	-16%
2017	4.1E-05	4.1E-05	0%	0.0331	0.0308	-7%	0.0367	0.0308	-16%
2018	2.4E-05	2.4E-05	0%	0.0195	0.0181	-7%	0.0216	0.0181	-16%
2019	3.5E-05	3.5E-05	0%	0.0284	0.0263	-7%	0.0314	0.0263	-16%
2020	3.3E-05	3.3E-05	0%	0.0267	0.0248	-7%	0.0295	0.0248	-16%
2021	3.8E-05	3.8E-05	0%	0.0306	0.0284	-7%	0.0338	0.0284	-16%

YEAR	TSP [kt]			BC [kt]			CO [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	0.1066	-	IE	0.0019	-	IE	0.0752	-
1991	IE	0.0936	-	IE	0.0016	-	IE	0.0661	-
1992	IE	0.0884	-	IE	0.0015	-	IE	0.0624	-
1993	IE	0.0728	-	IE	0.0013	-	IE	0.0514	-
1994	IE	0.0696	-	IE	0.0012	-	IE	0.0491	-
1995	IE	0.0939	-	IE	0.0016	-	IE	0.0663	-
1996	IE	0.0800	-	IE	0.0014	-	IE	0.0565	-
1997	IE	0.0477	-	IE	0.0008	-	IE	0.0336	-
1998	IE	0.0666	-	IE	0.0012	-	IE	0.0470	-
1999	IE	0.0140	-	IE	0.0002	-	IE	0.0099	-
2000	IE	NO	-	IE	NO	-	IE	NO	-
2001	IE	0.0435	-	IE	0.0008	-	IE	0.0307	-
2002	IE	0.0469	-	IE	0.0008	-	IE	0.0331	-
2003	IE	0.0355	-	IE	0.0006	-	IE	0.0251	-
2004	IE	0.0138	-	IE	0.0002	-	IE	0.0098	-
2005	IE	0.0011	-	IE	0.0000	-	IE	0.0008	-
2006	IE	0.0493	-	IE	0.0009	-	IE	0.0348	-
2007	IE	0.0527	-	IE	0.0009	-	IE	0.0372	-
2008	IE	0.0563	-	IE	0.0010	-	IE	0.0397	-
2009	IE	0.0516	-	IE	0.0009	-	IE	0.0364	-
2010	IE	0.0543	-	IE	0.0009	-	IE	0.0384	-
2011	IE	0.0473	-	IE	0.0008	-	IE	0.0334	-

YEAR	TSP [kt]			BC [kt]			CO [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	IE	0.0151	-	IE	0.0003	-	IE	0.0107	-
2013	IE	0.0211	-	IE	0.0004	-	IE	0.0149	-
2014	IE	0.0238	-	IE	0.0004	-	IE	0.0168	-
2015	IE	0.0364	-	IE	0.0006	-	IE	0.0257	-
2016	0.0372	0.0312	-16%	0.0040	0.0005	-87%	0.0444	0.0220	-50%
2017	0.0367	0.0308	-16%	0.0040	0.0005	-87%	0.0438	0.0217	-50%
2018	0.0216	0.0181	-16%	0.0023	0.0003	-87%	0.0438	0.0128	-71%
2019	0.0314	0.0263	-16%	0.0034	0.0005	-87%	0.0375	0.0186	-50%
2020	0.0295	0.0248	-16%	0.0035	0.0004	-88%	0.0352	0.0175	-50%
2021	0.0338	0.0284	-16%	0.0037	0.0005	-87%	0.0404	0.0200	-50%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	0.0037	-	IE	0.0004	-	IE	0.0004	-
1991	IE	0.0032	-	IE	0.0004	-	IE	0.0004	-
1992	IE	0.0031	-	IE	0.0003	-	IE	0.0003	-
1993	IE	0.0025	-	IE	0.0003	-	IE	0.0003	-
1994	IE	0.0024	-	IE	0.0003	-	IE	0.0003	-
1995	IE	0.0033	-	IE	0.0004	-	IE	0.0004	-
1996	IE	0.0028	-	IE	0.0003	-	IE	0.0003	-
1997	IE	0.0017	-	IE	0.0002	-	IE	0.0002	-
1998	IE	0.0023	-	IE	0.0003	-	IE	0.0003	-
1999	IE	0.0005	-	IE	0.0001	-	IE	0.0001	-
2000	IE	NO	-	IE	NO	-	IE	NO	-
2001	IE	0.0015	-	IE	0.0002	-	IE	0.0002	-
2002	IE	0.0016	-	IE	0.0002	-	IE	0.0002	-
2003	IE	0.0012	-	IE	0.0001	-	IE	0.0001	-
2004	IE	0.0005	-	IE	0.0001	-	IE	0.0001	-
2005	IE	0.0000	-	IE	0.0000	-	IE	0.0000	-
2006	IE	0.0017	-	IE	0.0002	-	IE	0.0002	-
2007	IE	0.0018	-	IE	0.0002	-	IE	0.0002	-
2008	IE	0.0019	-	IE	0.0002	-	IE	0.0002	-
2009	IE	0.0018	-	IE	0.0002	-	IE	0.0002	-
2010	IE	0.0019	-	IE	0.0002	-	IE	0.0002	-
2011	IE	0.0016	-	IE	0.0002	-	IE	0.0002	-
2012	IE	0.0005	-	IE	0.0001	-	IE	0.0001	-
2013	IE	0.0007	-	IE	0.0001	-	IE	0.0001	-
2014	IE	0.0008	-	IE	0.0001	-	IE	0.0001	-
2015	IE	0.0013	-	IE	0.0001	-	IE	0.0001	-
2016	0.0011	0.0011	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
2017	0.0011	0.0011	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
2018	0.0011	0.0006	-41%	0.0001	0.0001	-41%	0.0001	0.0001	-41%
2019	0.0009	0.0009	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
2020	0.0009	0.0009	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
2021	0.0010	0.0010	0%	0.0001	0.0001	0%	0.0001	0.0001	0%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	0.0139	-	IE	0.0148	-	IE	0.0256	-
1991	IE	0.0122	-	IE	0.0130	-	IE	0.0225	-

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1992	IE	0.0116	-	IE	0.0122	-	IE	0.0213	-
1993	IE	0.0095	-	IE	0.0101	-	IE	0.0175	-
1994	IE	0.0091	-	IE	0.0096	-	IE	0.0167	-
1995	IE	0.0123	-	IE	0.0130	-	IE	0.0226	-
1996	IE	0.0105	-	IE	0.0111	-	IE	0.0192	-
1997	IE	0.0062	-	IE	0.0066	-	IE	0.0115	-
1998	IE	0.0087	-	IE	0.0092	-	IE	0.0160	-
1999	IE	0.0018	-	IE	0.0019	-	IE	0.0034	-
2000	IE	NO	-	IE	NO	-	IE	NO	-
2001	IE	0.0057	-	IE	0.0060	-	IE	0.0105	-
2002	IE	0.0061	-	IE	0.0065	-	IE	0.0113	-
2003	IE	0.0046	-	IE	0.0049	-	IE	0.0085	-
2004	IE	0.0018	-	IE	0.0019	-	IE	0.0033	-
2005	IE	0.0001	-	IE	0.0002	-	IE	0.0003	-
2006	IE	0.0064	-	IE	0.0068	-	IE	0.0118	-
2007	IE	0.0069	-	IE	0.0073	-	IE	0.0127	-
2008	IE	0.0074	-	IE	0.0078	-	IE	0.0135	-
2009	IE	0.0067	-	IE	0.0071	-	IE	0.0124	-
2010	IE	0.0071	-	IE	0.0075	-	IE	0.0131	-
2011	IE	0.0062	-	IE	0.0066	-	IE	0.0114	-
2012	IE	0.0020	-	IE	0.0021	-	IE	0.0036	-
2013	IE	0.0028	-	IE	0.0029	-	IE	0.0051	-
2014	IE	0.0031	-	IE	0.0033	-	IE	0.0057	-
2015	IE	0.0048	-	IE	0.0050	-	IE	0.0088	-
2016	0.0041	0.0041	0%	0.0043	0.0043	0%	0.0075	0.0075	0%
2017	0.0040	0.0040	0%	0.0043	0.0043	0%	0.0074	0.0074	0%
2018	0.0040	0.0024	-41%	0.0043	0.0025	-41%	0.0074	0.0044	-41%
2019	0.0034	0.0034	0%	0.0036	0.0036	0%	0.0063	0.0063	0%
2020	0.0032	0.0032	0%	0.0034	0.0034	0%	0.0060	0.0060	0%
2021	0.0037	0.0037	0%	0.0039	0.0039	0%	0.0068	0.0068	0%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	0.6560	-	IE	0.0043	-	IE	0.0246	-
1991	IE	0.5760	-	IE	0.0038	-	IE	0.0216	-
1992	IE	0.5440	-	IE	0.0036	-	IE	0.0204	-
1993	IE	0.4480	-	IE	0.0029	-	IE	0.0168	-
1994	IE	0.4284	-	IE	0.0028	-	IE	0.0161	-
1995	IE	0.5781	-	IE	0.0038	-	IE	0.0217	-
1996	IE	0.4925	-	IE	0.0032	-	IE	0.0185	-
1997	IE	0.2933	-	IE	0.0019	-	IE	0.0110	-
1998	IE	0.4100	-	IE	0.0027	-	IE	0.0154	-
1999	IE	0.0864	-	IE	0.0006	-	IE	0.0032	-
2000	IE	NO	-	IE	NO	-	IE	NO	-
2001	IE	0.2677	-	IE	0.0018	-	IE	0.0100	-
2002	IE	0.2889	-	IE	0.0019	-	IE	0.0108	-
2003	IE	0.2188	-	IE	0.0014	-	IE	0.0082	-
2004	IE	0.0852	-	IE	0.0006	-	IE	0.0032	-
2005	IE	0.0068	-	IE	0.0000	-	IE	0.0003	-

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2006	IE	0.3033	-	IE	0.0020	-	IE	0.0114	-
2007	IE	0.3244	-	IE	0.0021	-	IE	0.0122	-
2008	IE	0.3464	-	IE	0.0023	-	IE	0.0130	-
2009	IE	0.3174	-	IE	0.0021	-	IE	0.0119	-
2010	IE	0.3344	-	IE	0.0022	-	IE	0.0125	-
2011	IE	0.2912	-	IE	0.0019	-	IE	0.0109	-
2012	IE	0.0932	-	IE	0.0006	-	IE	0.0035	-
2013	IE	0.1296	-	IE	0.0009	-	IE	0.0049	-
2014	IE	0.1464	-	IE	0.0010	-	IE	0.0055	-
2015	IE	0.2243	-	IE	0.0015	-	IE	0.0084	-
2016	0.1922	0.1922	0%	0.0013	0.0013	0%	0.0072	0.0072	0%
2017	0.1894	0.1894	0%	0.0012	0.0012	0%	0.0071	0.0071	0%
2018	0.1894	0.1115	-41%	0.0012	0.0007	-41%	0.0071	0.0042	-41%
2019	0.1620	0.1620	0%	0.0011	0.0011	0%	0.0061	0.0061	0%
2020	0.1524	0.1524	0%	0.0010	0.0010	0%	0.0057	0.0057	0%
2021	0.1746	0.1746	0%	0.0011	0.0011	0%	0.0065	0.0065	0%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	9.6E-07	-	IE	0.0022	-
1991	IE	8.5E-07	-	IE	0.0020	-
1992	IE	8.0E-07	-	IE	0.0019	-
1993	IE	6.6E-07	-	IE	0.0015	-
1994	IE	6.3E-07	-	IE	0.0015	-
1995	IE	8.5E-07	-	IE	0.0020	-
1996	IE	7.2E-07	-	IE	0.0017	-
1997	IE	4.3E-07	-	IE	0.0010	-
1998	IE	6.0E-07	-	IE	0.0014	-
1999	IE	1.3E-07	-	IE	0.0003	-
2000	IE	NO	-	IE	NO	-
2001	IE	3.9E-07	-	IE	0.0009	-
2002	IE	4.2E-07	-	IE	0.0010	-
2003	IE	3.2E-07	-	IE	0.0007	-
2004	IE	1.3E-07	-	IE	0.0003	-
2005	IE	1.0E-08	-	IE	0.0000	-
2006	IE	4.5E-07	-	IE	0.0010	-
2007	IE	4.8E-07	-	IE	0.0011	-
2008	IE	5.1E-07	-	IE	0.0012	-
2009	IE	4.7E-07	-	IE	0.0011	-
2010	IE	4.9E-07	-	IE	0.0011	-
2011	IE	4.3E-07	-	IE	0.0010	-
2012	IE	1.4E-07	-	IE	0.0003	-
2013	IE	1.9E-07	-	IE	0.0004	-
2014	IE	2.2E-07	-	IE	0.0005	-
2015	IE	3.3E-07	-	IE	0.0008	-
2016	0.0003	2.8E-07	-100%	0.0005	0.0007	36%
2017	0.0003	2.8E-07	-100%	0.0005	0.0006	36%
2018	0.0003	1.6E-07	-100%	0.0005	0.0004	-20%
2019	0.0002	2.4E-07	-100%	0.0004	0.0006	36%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2020	0.0002	2.2E-07	-100%	0.0004	0.0005	36%
2021	0.0003	2.6E-07	-100%	0.0004	0.0006	36%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	IE	0.0029	-	IE	0.0117	-
1991	IE	0.0025	-	IE	0.0103	-
1992	IE	0.0024	-	IE	0.0097	-
1993	IE	0.0020	-	IE	0.0080	-
1994	IE	0.0019	-	IE	0.0076	-
1995	IE	0.0025	-	IE	0.0103	-
1996	IE	0.0022	-	IE	0.0088	-
1997	IE	0.0013	-	IE	0.0052	-
1998	IE	0.0018	-	IE	0.0073	-
1999	IE	0.0004	-	IE	0.0015	-
2000	IE	NO	-	IE	NO	-
2001	IE	0.0012	-	IE	0.0048	-
2002	IE	0.0013	-	IE	0.0051	-
2003	IE	0.0010	-	IE	0.0039	-
2004	IE	0.0004	-	IE	0.0015	-
2005	IE	0.0000	-	IE	0.0001	-
2006	IE	0.0013	-	IE	0.0054	-
2007	IE	0.0014	-	IE	0.0058	-
2008	IE	0.0015	-	IE	0.0062	-
2009	IE	0.0014	-	IE	0.0057	-
2010	IE	0.0015	-	IE	0.0060	-
2011	IE	0.0013	-	IE	0.0052	-
2012	IE	0.0004	-	IE	0.0017	-
2013	IE	0.0006	-	IE	0.0023	-
2014	IE	0.0006	-	IE	0.0026	-
2015	IE	0.0010	-	IE	0.0040	-
2016	0.0008	0.0008	0%	0.0034	0.0034	0%
2017	0.0008	0.0008	0%	0.0034	0.0034	0%
2018	0.0008	0.0005	-41%	0.0034	0.0020	-41%
2019	0.0007	0.0007	0%	0.0029	0.0029	0%
2020	0.0007	0.0007	0%	0.0027	0.0027	0%
2021	0.0008	0.0008	0%	0.0031	0.0031	0%

Table 3.97: *Previous and revised emissions in the category 1A3dii National navigation (shipping)*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	1.6262	0.0005	-100%	0.0554	0.0000	-100%	0.4101	0.0001	-100%
1991	1.4279	0.0004	-100%	0.0486	0.0000	-100%	0.3601	0.0001	-100%
1992	1.3486	0.0004	-100%	0.0459	0.0000	-100%	0.3401	0.0001	-100%
1993	1.1107	0.0004	-100%	0.0378	0.0000	-100%	0.2801	0.0001	-100%
1994	1.0621	0.0004	-100%	0.0362	0.0000	-100%	0.2679	0.0001	-100%
1995	1.4332	0.0005	-100%	0.0488	0.0000	-100%	0.3615	0.0001	-100%
1996	1.2210	0.0005	-100%	0.0416	0.0000	-100%	0.3079	0.0001	-100%
1997	0.7275	0.0005	-100%	0.0248	0.0000	-100%	0.1835	0.0001	-100%
1998	1.0167	0.0005	-100%	0.0346	0.0000	-100%	0.2564	0.0001	-100%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1999	0.2148	0.0005	-100%	0.0073	0.0000	-100%	0.0542	0.0001	-100%
2000	0.0006	0.0005	-13%	0.0000	0.0000	-38%	0.0002	0.0001	-4%
2001	0.6641	0.0005	-100%	0.0226	0.0000	-100%	0.1675	0.0002	-100%
2002	0.7165	0.0006	-100%	0.0244	0.0000	-100%	0.1807	0.0002	-100%
2003	0.5428	0.0006	-100%	0.0185	0.0000	-100%	0.1369	0.0002	-100%
2004	0.2117	0.0006	-100%	0.0072	0.0000	-100%	0.0534	0.0002	-100%
2005	0.0177	0.0008	-96%	0.0006	0.0000	-97%	0.0045	0.0002	-95%
2006	0.7597	0.0070	-99%	0.0259	0.0002	-99%	0.1916	0.0019	-99%
2007	0.8122	0.0074	-99%	0.0277	0.0002	-99%	0.2049	0.0020	-99%
2008	0.8672	0.0078	-99%	0.0295	0.0002	-99%	0.2187	0.0022	-99%
2009	0.7946	0.0071	-99%	0.0271	0.0002	-99%	0.2004	0.0020	-99%
2010	0.8370	0.0072	-99%	0.0285	0.0002	-99%	0.2111	0.0020	-99%
2011	0.7428	0.0183	-98%	0.0253	0.0004	-98%	0.1873	0.0051	-97%
2012	0.2590	0.0243	-91%	0.0088	0.0006	-93%	0.0653	0.0068	-90%
2013	0.4079	0.0755	-81%	0.0139	0.0018	-87%	0.1029	0.0210	-80%
2014	0.4742	0.0970	-80%	0.0161	0.0023	-85%	0.1196	0.0269	-77%
2015	0.7136	0.1375	-81%	0.0243	0.0033	-86%	0.1800	0.0382	-79%
2016	0.1203	0.1052	-13%	0.0041	0.0025	-38%	0.0304	0.0292	-4%
2017	0.1186	0.1037	-13%	0.0041	0.0025	-38%	0.0299	0.0288	-4%
2018	0.0644	0.0565	-12%	0.0041	0.0014	-66%	0.0299	0.0157	-48%
2019	0.1055	0.0926	-12%	0.0036	0.0022	-38%	0.0266	0.0257	-3%
2020	0.1361	0.1186	-13%	0.0046	0.0029	-38%	0.0343	0.0330	-4%
2021	0.1474	0.1285	-13%	0.0050	0.0031	-38%	0.0372	0.0357	-4%

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0001	0.0000	-100%	0.1148	0.0000	-100%	0.1271	0.0000	-100%
1991	0.0001	0.0000	-100%	0.1008	0.0000	-100%	0.1116	0.0000	-100%
1992	0.0001	0.0000	-100%	0.0952	0.0000	-100%	0.1054	0.0000	-100%
1993	0.0001	0.0000	-100%	0.0784	0.0000	-100%	0.0868	0.0000	-100%
1994	0.0001	0.0000	-100%	0.0750	0.0000	-100%	0.0830	0.0000	-100%
1995	0.0001	0.0000	-100%	0.1012	0.0000	-100%	0.1120	0.0000	-100%
1996	0.0001	0.0000	-100%	0.0862	0.0000	-100%	0.0955	0.0000	-100%
1997	0.0001	0.0000	-100%	0.0514	0.0000	-100%	0.0569	0.0000	-100%
1998	0.0001	0.0000	-100%	0.0718	0.0000	-100%	0.0795	0.0000	-100%
1999	0.0000	0.0000	-100%	0.0152	0.0000	-100%	0.0168	0.0000	-100%
2000	0.0000	0.0000	0%	0.0000	0.0000	-7%	0.0000	0.0000	-16%
2001	0.0001	0.0000	-100%	0.0469	0.0000	-100%	0.0519	0.0000	-100%
2002	0.0001	0.0000	-100%	0.0506	0.0000	-100%	0.0560	0.0000	-100%
2003	0.0000	0.0000	-100%	0.0383	0.0000	-100%	0.0424	0.0000	-100%
2004	0.0000	0.0000	-100%	0.0150	0.0000	-100%	0.0166	0.0000	-100%
2005	0.0000	0.0000	-95%	0.0013	0.0001	-95%	0.0014	0.0001	-96%
2006	0.0001	0.0000	-99%	0.0536	0.0005	-99%	0.0594	0.0005	-99%
2007	0.0001	0.0000	-99%	0.0574	0.0006	-99%	0.0635	0.0006	-99%
2008	0.0001	0.0000	-99%	0.0612	0.0006	-99%	0.0678	0.0006	-99%
2009	0.0001	0.0000	-99%	0.0561	0.0005	-99%	0.0621	0.0005	-99%
2010	0.0001	0.0000	-99%	0.0591	0.0005	-99%	0.0654	0.0005	-99%
2011	0.0001	0.0000	-97%	0.0525	0.0014	-97%	0.0581	0.0014	-98%
2012	0.0000	0.0000	-89%	0.0183	0.0018	-90%	0.0202	0.0018	-91%

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2013	0.0000	0.0000	-79%	0.0288	0.0057	-80%	0.0319	0.0057	-82%
2014	0.0000	0.0000	-77%	0.0335	0.0073	-78%	0.0371	0.0073	-80%
2015	0.0001	0.0000	-78%	0.0504	0.0103	-79%	0.0558	0.0103	-81%
2016	0.0000	0.0000	-39%	0.0088	0.0079	-10%	0.0097	0.0079	-18%
2017	0.0000	0.0000	-40%	0.0086	0.0078	-10%	0.0095	0.0078	-18%
2018	0.0000	0.0000	-67%	0.0086	0.0043	-51%	0.0095	0.0043	-55%
2019	0.0000	0.0000	-42%	0.0077	0.0070	-10%	0.0085	0.0070	-18%
2020	0.0000	0.0000	0%	0.0096	0.0089	-7%	0.0106	0.0089	-16%
2021	0.0000	0.0000	0%	0.0104	0.0097	-7%	0.0115	0.0097	-16%

YEAR	TSP [kt]			BC [kt]			CO [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.1271	0.0000	-100%	0.0153	0.0000	-100%	0.1518	0.0000	-100%
1991	0.1116	0.0000	-100%	0.0134	0.0000	-100%	0.1332	0.0000	-100%
1992	0.1054	0.0000	-100%	0.0127	0.0000	-100%	0.1258	0.0000	-100%
1993	0.0868	0.0000	-100%	0.0104	0.0000	-100%	0.1036	0.0000	-100%
1994	0.0830	0.0000	-100%	0.0100	0.0000	-100%	0.0991	0.0000	-100%
1995	0.1120	0.0000	-100%	0.0134	0.0000	-100%	0.1337	0.0000	-100%
1996	0.0955	0.0000	-100%	0.0115	0.0000	-100%	0.1139	0.0000	-100%
1997	0.0569	0.0000	-100%	0.0068	0.0000	-100%	0.0679	0.0000	-100%
1998	0.0795	0.0000	-100%	0.0095	0.0000	-100%	0.0949	0.0000	-100%
1999	0.0168	0.0000	-100%	0.0020	0.0000	-100%	0.0200	0.0000	-100%
2000	0.0000	0.0000	-16%	0.0000	0.0000	-88%	0.0001	0.0000	-50%
2001	0.0519	0.0000	-100%	0.0062	0.0000	-100%	0.0620	0.0000	-100%
2002	0.0560	0.0000	-100%	0.0067	0.0000	-100%	0.0669	0.0000	-100%
2003	0.0424	0.0000	-100%	0.0051	0.0000	-100%	0.0507	0.0000	-100%
2004	0.0166	0.0000	-100%	0.0020	0.0000	-100%	0.0198	0.0000	-100%
2005	0.0014	0.0001	-96%	0.0002	0.0000	-99%	0.0017	0.0000	-98%
2006	0.0594	0.0005	-99%	0.0071	0.0000	-100%	0.0709	0.0004	-99%
2007	0.0635	0.0006	-99%	0.0076	0.0000	-100%	0.0758	0.0004	-99%
2008	0.0678	0.0006	-99%	0.0081	0.0000	-100%	0.0809	0.0004	-99%
2009	0.0621	0.0005	-99%	0.0075	0.0000	-100%	0.0741	0.0004	-99%
2010	0.0654	0.0005	-99%	0.0079	0.0000	-100%	0.0781	0.0004	-100%
2011	0.0581	0.0014	-98%	0.0070	0.0000	-100%	0.0693	0.0010	-99%
2012	0.0202	0.0018	-91%	0.0024	0.0000	-99%	0.0242	0.0013	-95%
2013	0.0319	0.0057	-82%	0.0038	0.0001	-97%	0.0381	0.0040	-89%
2014	0.0371	0.0073	-80%	0.0044	0.0001	-97%	0.0442	0.0052	-88%
2015	0.0558	0.0103	-81%	0.0067	0.0002	-97%	0.0666	0.0073	-89%
2016	0.0097	0.0079	-18%	0.0010	0.0001	-87%	0.0124	0.0056	-55%
2017	0.0095	0.0078	-18%	0.0010	0.0001	-87%	0.0111	0.0055	-50%
2018	0.0095	0.0043	-55%	0.0010	0.0001	-93%	0.0123	0.0030	-76%
2019	0.0085	0.0070	-18%	0.0009	0.0001	-87%	0.0111	0.0049	-56%
2020	0.0106	0.0089	-16%	0.0013	0.0002	-88%	0.0127	0.0063	-50%
2021	0.0115	0.0097	-16%	0.0012	0.0002	-87%	0.0138	0.0068	-50%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0037	0.0000	-100%	0.0004	0.0000	-100%	0.0004	0.0000	-100%
1991	0.0032	0.0000	-100%	0.0004	0.0000	-100%	0.0004	0.0000	-100%
1992	0.0031	0.0000	-100%	0.0003	0.0000	-100%	0.0003	0.0000	-100%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1993	0.0025	0.0000	-100%	0.0003	0.0000	-100%	0.0003	0.0000	-100%
1994	0.0024	0.0000	-100%	0.0003	0.0000	-100%	0.0003	0.0000	-100%
1995	0.0033	0.0000	-100%	0.0004	0.0000	-100%	0.0004	0.0000	-100%
1996	0.0028	0.0000	-100%	0.0003	0.0000	-100%	0.0003	0.0000	-100%
1997	0.0017	0.0000	-100%	0.0002	0.0000	-100%	0.0002	0.0000	-100%
1998	0.0023	0.0000	-100%	0.0003	0.0000	-100%	0.0003	0.0000	-100%
1999	0.0005	0.0000	-100%	0.0001	0.0000	-100%	0.0001	0.0000	-100%
2000	0.0000	0.0000	0%	0.0000	0.0000	0%	0.0000	0.0000	0%
2001	0.0015	0.0000	-100%	0.0002	0.0000	-100%	0.0002	0.0000	-100%
2002	0.0016	0.0000	-100%	0.0002	0.0000	-100%	0.0002	0.0000	-100%
2003	0.0012	0.0000	-100%	0.0001	0.0000	-100%	0.0001	0.0000	-100%
2004	0.0005	0.0000	-100%	0.0001	0.0000	-100%	0.0001	0.0000	-100%
2005	0.0000	0.0000	-95%	0.0000	0.0000	-95%	0.0000	0.0000	-95%
2006	0.0017	0.0000	-99%	0.0002	0.0000	-99%	0.0002	0.0000	-99%
2007	0.0018	0.0000	-99%	0.0002	0.0000	-99%	0.0002	0.0000	-99%
2008	0.0020	0.0000	-99%	0.0002	0.0000	-99%	0.0002	0.0000	-99%
2009	0.0018	0.0000	-99%	0.0002	0.0000	-99%	0.0002	0.0000	-99%
2010	0.0019	0.0000	-99%	0.0002	0.0000	-99%	0.0002	0.0000	-99%
2011	0.0017	0.0000	-97%	0.0002	0.0000	-97%	0.0002	0.0000	-97%
2012	0.0006	0.0001	-89%	0.0001	0.0000	-89%	0.0001	0.0000	-89%
2013	0.0009	0.0002	-79%	0.0001	0.0000	-79%	0.0001	0.0000	-79%
2014	0.0011	0.0003	-77%	0.0001	0.0000	-77%	0.0001	0.0000	-77%
2015	0.0016	0.0004	-78%	0.0002	0.0000	-78%	0.0002	0.0000	-78%
2016	0.0003	0.0003	0%	0.0000	0.0000	0%	0.0000	0.0000	0%
2017	0.0003	0.0003	0%	0.0000	0.0000	0%	0.0000	0.0000	0%
2018	0.0003	0.0001	-46%	0.0000	0.0000	-46%	0.0000	0.0000	-46%
2019	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0000	0.0000	0%
2020	0.0003	0.0003	0%	0.0000	0.0000	0%	0.0000	0.0000	0%
2021	0.0003	0.0003	0%	0.0000	0.0000	0%	0.0000	0.0000	0%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0139	0.0000	-100%	0.0148	0.0000	-100%	0.0256	0.0000	-100%
1991	0.0122	0.0000	-100%	0.0130	0.0000	-100%	0.0225	0.0000	-100%
1992	0.0116	0.0000	-100%	0.0122	0.0000	-100%	0.0213	0.0000	-100%
1993	0.0095	0.0000	-100%	0.0101	0.0000	-100%	0.0175	0.0000	-100%
1994	0.0091	0.0000	-100%	0.0096	0.0000	-100%	0.0167	0.0000	-100%
1995	0.0123	0.0000	-100%	0.0130	0.0000	-100%	0.0226	0.0000	-100%
1996	0.0105	0.0000	-100%	0.0111	0.0000	-100%	0.0192	0.0000	-100%
1997	0.0062	0.0000	-100%	0.0066	0.0000	-100%	0.0115	0.0000	-100%
1998	0.0087	0.0000	-100%	0.0092	0.0000	-100%	0.0160	0.0000	-100%
1999	0.0018	0.0000	-100%	0.0020	0.0000	-100%	0.0034	0.0000	-100%
2000	0.0000	0.0000	0%	0.0000	0.0000	0%	0.0000	0.0000	0%
2001	0.0057	0.0000	-100%	0.0060	0.0000	-100%	0.0105	0.0000	-100%
2002	0.0061	0.0000	-100%	0.0065	0.0000	-100%	0.0113	0.0000	-100%
2003	0.0047	0.0000	-100%	0.0049	0.0000	-100%	0.0086	0.0000	-100%
2004	0.0018	0.0000	-100%	0.0019	0.0000	-100%	0.0033	0.0000	-100%
2005	0.0002	0.0000	-95%	0.0002	0.0000	-95%	0.0003	0.0000	-95%
2006	0.0065	0.0000	-99%	0.0069	0.0001	-99%	0.0120	0.0001	-99%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2007	0.0070	0.0000	-99%	0.0074	0.0001	-99%	0.0128	0.0001	-99%
2008	0.0074	0.0000	-99%	0.0079	0.0001	-99%	0.0137	0.0001	-99%
2009	0.0068	0.0000	-99%	0.0072	0.0001	-99%	0.0125	0.0001	-99%
2010	0.0072	0.0000	-99%	0.0076	0.0001	-99%	0.0132	0.0001	-99%
2011	0.0064	0.0000	-97%	0.0067	0.0002	-97%	0.0117	0.0003	-97%
2012	0.0022	0.0000	-89%	0.0024	0.0003	-89%	0.0041	0.0004	-89%
2013	0.0035	0.0000	-79%	0.0037	0.0008	-79%	0.0064	0.0014	-79%
2014	0.0041	0.0000	-77%	0.0043	0.0010	-77%	0.0075	0.0018	-77%
2015	0.0061	0.0000	-78%	0.0065	0.0014	-78%	0.0112	0.0025	-78%
2016	0.0010	0.0000	0%	0.0011	0.0011	0%	0.0019	0.0019	0%
2017	0.0010	0.0000	0%	0.0011	0.0011	0%	0.0019	0.0019	0%
2018	0.0010	0.0000	-46%	0.0011	0.0006	-46%	0.0019	0.0010	-46%
2019	0.0009	0.0000	0%	0.0010	0.0010	0%	0.0017	0.0017	0%
2020	0.0012	0.0000	0%	0.0012	0.0012	0%	0.0021	0.0021	0%
2021	0.0013	0.0000	0%	0.0013	0.0013	0%	0.0023	0.0023	0%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.6562	0.0002	-100%	0.0043	0.0000	-100%	0.0246	0.0000	-100%
1991	0.5762	0.0002	-100%	0.0038	0.0000	-100%	0.0216	0.0000	-100%
1992	0.5442	0.0002	-100%	0.0036	0.0000	-100%	0.0204	0.0000	-100%
1993	0.4482	0.0002	-100%	0.0029	0.0000	-100%	0.0168	0.0000	-100%
1994	0.4286	0.0002	-100%	0.0028	0.0000	-100%	0.0161	0.0000	-100%
1995	0.5783	0.0002	-100%	0.0038	0.0000	-100%	0.0217	0.0000	-100%
1996	0.4927	0.0002	-100%	0.0032	0.0000	-100%	0.0185	0.0000	-100%
1997	0.2936	0.0002	-100%	0.0019	0.0000	-100%	0.0110	0.0000	-100%
1998	0.4103	0.0002	-100%	0.0027	0.0000	-100%	0.0154	0.0000	-100%
1999	0.0867	0.0002	-100%	0.0006	0.0000	-100%	0.0033	0.0000	-100%
2000	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0000	0.0000	0%
2001	0.2680	0.0003	-100%	0.0018	0.0000	-100%	0.0100	0.0000	-100%
2002	0.2891	0.0003	-100%	0.0019	0.0000	-100%	0.0108	0.0000	-100%
2003	0.2190	0.0003	-100%	0.0014	0.0000	-100%	0.0082	0.0000	-100%
2004	0.0854	0.0003	-100%	0.0006	0.0000	-100%	0.0032	0.0000	-100%
2005	0.0072	0.0004	-95%	0.0000	0.0000	-95%	0.0003	0.0000	-95%
2006	0.3065	0.0032	-99%	0.0020	0.0000	-99%	0.0115	0.0001	-99%
2007	0.3278	0.0034	-99%	0.0022	0.0000	-99%	0.0123	0.0001	-99%
2008	0.3499	0.0036	-99%	0.0023	0.0000	-99%	0.0131	0.0001	-99%
2009	0.3206	0.0033	-99%	0.0021	0.0000	-99%	0.0120	0.0001	-99%
2010	0.3378	0.0033	-99%	0.0022	0.0000	-99%	0.0127	0.0001	-99%
2011	0.2997	0.0085	-97%	0.0020	0.0001	-97%	0.0112	0.0003	-97%
2012	0.1045	0.0113	-89%	0.0007	0.0001	-89%	0.0039	0.0004	-89%
2013	0.1646	0.0350	-79%	0.0011	0.0002	-79%	0.0062	0.0013	-79%
2014	0.1913	0.0449	-77%	0.0013	0.0003	-77%	0.0072	0.0017	-77%
2015	0.2880	0.0637	-78%	0.0019	0.0004	-78%	0.0108	0.0024	-78%
2016	0.0486	0.0487	0%	0.0003	0.0003	0%	0.0018	0.0018	0%
2017	0.0480	0.0480	0%	0.0003	0.0003	0%	0.0018	0.0018	0%
2018	0.0481	0.0262	-46%	0.0003	0.0002	-46%	0.0018	0.0010	-46%
2019	0.0428	0.0429	0%	0.0003	0.0003	0%	0.0016	0.0016	0%
2020	0.0549	0.0549	0%	0.0004	0.0004	0%	0.0021	0.0021	0%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	0.0595	0.0595	0%	0.0004	0.0004	0%	0.0022	0.0022	0%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0010	3.4E-10	-100%	0.0016	7.8E-07	-100%
1991	0.0008	2.9E-10	-100%	0.0014	6.6E-07	-100%
1992	0.0008	2.7E-10	-100%	0.0014	6.2E-07	-100%
1993	0.0007	2.7E-10	-100%	0.0011	6.3E-07	-100%
1994	0.0006	2.9E-10	-100%	0.0011	6.7E-07	-100%
1995	0.0008	3.1E-10	-100%	0.0014	7.1E-07	-100%
1996	0.0007	3.3E-10	-100%	0.0012	7.6E-07	-100%
1997	0.0004	3.4E-10	-100%	0.0007	7.9E-07	-100%
1998	0.0006	3.6E-10	-100%	0.0010	8.3E-07	-100%
1999	0.0001	3.6E-10	-100%	0.0002	8.3E-07	-100%
2000	0.0000	3.6E-10	-100%	0.0000	8.4E-07	-
2001	0.0004	3.7E-10	-100%	0.0007	8.7E-07	-100%
2002	0.0004	3.9E-10	-100%	0.0007	9.1E-07	-100%
2003	0.0003	4.1E-10	-100%	0.0005	9.5E-07	-100%
2004	0.0001	4.3E-10	-100%	0.0002	1.0E-06	-100%
2005	0.0000	5.2E-10	-100%	0.0000	1.2E-06	-
2006	0.0005	4.8E-09	-100%	0.0008	1.1E-05	-99%
2007	0.0005	5.0E-09	-100%	0.0008	1.2E-05	-99%
2008	0.0005	5.3E-09	-100%	0.0009	1.2E-05	-99%
2009	0.0005	4.8E-09	-100%	0.0008	1.1E-05	-99%
2010	0.0005	4.9E-09	-100%	0.0008	1.1E-05	-99%
2011	0.0004	1.2E-08	-100%	0.0007	2.9E-05	-96%
2012	0.0002	1.7E-08	-100%	0.0003	3.8E-05	-87%
2013	0.0002	5.1E-08	-100%	0.0004	1.2E-04	-70%
2014	0.0003	6.6E-08	-100%	0.0005	1.5E-04	-70%
2015	0.0004	9.4E-08	-100%	0.0007	2.2E-04	-69%
2016	0.0001	7.2E-08	-100%	0.0001	1.7E-04	70%
2017	0.0001	7.1E-08	-100%	0.0001	1.6E-04	60%
2018	0.0001	3.8E-08	-100%	0.0001	8.9E-05	-11%
2019	0.0001	6.3E-08	-100%	0.0001	1.5E-04	50%
2020	0.0001	8.1E-08	-100%	0.0001	1.9E-04	90%
2021	0.0001	8.7E-08	-100%	0.0001	2.0E-04	100%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0029	1.0E-06	-100%	0.0117	0.0000	-100%
1991	0.0025	8.5E-07	-100%	0.0103	0.0000	-100%
1992	0.0024	8.0E-07	-100%	0.0097	0.0000	-100%
1993	0.0020	8.1E-07	-100%	0.0080	0.0000	-100%
1994	0.0019	8.6E-07	-100%	0.0076	0.0000	-100%
1995	0.0025	9.1E-07	-100%	0.0103	0.0000	-100%
1996	0.0022	9.8E-07	-100%	0.0088	0.0000	-100%
1997	0.0013	1.0E-06	-100%	0.0052	0.0000	-100%
1998	0.0018	1.1E-06	-100%	0.0073	0.0000	-100%
1999	0.0004	1.1E-06	-100%	0.0015	0.0000	-100%
2000	0.0000	1.1E-06	0%	0.0000	0.0000	0%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2001	0.0012	1.1E-06	-100%	0.0048	0.0000	-100%
2002	0.0013	1.2E-06	-100%	0.0052	0.0000	-100%
2003	0.0010	1.2E-06	-100%	0.0039	0.0000	-100%
2004	0.0004	1.3E-06	-100%	0.0015	0.0000	-100%
2005	0.0000	1.6E-06	-95%	0.0001	0.0000	-95%
2006	0.0013	1.4E-05	-99%	0.0055	0.0001	-99%
2007	0.0014	1.5E-05	-99%	0.0058	0.0001	-99%
2008	0.0015	1.6E-05	-99%	0.0062	0.0001	-99%
2009	0.0014	1.4E-05	-99%	0.0057	0.0001	-99%
2010	0.0015	1.5E-05	-99%	0.0060	0.0001	-99%
2011	0.0013	3.7E-05	-97%	0.0053	0.0002	-97%
2012	0.0005	4.9E-05	-89%	0.0019	0.0002	-89%
2013	0.0007	1.5E-04	-79%	0.0029	0.0006	-79%
2014	0.0008	2.0E-04	-77%	0.0034	0.0008	-77%
2015	0.0013	2.8E-04	-78%	0.0051	0.0011	-78%
2016	0.0002	2.1E-04	0%	0.0009	0.0009	0%
2017	0.0002	2.1E-04	0%	0.0009	0.0009	0%
2018	0.0002	1.1E-04	-46%	0.0009	0.0005	-46%
2019	0.0002	1.9E-04	0%	0.0008	0.0008	0%
2020	0.0002	2.4E-04	0%	0.0010	0.0010	0%
2021	0.0003	2.6E-04	0%	0.0011	0.0011	0%

3.6.6 Pipeline Transport (NFR 1A3ei)

3.6.6.1. Overview

There is a significant decrease in fuel consumption in recent years and this trend is related to the decrease in natural gas transit through the Slovak Republic. An overview of emissions in this category is shown in ***Table 3.98***.

Table 3.98: *Overview of emissions in the category 1A3ei*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.1069	0.1220	0.0009	0.0001	0.0001	0.0001	0.0000	0.3638
1995	3.0858	0.1211	0.0008	0.0001	0.0001	0.0001	0.0000	0.3613
2000	3.1252	0.0871	0.0010	0.0001	0.0001	0.0001	0.0000	0.4181
2005	3.9738	0.2380	0.0010	0.0000	0.0000	0.0000	0.0000	0.3650
2010	2.3498	0.1996	0.0039	0.0000	0.0000	0.0000	0.0000	0.1940
2011	2.4936	0.2109	0.0143	0.0000	0.0000	0.0000	0.0000	0.1710
2012	0.6886	0.1318	0.0000	0.0000	0.0000	0.0000	0.0000	0.0823
2013	0.6576	0.1489	0.0000	0.0000	0.0000	0.0000	0.0000	0.0662
2014	0.1859	0.2599	0.0000	0.0000	0.0000	0.0000	0.0000	0.0628
2015	0.2273	0.2333	0.0000	0.0001	0.0001	0.0001	0.0000	0.0486
2016	0.2893	0.2634	0.0000	0.0000	0.0000	0.0000	0.0000	0.0598
2017	0.2520	0.2149	0.0000	0.0001	0.0001	0.0001	0.0000	0.0892
2018	0.2089	0.1487	0.0000	0.0036	0.0036	0.0036	0.0001	0.1216
2019	0.2880	0.1268	0.0000	0.0046	0.0046	0.0046	0.0002	0.0886
2020	0.1492	0.2162	0.0000	0.0026	0.0026	0.0026	0.0001	0.0445
2021	0.1314	0.1702	0.0000	0.0016	0.0016	0.0016	0.0001	0.0252
2022	0.0171	0.1388	0.0000	0.0002	0.0002	0.0002	0.0000	0.0052
1990/2022	**-99%**	**14%**	**-100%**	**83%**	**83%**	**83%**	**153%**	**-99%**
2021/2022	**-87%**	**-18%**	**-97%**	**-88%**	**-88%**	**-88%**	**-84%**	**-79%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.99*** below.

Table 3.99: *Overview of activity data in the category 1A3ei*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	NO	NO	17 438.08	NO	NO
1995	NO	NO	17 319.30	NO	NO
2000	NO	NO	19 155.22	NO	NO
2005	0.18	NO	23 705.18	NO	NO
2010	1.19	NO	14 802.40	NO	NO
2011	0.82	NO	16 376.63	NO	NO
2012	0.51	NO	7 297.20	NO	NO
2013	0.61	NO	7 629.69	NO	NO
2014	0.19	NO	2 860.05	NO	NO
2015	NO	NO	2 983.61	NO	NO
2016	0.24	NO	4 923.82	NO	NO
2017	0.24	NO	5 287.33	NO	NO
2018	0.23	NO	4 869.17	NO	NO
2019	0.28	NO	6 535.92	NO	NO
2020	0.19	NO	2 763.62	NO	NO
2021	0.23	NO	1 886.90	NO	NO
2022	0.21	NO	163.77	NO	NO
1990/2022	-	-	**-99%**	-	-
2021/2022	**-7%**	-	**-91%**	-	-

3.6.6.2 Methodological issues

The activity data on the consumption of natural gas used for energy to drive turbines were obtained from the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.100***).

Table 3.100: *Emission factors for calculation of historical years*

	NOx [kg/tGJ]	NMVOC [kg/tGJ]	SOx [kg/tGJ]	TSP [kg/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [kg/tGJ]
EF	178.169	6.994	0.049	0.01	100%	100%	20.86

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.101***). The calculated BC emission values are presented in ***Table 3.98***.

Table 3.101: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.6.6.3 Completeness

Emissions are well covered. Emissions of NH_3, HMs and POPs are reported as NA.

3.6.6.4 Source-specific recalculations

The recalculations for BC were made based on changes in activity data (corrections in categorization of fuels for the years 2000-2004). (***Table 3.102***).

Table 3.102: *Previous and revised emissions in the category 1A3ei*

YEAR	BC [kt]		
	PREVIOUS	REVISED	CHANGE
2000	4.8E-06	4.9E-06	3%
2001	4.2E-06	4.2E-06	0.42%
2002	4.8E-06	4.8E-06	0.29%
2003	4.3E-06	4.3E-06	1%
2004	6.3E-06	6.4E-06	1%

3.6.7 Other (NFR 1A3eii)

This category is not occurring in the Slovak Republic.

3.7 SMALL COMBUSTION (NFR 1A4, 1A5)

3.7.1 Overview

Small combustion appliances are used to provide thermal energy for heating and cooking. In small combustion installations, a wide variety of fuels are used and several combustion technologies are applied. In residential activity, smaller combustion appliances, especially older single household installations are of very simple design, while some modern installations of all capacities are significantly improved. Emissions strongly depend on fuel, and combustion technologies as well as on operational practices and maintenance.

For the combustion of liquid and gaseous fuels, the technologies used are similar to those for the production of thermal energy in larger combustion activities, except for the simple design of smaller appliances like fireplaces and stoves.

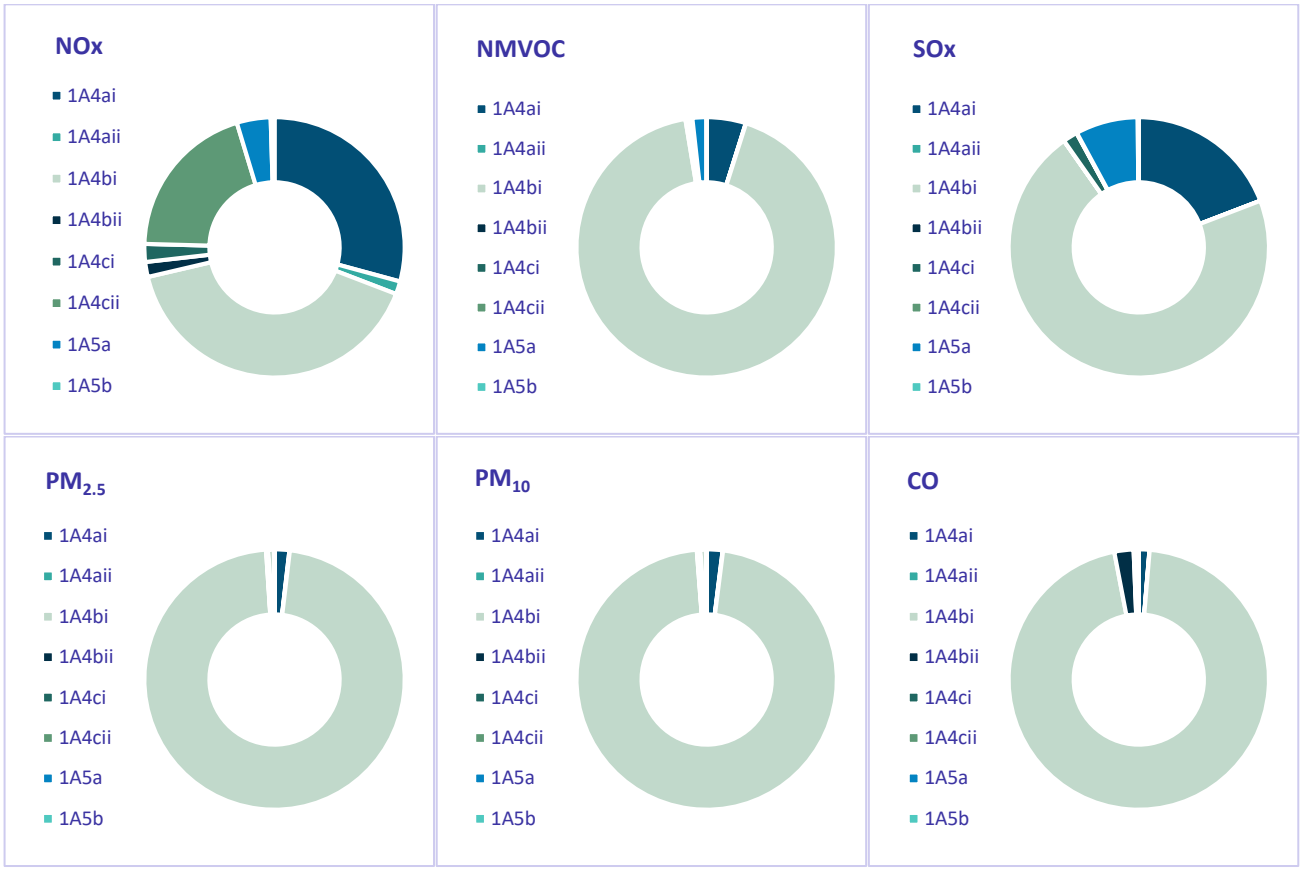
Relevant pollutants are SOx, NOx, CO, NMVOC, particulate matter (PM), black carbon (BC), heavy metals, PAH, polychlorinated dibenzo-dioxins and furans (PCDD/F) and hexachlorobenzene (HCB). For solid fuels, generally, the emissions due to incomplete combustion are many times greater in small appliances than in bigger plants. This is particularly valid for manually-fed appliances and poorly controlled automatic installations.

This chapter is focused on emission data from stationary sources with total nominal heat consumption from 0.3 MW to 50 MW (Technological units containing combustion plants having total rated thermal input between 0.3-50 MW and other technological units with a capacity under the defined limit for the large sources but over the defined limit for the medium sources) and household heating. These sources are divided by NACE code into categories:

- **1A4a** – Commercial/institutional;
- **1A4b** – Residential;
- **1A4c** – Agriculture/forestry; and
- **1A5** – Other (stationary combustion).

From the figures below is clear that the main contributor to emissions in this subsector is category **1A4bi** (***Figure 3.9***).

Figure 3.9: *Share of emissions of main pollutants in 1A4 and 1A5 in 2022*



3.7.2 Commercial/institutional: Stationary (NFR 1A4ai)

3.7.2.1 Overview

The category covers the sources that cannot be clearly identified to particular activity but generally, it is the combustion process. Activities listed within this category are shown in ***Table 3.103***.

Table 3.103: *Activities according to national categorization included in 1A4ai*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	MEDIUM S.: NACE 35.1; 35.3; 45-66; 68; 69-99
1.4. Facilities for fuel gasification or liquefaction with a total rated thermal input in MW *a) coal* *b) other fuels except for biogas production facilities and thermal treatment of waste in cat.. 5.7*	combustion

An overview of the emissions is shown in ***Table 3.104***. Most of the emissions have an overall decreasing trend due to the decrease in the volume of use of coal. Emissions of NMVOC, Cd, Cr, Zn and HCB increased significantly due to the preference of biomass fuels as a renewable source and political support of this fuel.

Table 3.104: *Overview of emissions in the category 1A4ai*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	2.7458	0.2274	2.1826	NO	0.8341	1.0078	1.4835	0.0711	4.3300
1995	2.7473	0.2275	2.1838	NO	0.8345	1.0084	1.4843	0.0708	4.3323
2000	2.7491	0.1819	2.8190	NO	1.0416	1.2586	1.8527	0.0915	5.3649
2005	1.9757	0.0940	0.9169	NO	0.2511	0.3374	0.6377	0.0301	2.1883
2010	2.0710	0.7784	0.5606	NO	0.2450	0.3000	0.4388	0.0570	2.3221
2011	2.2152	0.9788	0.4986	NO	0.2597	0.3108	0.4357	0.0647	2.5274
2012	2.3288	1.2330	0.4348	NO	0.2945	0.3445	0.4586	0.0756	2.9270
2013	2.4146	1.5068	0.3968	NO	0.3166	0.3627	0.4524	0.0826	3.1083

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2014	2.6183	1.5829	0.3815	0.0001	0.3008	0.3378	0.4052	0.0800	2.9019
2015	2.7388	1.7181	0.4286	0.0001	0.3118	0.3471	0.4124	0.0838	2.8848
2016	2.6993	1.7454	0.3609	0.0001	0.3150	0.3507	0.4131	0.0850	2.8042
2017	2.7854	1.7891	0.3608	0.0001	0.3287	0.3664	0.4278	0.0886	2.7492
2018	2.6311	1.6964	0.2901	0.0001	0.2985	0.3305	0.3766	0.0803	2.4489
2019	2.5737	1.8088	0.2527	0.0001	0.2799	0.3100	0.3593	0.0759	2.4490
2020	2.6426	1.9572	0.3634	0.0001	0.2787	0.3101	0.3489	0.0766	2.4159
2021	2.7199	1.9950	0.3335	0.0001	0.3076	0.3421	0.3796	0.0845	2.4759
2022	2.3788	1.6667	0.3284	0.0001	0.2611	0.2877	0.3207	0.0714	2.1543
1990/2022	**-13%**	**633%**	**-85%**	**-**	**-69%**	**-71%**	**-78%**	**0%**	**-50%**
2021/2022	**-13%**	**-16%**	**-2%**	**-13%**	**-15%**	**-16%**	**-16%**	**-15%**	**-13%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.7574	0.0519	0.0375	0.0235	0.1420	0.1128	0.1294	0.0104	2.6879
1995	0.3168	0.0141	0.0171	0.0113	0.0471	0.0458	0.0557	0.0044	0.8403
2000	0.1188	0.0046	0.0075	0.0055	0.0164	0.0170	0.0184	0.0018	0.2895
2005	0.0626	0.0115	0.0054	0.0050	0.0242	0.0110	0.0239	0.0013	0.4910
2010	0.2460	0.0553	0.0138	0.0087	0.1105	0.0416	0.0253	0.0046	2.3230
2011	0.2498	0.0660	0.0129	0.0079	0.1279	0.0441	0.0246	0.0047	2.7230
2012	0.2675	0.0812	0.0127	0.0075	0.1535	0.0493	0.0249	0.0052	3.3064
2013	0.2890	0.0937	0.0128	0.0075	0.1751	0.0546	0.0259	0.0057	3.7957
2014	0.2598	0.0947	0.0108	0.0062	0.1740	0.0513	0.0229	0.0057	3.8092
2015	0.2732	0.1020	0.0111	0.0064	0.1867	0.0545	0.0239	0.0060	4.0943
2016	0.2624	0.1005	0.0104	0.0061	0.1831	0.0529	0.0227	0.0058	4.0254
2017	0.2820	0.1085	0.0111	0.0064	0.1979	0.0569	0.0238	0.0063	4.3479
2018	0.2568	0.0993	0.0102	0.0059	0.1810	0.0519	0.0214	0.0059	3.9808
2019	0.2649	0.1063	0.0100	0.0056	0.1928	0.0544	0.0221	0.0061	4.2524
2020	0.2352	0.1031	0.0079	0.0046	0.1843	0.0504	0.0188	0.0056	4.0982
2021	0.2249	0.0994	0.0077	0.0046	0.1774	0.0484	0.0181	0.0054	3.9485
2022	0.1935	0.0829	0.0071	0.0042	0.1488	0.0409	0.0157	0.0048	3.3014
1990/2022	**-74%**	**60%**	**-81%**	**-82%**	**5%**	**-64%**	**-88%**	**-54%**	**23%**
2021/2022	**-14%**	**-17%**	**-8%**	**-8%**	**-16%**	**-15%**	**-13%**	**-11%**	**-16%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	1.5045	0.3206	0.4327	0.1817	0.1480	1.0830	0.0190	0.7102
1995	0.6020	0.1400	0.1884	0.0845	0.0702	0.4832	0.0050	0.3144
2000	0.2281	0.0582	0.0795	0.0402	0.0349	0.2128	0.0016	0.1196
2005	0.1671	0.0417	0.0619	0.0383	0.0356	0.1775	0.0044	0.0413
2010	0.6269	0.0999	0.1518	0.0686	0.0591	0.3794	0.0213	0.1730
2011	0.6780	0.0996	0.1549	0.0666	0.0571	0.3783	0.0254	0.1516
2012	0.7728	0.1062	0.1699	0.0695	0.0596	0.4052	0.0312	0.1349
2013	0.8648	0.1155	0.1896	0.0745	0.0638	0.4434	0.0360	0.1272
2014	0.8282	0.1078	0.1948	0.0710	0.0616	0.4352	0.0364	0.0853
2015	0.8822	0.1137	0.2070	0.0746	0.0648	0.4601	0.0392	0.0831
2016	0.8619	0.1112	0.2037	0.0735	0.0641	0.4525	0.0386	0.0713
2017	0.9263	0.1180	0.2169	0.0775	0.0674	0.4798	0.0418	0.0768
2018	0.8466	0.1089	0.2070	0.0725	0.0634	0.4517	0.0382	0.0684
2019	0.8909	0.1121	0.2160	0.0737	0.0644	0.4662	0.0409	0.0598
2020	0.8398	0.1047	0.2050	0.0691	0.0608	0.4395	0.0396	0.0235
2021	0.8077	0.1015	0.2001	0.0680	0.0601	0.4298	0.0382	0.0203

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2022	0.6804	0.0870	0.1756	0.0595	0.0528	0.3749	0.0319	0.0269
1990/2022	**-55%**	**-73%**	**-59%**	**-67%**	**-64%**	**-65%**	**67%**	**-96%**
2021/2022	**-16%**	**-14%**	**-12%**	**-13%**	**-12%**	**-13%**	**-17%**	**33%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.105*** below.

Table 3.105: *Overview of activity data in the category 1A4ai*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	375.15	3 778.73	43 053.56	225.84	NO
1995	361.45	3 664.15	43 217.31	216.44	NO
2000	404.13	3 326.20	41 220.69	225.84	NO
2005	164.99	1 176.35	37 589.84	332.87	NO
2010	138.98	1 306.13	28 860.16	3 917.21	NO
2011	115.82	1 011.43	25 399.22	5 151.81	NO
2012	87.79	911.25	24 388.98	6 639.92	NO
2013	60.40	892.57	24 507.10	8 078.16	NO
2014	51.64	615.17	22 211.10	10 867.04	NO
2015	49.81	489.84	23 292.66	11 325.35	NO
2016	40.06	418.85	24 016.88	10 877.96	NO
2017	41.44	450.99	24 660.76	11 105.85	NO
2018	29.51	402.26	22 711.85	9 373.46	NO
2019	71.43	351.29	22 524.90	9 842.97	NO
2020	38.85	137.65	21 982.57	10 333.35	NO
2021	30.19	118.83	23 369.43	10 075.90	NO
2022	31.37	157.88	21 338.48	8 571.72	NO
1990/2022	**-92%**	**-96%**	**-50%**	**3695%**	-
2021/2022	**4%**	**33%**	**-9%**	**-15%**	-

3.7.2.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022. NH_3 emissions from solid biomass combustion are reported as 'NO' because measurements show that NH_3 is not relevant (***Recommendation No 1A4ai-SK-2022-0001***).

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.106***).

Table 3.106: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	57.88	4.79	46.01	31.27	56%	68%	91.27

The emissions of heavy metals and POPs are calculated at the Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore these detailed methodologies could be used focused on the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of emissions of heavy metals and POPs are default EF from EMEP/EEA GB_{2019} (***Table 3.107***).

The annual emission is determined by activity data and an emission factor:

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

Where:

E_i = annual emission of pollutant *i*,

$EF_{i,j,k}$ = default emission factor of pollutant *i* for source type *j* and fuel *k*,

$A_{j,k}$ = annual consumption of fuel *k* in source type *j*.

Table 3.107: *Emission factors for heavy metals and POPs in the category 1A4ai*

TYPE OF FUEL		LIQUID FUELS				HARD COAL/BROWN COAL	
T2	**UNIT**	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (> 1 MWth ≤ 50 MWth)	**GAS TURBINES** (50 kWth – 50 MWth)	**STATIONARY RECIPROCATING ENGINES** (50 kWth – 50 MWth)	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	20	10	0.012	0.15	200	100
Cd	[mg/GJ]	0.3	0.3	0.001	0.01	3	1
Hg	[mg/GJ]	0.1	0.1	0.12	0.11	7	9
As	[mg/GJ]	1	1	0.002	0.06	5	4
Cr	[mg/GJ]	20	20	0.2	0.2	15	15
Cu	[mg/GJ]	10	3	0.13	0.3	17.5	10
Ni	[mg/GJ]	300	200	0.005	0.01	13	10
Se	[mg/GJ]	NA	0.5	0.002	0.22	1.8	2
Zn	[mg/GJ]	10	5	0.42	58	200	150
PCDD/F	[ng I-TEQ/GJ]	10	10	1.8	0.99	203	100
B(a)P	[mg/GJ]	8	1	NE	1.9	45.5	13
B(b)F	[mg/GJ]	9	2	NE	15	58.9	17
B(k)F	[mg/GJ]	6	1	NE	1.7	23.7	9
I()P	[mg/GJ]	3	1	NE	1.5	18.5	6
PAHs	[mg/GJ]	26	5	NE	20.1	146.6	45
HCB	[µg/GJ]	NE	NE	NE	0.22	0.62	0.62
PCBs	[µg/GJ]	NE	NE	NE	0.13	170	170

TYPE OF FUEL		GASEOUS FUELS				BIOMASS	
T2	**UNIT**	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (> 1 MWth ≤ 50 MWth)	**GAS TURBINES** (50 kWth – 50 MWth)	**STATIONARY RECIPROCATING ENGINES** (50 kWth – 50 MWth)	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	0.0015	0.0015	0.0015	0.04	27	27
Cd	[mg/GJ]	0.00025	0.00025	0.00025	0.003	13	13
Hg	[mg/GJ]	0.1	0.1	0.1	0.1	0.56	0.56
As	[mg/GJ]	0.12	0.12	0.12	0.05	0.19	0.19
Cr	[mg/GJ]	0.00076	0.00076	0.00076	0.05	23	23
Cu	[mg/GJ]	0.000076	0.000076	0.000076	0.01	6	6
Ni	[mg/GJ]	0.00051	0.00051	0.00051	0.05	2	2
Se	[mg/GJ]	0.011	0.011	0.011	0.2	0.5	0.5
Zn	[mg/GJ]	0.0015	0.0015	0.0015	2.9	512	512
PCDD/F	[ng I-TEQ/GJ]	0.5	0.5	0.5	0.57	100	100
B(a)P	[mg/GJ]	0.56	0.56	0.56	1.2	10	10
B(b)F	[mg/GJ]	0.84	0.84	0.84	9	16	16
B(k)F	[mg/GJ]	0.84	0.84	0.84	1.7	5	5
I()P	[mg/GJ]	0.84	0.84	0.84	1.8	4	4
PAHs	[mg/GJ]	3.08	3.08	3.08	13.7	35	35

TYPE OF FUEL		GASEOUS FUELS				BIOMASS	
T2	UNIT	STANDARD BOILERS (> 50 KWth ≤ 1 MWth)	STANDARD BOILERS (> 1 MWth ≤ 50 MWth)	GAS TURBINES (50 kWth – 50 MWth)	STATIONARY RECIPROCATING ENGINES (50 kWth – 50 MWth)	STANDARD BOILERS (> 50 KWth ≤ 1 MWth)	STANDARD BOILERS (>1 MWth ≤ 50 MWth)
HCB	[µg/GJ]	NA	NA	NA	NA	5	5
PCBs	[µg/GJ]	NA	NA	NA	NA	0.03	0.007

BC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.108***). The calculated BC emission values are presented in ***Table 3.104***.

Table 3.108: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.7.2.3 Completeness

Ammonia emissions are not occurring in this category until 2014.

3.7.2.4 Source-specific recalculations

The recalculations for main pollutants were made based on changes in activity data. The recalculations for HM and POPs were made based on changes in activity data (supplemented activity values). The results of the recalculations are in ***Table 3.109***.

Table 3.109: *Previous and revised emissions in the category 1A4ai*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	2.7454	2.7458	0.02%	0.2273	0.2274	0.02%	2.1823	2.1826	0.02%
1991	2.7472	2.7477	0.02%	0.2275	0.2275	0.02%	2.1837	2.1841	0.02%
1992	2.7450	2.7455	0.02%	0.2273	0.2274	0.02%	2.1820	2.1824	0.02%
1993	2.7419	2.7423	0.02%	0.2271	0.2271	0.02%	2.1795	2.1798	0.02%
1994	2.7399	2.7404	0.02%	0.2269	0.2269	0.02%	2.1780	2.1783	0.02%
1995	2.7469	2.7473	0.01%	0.2275	0.2275	0.01%	2.1835	2.1838	0.01%
1996	2.7227	2.7231	0.02%	0.2255	0.2255	0.02%	2.1642	2.1646	0.02%
1997	2.7271	2.7275	0.02%	0.2258	0.2259	0.02%	2.1677	2.1680	0.02%
1998	2.7269	2.7273	0.01%	0.2258	0.2259	0.01%	2.1676	2.1679	0.01%
1999	2.7133	2.7136	0.01%	0.2247	0.2247	0.01%	2.1568	2.1570	0.01%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.8339	0.8341	0.02%	1.0077	1.0078	0.02%	1.4833	1.4835	0.02%
1991	0.8345	0.8346	0.02%	1.0084	1.0085	0.02%	1.4843	1.4845	0.02%
1992	0.8338	0.8340	0.02%	1.0076	1.0077	0.02%	1.4831	1.4834	0.02%
1993	0.8329	0.8330	0.02%	1.0064	1.0065	0.02%	1.4814	1.4816	0.02%
1994	0.8323	0.8324	0.02%	1.0057	1.0058	0.02%	1.4804	1.4806	0.02%
1995	0.8344	0.8345	0.01%	1.0082	1.0084	0.01%	1.4841	1.4843	0.01%
1996	0.8270	0.8272	0.02%	0.9993	0.9995	0.02%	1.4710	1.4713	0.02%
1997	0.8284	0.8285	0.02%	1.0009	1.0011	0.02%	1.4734	1.4736	0.02%
1998	0.8283	0.8284	0.01%	1.0009	1.0010	0.01%	1.4733	1.4735	0.01%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1999	0.8242	0.8243	0.01%	0.9959	0.9960	0.01%	1.4660	1.4661	0.01%

YEAR	BC [kt]			CO [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0710	0.0711	0.02%	4.3293	4.3300	0.02%
1991	0.0710	0.0710	0.02%	4.3323	4.3330	0.02%
1992	0.0710	0.0710	0.02%	4.3288	4.3296	0.02%
1993	0.0710	0.0710	0.02%	4.3238	4.3245	0.02%
1994	0.0709	0.0709	0.02%	4.3208	4.3215	0.02%
1995	0.0708	0.0708	0.01%	4.3317	4.3323	0.01%
1996	0.0707	0.0708	0.02%	4.2936	4.2943	0.02%
1997	0.0706	0.0706	0.01%	4.3005	4.3011	0.02%
1998	0.0701	0.0701	0.01%	4.3002	4.3008	0.01%
1999	0.0699	0.0699	0.01%	4.2788	4.2793	0.01%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.7522	0.7574	1%	0.0494	0.0519	5%	0.0374	0.0375	0.29%
1991	0.6424	0.6464	1%	0.0394	0.0414	5%	0.0323	0.0324	0.26%
1992	0.5444	0.5475	1%	0.0309	0.0324	5%	0.0278	0.0279	0.23%
1993	0.4577	0.4600	1%	0.0239	0.0250	5%	0.0238	0.0239	0.20%
1994	0.3817	0.3834	0.45%	0.0181	0.0189	5%	0.0202	0.0202	0.18%
1995	0.3156	0.3168	0.38%	0.0135	0.0141	4%	0.0171	0.0171	0.15%
1996	0.2585	0.2593	0.33%	0.0100	0.0104	4%	0.0143	0.0144	0.12%
1997	0.4931	0.4938	0.12%	0.0114	0.0117	3%	0.0259	0.0259	0.05%
1998	0.2896	0.2901	0.16%	0.0075	0.0078	3%	0.0160	0.0160	0.06%
1999	0.2073	0.2077	0.20%	0.0060	0.0063	3%	0.0119	0.0119	0.07%
2000	0.1184	0.1188	0.31%	0.0044	0.0046	4%	0.0075	0.0075	0.10%
2001	0.1046	0.1053	1%	0.0065	0.0068	5%	0.0068	0.0068	0.21%
2002	0.1697	0.1702	0.33%	0.0066	0.0068	4%	0.0099	0.0099	0.12%
2003	0.0216	0.0225	4%	0.0067	0.0071	6%	0.0024	0.0025	0.72%
2004	0.0957	0.0966	1%	0.0084	0.0089	5%	0.0060	0.0060	0.33%
2005	0.0613	0.0626	2%	0.0108	0.0115	6%	0.0054	0.0054	0.51%
2006	0.0790	0.0804	2%	0.0115	0.0122	6%	0.0065	0.0066	0.44%
2007	0.1553	0.1570	1%	0.0143	0.0151	5%	0.0100	0.0100	0.34%
2008	0.1434	0.1534	7%	0.0170	0.0218	28%	0.0089	0.0092	2.32%
2009	0.2022	0.2090	3%	0.0282	0.0314	12%	0.0130	0.0131	1.08%
2010	0.2422	0.2460	2%	0.0535	0.0553	3%	0.0137	0.0138	0.57%
2011	0.2464	0.2498	1%	0.0643	0.0660	3%	0.0128	0.0129	0.55%
2012	0.2657	0.2675	1%	0.0803	0.0812	1%	0.0127	0.0127	0.30%
2013	0.2869	0.2890	1%	0.0927	0.0937	1%	0.0129	0.0128	-0.67%
2014	0.2578	0.2598	1%	0.0938	0.0947	1%	0.0107	0.0108	0.31%
2015	0.2722	0.2732	0.37%	0.1015	0.1020	0.48%	0.0110	0.0111	0.19%
2016	0.2503	0.2624	5%	0.0946	0.1005	6%	0.0102	0.0104	3%
2017	0.2645	0.2820	7%	0.1001	0.1085	8%	0.0108	0.0111	3%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0235	0.0235	0.14%	0.1376	0.1420	3%	0.1117	0.1128	1%
1991	0.0205	0.0205	0.12%	0.1130	0.1164	3%	0.0948	0.0957	1%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1992	0.0178	0.0178	0.11%	0.0917	0.0943	3%	0.0799	0.0806	1%
1993	0.0155	0.0155	0.09%	0.0735	0.0755	3%	0.0667	0.0673	1%
1994	0.0132	0.0132	0.07%	0.0585	0.0600	2%	0.0554	0.0558	1%
1995	0.0113	0.0113	0.06%	0.0461	0.0471	2%	0.0456	0.0458	1%
1996	0.0097	0.0097	0.05%	0.0360	0.0367	2%	0.0371	0.0373	1%
1997	0.0164	0.0165	0.02%	0.0548	0.0553	1%	0.0688	0.0690	0.19%
1998	0.0106	0.0106	0.02%	0.0338	0.0341	1%	0.0406	0.0407	0.25%
1999	0.0082	0.0082	0.03%	0.0253	0.0256	1%	0.0292	0.0293	0.32%
2000	0.0055	0.0055	0.04%	0.0161	0.0164	2%	0.0169	0.0170	0.48%
2001	0.0051	0.0051	0.08%	0.0187	0.0193	3%	0.0155	0.0157	1%
2002	0.0070	0.0070	0.03%	0.0240	0.0245	2%	0.0245	0.0246	0.50%
2003	0.0025	0.0025	0.17%	0.0137	0.0144	5%	0.0046	0.0048	4%
2004	0.0046	0.0046	0.11%	0.0220	0.0227	4%	0.0150	0.0152	1%
2005	0.0050	0.0050	0.16%	0.0231	0.0242	5%	0.0107	0.0110	3%
2006	0.0058	0.0058	0.15%	0.0254	0.0265	5%	0.0131	0.0134	2%
2007	0.0076	0.0076	0.15%	0.0347	0.0361	4%	0.0236	0.0240	2%
2008	0.0071	0.0071	1.00%	0.0379	0.0464	22%	0.0228	0.0250	10%
2009	0.0085	0.0085	0.56%	0.0631	0.0688	9%	0.0309	0.0324	5%
2010	0.0086	0.0087	0.31%	0.1073	0.1105	3%	0.0408	0.0416	2%
2011	0.0078	0.0079	0.31%	0.1250	0.1279	2%	0.0434	0.0441	2%
2012	0.0075	0.0075	0.17%	0.1520	0.1535	1%	0.0489	0.0493	1%
2013	0.0075	0.0075	-0.67%	0.1733	0.1751	1%	0.0542	0.0546	1%
2014	0.0062	0.0062	0.17%	0.1724	0.1740	1%	0.0509	0.0513	1%
2015	0.0064	0.0064	0.11%	0.1859	0.1867	0%	0.0543	0.0545	0.41%
2016	0.0060	0.0061	2%	0.1728	0.1831	6%	0.0503	0.0529	5%
2017	0.0063	0.0064	2%	0.1830	0.1979	8%	0.0530	0.0569	7%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.1299	0.1294	-0.43%	0.0103	0.0104	1%	2.5886	2.6879	4%
1991	0.1098	0.1093	-0.44%	0.0088	0.0089	1%	2.1076	2.1854	4%
1992	0.0919	0.0915	-0.45%	0.0074	0.0075	1%	1.6943	1.7540	4%
1993	0.0761	0.0757	-0.46%	0.0063	0.0063	1%	1.3443	1.3890	3%
1994	0.0659	0.0656	-1%	0.0052	0.0053	1%	1.0536	1.0862	3%
1995	0.0561	0.0557	-1%	0.0043	0.0044	1%	0.8170	0.8403	3%
1996	0.0443	0.0440	-1%	0.0036	0.0036	0.43%	0.6298	0.6462	3%
1997	0.0630	0.0628	-0.30%	0.0065	0.0065	0.17%	0.9130	0.9248	1%
1998	0.0397	0.0395	-0.37%	0.0039	0.0039	0.21%	0.5682	0.5773	2%
1999	0.0297	0.0295	-0.40%	0.0029	0.0029	0.26%	0.4310	0.4391	2%
2000	0.0185	0.0184	-0.46%	0.0017	0.0018	0.38%	0.2824	0.2895	3%
2001	0.0211	0.0209	-1%	0.0016	0.0016	1%	0.3468	0.3597	4%
2002	0.0359	0.0357	-1%	0.0024	0.0024	0.40%	0.4138	0.4246	3%
2003	0.0228	0.0225	-1%	0.0006	0.0006	3%	0.2725	0.2888	6%
2004	0.0319	0.0316	-1%	0.0015	0.0015	1%	0.4109	0.4290	4%
2005	0.0241	0.0239	-1%	0.0013	0.0013	2%	0.4656	0.4910	5%
2006	0.0237	0.0236	-1%	0.0015	0.0016	2%	0.5093	0.5358	5%
2007	0.0196	0.0197	0.22%	0.0025	0.0025	1%	0.6884	0.7194	5%
2008	0.0192	0.0199	4%	0.0023	0.0025	8%	0.7774	0.9669	24%
2009	0.0224	0.0229	2%	0.0036	0.0037	3%	1.2586	1.3868	10%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2010	0.0250	0.0253	1%	0.0045	0.0046	2%	2.2515	2.3230	3%
2011	0.0244	0.0246	1%	0.0047	0.0047	1%	2.6581	2.7230	2%
2012	0.0247	0.0249	1%	0.0052	0.0052	1%	3.2720	3.3064	1%
2013	0.0258	0.0259	0.37%	0.0059	0.0057	-4%	3.7585	3.7957	1%
2014	0.0227	0.0229	1%	0.0056	0.0057	0.41%	3.7731	3.8092	1%
2015	0.0238	0.0239	0.31%	0.0060	0.0060	0.31%	4.0752	4.0943	0%
2016	0.0218	0.0227	4%	0.0056	0.0058	5%	3.7951	4.0254	6%
2017	0.0225	0.0238	6%	0.0059	0.0063	6%	4.0157	4.3479	8%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	1.4851	1.5045	1%	1.0762	1.0830	1%
1991	1.2579	1.2731	1%	0.9262	0.9315	1%
1992	1.0572	1.0688	1%	0.7929	0.7970	1%
1993	0.8816	0.8903	1%	0.6776	0.6806	0.45%
1994	0.7286	0.7349	1%	0.5718	0.5741	0.39%
1995	0.5975	0.6020	1%	0.4816	0.4832	0.33%
1996	0.4865	0.4897	1%	0.4036	0.4047	0.28%
1997	0.8880	0.8903	0.26%	0.7075	0.7083	0.11%
1998	0.5289	0.5307	0.33%	0.4409	0.4415	0.14%
1999	0.3837	0.3853	0.41%	0.3317	0.3323	0.17%
2000	0.2267	0.2281	1%	0.2123	0.2128	0.23%
2001	0.2124	0.2150	1%	0.1985	0.1993	0.44%
2002	0.3214	0.3235	1%	0.2817	0.2824	0.26%
2003	0.0719	0.0750	4%	0.0861	0.0872	1%
2004	0.2036	0.2071	2%	0.1807	0.1819	1%
2005	0.1622	0.1671	3%	0.1758	0.1775	1%
2006	0.1968	0.2020	3%	0.2089	0.2107	1%
2007	0.3369	0.3430	2%	0.3003	0.3024	1%
2008	0.3326	0.3696	11%	0.2911	0.3041	4%
2009	0.4412	0.4663	6%	0.3196	0.3283	3%
2010	0.6129	0.6269	2%	0.3745	0.3794	1%
2011	0.6654	0.6780	2%	0.3738	0.3783	1%
2012	0.7661	0.7728	1%	0.4028	0.4052	1%
2013	0.8575	0.8648	1%	0.4587	0.4434	-3%
2014	0.8211	0.8282	1%	0.4336	0.4352	0%
2015	0.8785	0.8822	0.43%	0.4588	0.4601	0.28%
2016	0.8170	0.8619	6%	0.4340	0.4525	4%
2017	0.8614	0.9263	8%	0.4558	0.4798	5%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0181	0.0190	5%	0.7102	0.7102	0.00%
1991	0.0144	0.0151	5%	0.6129	0.6129	0.00%
1992	0.0112	0.0118	5%	0.5251	0.5251	0.00%
1993	0.0086	0.0090	5%	0.4465	0.4465	0.00%
1994	0.0065	0.0068	5%	0.3764	0.3764	0.00%
1995	0.0048	0.0050	5%	0.3144	0.3144	0.00%
1996	0.0035	0.0037	5%	0.2600	0.2600	0.00%
1997	0.0037	0.0038	3%	0.5151	0.5151	0.00%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1998	0.0025	0.0026	4%	0.3004	0.3004	0.00%
1999	0.0020	0.0021	4%	0.2134	0.2134	0.00%
2000	0.0015	0.0016	4%	0.1196	0.1196	0.00%
2001	0.0024	0.0025	5%	0.0993	0.0993	0.00%
2002	0.0023	0.0024	5%	0.1702	0.1702	0.00%
2003	0.0026	0.0027	6%	0.0070	0.0070	0.01%
2004	0.0031	0.0033	6%	0.0843	0.0843	0.00%
2005	0.0041	0.0044	6%	0.0413	0.0413	0.00%
2006	0.0044	0.0046	6%	0.0594	0.0594	0.00%
2007	0.0053	0.0056	6%	0.1377	0.1377	0.00%
2008	0.0064	0.0082	29%	0.1144	0.1144	0.00%
2009	0.0108	0.0120	12%	0.1846	0.1846	0.00%
2010	0.0206	0.0213	3%	0.1730	0.1730	0.00%
2011	0.0248	0.0254	3%	0.1516	0.1516	0.00%
2012	0.0309	0.0312	1%	0.1349	0.1349	0.00%
2013	0.0356	0.0360	1%	0.1272	0.1272	0.00%
2014	0.0361	0.0364	1%	0.0853	0.0853	0.00%
2015	0.0390	0.0392	0.48%	0.0831	0.0831	0.00%
2016	0.0364	0.0386	6%	0.0713	0.0713	0.00%
2017	0.0385	0.0418	8%	0.0768	0.0768	0.01%

3.7.3 Commercial/institutional: Mobile (NFR 1A4aii)

3.7.3.1 Overview

According to ***Recommendations No SK-1A4cii-2018-0001*** and ***SK-1A4cii-2021-0002*** Slovakia after receiving the most necessary data, was able to disaggregate all non-road mobile combustion categories (**1A2gvii**, **1A4aii**, **1A4bii** and **1A4cii**). Results of the separation are shown in ***Table 3.110***.

Table 3.110: *Overview of emissions in the category 1A4aii*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1142	0.0118	0.0001	0.0000	0.0074	0.0074	0.0074	0.0046	0.0377
1995	0.1244	0.0129	0.0001	0.0000	0.0080	0.0080	0.0080	0.0050	0.0411
2000	0.1346	0.0139	0.0001	0.0000	0.0087	0.0087	0.0087	0.0054	0.0444
2005	0.1448	0.0150	0.0001	0.0000	0.0093	0.0093	0.0093	0.0058	0.0478
2010	0.1550	0.0160	0.0001	0.0000	0.0100	0.0100	0.0100	0.0062	0.0512
2011	0.1570	0.0163	0.0001	0.0000	0.0101	0.0101	0.0101	0.0063	0.0518
2012	0.1591	0.0165	0.0001	0.0000	0.0103	0.0103	0.0103	0.0064	0.0525
2013	NO	NO	NO	NO	NO	NO	NO	NO	NO
2014	0.1631	0.0169	0.0001	0.0000	0.0105	0.0105	0.0105	0.0065	0.0539
2015	0.1958	0.0203	0.0001	0.0000	0.0126	0.0126	0.0126	0.0078	0.0646
2016	0.1305	0.0135	0.0001	0.0000	0.0084	0.0084	0.0084	0.0052	0.0431
2017	0.0979	0.0101	0.0001	0.0000	0.0063	0.0063	0.0063	0.0039	0.0323
2018	0.0653	0.0068	0.0000	0.0000	0.0042	0.0042	0.0042	0.0026	0.0215
2019	0.1631	0.0169	0.0001	0.0000	0.0105	0.0105	0.0105	0.0065	0.0539
2020	0.0979	0.0101	0.0001	0.0000	0.0063	0.0063	0.0063	0.0039	0.0323
2021	0.0979	0.0101	0.0001	0.0000	0.0063	0.0063	0.0063	0.0039	0.0323
2022	0.1305	0.0135	0.0001	0.0000	0.0084	0.0084	0.0084	0.0052	0.0431
1990/2022	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**
2021/2022	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	B(a)P [t]	B(b)F [t]	PAHs [t]
1990	0.0000	0.0002	0.0060	0.0002	0.0000	0.0035	0.0001	0.0002	0.0003
1995	0.0000	0.0002	0.0065	0.0003	0.0000	0.0038	0.0001	0.0002	0.0003
2000	0.0000	0.0002	0.0070	0.0003	0.0000	0.0041	0.0001	0.0002	0.0003
2005	0.0000	0.0002	0.0075	0.0003	0.0000	0.0044	0.0001	0.0002	0.0004
2010	0.0000	0.0002	0.0081	0.0003	0.0000	0.0048	0.0001	0.0002	0.0004
2011	0.0000	0.0002	0.0082	0.0003	0.0000	0.0048	0.0001	0.0002	0.0004
2012	0.0000	0.0002	0.0083	0.0003	0.0000	0.0049	0.0001	0.0002	0.0004
2013	NO	NO	NO	NO	NO	NO	NO	NO	NO
2014	0.0001	0.0003	0.0085	0.0004	0.0001	0.0050	0.0002	0.0003	0.0004
2015	0.0001	0.0003	0.0102	0.0004	0.0001	0.0060	0.0002	0.0003	0.0005
2016	0.0000	0.0002	0.0068	0.0003	0.0000	0.0040	0.0001	0.0002	0.0003
2017	0.0000	0.0002	0.0051	0.0002	0.0000	0.0030	0.0001	0.0002	0.0002
2018	0.0000	0.0001	0.0034	0.0001	0.0000	0.0020	0.0001	0.0001	0.0002
2019	0.0001	0.0003	0.0085	0.0004	0.0001	0.0050	0.0002	0.0003	0.0004
2020	0.0000	0.0002	0.0051	0.0002	0.0000	0.0030	0.0001	0.0002	0.0002
2021	0.0000	0.0002	0.0051	0.0002	0.0000	0.0030	0.0001	0.0002	0.0002
2022	0.0000	0.0002	0.0068	0.0003	0.0000	0.0040	0.0001	0.0002	0.0000
1990/2022	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**
2021/2022	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.111*** below.

Table 3.111: *Overview of activity data in the category 1A4aii*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	148.79	NA	NA	NO	NA
1995	160.41	NA	NA	NO	NA
2000	175.68	NA	NA	NO	NA
2005	187.30	NA	NA	NO	NA
2010	181.12	NA	NA	8.94	NA
2011	180.85	NA	NA	10.33	NA
2012	184.20	NA	NA	9.97	NA
2013	NO	NA	NA	NO	NA
2014	195.30	NA	NA	13.64	NA
2015	234.58	NA	NA	17.03	NA
2016	156.59	NA	NA	11.20	NA
2017	117.14	NA	NA	8.71	NA
2018	78.53	NA	NA	5.37	NA
2019	196.34	NA	NA	13.46	NA
2020	116.95	NA	NA	8.80	NA
2021	116.98	NA	NA	8.75	NA
2022	156.72	NA	NA	11.71	NA
1990/2022	**5%**	-	-	-	-
2021/2022	**34%**	-	-	**34%**	-

3.7.3.2 Methodological issues

Slovakia was able to receive statistical data about fuel combustion from the year 2012. Years 1990-2011 were estimated using expert judgment and linear regression model back to the base year. This model caused the trend to be clearly linear up to 2012. After this year we can observe deviations in fuel consumption, as well as in estimated emissions. For the emission estimation, EMEP/EEA GB_{2019} Tier 1 emission factors were used.

3.7.3.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB$_{2019}$.

3.7.3.4 Source-specific recalculations

In the IIR 2024, there were no source-specific recalculations made.

3.7.4 Residential: Stationary (NFR 1A4bi)

3.7.4.1 Overview

Households are generally the key sector in the emission inventory. Therefore, continuous improvement of methodology has been undergone. Households' heating is a very significant contributor to particulate matter (approximately 80% as well as other emissions in Slovakia). The trend in emission, as well as fuel consumption, are relatively stable with a slight downward trend. A small decrease in emissions and fuel consumption in the year 2022 was driven by warmer winter conditions.

This category is key for most of the pollutants (NOx, SOx, NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Hg, As, Cr, Ni, Zn, PCDD/F, PAHs, HCB, PCBs). The emission trend of all pollutants shows a very similar trend which correlates with the trend of biomass burning (wood) in Slovak households.

The overview of the emissions is shown in ***Table 3.112***.

Table 3.112: *Overview of emissions in the category 1A4bi*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	5.1971	136.8648	28.8620	0.3259	78.1729	79.3979	87.1231	5.6817	690.2921
1995	3.6223	63.0227	11.1223	0.7147	34.1807	34.7633	37.9143	2.6490	315.4333
2000	3.8857	47.1180	6.7151	0.9072	24.5206	24.9708	27.0765	2.0141	229.6318
2005	4.1456	48.6813	2.3431	2.0635	21.9844	22.4908	23.8950	2.1639	226.4921
2010	4.0201	46.3647	1.7528	2.0910	20.5575	21.0422	22.2990	2.0660	215.1242
2011	3.6592	43.4006	1.6277	1.9526	19.1940	19.6460	20.8239	1.9278	201.6142
2012	3.7587	47.0031	1.7415	2.1223	20.7021	21.1903	22.4569	2.0831	218.5896
2013	3.6595	43.4082	1.6150	1.9455	19.0797	19.5281	20.7025	1.9162	201.7557
2014	2.7308	25.7014	1.2083	1.0727	11.5296	11.7919	12.5410	1.1293	119.2216
2015	3.2322	35.7571	1.4128	1.6024	15.7567	16.1245	17.1055	1.5760	167.6001
2016	3.4269	38.3712	1.4311	1.7698	16.2011	16.5863	17.5628	1.6418	181.8626
2017	3.5681	36.5970	1.5957	1.6390	16.2622	16.6369	17.6671	1.6158	174.2116
2018	3.0805	28.2144	1.2823	1.2674	12.5687	12.8570	13.6574	1.2464	135.6463
2019	3.1823	29.4394	1.2590	1.3652	13.0769	13.3792	14.1997	1.3057	142.5483
2020	3.2329	29.3184	1.1654	1.3874	12.9347	13.2360	14.0370	1.3000	142.6604
2021	3.8047	35.5260	1.2739	1.7426	15.3317	15.6940	16.6202	1.5596	174.3040
2022	3.2976	31.7184	1.2175	1.5368	13.8414	14.1678	15.0076	1.3996	156.8917
1990/2022	-37%	-77%	-96%	372%	-82%	-82%	-83%	-75%	-77%
2021/2022	-13%	-11%	-4%	-12%	-10%	-10%	-10%	-10%	-10%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	1.0447	0.0684	0.3578	0.6257	2.3932	0.4375	0.3237	0.1510	3.9820
1995	0.4997	0.1126	0.1634	0.2516	1.1664	0.2287	0.1553	0.0661	3.0831
2000	0.4016	0.1376	0.1279	0.1589	0.8867	0.1895	0.1195	0.0521	3.1385
2005	0.4777	0.3042	0.0889	0.0746	1.0087	0.2517	0.1349	0.0528	5.7984
2010	0.4771	0.3089	0.0806	0.0618	0.9751	0.2512	0.1308	0.0514	5.9301
2011	0.4516	0.2888	0.0740	0.0582	0.9147	0.2367	0.1229	0.0487	5.5733
2012	0.4928	0.3141	0.0761	0.0623	0.9948	0.2584	0.1338	0.0529	6.0724
2013	0.4592	0.2883	0.0743	0.0590	0.9184	0.2393	0.1239	0.0497	5.5948
2014	0.2735	0.1598	0.0573	0.0418	0.5340	0.1388	0.0728	0.0311	3.1564

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2015	0.3921	0.2387	0.0658	0.0520	0.7688	0.2025	0.1042	0.0426	4.6930
2016	0.4246	0.2577	0.0677	0.0509	0.8217	0.2207	0.1133	0.0454	4.9006
2017	0.4202	0.2445	0.0738	0.0588	0.8073	0.2138	0.1101	0.0463	4.8788
2018	0.3308	0.1892	0.0633	0.0485	0.6329	0.1678	0.0863	0.0365	3.8021
2019	0.3514	0.2036	0.0643	0.0490	0.6713	0.1790	0.0915	0.0384	4.0819
2020	0.3519	0.2066	0.0646	0.0481	0.6764	0.1802	0.0920	0.0382	4.1231
2021	0.4464	0.2636	0.0723	0.0552	0.8381	0.2284	0.1137	0.0454	5.3767
2022	0.3817	0.2290	0.0646	0.0523	0.7527	0.1974	0.1006	0.0387	4.6424
1990/2022	**-63%**	**235%**	**-82%**	**-92%**	**-69%**	**-55%**	**-69%**	**-74%**	**17%**
2021/2022	**-14%**	**-13%**	**-11%**	**-5%**	**-10%**	**-14%**	**-11%**	**-15%**	**-14%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	7.2341	13.0128	9.1373	5.4515	6.8838	34.4854	13.2872	0.6582
1995	5.0417	6.3108	4.3872	2.6327	3.3305	16.6612	4.0829	0.2632
2000	5.0213	5.0609	3.5942	2.0664	2.6671	13.3886	3.5156	0.1773
2005	8.6865	6.0544	4.3476	2.4055	3.1740	15.9816	2.0659	0.1128
2010	8.6880	5.8444	4.2371	2.3137	3.0733	15.4685	2.1280	0.1021
2011	8.1192	5.4624	3.9876	2.1627	2.8820	14.4947	2.1496	0.0974
2012	8.7881	5.9109	4.3273	2.3412	3.1246	15.7040	2.3392	0.1054
2013	8.0849	5.4525	4.0294	2.1586	2.8945	14.5350	2.4368	0.1003
2014	4.6611	3.1974	2.4089	1.2644	1.7097	8.5804	2.0066	0.0673
2015	6.7568	4.4951	3.3625	1.7840	2.4111	12.0528	2.2878	0.0878
2016	7.2421	4.7664	3.5649	1.9127	2.5670	12.8110	2.0317	0.1022
2017	7.1096	4.6140	3.5429	1.8405	2.5329	12.5303	2.8782	0.0999
2018	5.5628	3.5564	2.7600	1.4244	1.9749	9.7157	2.3085	0.0801
2019	5.9315	3.7381	2.9002	1.4989	2.0844	10.2216	2.3495	0.0827
2020	5.9742	3.7299	2.9020	1.4994	2.0920	10.2233	2.2373	0.0815
2021	7.2059	4.4747	3.4422	1.8058	2.4974	12.2201	2.1866	0.0904
2022	6.4060	3.9525	3.0492	1.6066	2.2304	10.8388	1.4999	0.0755
1990/2022	**-11%**	**-70%**	**-67%**	**-71%**	**-68%**	**-69%**	**-89%**	**-89%**
2021/2022	**-11%**	**-12%**	**-11%**	**-11%**	**-11%**	**-11%**	**-31%**	**-16%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.113*** below. This table represents fuels allocated to the fuel type for calculations. Fuels in the template are allocated following principles from IPCC 2006 Guidelines.

Table 3.113: *Overview of activity data in the category 1A4bi*

YEAR	HC [TJ NCV]	COKE [TJ NCV]	BC [Tj NCV]	CB [TJ NCV]	NG [TJ NCV]	LF [TJ NCV]	FW [TJ NCV]	P&WB [TJ NCV]
1990	2 391.54	3 919.58	42 706.76	NO	28 588.64	1 472.00	4 786.82	NO
1995	776.15	1 124.53	16 578.16	NO	42 360.63	1 058.00	10 554.05	NO
2000	520.51	1 135.69	9 566.68	28.78	60 243.02	552.00	13 401.63	23.44
2005	652.91	305.54	2 660.03	51.78	59 225.83	322.00	30 702.27	96.75
2010	706.47	293.34	1 588.60	185.17	55 629.42	552.00	31 445.73	357.29
2011	802.14	216.50	1 390.84	288.50	49 133.79	276.00	29 376.04	523.34
2012	887.42	222.68	1 418.31	392.86	47 192.12	460.00	31 872.81	778.25
2013	942.90	230.19	1 177.86	506.85	48 200.08	368.00	29 172.59	925.55
2014	828.07	170.77	913.26	414.61	43 395.60	184.00	16 258.07	419.52
2015	982.83	147.10	955.40	570.61	43 903.00	184.00	24 259.42	869.96
2016	1 025.72	204.57	804.37	641.48	44 697.43	368.00	26 845.53	1 087.12
2017	1 252.68	217.24	863.90	936.44	49 339.18	368.00	24 834.57	1 170.13

YEAR	HC [TJ NCV]	COKE [TJ NCV]	BC [Tj NCV]	CB [TJ NCV]	NG [TJ NCV]	LF [TJ NCV]	FW [TJ NCV]	P&WB [TJ NCV]
2018	1 056.04	131.98	652.26	862.55	45 735.20	322.00	19 203.87	1 033.62
2019	1 100.86	106.96	556.82	899.92	45 951.45	276.00	20 714.47	1 255.64
2020	1 084.83	63.95	412.97	958.40	47 205.23	276.00	20 938.30	1 269.21
2021	1 047.39	54.61	442.30	1 082.14	51 702.44	368.00	27 164.66	1 646.62
2022	644.55	56.67	702.01	1 018.33	45 498.76	322.00	23 415.51	1 419.37
1990/2022	**-73%**	**-99%**	**-98%**	**-**	**59%**	**-78%**	**389%**	**-**
2021/2022	**-38%**	**4%**	**59%**	**-6%**	**-12%**	**-13%**	**-14%**	**-14%**

HC – Hard coal
BC – Brown coal
CB – Coal briquettes
LF – Liquid fuels
FW – Firewood
P&WB – Pellets and wooden briquettes

3.7.4.2 Methodological issues

Category **1A4bi** balanced mostly gaseous (natural gas), solid (coal) and biomass (wood) fuels. Whereas the gaseous fuels consumption is consistent and accurate due to statistics made directly by the natural gas suppliers, solid fuels and biomass statistics is not fully covered by the ŠÚ SR. Direct statistics is missing or very complicated to obtain. Due to these reasons, several inconsistencies between fuels consumption reported in this category were recorded and commented on in the previous inventory. Major differences occurred between the data reported in the national energy balance provided by the ŠÚ SR and data reported by the companies selling solid fuels and biomass to households (data reported in the NEIS database). The Slovak NIS experts, therefore, planned to focus on better input data collection and removing these inconstancies and harmonise national statistics in this field.

In 2018, the Project Grant "Quality Improvement of Air Emission Accounts and Extension of Provided Time series" launched by the European Commission – EUROSTAT was successfully finished. Results were published online in several partial reports http://www.shmu.sk/sk/?page=2339 and on the international conference "Air Protection in Slovakia" held in the High Tatras on 11-13 November 2020. The Project Grant was carried out in cooperation with the Statistical Office of the Slovak Republic.

Cooperation with the Statistical Office of the Slovak Republic continued and resulted in the second statistical survey in households. This activity, together with the help and interest of other relevant national authorities, confirmed and improved the previous estimation of biomass consumption in households.

Statistical data and time series were corrected based on improved methodology and inputs were also provided to the ŠÚ SR for energy balance. According to the information provided by the ŠÚ SR, the revision of households energy statistics to the EUROSTAT was done for the year 2019. The revision will be focused on solid fuels and biomass (non-fossil fuels) and will be performed since the year 2012. With this revision, consistency in the reporting data in households will be improved.

Time series on fuel consumption (solid and biomass) from households reconstructed in the frame of the EUROSTAT project and published on the SHMÚ website[15] were further corrected and improved for the inventory balance considering the effect of regional-climatological data. The principle of the new methodological approach was supported by a second statistical survey and further estimation of "total energy demand for heating" in households calculated using data from questionnaires and climatological data in different regions. In principle, the average value of "energy demand" is a parameter on heating demand (including preparation of hot water) for 1 m^2 of housing area for 1 year. Total housing area, energy effectivity of houses and climatological factors in regional scaling were taken into consideration for the calculation of total energy demand for heating in houses without a central heating system.

We expect a further improvement of the methodology thanks to the ongoing Life project focused on clean air in the most critical and most polluted areas of Slovakia, but also throughout Slovakia with a focus on households and transport. As part of this project, another statistical survey was already realized in households.

[15] Detail information is provided in the Final Report "SK_AEA_Methodology_HH".

Boiler structure

Data on the household's equipment structure are one of the most important outputs of the statistical surveys. The results of the surveys included data such as age, type, power, fuel consumption for each device. The last survey was carried out as part of the project LIFE IP – Improvement of air quality supported by the European Union, The OEaB experts in cooperation with the Statistical Office of the Slovak Republic have prepared a report that describes the structured distribution of small sources of pollution. Based on data from the third survey, we obtained the improved structure of combustion equipment in Households. ***Table 3.114*** shows the boiler structure for 2022.

Table 3.114: *Households share by type of fuels and type of equipment for the year 2022*

2021	TYPE OF EQUIPMENT	BC	HC & COKE	CB	PELETS & WOOD BRIQUETTES	FIREWOOD	OTHER
1	Over-fire boilers	55.9%	68.4%	91.4%	85.4%	32.7%	45.1%
2	Under-fire boilers	25.4%	15.0%	8.3%	5.5%	9.1%	12.7%
3	Gasification boilers	2.3%	4.0%	0.4%	3.2%	12.4%	7.6%
4	Automatic boilers	6.8%	7.2%	0.0%	1.9%	32.3%	2.6%
5	Fireplaces, stoves, masonry stoves	9.5%	5.4%	0.0%	3.9%	9.9%	28.7%
6	Modern masonry stoves and pellets stoves	0.1%	0.0%	0.0%	0.1%	3.4%	3.3%
Sum		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

BC-Brown coal, **HC**-Hard coal, **CB**-Coal Briquettes

Based on data on the installation year, we reconstructed the structure of the equipment until 1990. We estimated the trend of the structure of the equipment from the present to 1990. Each year we gradually counted new equipment in the categories gasification boilers and automatic boilers subsequently redistributed into the category of over-fire and under-fire boilers in a ratio of 1: 1. And from the category of modern masonry stoves and pellets stoves, we moved the share to the category of fireplaces, stoves, masonry stoves. By this procedure, we obtained tables of the updated structure of combustion equipment from the second survey for all years since 1990. ***Table 3.115*** shows the share of plants in 2005 and ***Table 3.116*** in 1990.

Table 3.115: *Households share by type of fuels and type of equipment for the year 2005*

2005	TYPE OF EQUIPMENT	BC	HC & COKE	CB	PELETS & WOOD BRIQUETTES	FIREWOOD	OTHER
1	Over-fire boilers	58.3%	71.8%	80.3%	54.2%	50.5%	50.7%
2	Under-fire boilers	32.2%	18.6%	11.6%	29.5%	15.8%	33.7%
3	Gasification boilers	1.0%	0.2%	0.4%	1.1%	1.3%	0.0%
4	Automatic boilers	2.5%	0.0%	0.0%	1.7%	0.8%	2.4%
5	Fireplaces, stoves, masonry stoves	5.9%	9.3%	7.7%	13.0%	31.3%	9.5%
6	Modern masonry stoves and pellets stoves	0.0%	0.0%	0.0%	0.5%	0.3%	3.8%
Sum		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

BC-Brown coal, **HC**-Hard coal, **CB**-Coal Briquettes

Table 3.116: *Households share by type of fuels and type of equipment for the year 1990*

1990	TYPE OF EQUIPMENT	BC	HC & COKE	CB	PELETS & WOOD BRIQUETTES	FIREWOOD	OTHER
1	Over-fire boilers	59.1%	71.9%	-	-	51.4%	50.7%
2	Under-fire boilers	33.0%	18.7%	-	-	16.7%	33.7%
3	Gasification boilers	0.0%	0.0%	-	-	0.1%	0.0%
4	Automatic boilers	1.9%	0.0%	-	-	0.2%	2.4%
5	Fireplaces, stoves, masonry stoves	5.9%	9.3%	-	-	31.7%	13.3%
6	Modern masonry stoves and pellets stoves	0.0%	0.0%	-	-	0.0%	0.0%
Sum		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

BC-Brown coal, **HC**-Hard coal, **CB**-Coal Briquettes

Emission factors

The country specific emission factors for the combustion of solid fuels (hard and brown coal, briquettes, coal and wood), natural gas and fuel oil were obtained from results of VEC VŠB[16] measurement at low and nominal heat ratings. These data were provided in cooperation with the air quality modellers´ team (Air Quality Department, SHMÚ) throughout their active participation in the project *LIFE Integrated Project: Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere*.[5] The values were set for over-fire boilers, under-fire boilers, gasification boilers and automatic boilers.

Emission factors of air pollutants for two additional categories for fireplaces, stoves, masonry/built-in tile stoves (Tables 3-39) modern masonry/built-in tile stoves and pellets stoves (Table 3-44) were obtained from the EMEP/EEA GB_{2019} (Tier 2). The GHGs emission factors for relevant fuel types were taken from IPCC Guidelines, Tier 1 methodology. For category Modern masonry/built-in tile stoves and pellets stoves, emission factors only for combustion of wood, wooden pellets and briquettes were available.

Description of all EF is available in the **Final report on the implementation of the action**.

3.7.4.3 Completeness

Emissions are well covered.

3.7.4.4 Source-specific recalculations

The recalculations in sector 1A4b were made based on data from new 2021 Census. The changes concerned the number of apartments connected to district heating system. This resulted in changes of fuel consumption for this sector. Based on the available data, we previously assumed a declining trend in the share of households connected to district heating. However, the data from the Census 2021 confirmed a stable to slightly increasing trend. This affected the calculation of biomass consumption in households, leading to a reduction in the fuel (biomass) consumption for heating in residences. The results of the recalculations are in ***Table 3.117***.

***Table 3.117**: Previous and revised emissions in the category 1A4bi*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	3.7751	3.7587	0%	47.3901	47.0031	-1%	1.7450	1.7415	-0.20%
2013	3.6917	3.6595	-1%	44.1582	43.4082	-2%	1.6218	1.6150	-0.42%
2014	2.7537	2.7308	-1%	26.2323	25.7014	-2%	1.2132	1.2083	-0.40%
2015	3.2537	3.2322	-1%	36.2392	35.7571	-1%	1.4173	1.4128	-0.32%
2016	3.4790	3.4269	-1%	39.5439	38.3712	-3%	1.4421	1.4311	-1%
2017	3.6702	3.5681	-3%	38.7664	36.5970	-6%	1.6167	1.5957	-1%
2018	3.1746	3.0805	-3%	30.1586	28.2144	-6%	1.3016	1.2823	-1%
2019	3.3002	3.1823	-4%	31.8227	29.4394	-7%	1.2831	1.2590	-2%
2020	3.3476	3.2329	-3%	31.6204	29.3184	-7%	1.1888	1.1654	-2%
2021	3.7626	3.8047	1%	34.7288	35.5260	2%	1.2655	1.2739	1%

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	2.1430	2.1223	-1%	20.8628	20.7021	-1%	21.3551	21.1903	-1%
2013	1.9855	1.9455	-2%	19.3900	19.0797	-2%	19.8464	19.5281	-2%
2014	1.1010	1.0727	-3%	11.7489	11.5296	-2%	12.0168	11.7919	-2%
2015	1.6285	1.6024	-2%	15.9562	15.7567	-1%	16.3291	16.1245	-1%
2016	1.8327	1.7698	-3%	16.6725	16.2011	-3%	17.0698	16.5863	-3%
2017	1.7598	1.6390	-7%	17.1646	16.2622	-5%	17.5625	16.6369	-5%
2018	1.3773	1.2674	-8%	13.3804	12.5687	-6%	13.6895	12.8570	-6%
2019	1.5017	1.3652	-9%	14.0751	13.0769	-7%	14.4030	13.3792	-7%

[16] https://powietrze.malopolska.pl/en/life-project/

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2020	1.5200	1.3874	-9%	13.8994	12.9347	-7%	14.2255	13.2360	-7%
2021	1.6966	1.7426	3%	15.0022	15.3317	2%	15.3561	15.6940	2%

YEAR	TSP [kt]			BC [kt]			CO [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	22.6300	22.4569	-1%	2.1004	2.0831	-1%	220.3918	218.5896	-1%
2013	21.0368	20.7025	-2%	1.9497	1.9162	-2%	205.2521	201.7557	-2%
2014	12.7773	12.5410	-2%	1.1529	1.1293	-2%	121.6985	119.2216	-2%
2015	17.3203	17.1055	-1%	1.5975	1.5760	-1%	169.8696	167.6001	-1%
2016	18.0706	17.5628	-3%	1.6926	1.6418	-3%	187.4071	181.8626	-3%
2017	18.6391	17.6671	-5%	1.7131	1.6158	-6%	184.6048	174.2116	-6%
2018	14.5317	13.6574	-6%	1.3339	1.2464	-7%	145.0451	135.6463	-6%
2019	15.2749	14.1997	-7%	1.4133	1.3057	-8%	154.1601	142.5483	-8%
2020	15.0762	14.0370	-7%	1.4040	1.3000	-7%	153.9179	142.6604	-7%
2021	16.2653	16.6202	2%	1.5240	1.5596	2%	170.3840	174.3040	2%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	0.4969	0.4928	-1%	0.3172	0.3141	-1%	0.0763	0.0761	0%
2013	0.4673	0.4592	-2%	0.2942	0.2883	-2%	0.0748	0.0743	-1%
2014	0.2793	0.2735	-2%	0.1640	0.1598	-3%	0.0576	0.0573	-1%
2015	0.3975	0.3921	-1%	0.2426	0.2387	-2%	0.0661	0.0658	0%
2016	0.4373	0.4246	-3%	0.2668	0.2577	-3%	0.0685	0.0677	-1%
2017	0.4452	0.4202	-6%	0.2624	0.2445	-7%	0.0752	0.0738	-2%
2018	0.3538	0.3308	-6%	0.2055	0.1892	-8%	0.0646	0.0633	-2%
2019	0.3800	0.3514	-8%	0.2239	0.2036	-9%	0.0659	0.0643	-2%
2020	0.3796	0.3519	-7%	0.2263	0.2066	-9%	0.0661	0.0646	-2%
2021	0.4362	0.4464	2%	0.2567	0.2636	3%	0.0718	0.0723	1%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	0.0626	0.0623	0%	1.0034	0.9948	-1%	0.2607	0.2584	-1%
2013	0.0594	0.0590	-1%	0.9351	0.9184	-2%	0.2438	0.2393	-2%
2014	0.0421	0.0418	-1%	0.5458	0.5340	-2%	0.1420	0.1388	-2%
2015	0.0523	0.0520	-1%	0.7797	0.7688	-1%	0.2054	0.2025	-1%
2016	0.0517	0.0509	-2%	0.8477	0.8217	-3%	0.2278	0.2207	-3%
2017	0.0603	0.0588	-2%	0.8577	0.8073	-6%	0.2275	0.2138	-6%
2018	0.0498	0.0485	-3%	0.6787	0.6329	-7%	0.1804	0.1678	-7%
2019	0.0507	0.0490	-3%	0.7281	0.6713	-8%	0.1946	0.1790	-8%
2020	0.0497	0.0481	-3%	0.7315	0.6764	-8%	0.1953	0.1802	-8%
2021	0.0547	0.0552	1%	0.8187	0.8381	2%	0.2229	0.2284	2%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	0.1349	0.1338	-1%	0.0533	0.0529	-1%	6.1297	6.0724	-1%
2013	0.1261	0.1239	-2%	0.0505	0.0497	-1%	5.7062	5.5948	-2%
2014	0.0744	0.0728	-2%	0.0316	0.0311	-2%	3.2360	3.1564	-2%
2015	0.1057	0.1042	-1%	0.0431	0.0426	-1%	4.7668	4.6930	-2%
2016	0.1168	0.1133	-3%	0.0466	0.0454	-3%	5.0692	4.9006	-3%
2017	0.1167	0.1101	-6%	0.0486	0.0463	-5%	5.2238	4.8788	-7%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2018	0.0924	0.0863	-7%	0.0386	0.0365	-5%	4.1176	3.8021	-8%
2019	0.0991	0.0915	-8%	0.0410	0.0384	-6%	4.4740	4.0819	-9%
2020	0.0993	0.0920	-7%	0.0407	0.0382	-6%	4.5026	4.1231	-8%
2021	0.1111	0.1137	2%	0.0445	0.0454	2%	5.2387	5.3767	3%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	8.8678	8.7881	-1%	15.8353	15.7040	-1%
2013	8.2384	8.0849	-2%	14.7890	14.5350	-2%
2014	4.7695	4.6611	-2%	8.7600	8.5804	-2%
2015	6.8563	6.7568	-1%	12.2164	12.0528	-1%
2016	7.4696	7.2421	-3%	13.2036	12.8110	-3%
2017	7.5682	7.1096	-6%	13.2715	12.5303	-6%
2018	5.9795	5.5628	-7%	10.3826	9.7157	-6%
2019	6.4483	5.9315	-8%	11.0431	10.2216	-7%
2020	6.4751	5.9742	-8%	11.0189	10.2233	-7%
2021	7.0358	7.2059	2%	11.9475	12.2201	2%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2012	2.3405	2.3392	0%	0.1060	0.1054	-1%
2013	2.4393	2.4368	0%	0.1015	0.1003	-1%
2014	2.0084	2.0066	0%	0.0681	0.0673	-1%
2015	2.2895	2.2878	0%	0.0886	0.0878	-1%
2016	2.0360	2.0317	0%	0.1041	0.1022	-2%
2017	2.8869	2.8782	0%	0.1033	0.0999	-3%
2018	2.3167	2.3085	0%	0.0832	0.0801	-4%
2019	2.3599	2.3495	0%	0.0866	0.0827	-4%
2020	2.2473	2.2373	0%	0.0853	0.0815	-4%
2021	2.1826	2.1866	0%	0.0891	0.0904	1%

3.7.5 Residential: Mobile (NFR 1A4bii)

3.9.4.1 Overview

According to ***Recommendations No SK-1A4cii-2018-0001*** and ***SK-1A4cii-2021-0002*** Slovakia after receiving the most necessary data was able to disaggregate all non-road mobile combustion categories (**1A2gvii**, **1A4aii**, **1A4bii** and **1A4cii**). The results of the separation are shown in ***Table 3.118***. Data for this category is based on the results from the project "Quality Improvement of Air Emission Accounts and Extension of Provided Time Series" (2017-2018) and the subsequent second survey in 2019.

Table 3.118: *Overview of emissions in the category 1A4bii*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0561	0.0274	0.0001	0.0000	0.0033	0.0033	0.0033	0.0019	0.9325
1995	0.0731	0.0426	0.0001	0.0000	0.0041	0.0041	0.0041	0.0024	1.5080
2000	0.0902	0.0579	0.0001	0.0000	0.0050	0.0050	0.0050	0.0029	2.0835
2005	0.1072	0.0731	0.0001	0.0000	0.0059	0.0059	0.0059	0.0033	2.6589
2010	0.1242	0.0884	0.0001	0.0000	0.0068	0.0068	0.0068	0.0038	3.2344
2011	0.1276	0.0914	0.0001	0.0000	0.0069	0.0069	0.0069	0.0039	3.3495
2012	0.1310	0.0944	0.0001	0.0000	0.0071	0.0071	0.0071	0.0040	3.4646
2013	0.1344	0.0975	0.0002	0.0000	0.0073	0.0073	0.0073	0.0041	3.5797

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2014	0.1412	0.1036	0.0002	0.0000	0.0076	0.0076	0.0076	0.0043	3.8099
2015	0.1412	0.1036	0.0002	0.0000	0.0076	0.0076	0.0076	0.0043	3.8099
2016	0.1412	0.1036	0.0002	0.0000	0.0076	0.0076	0.0076	0.0043	3.8099
2017	0.1412	0.1036	0.0002	0.0000	0.0076	0.0076	0.0076	0.0043	3.8099
2018	0.1412	0.1036	0.0002	0.0000	0.0076	0.0076	0.0076	0.0043	3.8099
2019	0.1647	0.1065	0.0002	0.0001	0.0091	0.0091	0.0091	0.0052	3.8384
2020	0.1647	0.1065	0.0002	0.0001	0.0091	0.0091	0.0091	0.0052	3.8384
2021	0.1718	0.1254	0.0002	0.0001	0.0093	0.0093	0.0093	0.0052	4.6088
2022	0.1509	0.1070	0.0002	0.0000	0.0082	0.0082	0.0082	0.0046	3.9169
1990/2022	**169%**	**290%**	**223%**	**194%**	**152%**	**152%**	**152%**	**143%**	**320%**
2021/2022	**-12%**	**-15%**	**-14%**	**-13%**	**-12%**	**-12%**	**-12%**	**-11%**	**-15%**

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	B(a)P [t]	B(b)F [t]	PAHs [t]
1990	0.0000	0.0001	0.0045	0.0002	0.0000	0.0027	0.0001	0.0001	0.0002
1995	0.0000	0.0002	0.0064	0.0003	0.0000	0.0038	0.0001	0.0002	0.0003
2000	0.0000	0.0002	0.0083	0.0003	0.0000	0.0049	0.0002	0.0002	0.0004
2005	0.0001	0.0003	0.0101	0.0004	0.0001	0.0060	0.0002	0.0003	0.0005
2010	0.0001	0.0004	0.0120	0.0005	0.0001	0.0071	0.0003	0.0003	0.0006
2011	0.0001	0.0004	0.0124	0.0005	0.0001	0.0073	0.0003	0.0003	0.0006
2012	0.0001	0.0004	0.0127	0.0005	0.0001	0.0075	0.0003	0.0003	0.0006
2013	0.0001	0.0004	0.0131	0.0005	0.0001	0.0077	0.0003	0.0003	0.0006
2014	0.0001	0.0004	0.0139	0.0006	0.0001	0.0082	0.0003	0.0004	0.0007
2015	0.0001	0.0004	0.0139	0.0006	0.0001	0.0082	0.0003	0.0004	0.0007
2016	0.0001	0.0004	0.0139	0.0006	0.0001	0.0082	0.0003	0.0004	0.0007
2017	0.0001	0.0004	0.0139	0.0006	0.0001	0.0082	0.0003	0.0004	0.0007
2018	0.0001	0.0004	0.0139	0.0006	0.0001	0.0082	0.0003	0.0004	0.0007
2019	0.0001	0.0004	0.0151	0.0006	0.0001	0.0089	0.0003	0.0004	0.0007
2020	0.0001	0.0004	0.0151	0.0006	0.0001	0.0089	0.0003	0.0004	0.0007
2021	0.0001	0.0005	0.0168	0.0007	0.0001	0.0099	0.0004	0.0004	0.0008
2022	0.0001	0.0004	0.0146	0.0006	0.0001	0.0086	0.0003	0.0004	0.0007
1990/2022	**223%**	**223%**	**223%**	**223%**	**223%**	**223%**	**236%**	**213%**	**223%**
2021/2022	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-13%**	**-14%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.119*** below.

Table 3.119: *Overview of activity data in the category 1A4bii*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	113.48	NA	NA	NO	NA
1995	160.40	NA	NA	NO	NA
2000	208.67	NA	NA	NO	NA
2005	256.83	NA	NA	NO	NA
2010	292.40	NA	NA	5.46	NA
2011	298.07	NA	NA	7.70	NA
2012	306.40	NA	NA	8.36	NA
2013	321.14	NA	NA	9.72	NA
2014	333.05	NA	NA	14.69	NA
2015	336.09	NA	NA	13.26	NA
2016	330.90	NA	NA	16.43	NA
2017	327.34	NA	NA	18.73	NA
2018	328.81	NA	NA	17.64	NA

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2019	357.78	NA	NA	19.73	NA
2020	355.39	NA	NA	21.46	NA
2021	390.00	NA	NA	27.12	NA
2022	339.82	NA	NA	23.69	NA
1990/2022	**199%**	-	-	-	-
2021/2022	**-13%**	-	-	**-13%**	-

3.7.5.2 Methodological issues

The data collected by questionnaires in households in the frame of the project "Quality Improvement of Air Emission Accounts and Extension of Provided Time-series" were used for the estimation of emissions from residential machinery for the first time in the 2018 inventory. After the second questionnaire in 2019, Slovakia was able to estimate the time series back to the base year 1990. The years 1990-2013 were estimated using expert judgment and a linear regression model back to the base year. This model caused the trend to be clearly linear up to 2013. After this year we can observe deviations in fuel consumption, as well as in estimated emissions. For the emission estimation, EMEP/EEA GB$_{2019}$ Tier 1 emission factors were used.

3.7.5.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB$_{2023}$.

3.7.5.4 Source-specific recalculations

In the IIR 2024, there were no source-specific recalculations made.

3.7.6 Agriculture/Forestry/Fishing: Stationary (NFR 1A4ci)

3.7.6.1 Overview

Activities listed within this category are shown in ***Table 3.120***.

Table 3.120: *Activities according to national categorization included in 1A4ci*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	MEDIUM S.: NACE 01-03
6.12. Livestock farming with a projected number of breeding sites	combustion
6.20. Agricultural and food products driers with a projected production capacity in t/h	combustion

The overview of the emissions is shown in ***Table 3.121.***

Table 3.121: *Overview of emissions in the category 1A4ci*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1088	0.0282	0.1466	NE	0.0307	0.0701	0.1533	0.0044	0.2780
1995	0.1156	0.0299	0.1557	NE	0.0326	0.0744	0.1628	0.0048	0.2952
2000	0.1124	0.0056	0.1689	NE	0.0418	0.0955	0.2089	0.0061	0.4136
2005	0.1542	0.0092	0.1420	NE	0.0462	0.0948	0.2044	0.0097	0.2216
2010	0.1022	0.0108	0.0266	NE	0.0329	0.0795	0.1791	0.0067	0.1218
2011	0.1020	0.0128	0.0194	NE	0.0357	0.0892	0.1984	0.0085	0.1267
2012	0.1129	0.0129	0.0292	NE	0.0303	0.0713	0.1543	0.0072	0.1518
2013	0.1258	0.0144	0.0336	NE	0.0276	0.0689	0.1528	0.0065	0.1589
2014	0.2434	0.0395	0.0698	NE	0.0313	0.0862	0.1967	0.0083	0.2094
2015	0.2736	0.0196	0.0908	NE	0.0297	0.0678	0.1451	0.0072	0.2131
2016	0.2515	0.0157	0.0722	NE	0.0308	0.0754	0.1648	0.0070	0.2072
2017	0.2266	0.0147	0.0555	NE	0.0269	0.0602	0.1265	0.0061	0.1891

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2018	0.2215	0.0256	0.0564	NE	0.0363	0.0699	0.1343	0.0094	0.2005
2019	0.2276	0.0201	0.0552	NE	0.0389	0.0696	0.1312	0.0096	0.2027
2020	0.2664	0.0243	0.0415	NE	0.0388	0.0813	0.1634	0.0096	0.2010
2021	0.2543	0.0319	0.0412	NE	0.0437	0.0881	0.1733	0.0112	0.2333
2022	0.1810	0.0229	0.0307	NE	0.0351	0.0610	0.1090	0.0090	0.1555
1990/2022	**66%**	**-19%**	**-79%**	**-**	**14%**	**-13%**	**-29%**	**105%**	**-44%**
2021/2022	**-29%**	**-28%**	**-26%**	**-**	**-20%**	**-31%**	**-37%**	**-20%**	**-33%**

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	B(a)P [t]	B(b)F [t]	PAHs [t]
1990	0.0035	0.0001	0.0002	0.0002	0.0005	0.0006	0.0037	0.0000	0.0053
1995	0.0599	0.0009	0.0024	0.0016	0.0053	0.0089	0.0118	0.0007	0.0898
2000	0.0413	0.0011	0.0017	0.0013	0.0051	0.0064	0.0187	0.0005	0.0806
2005	0.0208	0.0012	0.0009	0.0008	0.0040	0.0035	0.0162	0.0003	0.0628
2010	0.0062	0.0008	0.0004	0.0003	0.0019	0.0011	0.0040	0.0001	0.0353
2011	0.0056	0.0010	0.0003	0.0003	0.0021	0.0010	0.0012	0.0001	0.0438
2012	0.0044	0.0009	0.0003	0.0002	0.0017	0.0008	0.0007	0.0001	0.0364
2013	0.0042	0.0009	0.0003	0.0003	0.0017	0.0008	0.0007	0.0001	0.0364
2014	0.0033	0.0008	0.0003	0.0002	0.0015	0.0006	0.0005	0.0002	0.0347
2015	0.0048	0.0013	0.0004	0.0002	0.0025	0.0009	0.0006	0.0003	0.0579
2016	0.0035	0.0008	0.0003	0.0002	0.0016	0.0007	0.0007	0.0003	0.0365
2017	0.0038	0.0008	0.0003	0.0002	0.0017	0.0007	0.0008	0.0003	0.0380
2018	0.0053	0.0020	0.0003	0.0002	0.0036	0.0011	0.0009	0.0003	0.0820
2019	0.0041	0.0013	0.0003	0.0002	0.0024	0.0008	0.0011	0.0003	0.0545
2020	0.0041	0.0014	0.0003	0.0003	0.0026	0.0008	0.0006	0.0002	0.0596
2021	0.0047	0.0020	0.0004	0.0003	0.0037	0.0010	0.0004	0.0003	0.0835
2022	0.0034	0.0014	0.0003	0.0002	0.0025	0.0007	0.0003	0.0002	0.0566
1990/2022	**-5%**	**2529%**	**29%**	**12%**	**390%**	**20%**	**-92%**	**363%**	**968%**
2021/2022	**-29%**	**-33%**	**-33%**	**-37%**	**-33%**	**-30%**	**-27%**	**-21%**	**-32%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0068	0.0021	0.0029	0.0015	0.0013	0.0077	0.0000	0.0031
1995	0.1141	0.0282	0.0368	0.0145	0.0116	0.0912	0.0002	0.0552
2000	0.0801	0.0199	0.0264	0.0109	0.0088	0.0660	0.0003	0.0363
2005	0.0427	0.0105	0.0144	0.0064	0.0054	0.0367	0.0004	0.0168
2010	0.0153	0.0038	0.0054	0.0029	0.0026	0.0147	0.0003	0.0040
2011	0.0152	0.0033	0.0050	0.0025	0.0023	0.0132	0.0004	0.0032
2012	0.0121	0.0028	0.0050	0.0023	0.0021	0.0122	0.0003	0.0024
2013	0.0120	0.0029	0.0053	0.0025	0.0023	0.0131	0.0003	0.0023
2014	0.0100	0.0030	0.0107	0.0031	0.0031	0.0199	0.0003	0.0016
2015	0.0151	0.0039	0.0141	0.0038	0.0037	0.0255	0.0005	0.0019
2016	0.0107	0.0033	0.0119	0.0033	0.0033	0.0217	0.0003	0.0017
2017	0.0115	0.0034	0.0121	0.0034	0.0033	0.0222	0.0003	0.0018
2018	0.0186	0.0039	0.0134	0.0036	0.0035	0.0245	0.0008	0.0010
2019	0.0136	0.0034	0.0121	0.0033	0.0033	0.0221	0.0005	0.0012
2020	0.0142	0.0034	0.0108	0.0034	0.0033	0.0210	0.0005	0.0009
2021	0.0181	0.0040	0.0124	0.0041	0.0040	0.0245	0.0008	0.0004
2022	0.0125	0.0028	0.0098	0.0029	0.0028	0.0184	0.0005	0.0004
1990/2022	**82%**	**38%**	**240%**	**96%**	**121%**	**138%**	**4325%**	**-86%**
2021/2022	**-31%**	**-29%**	**-21%**	**-29%**	**-29%**	**-25%**	**-33%**	**5%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.122*** below.

Table 3.122: *Overview of activity data in the category 1A4ci*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	42.65	210.52	1 015.84	73.46	NO
1995	58.78	206.46	1 086.01	74.42	NO
2000	47.35	197.46	1 060.56	72.61	NO
2005	159.91	100.24	1 930.10	85.17	NO
2010	50.35	38.59	1 677.71	69.99	NO
2011	36.71	18.80	1 500.25	119.47	NO
2012	29.40	14.09	1 356.93	249.89	NO
2013	36.01	13.29	1 590.77	299.07	NO
2014	66.47	9.08	1 755.51	1 240.14	NO
2015	40.08	10.86	1 502.22	1 520.94	NO
2016	98.12	9.76	1 805.38	1 271.10	NO
2017	87.89	10.67	1 537.70	1 164.30	NO
2018	86.26	6.45	1 399.74	1 187.64	NO
2019	115.71	7.73	1 595.10	1 025.93	NO
2020	204.99	5.40	2 189.06	804.42	NO
2021	215.82	2.37	2 582.76	867.13	NO
2022	97.51	2.51	1 361.36	783.71	NO
1990/2022	**129%**	**-99%**	**34%**	**967%**	**-**
2021/2022	**-55%**	**6%**	**-47%**	**-10%**	**-**

3.7.6.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022. NH_3 emissions from solid biomass combustion are reported as 'NO' because measurements show that NH_3 is not relevant (***Recommendation No 1A4ci-SK-2022-0001***).

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.123***).

Table 3.123: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	81.05	20.98	109.20	114.17	20%	46%	207.06

The emissions of heavy metals and POPs are calculated at Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore this detailed methodologies could be used focused on the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of heavy metals and POPs are default EF from EMEP/EEA GB_{2019} (***Table 3.124***).

The annual emission is determined by activity data and an emission factor:

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

Where:

E_i = annual emission of pollutant *i*,

$EF_{i,j,k}$ = default emission factor of pollutant *i* for source type *j* and fuel *k*,

$A_{j,k}$ = annual consumption of fuel *k* in source type *j*.

Table 3.124: *Emission factors for heavy metals and POPs in the category 1A4ci*

TYPE OF FUEL		LIQUID FUELS				HARD COAL/BROWN COAL	
T2	**UNIT**	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (> 1 MWth ≤ 50 MWth)	**GAS TURBINES** (50 kWth – 50 MWth)	**STATIONARY RECIPROCATING ENGINES** (50 kWth – 50 MWth)	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	20	10	0.012	0.15	200	100
Cd	[mg/GJ]	0.3	0.3	0.001	0.01	3	1
Hg	[mg/GJ]	0.1	0.1	0.12	0.11	7	9
As	[mg/GJ]	1	1	0.002	0.06	5	4
Cr	[mg/GJ]	20	20	0.2	0.2	15	15
Cu	[mg/GJ]	10	3	0.13	0.3	17.5	10
Ni	[mg/GJ]	300	200	0.005	0.01	13	10
Se	[mg/GJ]	NA	0.5	0.002	0.22	1.8	2
Zn	[mg/GJ]	10	5	0.42	58	200	150
PCDD/F	[ng I-TEQ/GJ]	10	10	1.8	0.99	203	100
B(a)P	[mg/GJ]	8	1	NE	1.9	45.5	13
B(b)F	[mg/GJ]	9	2	NE	15	58.9	17
B(k)F	[mg/GJ]	6	1	NE	1.7	23.7	9
I()P	[mg/GJ]	3	1	NE	1.5	18.5	6
PAHs	[mg/GJ]	26	5	NE	20.1	146.6	45
HCB	[µg/GJ]	NE	NE	NE	0.22	0.62	0.62
PCBs	[µg/GJ]	NE	NE	NE	0.13	170	170

TYPE OF FUEL		GASEOUS FUELS				BIOMASS	
T2	**UNIT**	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (> 1 MWth ≤ 50 MWth)	**GAS TURBINES** (50 kWth – 50 MWth)	**STATIONARY RECIPROCATING ENGINES** (50 kWth – 50 MWth)	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	0.0015	0.0015	0.0015	0.04	27	27
Cd	[mg/GJ]	0.00025	0.00025	0.00025	0.003	13	13
Hg	[mg/GJ]	0.1	0.1	0.1	0.1	0.56	0.56
As	[mg/GJ]	0.12	0.12	0.12	0.05	0.19	0.19
Cr	[mg/GJ]	0.00076	0.00076	0.00076	0.05	23	23
Cu	[mg/GJ]	0.000076	0.000076	0.000076	0.01	6	6
Ni	[mg/GJ]	0.00051	0.00051	0.00051	0.05	2	2
Se	[mg/GJ]	0.011	0.011	0.011	0.2	0.5	0.5
Zn	[mg/GJ]	0.0015	0.0015	0.0015	2.9	512	512
PCDD/F	[ng I-TEQ/GJ]	0.5	0.5	0.5	0.57	100	100
B(a)P	[mg/GJ]	0.56	0.56	0.56	1.2	10	10
B(b)F	[mg/GJ]	0.84	0.84	0.84	9	16	16
B(k)F	[mg/GJ]	0.84	0.84	0.84	1.7	5	5
I()P	[mg/GJ]	0.84	0.84	0.84	1.8	4	4
PAHs	[mg/GJ]	3.08	3.08	3.08	13.7	35	35
HCB	[µg/GJ]	NA	NA	NA	NA	5	5
PCBs	[µg/GJ]	NA	NA	NA	NA	0.03	0.007

DBC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.125***). The calculated BC emission values are presented in ***Table 3.121***.

Table 3.125: Emission factors for calculation of BC emissions

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.7.6.3 Completeness

Emissions are well covered. Emissions of NH_3 are reported as NE. NH_3 emissions from solid biomass will be included in the next submission.

3.7.6.4 Source-specific recalculations

The recalculations for HM and POPs were made based on changes in activity data (supplemented activity values). Results of the recalculations are in ***Table 3.126***.

Table 3.126: Previous and revised emissions in the category 1A4ci

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1996	0.0625	0.0626	0.03%	0.0009	0.0009	1%	0.0025	0.0025	0.02%
1997	0.0631	0.0632	0.21%	0.0010	0.0011	6%	0.0026	0.0026	0.11%
1998	0.0617	0.0620	0.42%	0.0011	0.0012	12%	0.0025	0.0025	0.21%
1999	0.0587	0.0591	1%	0.0011	0.0013	17%	0.0024	0.0024	0.33%
2000	0.0408	0.0413	1%	0.0009	0.0011	25%	0.0017	0.0017	1%
2001	0.0372	0.0380	2%	0.0011	0.0014	36%	0.0016	0.0016	1%
2002	0.0343	0.0352	3%	0.0011	0.0015	40%	0.0015	0.0015	1%
2003	0.0253	0.0262	3%	0.0009	0.0014	45%	0.0011	0.0011	2%
2004	0.0184	0.0192	4%	0.0008	0.0012	49%	0.0008	0.0008	2%
2005	0.0201	0.0208	4%	0.0008	0.0012	47%	0.0009	0.0009	2%
2006	0.0094	0.0101	8%	0.0006	0.0010	58%	0.0005	0.0005	3%
2007	0.0082	0.0089	9%	0.0006	0.0010	60%	0.0005	0.0005	3%
2008	0.0077	0.0082	6%	0.0006	0.0008	37%	0.0005	0.0005	2%
2009	0.0070	0.0077	10%	0.0005	0.0009	61%	0.0004	0.0004	4%
2010	0.0058	0.0062	7%	0.0006	0.0008	32%	0.0004	0.0004	2%
2011	0.0051	0.0056	10%	0.0008	0.0010	30%	0.0003	0.0003	3%
2012	0.0042	0.0044	4%	0.0008	0.0009	10%	0.0003	0.0003	1%
2013	0.0041	0.0042	2%	0.0008	0.0009	4%	0.0003	0.0003	1%
2014	0.0031	0.0033	4%	0.0007	0.0008	9%	0.0003	0.0003	1%
2016	0.0035	0.0035	-0.13%	0.0008	0.0008	-0.01%	0.0003	0.0003	-0.01%
2017	0.0038	0.0038	0.10%	0.0008	0.0008	0.03%	0.0003	0.0003	3%
2021	0.0048	0.0047	-0.58%	0.0020	0.0020	-0.04%	0.0004	0.0004	-0.07%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1996	0.0017	0.0017	0.01%	0.0056	0.0056	0%	0.0093	0.0093	0%
1997	0.0018	0.0018	0.05%	0.0059	0.0060	2%	0.0094	0.0094	0%
1998	0.0017	0.0017	0.10%	0.0060	0.0063	4%	0.0093	0.0093	1%
1999	0.0017	0.0017	0.16%	0.0061	0.0064	5%	0.0089	0.0090	1%
2000	0.0013	0.0013	0.26%	0.0048	0.0051	8%	0.0063	0.0064	2%
2001	0.0012	0.0012	0.48%	0.0050	0.0056	14%	0.0059	0.0061	3%
2002	0.0011	0.0011	1%	0.0049	0.0057	16%	0.0055	0.0057	4%
2003	0.0008	0.0008	1%	0.0039	0.0047	19%	0.0041	0.0043	5%
2004	0.0007	0.0007	1%	0.0037	0.0044	19%	0.0032	0.0034	6%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2005	0.0007	0.0008	1%	0.0034	0.0040	19%	0.0033	0.0035	5%
2006	0.0005	0.0005	1%	0.0027	0.0033	23%	0.0019	0.0020	9%
2007	0.0004	0.0004	1%	0.0017	0.0023	38%	0.0013	0.0015	13%
2008	0.0004	0.0004	1%	0.0016	0.0020	22%	0.0013	0.0014	7%
2009	0.0003	0.0003	1%	0.0015	0.0021	40%	0.0012	0.0013	13%
2010	0.0003	0.0003	1%	0.0015	0.0019	22%	0.0010	0.0011	9%
2011	0.0003	0.0003	1%	0.0016	0.0021	26%	0.0009	0.0010	12%
2012	0.0002	0.0002	0.47%	0.0015	0.0017	9%	0.0007	0.0008	5%
2013	0.0003	0.0003	0.19%	0.0016	0.0017	4%	0.0007	0.0008	2%
2014	0.0002	0.0002	0.32%	0.0014	0.0015	8%	0.0006	0.0006	5%
2016	0.0002	0.0002	-0.10%	0.0016	0.0016	-0.28%	0.0007	0.0007	-0.35%
2017	0.0002	0.0002	2%	0.0017	0.0017	0.28%	0.0007	0.0007	0.13%
2021	0.0003	0.0003	-1%	0.0037	0.0037	-1%	0.0010	0.0010	-1%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1996	0.0157	0.0157	0.06%	0.0007	0.0007	0.35%	0.0977	0.1002	3%
1997	0.0176	0.0176	0.11%	0.0007	0.0007	1%	0.0986	0.1035	5%
1998	0.0192	0.0192	0.15%	0.0007	0.0007	1%	0.0973	0.1046	8%
1999	0.0187	0.0187	0.18%	0.0005	0.0005	2%	0.0720	0.0806	12%
2000	0.0205	0.0206	0.29%	0.0004	0.0004	3%	0.0748	0.0899	20%
2001	0.0215	0.0215	0.31%	0.0004	0.0004	4%	0.0729	0.0899	23%
2002	0.0169	0.0169	0.38%	0.0003	0.0003	5%	0.0589	0.0754	28%
2003	0.0223	0.0223	0.27%	0.0002	0.0002	7%	0.0470	0.0625	33%
2004	0.0162	0.0162	0.35%	0.0002	0.0003	6%	0.0483	0.0628	30%
2005	0.0184	0.0185	0.30%	0.0001	0.0001	11%	0.0316	0.0455	44%
2006	0.0040	0.0041	1%	0.0001	0.0001	12%	0.0306	0.0450	47%
2007	0.0048	0.0048	1%	0.0001	0.0001	7%	0.0279	0.0361	29%
2008	0.0033	0.0033	2%	0.0001	0.0001	12%	0.0275	0.0407	48%
2009	0.0039	0.0040	1%	0.0001	0.0001	8%	0.0277	0.0353	27%
2010	0.0012	0.0012	3%	0.0001	0.0001	10%	0.0345	0.0438	27%
2011	0.0007	0.0007	2%	0.0001	0.0001	3%	0.0333	0.0364	9%
2012	0.0007	0.0007	1%	0.0001	0.0001	1%	0.0350	0.0364	4%
2013	0.0005	0.0005	2%	0.0002	0.0002	1%	0.0323	0.0347	8%
2014	0.0157	0.0157	0.06%	0.0007	0.0007	0.35%	0.0977	0.1002	3%
2016	0.0008	0.0007	-9%	0.0003	0.0003	0.00%	0.0365	0.0365	-0.01%
2017	0.0008	0.0008	1%	0.0002	0.0003	8%	0.0377	0.0380	1%
2021	0.0009	0.0004	-57%	0.0003	0.0003	-0.42%	0.0835	0.0835	-0.02%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1996	0.1203	0.1208	0.41%	0.0967	0.0969	0.18%
1997	0.1179	0.1189	1%	0.0952	0.0955	0.35%
1998	0.1125	0.1139	1%	0.0913	0.0918	1%
1999	0.0784	0.0801	2%	0.0654	0.0660	1%
2000	0.0723	0.0752	4%	0.0605	0.0616	2%
2001	0.0669	0.0702	5%	0.0564	0.0576	2%
2002	0.0500	0.0532	6%	0.0424	0.0436	3%
2003	0.0361	0.0391	8%	0.0326	0.0336	3%
2004	0.0398	0.0427	7%	0.0358	0.0367	3%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2005	0.0190	0.0217	14%	0.0192	0.0201	5%
2006	0.0180	0.0208	16%	0.0170	0.0180	6%
2007	0.0168	0.0184	9%	0.0167	0.0173	3%
2008	0.0156	0.0182	16%	0.0152	0.0161	6%
2009	0.0138	0.0153	11%	0.0141	0.0147	4%
2010	0.0133	0.0152	14%	0.0126	0.0132	5%
2011	0.0115	0.0121	5%	0.0120	0.0122	2%
2012	0.0117	0.0120	2%	0.0130	0.0131	1%
2013	0.0095	0.0100	5%	0.0198	0.0199	1%
2014	0.1203	0.1208	0.41%	0.0967	0.0969	0.18%
2016	0.0107	0.0107	-0.02%	0.0217	0.0217	-0.03%
2017	0.0114	0.0115	0.46%	0.0209	0.0222	6%
2021	0.0181	0.0181	-0.14%	0.0245	0.0245	-0.07%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1996	0.0002	0.0002	2%	0.0575	0.0575	0.00%
1997	0.0002	0.0003	10%	0.0577	0.0577	0.00%
1998	0.0003	0.0003	17%	0.0562	0.0562	0.00%
1999	0.0003	0.0004	24%	0.0531	0.0531	0.00%
2000	0.0003	0.0003	34%	0.0363	0.0363	0.00%
2001	0.0003	0.0005	45%	0.0324	0.0324	0.00%
2002	0.0003	0.0005	49%	0.0295	0.0295	0.00%
2003	0.0003	0.0005	53%	0.0215	0.0215	0.00%
2004	0.0003	0.0004	57%	0.0148	0.0148	0.01%
2005	0.0003	0.0004	55%	0.0168	0.0168	0.01%
2006	0.0002	0.0004	63%	0.0067	0.0067	0.01%
2007	0.0002	0.0004	65%	0.0064	0.0064	0.01%
2008	0.0002	0.0003	40%	0.0061	0.0061	0.01%
2009	0.0002	0.0003	65%	0.0054	0.0054	0.01%
2010	0.0002	0.0003	34%	0.0040	0.0040	0.01%
2011	0.0003	0.0004	31%	0.0032	0.0032	0.01%
2012	0.0003	0.0003	11%	0.0024	0.0024	0.00%
2013	0.0003	0.0003	5%	0.0023	0.0023	0.00%
2014	0.0003	0.0003	9%	0.0016	0.0016	0.01%

3.7.7 Agriculture/Forestry/Fishing: Off-road vehicles and other machinery (NFR 1A4cii)

3.7.7.1 Overview

In this category are reported emissions from off-road vehicles in the agriculture sector e.g. tractors, harvesters and it is not considered as a key category. The overview of the emissions is shown in ***Table 3.127***.

Table 3.127: *Overview of emissions in the category 1A4cii*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	8.5506	1.2249	0.0053	0.0020	0.4702	0.4702	0.4702	0.2715	17.4750
1995	3.7524	0.5490	0.0023	0.0009	0.2062	0.2062	0.2062	0.1190	8.1523
2000	2.6186	0.3962	0.0016	0.0006	0.1437	0.1437	0.1437	0.0829	6.2438
2005	2.6627	0.3645	0.0016	0.0006	0.1466	0.1466	0.1466	0.0847	4.7263
2010	2.4200	0.3221	0.0015	0.0006	0.1334	0.1334	0.1334	0.0771	3.9074

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2011	2.4355	0.3202	0.0015	0.0006	0.1343	0.1343	0.1343	0.0777	3.7649
2012	2.4289	0.3160	0.0015	0.0006	0.1340	0.1340	0.1340	0.0775	3.6151
2013	2.3319	0.2991	0.0014	0.0005	0.1287	0.1287	0.1287	0.0745	3.2875
2014	2.6420	0.3310	0.0016	0.0006	0.1459	0.1459	0.1459	0.0845	3.3907
2015	2.2974	0.2956	0.0014	0.0005	0.1268	0.1268	0.1268	0.0734	3.2761
2016	2.2630	0.2920	0.0014	0.0005	0.1249	0.1249	0.1249	0.0722	3.2646
2017	2.0907	0.2743	0.0013	0.0005	0.1153	0.1153	0.1153	0.0667	3.2072
2018	2.0907	0.2743	0.0013	0.0005	0.1153	0.1153	0.1153	0.0667	3.2072
2019	1.9529	0.2601	0.0012	0.0005	0.1076	0.1076	0.1076	0.0622	3.1614
2020	1.9640	0.2019	0.0011	0.0005	0.1090	0.1090	0.1090	0.0633	0.6537
2021	1.7918	0.1842	0.0010	0.0004	0.0995	0.0995	0.0995	0.0578	0.5964
2022	1.6195	0.1665	0.0009	0.0004	0.0899	0.0899	0.0899	0.0522	0.5390
1990/2022	**-79%**	**-85%**	**-80%**	**-80%**	**-79%**	**-79%**	**-79%**	**-79%**	**-97%**
2021/2022	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	B(a)P [t]	B(b)F [t]	PAHs [t]
1990	0.0026	0.0132	0.4476	0.0184	0.0026	0.2633	0.0081	0.0130	0.0211
1995	0.0012	0.0058	0.1973	0.0081	0.0012	0.1160	0.0036	0.0057	0.0093
2000	0.0008	0.0041	0.1386	0.0057	0.0008	0.0815	0.0025	0.0040	0.0065
2005	0.0008	0.0041	0.1381	0.0057	0.0008	0.0812	0.0025	0.0040	0.0065
2010	0.0007	0.0037	0.1248	0.0051	0.0007	0.0734	0.0022	0.0036	0.0059
2011	0.0007	0.0037	0.1253	0.0052	0.0007	0.0737	0.0023	0.0036	0.0059
2012	0.0007	0.0037	0.1248	0.0051	0.0007	0.0734	0.0022	0.0036	0.0059
2013	0.0007	0.0035	0.1195	0.0049	0.0007	0.0703	0.0021	0.0035	0.0056
2014	0.0008	0.0040	0.1348	0.0055	0.0008	0.0793	0.0024	0.0039	0.0063
2015	0.0007	0.0035	0.1178	0.0048	0.0007	0.0693	0.0021	0.0034	0.0055
2016	0.0007	0.0034	0.1161	0.0048	0.0007	0.0683	0.0021	0.0034	0.0055
2017	0.0006	0.0032	0.1076	0.0044	0.0006	0.0633	0.0019	0.0031	0.0051
2018	0.0006	0.0032	0.1076	0.0044	0.0006	0.0633	0.0019	0.0031	0.0051
2019	0.0006	0.0030	0.1008	0.0041	0.0006	0.0593	0.0018	0.0029	0.0047
2020	0.0006	0.0029	0.0969	0.0040	0.0006	0.0570	0.0017	0.0029	0.0046
2021	0.0005	0.0026	0.0884	0.0036	0.0005	0.0520	0.0016	0.0026	0.0042
2022	0.0005	0.0024	0.0799	0.0033	0.0005	0.0470	0.0014	0.0024	0.0038
1990/2022	**-82%**	**-82%**	**-82%**	**-82%**	**-82%**	**-82%**	**-83%**	**-82%**	**-82%**
2021/2022	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**

Slovakia was able to separate the consumption in this report for category **1A4cii** from other categories previously reported within this category (***Table 3.127***). It is according to ***Recommendations No SK-1A4cii-2018-0001, SK-1A4cii-2021-0002*** and ***SK-1A4cii-2021-0002***. Based on the separation, in agriculture non-road mobile machinery was in the year 2022 was used 1 841.49 TJ of liquid fuels. An overview of the activity data (energy consumption) for this source category is in ***Table 3.128*** below.

Table 3.128: *Overview of activity data in the category 1A4cii*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	11 205.00	NA	NA	NO	NA
1995	4 894.00	NA	NA	NO	NA
2000	3 478.00	NA	NA	NO	NA
2005	3 437.00	NA	NA	NO	NA
2010	2 822.78	NA	NA	130.63	NA
2011	2 792.78	NA	NA	151.16	NA

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2012	2 791.86	NA	NA	144.36	NA
2013	2 788.41	NA	NA	153.94	NA
2014	3 105.83	NA	NA	211.21	NA
2015	2 719.59	NA	NA	190.03	NA
2016	2 680.30	NA	NA	186.86	NA
2017	2 476.26	NA	NA	180.39	NA
2018	2 489.92	NA	NA	166.96	NA
2019	2 332.96	NA	NA	156.74	NA
2020	2 222.08	NA	NA	167.26	NA
2021	2 027.59	NA	NA	151.60	NA
2022	1 841.49	NA	NA	137.58	NA
1990/2022	**-84%**	-	-	-	-
2021/2022	**-9.18%**	-	-	**-9%**	-

3.7.7.2 Methodological issues

Slovakia used to estimate fuel consumption in category **1A4cii** statistical data from EUROSTAT as national data are not available for the whole time series. According to ***Recommendations No SK-1A4cii-2018-0001***, ***SK-1A4cii-2021-0002*** and ***SK-1A4cii-2021-0002***, Slovakia is reporting in this category only emission described in EMEP/EEA GB$_{2019}$ and for the emission estimation, EMEP/EEA GB$_{2019}$ Tier 1 emission factors were used.

3.7.7.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB$_{2019}$.

3.7.7.4 Source-specific recalculations

In the IIR 2024, there were no source-specific recalculations made.

3.7.8 Agriculture/Forestry/Fishing: National fishing (NFR 1A4ciii)

The category is reported as NO - no activity in SR.

3.7.9 Other stationery (including military) (NFR 1A5a)

3.7.9.1 Overview

Activities listed within this category are shown in ***Table 3.129***.

Table 3.129: *Activities according to national categorization included in 1A5a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	MEDIUM S.: NACE 05-09; 35.2; 36-43
1.5. Biogas production with projected production capacity: quantity of processed raw material or biological waste in t/d	

The overview of the emissions is shown in ***Table 3.130***.

Table 3.130: *Overview of emissions in the category 1A5a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1822	0.0067	0.3165	0.0052	0.0377	0.0503	0.0952	0.0025	0.2203
1995	0.1888	0.0069	0.3280	0.0054	0.0391	0.0521	0.0987	0.0026	0.2282
2000	0.1571	0.0305	0.3803	0.0051	0.0575	0.0767	0.1453	0.0039	0.2958
2005	0.1958	0.4743	0.3183	0.0043	0.0218	0.0322	0.0800	0.0019	0.1827
2010	0.1304	0.5664	0.1006	0.0016	0.0120	0.0173	0.0351	0.0016	0.1396

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2011	0.1740	0.5174	0.1186	0.0015	0.0143	0.0197	0.0391	0.0021	0.1770
2012	0.3651	0.6715	0.2344	0.0013	0.0244	0.0302	0.0510	0.0067	0.2433
2013	0.6197	0.7291	0.2973	0.0016	0.0271	0.0324	0.0522	0.0074	0.3603
2014	0.4491	0.7664	0.2368	0.0003	0.0230	0.0269	0.0388	0.0064	0.2366
2015	0.4062	0.8148	0.2074	0.0020	0.0218	0.0259	0.0391	0.0060	0.2101
2016	0.5112	0.8024	0.2863	0.0005	0.0264	0.0310	0.0455	0.0073	0.2621
2017	0.6503	0.8948	0.3673	0.0006	0.0171	0.0212	0.0357	0.0047	0.2710
2018	0.6149	0.8833	0.3471	0.0011	0.0155	0.0208	0.0442	0.0042	0.2641
2019	0.6353	0.8573	0.3577	0.0018	0.0141	0.0165	0.0211	0.0038	0.3601
2020	0.3977	0.5465	0.1885	0.0005	0.0142	0.0165	0.0202	0.0025	0.3501
2021	0.3803	0.5452	0.1534	0.0006	0.0154	0.0181	0.0223	0.0028	0.3655
2022	0.3420	0.6022	0.1329	0.0000	0.0156	0.0185	0.0228	0.0028	0.3329
1990/2022	**88%**	**8939%**	**-58%**	**-99%**	**-59%**	**-63%**	**-76%**	**11%**	**51%**
2021/2022	**-10%**	**10%**	**-13%**	**-94%**	**1%**	**2%**	**2%**	**-1%**	**-9%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.3689	0.0045	0.0244	0.0126	0.0438	0.0453	0.0468	0.0058	0.5534
1995	0.1472	0.0019	0.0098	0.0051	0.0180	0.0181	0.0227	0.0023	0.2250
2000	0.0358	0.0006	0.0024	0.0014	0.0056	0.0046	0.0178	0.0006	0.0589
2005	0.0135	0.0004	0.0009	0.0005	0.0026	0.0018	0.0087	0.0002	0.0298
2010	0.0083	0.0003	0.0006	0.0004	0.0016	0.0012	0.0042	0.0002	0.0218
2011	0.0056	0.0004	0.0005	0.0003	0.0013	0.0008	0.0026	0.0002	0.0205
2012	0.0445	0.0189	0.0014	0.0007	0.0342	0.0094	0.0056	0.0011	0.7547
2013	0.0524	0.0233	0.0016	0.0008	0.0419	0.0113	0.0058	0.0015	0.9300
2014	0.0575	0.0260	0.0016	0.0007	0.0466	0.0125	0.0063	0.0014	1.0347
2015	0.0631	0.0286	0.0017	0.0007	0.0511	0.0137	0.0069	0.0015	1.1331
2016	0.0578	0.0257	0.0017	0.0007	0.0461	0.0124	0.0061	0.0015	1.0223
2017	0.0747	0.0339	0.0021	0.0009	0.0606	0.0162	0.0066	0.0019	1.3479
2018	0.0284	0.0120	0.0010	0.0005	0.0216	0.0060	0.0030	0.0010	0.4820
2019	0.0254	0.0108	0.0009	0.0004	0.0195	0.0054	0.0026	0.0009	0.4362
2020	0.0245	0.0106	0.0009	0.0004	0.0191	0.0052	0.0024	0.0009	0.4276
2021	0.0247	0.0107	0.0009	0.0005	0.0192	0.0053	0.0025	0.0009	0.4291
2022	0.0283	0.0125	0.0010	0.0005	0.0225	0.0061	0.0032	0.0010	0.5025
1990/2022	**-92%**	**177%**	**-96%**	**-96%**	**-49%**	**-86%**	**-93%**	**-83%**	**-9%**
2021/2022	**14%**	**17%**	**10%**	**11%**	**17%**	**16%**	**31%**	**10%**	**17%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.5352	0.1106	0.1451	0.0620	0.0477	0.3654	0.0018	0.4859
1995	0.2143	0.0446	0.0587	0.0254	0.0196	0.1483	0.0008	0.1933
2000	0.0527	0.0112	0.0152	0.0068	0.0054	0.0386	0.0002	0.0459
2005	0.0210	0.0045	0.0062	0.0029	0.0024	0.0159	0.0002	0.0166
2010	0.0140	0.0034	0.0060	0.0026	0.0023	0.0142	0.0001	0.0097
2011	0.0104	0.0030	0.0077	0.0027	0.0025	0.0160	0.0001	0.0062
2012	0.1544	0.0186	0.0386	0.0116	0.0101	0.0788	0.0073	0.0065
2013	0.1871	0.0229	0.0540	0.0151	0.0134	0.1054	0.0090	0.0050
2014	0.2069	0.0239	0.0518	0.0145	0.0126	0.1028	0.0100	0.0040
2015	0.2267	0.0257	0.0525	0.0152	0.0130	0.1063	0.0110	0.0045
2016	0.2053	0.0243	0.0552	0.0152	0.0133	0.1080	0.0099	0.0057
2017	0.2686	0.0311	0.0691	0.0191	0.0166	0.1360	0.0130	0.0056
2018	0.0990	0.0138	0.0395	0.0101	0.0093	0.0728	0.0046	0.0043

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2019	0.0897	0.0127	0.0371	0.0094	0.0087	0.0679	0.0042	0.0031
2020	0.0872	0.0122	0.0354	0.0090	0.0084	0.0650	0.0041	0.0027
2021	0.0883	0.0126	0.0350	0.0094	0.0087	0.0656	0.0041	0.0025
2022	0.1024	0.0142	0.0383	0.0104	0.0096	0.0725	0.0048	0.0021
1990/2022	**-81%**	**-87%**	**-74%**	**-83%**	**-80%**	**-80%**	**172%**	**-100%**
2021/2022	**16%**	**13%**	**10%**	**11%**	**11%**	**11%**	**17%**	**-18%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.131*** below.

Table 3.131: *Overview of activity data in the category 1A5a*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	10.04	318.74	1 867.55	201.96	NO
1995	10.71	315.99	1 958.98	199.46	NO
2000	13.05	300.32	1 841.01	200.73	NO
2005	4.50	199.38	2 846.78	267.09	49.83
2010	20.21	57.35	1 630.65	472.22	43.57
2011	12.64	36.82	1 561.37	1 060.63	13.29
2012	13.77	37.03	1 715.44	3 425.48	NO
2013	12.58	29.40	1 434.60	5 966.51	NO
2014	14.76	23.53	1 361.15	4 235.23	NO
2015	35.00	26.30	1 588.89	4 022.90	NO
2016	12.53	33.60	1 598.70	4 639.14	13.29
2017	20.03	32.70	1 549.59	6 168.42	13.29
2018	15.67	25.26	1 336.08	3 592.36	NO
2019	8.32	18.37	1 517.25	3 328.13	NO
2020	15.67	15.74	1 267.72	2 382.70	NO
2021	15.95	14.93	1 414.83	2 260.37	NO
2022	14.72	12.27	1 734.86	2 117.27	NO
1990/2022	**47%**	**-96%**	**-7%**	**948%**	**-**
2021/2022	**-8%**	**-18%**	**23%**	**-6%**	**-**

3.7.9.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV.** PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2022.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.132***).

Table 3.132: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/GJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	75.93	2.78	131.88	2.17	39.68	40%	53%	91.77

Emissions of heavy metals and POPs are calculated at the Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore this detailed methodologies could be used focused on the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of heavy metals and POPs are default EF from EMEP/EEA GB_{2019} (***Table 3.133***).

The annual emission is determined by activity data and an emission factor:

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

Where:

E_i = annual emission of pollutant *i*,

$EF_{i,j,k}$ = default emission factor of pollutant *i* for source type *j* and fuel *k*,

$A_{j,k}$ = annual consumption of fuel *k* in source type *j*.

Table 3.133: *Emission factors for heavy metals and POPs in the category 1A5a*

TYPE OF FUEL		LIQUID FUELS				HARD COAL/BROWN COAL	
T2	**UNIT**	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (> 1 MWth ≤ 50 MWth)	**GAS TURBINES** (50 kWth – 50 MWth)	**STATIONARY RECIPROCATING ENGINES** (50 kWth – 50 MWth)	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	20	10	0.012	0.15	200	100
Cd	[mg/GJ]	0.3	0.3	0.001	0.01	3	1
Hg	[mg/GJ]	0.1	0.1	0.12	0.11	7	9
As	[mg/GJ]	1	1	0.002	0.06	5	4
Cr	[mg/GJ]	20	20	0.2	0.2	15	15
Cu	[mg/GJ]	10	3	0.13	0.3	17.5	10
Ni	[mg/GJ]	300	200	0.005	0.01	13	10
Se	[mg/GJ]	NA	0.5	0.002	0.22	1.8	2
Zn	[mg/GJ]	10	5	0.42	58	200	150
PCDD/F	[ng I-TEQ/GJ]	10	10	1.8	0.99	203	100
B(a)P	[mg/GJ]	8	1	NE	1.9	45.5	13
B(b)F	[mg/GJ]	9	2	NE	15	58.9	17
B(k)F	[mg/GJ]	6	1	NE	1.7	23.7	9
I()P	[mg/GJ]	3	1	NE	1.5	18.5	6
PAHs	[mg/GJ]	26	5	NE	20.1	146.6	45
HCB	[µg/GJ]	NE	NE	NE	0.22	0.62	0.62
PCBs	[µg/GJ]	NE	NE	NE	0.13	170	170

TYPE OF FUEL		GASEOUS FUELS				BIOMASS	
T2	**UNIT**	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (> 1 MWth ≤ 50 MWth)	**GAS TURBINES** (50 kWth – 50 MWth)	**STATIONARY RECIPROCATING ENGINES** (50 kWth – 50 MWth)	**STANDARD BOILERS** (> 50 KWth ≤ 1 MWth)	**STANDARD BOILERS** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	0.0015	0.0015	0.0015	0.04	27	27
Cd	[mg/GJ]	0.00025	0.00025	0.00025	0.003	13	13
Hg	[mg/GJ]	0.1	0.1	0.1	0.1	0.56	0.56
As	[mg/GJ]	0.12	0.12	0.12	0.05	0.19	0.19
Cr	[mg/GJ]	0.00076	0.00076	0.00076	0.05	23	23
Cu	[mg/GJ]	0.000076	0.000076	0.000076	0.01	6	6
Ni	[mg/GJ]	0.00051	0.00051	0.00051	0.05	2	2
Se	[mg/GJ]	0.011	0.011	0.011	0.2	0.5	0.5
Zn	[mg/GJ]	0.0015	0.0015	0.0015	2.9	512	512
PCDD/F	[ng I-TEQ/GJ]	0.5	0.5	0.5	0.57	100	100
B(a)P	[mg/GJ]	0.56	0.56	0.56	1.2	10	10
B(b)F	[mg/GJ]	0.84	0.84	0.84	9	16	16
B(k)F	[mg/GJ]	0.84	0.84	0.84	1.7	5	5
I()P	[mg/GJ]	0.84	0.84	0.84	1.8	4	4
PAHs	[mg/GJ]	3.08	3.08	3.08	13.7	35	35

TYPE OF FUEL		GASEOUS FUELS				BIOMASS	
T2	UNIT	STANDARD BOILERS (> 50 KWth ≤ 1 MWth)	STANDARD BOILERS (> 1 MWth ≤ 50 MWth)	GAS TURBINES (50 kWth – 50 MWth)	STATIONARY RECIPROCATING ENGINES (50 kWth – 50 MWth)	STANDARD BOILERS (> 50 KWth ≤ 1 MWth)	STANDARD BOILERS (>1 MWth ≤ 50 MWth)
HCB	[µg/GJ]	NA	NA	NA	NA	5	5
PCBs	[µg/GJ]	NA	NA	NA	NA	0.03	0.007

DBC emissions were estimated in this submission for this category based on total $PM_{2.5}$ emissions – using corrected EF for BC (EMEP/EEA GB_{2019}) (***Table 3.134***). The calculated BC emission values are presented in ***Table 3.130.***

Table 3.134: *Emission factors for calculation of BC emissions*

EF	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
TSP	[g/GJ]	20	124	0.78	150
PM_{10}	[g/GJ]	20	117	0.78	143
$PM_{2.5}$	[g/GJ]	20	108	0.78	140
BC	[% of $PM_{2.5}$]	56%	6.4%	4%	28%

3.7.9.3 Completeness

Emissions are well covered.

3.7.9.4 Source-specific recalculations

The recalculations for HM and POPs were made based on changes in activity data (supplemented activity values). The results of the recalculations are in ***Table 3.135***.

Table 3.135: *Previous and revised emissions in the category 1A5a*

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1991	0.3119	0.3120	0.02%	0.0038	0.0039	1%	0.0206	0.0206	0.01%
1992	0.2617	0.2618	0.04%	0.0032	0.0033	1%	0.0173	0.0173	0.01%
1993	0.2178	0.2179	0.06%	0.0027	0.0028	2%	0.0144	0.0144	0.02%
1994	0.1797	0.1799	0.09%	0.0022	0.0023	3%	0.0118	0.0118	0.03%
1995	0.1470	0.1472	0.12%	0.0018	0.0019	5%	0.0098	0.0098	0.04%
1996	0.1193	0.1195	0.17%	0.0015	0.0016	6%	0.0080	0.0080	0.05%
1997	0.0961	0.0963	0.22%	0.0012	0.0013	8%	0.0064	0.0064	0.07%
1998	0.0769	0.0771	0.29%	0.0010	0.0011	11%	0.0052	0.0052	0.09%
1999	0.0614	0.0616	0.38%	0.0008	0.0009	14%	0.0041	0.0041	0.12%
2000	0.0356	0.0358	1%	0.0005	0.0006	23%	0.0024	0.0024	0.20%
2001	0.0302	0.0305	1%	0.0004	0.0006	33%	0.0020	0.0020	0.30%
2002	0.0249	0.0252	1%	0.0004	0.0005	39%	0.0017	0.0017	0.35%
2003	0.0206	0.0209	1%	0.0003	0.0004	46%	0.0014	0.0014	0.42%
2004	0.0148	0.0152	2%	0.0002	0.0004	67%	0.0010	0.0010	1%
2005	0.0131	0.0135	3%	0.0002	0.0004	89%	0.0009	0.0009	1%
2006	0.0106	0.0111	4%	0.0002	0.0004	109%	0.0008	0.0008	1%
2007	0.0114	0.0118	4%	0.0002	0.0004	103%	0.0009	0.0009	1%
2008	0.0129	0.0133	3%	0.0005	0.0008	40%	0.0010	0.0010	1%
2009	0.0070	0.0075	7%	0.0002	0.0004	109%	0.0005	0.0005	2%
2010	0.0080	0.0083	5%	0.0002	0.0003	108%	0.0006	0.0006	1%
2011	0.0052	0.0056	7%	0.0002	0.0004	98%	0.0005	0.0005	-2%
2012	0.0442	0.0445	1%	0.0188	0.0189	1%	0.0014	0.0014	0.42%
2013	0.0522	0.0524	1%	0.0232	0.0233	1%	0.0017	0.0016	-2%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2014	0.0572	0.0575	1%	0.0259	0.0260	1%	0.0016	0.0016	0.40%
2016	0.0578	0.0578	0.01%	0.0257	0.0257	0.00%	0.0017	0.0017	0.41%
2017	0.0747	0.0747	0.01%	0.0339	0.0339	0.00%	0.0021	0.0021	1%
2021	0.0247	0.0247	0.03%	0.0107	0.0107	0.01%	0.0009	0.0009	7%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1991	0.0107	0.0107	0.00%	0.0371	0.0372	0.13%	0.0383	0.0383	0.03%
1992	0.0090	0.0090	0.01%	0.0312	0.0313	0.27%	0.0321	0.0322	0.07%
1993	0.0075	0.0075	0.01%	0.0261	0.0262	0.44%	0.0268	0.0268	0.11%
1994	0.0061	0.0061	0.02%	0.0216	0.0218	1%	0.0221	0.0221	0.16%
1995	0.0051	0.0051	0.02%	0.0179	0.0180	1%	0.0181	0.0181	0.22%
1996	0.0042	0.0042	0.03%	0.0146	0.0148	1%	0.0147	0.0148	0.30%
1997	0.0034	0.0034	0.04%	0.0120	0.0121	2%	0.0119	0.0119	0.39%
1998	0.0028	0.0028	0.06%	0.0098	0.0099	2%	0.0095	0.0096	1%
1999	0.0023	0.0023	0.07%	0.0080	0.0082	3%	0.0076	0.0077	1%
2000	0.0014	0.0014	0.12%	0.0054	0.0056	4%	0.0046	0.0046	1%
2001	0.0012	0.0012	0.17%	0.0048	0.0051	5%	0.0039	0.0040	2%
2002	0.0009	0.0009	0.21%	0.0036	0.0039	7%	0.0032	0.0032	2%
2003	0.0008	0.0008	0.24%	0.0032	0.0035	8%	0.0026	0.0027	2%
2004	0.0006	0.0006	0.37%	0.0025	0.0028	11%	0.0019	0.0020	4%
2005	0.0005	0.0005	1%	0.0023	0.0026	16%	0.0017	0.0018	5%
2006	0.0005	0.0005	1%	0.0020	0.0024	20%	0.0014	0.0015	7%
2007	0.0005	0.0005	1%	0.0016	0.0020	23%	0.0014	0.0015	7%
2008	0.0006	0.0006	1%	0.0024	0.0028	16%	0.0016	0.0017	6%
2009	0.0003	0.0003	1%	0.0013	0.0017	30%	0.0010	0.0011	11%
2010	0.0004	0.0004	1%	0.0013	0.0016	25%	0.0011	0.0012	8%
2011	0.0003	0.0003	-2%	0.0010	0.0013	32%	0.0007	0.0008	11%
2012	0.0007	0.0007	0.29%	0.0339	0.0342	1%	0.0094	0.0094	1%
2013	0.0008	0.0008	-2%	0.0416	0.0419	1%	0.0112	0.0113	1%
2014	0.0007	0.0007	0.31%	0.0463	0.0466	1%	0.0124	0.0125	1%
2016	0.0007	0.0007	0.10%	0.0461	0.0461	0.01%	0.0124	0.0124	0.01%
2017	0.0009	0.0009	1%	0.0606	0.0606	0.01%	0.0162	0.0162	0.01%
2021	0.0004	0.0005	15%	0.0192	0.0192	0.04%	0.0053	0.0053	0.03%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1991	0.0402	0.0402	0.01%	0.0049	0.0049	0.02%	0.4683	0.4693	0.22%
1992	0.0346	0.0346	0.02%	0.0041	0.0041	0.04%	0.3932	0.3951	0.48%
1993	0.0299	0.0299	0.03%	0.0034	0.0034	0.07%	0.3275	0.3300	1%
1994	0.0260	0.0260	0.05%	0.0028	0.0028	0.11%	0.2704	0.2735	1%
1995	0.0227	0.0227	0.06%	0.0023	0.0023	0.14%	0.2216	0.2250	2%
1996	0.0201	0.0201	0.07%	0.0019	0.0019	0.19%	0.1801	0.1838	2%
1997	0.0180	0.0180	0.09%	0.0015	0.0015	0.25%	0.1453	0.1493	3%
1998	0.0163	0.0164	0.10%	0.0012	0.0012	0.33%	0.1166	0.1208	4%
1999	0.0150	0.0150	0.12%	0.0010	0.0010	0.44%	0.0933	0.0978	5%
2000	0.0178	0.0178	0.10%	0.0006	0.0006	1%	0.0546	0.0589	8%
2001	0.0175	0.0175	0.12%	0.0005	0.0005	1%	0.0467	0.0522	12%
2002	0.0100	0.0101	0.21%	0.0004	0.0004	1%	0.0388	0.0442	14%
2003	0.0108	0.0108	0.20%	0.0003	0.0004	2%	0.0324	0.0378	17%

YEAR	Ni [t]			Se [t]			Zn [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2004	0.0100	0.0100	0.24%	0.0003	0.0003	2%	0.0240	0.0301	26%
2005	0.0087	0.0087	0.36%	0.0002	0.0002	3%	0.0219	0.0298	36%
2006	0.0086	0.0086	0.39%	0.0002	0.0002	4%	0.0184	0.0271	47%
2007	0.0030	0.0030	1%	0.0002	0.0002	4%	0.0195	0.0277	42%
2008	0.0034	0.0034	1%	0.0002	0.0003	3%	0.0340	0.0424	25%
2009	0.0051	0.0051	1%	0.0001	0.0002	6%	0.0151	0.0238	58%
2010	0.0042	0.0042	1%	0.0002	0.0002	4%	0.0148	0.0218	48%
2011	0.0026	0.0026	1%	0.0002	0.0002	-12%	0.0140	0.0205	47%
2012	0.0056	0.0056	0.37%	0.0011	0.0011	0.48%	0.7494	0.7547	1%
2013	0.0058	0.0058	0.11%	0.0015	0.0015	-4%	0.9252	0.9300	1%
2014	0.0063	0.0063	0.35%	0.0014	0.0014	0.38%	1.0291	1.0347	1%
2016	0.0061	0.0061	0.09%	0.0015	0.0015	1%	1.0220	1.0223	0.03%
2017	0.0066	0.0066	0.14%	0.0019	0.0019	2%	1.3474	1.3479	0.04%
2021	0.0025	0.0025	0.36%	0.0009	0.0009	4%	0.4286	0.4291	0.10%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1991	0.4526	0.4528	0.05%	0.3093	0.3094	0.02%
1992	0.3798	0.3802	0.10%	0.2596	0.2598	0.05%
1993	0.3161	0.3166	0.16%	0.2161	0.2162	0.08%
1994	0.2606	0.2612	0.23%	0.1770	0.1772	0.12%
1995	0.2137	0.2143	0.31%	0.1480	0.1483	0.16%
1996	0.1737	0.1744	0.42%	0.1222	0.1224	0.21%
1997	0.1400	0.1407	1%	0.0993	0.0996	0.28%
1998	0.1122	0.1131	1%	0.0810	0.0812	0.36%
1999	0.0895	0.0904	1%	0.0647	0.0650	0.47%
2000	0.0518	0.0527	2%	0.0383	0.0386	1%
2001	0.0440	0.0451	2%	0.0331	0.0334	1%
2002	0.0364	0.0375	3%	0.0269	0.0273	1%
2003	0.0302	0.0313	4%	0.0235	0.0239	2%
2004	0.0219	0.0231	5%	0.0174	0.0178	2%
2005	0.0194	0.0210	8%	0.0154	0.0159	4%
2006	0.0162	0.0179	10%	0.0152	0.0158	4%
2007	0.0174	0.0190	9%	0.0155	0.0161	4%
2008	0.0197	0.0214	8%	0.0158	0.0164	4%
2009	0.0112	0.0129	15%	0.0117	0.0123	5%
2010	0.0126	0.0140	11%	0.0138	0.0142	3%
2011	0.0091	0.0104	14%	0.0179	0.0160	-11%
2012	0.1534	0.1544	1%	0.0785	0.0788	0%
2013	0.1861	0.1871	0.50%	0.1093	0.1054	-4%
2014	0.2058	0.2069	1%	0.1025	0.1028	0.38%
2016	0.2052	0.2053	0.02%	0.1066	0.1080	1%
2017	0.2685	0.2686	0.04%	0.1336	0.1360	2%
2021	0.0880	0.0883	0.35%	0.0622	0.0656	6%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1991	0.0015	0.0015	1%	0.4108	0.4108	0.00%
1992	0.0013	0.0013	1%	0.3446	0.3446	0.00%
1993	0.0011	0.0011	2%	0.2867	0.2867	0.00%

YEAR	HCB [kg]			PCB [kg]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1994	0.0009	0.0009	3%	0.2365	0.2365	0.00%
1995	0.0007	0.0008	5%	0.1933	0.1933	0.00%
1996	0.0006	0.0006	6%	0.1567	0.1567	0.00%
1997	0.0005	0.0005	8%	0.1261	0.1261	0.00%
1998	0.0004	0.0004	11%	0.1007	0.1007	0.00%
1999	0.0003	0.0004	14%	0.0802	0.0802	0.00%
2000	0.0002	0.0002	23%	0.0459	0.0459	0.00%
2001	0.0002	0.0002	34%	0.0386	0.0386	0.00%
2002	0.0001	0.0002	39%	0.0322	0.0322	0.00%
2003	0.0001	0.0002	47%	0.0264	0.0264	0.00%
2004	0.0001	0.0001	68%	0.0188	0.0188	0.00%
2005	0.0001	0.0002	91%	0.0166	0.0166	0.00%
2006	0.0001	0.0002	112%	0.0133	0.0133	0.00%
2007	0.0001	0.0002	102%	0.0147	0.0147	0.00%
2008	0.0002	0.0003	38%	0.0169	0.0169	0.00%
2009	0.0001	0.0002	112%	0.0084	0.0084	0.01%
2010	0.0001	0.0001	112%	0.0097	0.0097	0.00%
2011	0.0001	0.0001	100%	0.0062	0.0062	0.01%
2012	0.0072	0.0073	1%	0.0065	0.0065	0.00%
2013	0.0089	0.0090	1%	0.0050	0.0050	0.01%
2014	0.0100	0.0100	1%	0.0040	0.0040	0.01%
2021	0.0041	0.0041	0.00%	0.0025	0.0025	0.00%

3.7.10 Other, Mobile (including military, land based and recreational boats) (NFR 1A5b)

3.7.10.1 Overview

This category was first time reported in the year 2018. Total fuel consumption was 115.91 TJ in 2022. This consumption includes petrol, diesel oil and jet fuel. Emissions of mobile combustion in the military are shown in ***Table 3.136***.

Table 3.136: *Overview of emissions in the category 1A5b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]	Pb [t]
1990	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1995	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2000	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2005	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2010	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2011	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2012	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2013	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2014	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2015	0.0773	0.0004	0.0045	2.4E-07	0.0004	0.0004	0.0004	0.0002	0.0337	1.6E-10
2016	0.0779	0.0004	0.0045	2.1E-07	0.0005	0.0005	0.0005	0.0002	0.0339	1.6E-10
2017	0.0724	0.0004	0.0042	1.8E-07	0.0004	0.0004	0.0004	0.0002	0.0315	1.5E-10
2018	0.0564	0.0003	0.0033	1.9E-07	0.0003	0.0003	0.0003	0.0002	0.0246	1.6E-10
2019	0.0502	0.0003	0.0029	1.8E-07	0.0003	0.0003	0.0003	0.0001	0.0219	1.6E-10
2020	0.0495	0.0003	0.0029	5.8E-08	0.0003	0.0003	0.0003	0.0001	0.0215	1.0E-10

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]	Pb [t]
2021	0.0495	0.0003	0.0029	8.8E-08	0.0003	0.0003	0.0003	0.0001	0.0215	1.1E-10
2022	0.0385	0.0002	0.0022	1.3E-07	0.0002	0.0002	0.0002	0.0001	0.0168	1.4E-10
1990/2022	-	-	-	-	-	-	-	-	-	-
2021/2022	**-22%**	**-21%**	**-22%**	**48%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**20%**

3.7.10.2 Methodological issues

For the emission estimation, GBEMEP/EEA_{2023} Tier 1 emission factors were used. Data are provided directly by the Ministry of Defence of the Slovak Republic (MoD) and include only fuels used for military purposes. Fuels used for passenger transport of the MoD are excluded from this category and are included in category ***1A3b*** Road transport.

3.7.10.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB_{2023}.

3.7.10.4 Source-specific recalculations

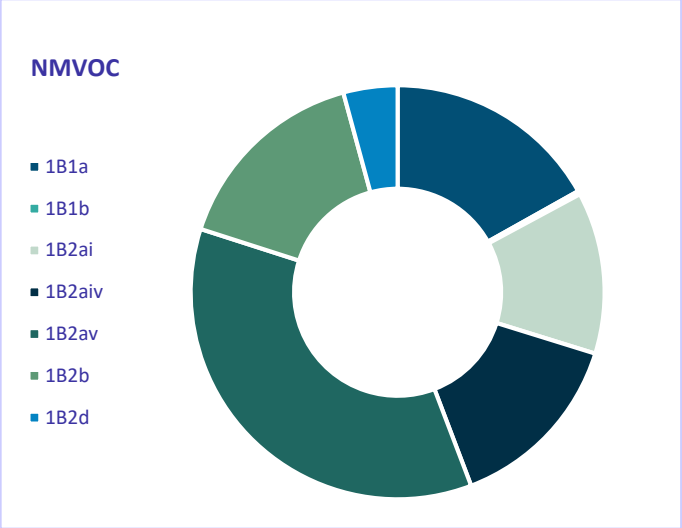
No recalculations in this submission.

3.8 FUGITIVE EMISSIONS (NFR 1B)

3.8.1 Overview

This chapter covers emissions from leaks and other irregular releases of gases or vapours from a pressurized containment, such as appliances, storage tanks, pipelines, wells, or other pieces of equipment mostly from industrial activities. Categories included in the chapter are fugitive emission (**1B**) from solid fuels: Coal mining and handling (**1B1a**), Fugitive emission from solid fuels: Solid fuel transformation (**1B1b**), Fugitive emissions oil: Exploration, production, transport (**1B2ai**), Fugitive emissions oil: Refining/storage (**1B2aiv**), Distribution of oil products (**1B2av**) and Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) (**1B2b**). Fugitive emissions are an important source of NMVOC emissions.
The trend is steadily decreasing as an outcome of the introduction of new technologies, methodologies and closing part of mines. Fugitive emissions from the transport and distribution of fossil fuels (oil and natural gas) are significant because Slovakia is an important transit country for oil and natural gas from East-European countries to the European Union. Raw materials are transported through high-pressure pipelines and distribution networks and are pumped by pipeline compressors. The trend in fugitive emissions from the transport and distribution of oil and natural gas in the Slovak Republic was stabilized and since 2000 slightly decreased. The increase in the past was caused by the expansion of the distribution system for natural gas and the growth of its consumption. Since 2000, fugitive emissions from oil have decreased due to the decrease in production and distribution. The share of emissions of NMVOC from each category is presented in ***Figure 3.10***.

Figure 3.10: *Share of emissions of NMVOC in 1B in 2022*



3.8.2 Fugitive emission from solid fuels: Coal mining and handling (NFR 1B1a)

3.8.1.1 Overview

The category reports the emissions of NMVOC and particulates from mining activities. This category is a key category for emissions of NMVOC and TSP. Emissions in this category have a decreasing trend due to the decrease in activity in the Slovak Republic. The overview of the emissions and activity data is shown in ***Table 3.137***.

Table 3.137: *Overview of emissions and activity data in the category 1B1a*

YEAR	COAL PRODUCED [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]]	TSP [kt]
1990	3.46	2.7648	0.0173	0.1452	0.3076
1995	3.66	3.0073	0.0188	0.1579	0.3346
2000	3.80	2.9194	0.0182	0.1533	0.3248
2005	3.61	2.0090	0.0126	0.1055	0.2235
2010	3.74	1.9020	0.0119	0.0999	0.2116
2011	3.76	1.9008	0.0119	0.0998	0.2115
2012	3.91	1.8338	0.0115	0.0963	0.2040
2013	3.91	1.8822	0.0118	0.0988	0.2094
2014	3.95	1.7502	0.0109	0.0919	0.1947
2015	3.81	1.5515	0.0097	0.0815	0.1726
2016	3.65	1.4777	0.0092	0.0776	0.1644
2017	3.42	1.4672	0.0092	0.0770	0.1632
2018	3.40	1.2016	0.0075	0.0631	0.1337
2019	3.08	1.2016	0.0075	0.0631	0.1337
2020	2.95	0.7844	0.0049	0.0412	0.0873
2021	2.51	0.8593	0.0054	0.0451	0.0956
2022	2.21	0.6948	0.0043	0.0365	0.0773
1990/2022	**-36%**	**-75%**	**-75%**	**-75%**	**-75%**
2021/2022	**-12%**	**-19%**	**-19%**	**-19%**	**-19%**

3.8.1.2 Methodological issues

Tier 1 emission factors for Underground mining from EMEP/EEA GB_{2023} were used for calculations of NMVOC, TSP and PM emissions (***Table 3.138***).

Table 3.138: Emission factors in the category 1B1a

T1	UNIT	EF
NMVOC	[kg/Mg coal]	0.8
$PM_{2.5}$	[kg/Mg coal]	0.005
PM_{10}	[kg/Mg coal]	0.042
TSP	[kg/Mg coal]	0.089

3.8.1.3 Completeness

Notation keys were used following EMEP/EEA GB_{2023}.

3.8.1.4 Source-specific recalculations

Revised emission factors were used based on improper use of T2 emission factors in previous submissions and updated emission factor for NMVOC based on the 2019 IPCC Refinements to the 2006 IPCC Guidelines. The results of the recalculations are in *Table 3.139*.

Table 3.139: Previous and revised emissions in the category 1B1a

YEAR	NMVOC [kt]			$PM_{2.5}$ [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	10.3680	2.7648	-73%	0.1382	0.0173	-88%
1991	10.9890	2.9304	-73%	0.1465	0.0183	-88%
1992	11.4105	3.0428	-73%	0.1521	0.0190	-88%
1993	10.8429	2.8914	-73%	0.1446	0.0181	-88%
1994	11.2344	2.9958	-73%	0.1498	0.0187	-88%
1995	11.2773	3.0073	-73%	0.1504	0.0188	-88%
1996	11.7426	3.1314	-73%	0.1566	0.0196	-88%
1997	11.7426	3.1314	-73%	0.1566	0.0196	-88%
1998	11.8530	3.1608	-73%	0.1580	0.0198	-88%
1999	11.4195	3.0452	-73%	0.1523	0.0190	-88%
2000	10.9479	2.9194	-73%	0.1460	0.0182	-88%
2001	10.2720	2.7392	-73%	0.1370	0.0171	-88%
2002	10.2030	2.7208	-73%	0.1360	0.0170	-88%
2003	9.2257	2.4602	-73%	0.1230	0.0154	-88%
2004	8.8556	2.3615	-73%	0.1181	0.0148	-88%
2005	7.5336	2.0090	-73%	0.1004	0.0126	-88%
2006	6.6188	1.7650	-73%	0.0883	0.0110	-88%
2007	6.1934	1.6516	-73%	0.0826	0.0103	-88%
2008	7.2692	1.9385	-73%	0.0969	0.0121	-88%
2009	7.7157	2.0575	-73%	0.1029	0.0129	-88%
2010	7.1326	1.9020	-73%	0.0951	0.0119	-88%
2011	7.1281	1.9008	-73%	0.0950	0.0119	-88%
2012	6.8766	1.8338	-73%	0.0917	0.0115	-88%
2013	7.0582	1.8822	-73%	0.0941	0.0118	-88%
2014	6.5632	1.7502	-73%	0.0875	0.0109	-88%
2015	5.8180	1.5515	-73%	0.0776	0.0097	-88%
2016	5.5414	1.4777	-73%	0.0739	0.0092	-88%
2017	5.5020	1.4672	-73%	0.0734	0.0092	-88%
2018	4.5060	1.2016	-73%	0.0601	0.0075	-88%
2019	4.2930	1.2016	-72%	0.0572	0.0075	-87%
2020	2.9415	0.7844	-73%	0.0392	0.0049	-88%
2021	3.2223	0.8593	-73%	0.0430	0.0054	-88%

YEAR	PM_{10} [kt]			TSP [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.9677	0.1452	-85%	2.0390	0.3076	-85%
1991	1.0256	0.1538	-85%	2.1612	0.3260	-85%
1992	1.0650	0.1597	-85%	2.2441	0.3385	-85%
1993	1.0120	0.1518	-85%	2.1324	0.3217	-85%
1994	1.0485	0.1573	-85%	2.2094	0.3333	-85%
1995	1.0525	0.1579	-85%	2.2179	0.3346	-85%
1996	1.0960	0.1644	-85%	2.3094	0.3484	-85%
1997	1.0960	0.1644	-85%	2.3094	0.3484	-85%
1998	1.1063	0.1659	-85%	2.3311	0.3516	-85%
1999	1.0658	0.1599	-85%	2.2458	0.3388	-85%
2000	1.0218	0.1533	-85%	2.1531	0.3248	-85%
2001	0.9587	0.1438	-85%	2.0202	0.3047	-85%
2002	0.9523	0.1428	-85%	2.0066	0.3027	-85%
2003	0.8611	0.1292	-85%	1.8144	0.2737	-85%
2004	0.8265	0.1240	-85%	1.7416	0.2627	-85%
2005	0.7031	0.1055	-85%	1.4816	0.2235	-85%
2006	0.6178	0.0927	-85%	1.3017	0.1964	-85%
2007	0.5781	0.0867	-85%	1.2180	0.1837	-85%
2008	0.6785	0.1018	-85%	1.4296	0.2157	-85%
2009	0.7201	0.1080	-85%	1.5174	0.2289	-85%
2010	0.6657	0.0999	-85%	1.4027	0.2116	-85%
2011	0.6653	0.0998	-85%	1.4019	0.2115	-85%
2012	0.6418	0.0963	-85%	1.3524	0.2040	-85%
2013	0.6588	0.0988	-85%	1.3881	0.2094	-85%
2014	0.6126	0.0919	-85%	1.2908	0.1947	-85%
2015	0.5430	0.0815	-85%	1.1442	0.1726	-85%
2016	0.5172	0.0776	-85%	1.0898	0.1644	-85%
2017	0.5135	0.0770	-85%	1.0821	0.1632	-85%
2018	0.4206	0.0631	-85%	0.8862	0.1337	-85%
2019	0.4007	0.0631	-84%	0.8443	0.1337	-84%
2020	0.2745	0.0412	-85%	0.5785	0.0873	-85%
2021	0.3007	0.0451	-85%	0.6337	0.0956	-85%

3.8.2 Fugitive emission from solid fuels: Solid fuel transformation (NFR 1B1b)

3.8.2.1 Overview

Production of coke shows a slightly decreasing trend that reflects also the emissions within this category. This category is key for emissions of PM_{10}, Ni and PCDD/F.

An overview of the emissions is shown in ***Table 3.140***.

Table 3.140: *Overview of emissions and activity data in the category 1B1b*

YEAR	SOLID FUEL TRANSFORMED [Mt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	2.34	0.0021	0.0180	0.0019	0.0087	0.1427	0.3416	0.8120	0.0699	1.0764
1995	1.86	0.0019	0.0143	0.0015	0.0069	0.1131	0.2707	0.6433	0.0554	1.5128
2000	1.60	0.0018	0.0123	0.0013	0.0059	0.0974	0.2332	0.5541	0.0477	1.8346
2005	1.79	0.0049	0.0134	0.0014	0.0064	0.1061	0.2540	0.6038	0.052	11.3604
2010	1.55	0.0016	0.0119	0.0012	0.0057	0.0946	0.2263	0.5379	0.0463	1.3774
2011	1.52	0.0017	0.0117	0.0012	0.0056	0.0927	0.2219	0.5274	0.0454	1.6298
2012	1.47	0.0016	0.0113	0.0012	0.0054	0.0897	0.2146	0.5101	0.0439	1.6222

YEAR	SOLID FUEL TRANSFORMED [Mt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2013	1.44	0.0016	0.0111	0.0012	0.0053	0.0878	0.2102	0.4997	0.043	1.5424
2014	1.47	0.0016	0.0113	0.0012	0.0054	0.0897	0.2146	0.5101	0.0439	1.6002
2015	1.53	0.0017	0.0118	0.0012	0.0057	0.0933	0.2234	0.5309	0.0457	1.5838
2016	1.54	0.0015	0.0119	0.0012	0.0057	0.0939	0.2248	0.5344	0.046	1.0267
2017	1.49	0.0016	0.0115	0.0012	0.0055	0.0909	0.2175	0.5170	0.0445	1.5654
2018	1.50	0.0016	0.0116	0.0012	0.0056	0.0915	0.2190	0.5205	0.0448	1.5920
2019	1.32	0.0015	0.0102	0.0011	0.0049	0.0805	0.1927	0.4580	0.0395	1.4872
2020	1.11	0.0013	0.0085	0.0009	0.0041	0.0677	0.1621	0.3852	0.0332	1.3466
2021	1.63	0.0017	0.0125	0.0013	0.0060	0.0992	0.2374	0.5642	0.0486	1.6280
2022	1.45	0.0016	0.0112	0.0012	0.0054	0.0885	0.2117	0.5032	0.0433	1.5470
1990/2022	**-38%**	**-25%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**44%**
2021/2022	**-11%**	**-9%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-5%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.8892	0.0164	0.0281	0.0304	0.3978	0.1123	0.2808	0.0374	0.5148
1995	0.7045	0.0130	0.0222	0.0241	0.3152	0.0890	0.2225	0.0297	0.4079
2000	0.6068	0.0112	0.0192	0.0208	0.2715	0.0767	0.1916	0.0256	0.3513
2005	0.6612	0.0122	0.0209	0.0226	0.2958	0.0835	0.2088	0.0278	0.3828
2010	0.5890	0.0109	0.0186	0.0202	0.2635	0.0744	0.1860	0.0248	0.3410
2011	0.5776	0.0106	0.0182	0.0198	0.2584	0.0730	0.1824	0.0243	0.3344
2012	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764	0.0235	0.3234
2013	0.5472	0.0101	0.0173	0.0187	0.2448	0.0691	0.1728	0.0230	0.3168
2014	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764	0.0235	0.3234
2015	0.5814	0.0107	0.0184	0.0199	0.2601	0.0734	0.1836	0.0245	0.3366
2016	0.5852	0.0108	0.0185	0.0200	0.2618	0.0739	0.1848	0.0246	0.3388
2017	0.5662	0.0104	0.0179	0.0194	0.2533	0.0715	0.1788	0.0238	0.3278
2018	0.5700	0.0105	0.0180	0.0195	0.2550	0.0720	0.1800	0.0240	0.3300
2019	0.5016	0.0092	0.0158	0.0172	0.2244	0.0634	0.1584	0.0211	0.2904
2020	0.4218	0.0078	0.0133	0.0144	0.1887	0.0533	0.1332	0.0178	0.2442
2021	0.6179	0.0114	0.0195	0.0211	0.2764	0.0780	0.1951	0.0260	0.3577
2022	0.5510	0.0102	0.0174	0.0189	0.2465	0.0696	0.1740	0.0232	0.3190
1990/2022	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**
2021/2022	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	7.0200	0.3744	0.4680	0.2340	0.1638	1.2402
1995	5.5620	0.2966	0.3708	0.1854	0.1298	0.9826
2000	4.7908	0.2555	0.3194	0.1597	0.1118	0.8464
2005	5.2200	0.2784	0.3480	0.1740	0.1218	0.9222
2010	4.6500	0.2480	0.3100	0.1550	0.1085	0.8215
2011	4.5600	0.2432	0.3040	0.1520	0.1064	0.8056
2012	4.4100	0.2352	0.2940	0.1470	0.1029	0.7791
2013	4.3200	0.2304	0.2880	0.1440	0.1008	0.7632
2014	4.4100	0.2352	0.2940	0.1470	0.1029	0.7791
2015	4.5900	0.2448	0.3060	0.1530	0.1071	0.8109
2016	4.6200	0.2464	0.3080	0.1540	0.1078	0.8162
2017	4.4700	0.2384	0.2980	0.1490	0.1043	0.7897
2018	4.5000	0.2400	0.3000	0.1500	0.1050	0.7950
2019	3.9600	0.2112	0.2640	0.1320	0.0924	0.6996
2020	3.3300	0.1776	0.2220	0.1110	0.0777	0.5883

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
2021	4.8780	0.2602	0.3252	0.1626	0.1138	0.8618
2022	4.3500	0.2320	0.2900	0.1450	0.1015	0.7685
1990/2022	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**	**-38%**
2021/2022	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**	**-11%**

3.8.2.2 Methodological issues

The category reports all emissions according to the method of EMEP/EEA GB$_{2023}$. Default emission factors were used for the calculation of the emissions (***Table 3.141***).

Table 3.141: *Default EF used in fugitive emission from solid fuels transformation*

T1 (coke)	UNIT	EF
NOx	g/Mg coke	0.9
NMVOC	g/Mg coke	7.7
SOx	g/Mg coke	0.8
NH_3	g/Mg coke	3.7
$PM_{2.5}$	g/Mg coke	61
PM_{10}	g/Mg coke	146
TSP	g/Mg coke	347
BC	% $PM_{2.5}$	0.49
CO	g/Mg coke	460
Pb	g/Mg coke	0.38
Cd	g/Mg coke	0.007
Hg	g/Mg coke	0.012
As	g/Mg coke	0.013
Cr	g/Mg coke	0.17
Cu	g/Mg coke	0.048
Ni	g/Mg coke	0.12
Se	g/Mg coke	0.016
Zn	g/Mg coke	0.22
PCDD/F	µg I-TEQ/Mg coke	3
B(a)P	g/Mg coke	0.16
B(b)F	g/Mg coke	0.2
B(k)F	g/Mg coke	0.1
I()P	g/Mg coke	0.07
PAHs	g/Mg coke	0.53

T1 (charcoal)	UNIT	EF
NOx	kg/t	0.07
CO	kg/t	220

3.8.2.3 Completeness

The emissions of HCB and PCB are reported with notation key NE.

3.8.2.4 Source-specific recalculations

In 1993, additional emissions were introduced due to changes in charcoal production activities. These alterations in activity resulted in increased emissions of nitrogen oxides (NOx) and carbon monoxide (CO). The results of the recalculations are in ***Table 3.142***.

***Table 3.142**: Previous and revised emissions in the category 1B1b*

YEAR	SOLID FUEL TRANSFORMED [Mt]			NOx [kt]			CO [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1993	2.05	2.05	0.15%	0.0018	0.0021	11%	0.9423	1.6023	70%
1994	1.95	1.95	0.15%	0.0018	0.0020	12%	0.8976	1.5576	74%
1995	1.85	1.86	0.16%	0.0017	0.0019	13%	0.8528	1.5128	77%
1996	1.79	1.80	0.17%	0.0016	0.0018	13%	0.8243	1.4843	80%
1997	1.73	1.73	0.17%	0.0016	0.0018	13%	0.7958	1.4558	83%
1998	1.42	1.42	0.21%	0.0013	0.0015	16%	0.6538	1.3138	101%
1999	1.51	1.52	0.26%	0.0014	0.0016	21%	0.6956	1.5756	127%
2000	1.60	1.60	0.31%	0.0014	0.0018	24%	0.7346	1.8346	150%
2001	1.60	1.60	0.38%	0.0014	0.0019	29%	0.7350	2.0550	180%
2002	1.70	1.74	2%	0.0015	0.0044	188%	0.7819	9.8019	1154%
2003	1.78	1.82	3%	0.0016	0.0048	197%	0.8185	10.7185	1210%
2004	1.78	1.82	3%	0.0016	0.0048	201%	0.8176	10.9376	1238%
2005	1.74	1.79	3%	0.0016	0.0049	215%	0.8004	11.3604	1319%
2006	1.74	1.82	5%	0.0016	0.0074	371%	0.8004	19.0604	2281%
2007	1.74	1.82	5%	0.0016	0.0074	375%	0.8004	19.2804	2309%
2008	1.63	1.72	5%	0.0015	0.0074	406%	0.7498	19.4498	2494%
2009	1.48	1.56	5%	0.0013	0.0069	420%	0.6808	18.2808	2585%
2010	1.55	1.55	0.19%	0.0014	0.0016	15%	0.7130	1.3774	93%
2011	1.52	1.52	0.28%	0.0014	0.0017	22%	0.6992	1.6298	133%
2012	1.47	1.47	0.29%	0.0013	0.0016	23%	0.6762	1.6222	140%
2013	1.44	1.44	0.28%	0.0013	0.0016	22%	0.6624	1.5424	133%
2014	1.47	1.47	0.29%	0.0013	0.0016	22%	0.6762	1.6002	137%
2015	1.53	1.53	0.26%	0.0014	0.0017	20%	0.7038	1.5838	125%
2016	1.54	1.54	0.09%	0.0014	0.0015	7%	0.7084	1.0267	45%
2017	1.49	1.49	0.27%	0.0013	0.0016	21%	0.6854	1.5654	128%
2018	1.50	1.50	0.27%	0.0014	0.0016	21%	0.6900	1.5920	131%
2019	1.32	1.32	0.30%	0.0012	0.0015	24%	0.6072	1.4872	145%
2020	1.11	1.11	0.34%	0.0010	0.0013	27%	0.5106	1.3466	164%
2021	1.63	1.63	0.25%	0.0015	0.0017	19%	0.7480	1.6280	118%

3.8.3 Fugitive emissions from solid fuels (NFR 1B1c)

There is no activity in the Slovak Republic, the notation key NO is used.

3.8.4 Fugitive emissions oil: Exploration, production, transport (NFR 1B2ai)

3.8.4.1 Overview

The category reports only NMVOC emissions. The definition of included activities is shown in ***Table 3.143***.

***Table 3.143:** Activities according to national categorization included in 1B2ai*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.2. Oil extraction and related transport and storage

The overview of emissions and activity data is shown in ***Table 3.144***. The production and transportation of crude oil show a decreasing trend since 1990. The production of oil from domestic sources is negligible in the Slovak Republic and the major share of these stocks comes from imports.

Table 3.144: Overview of emissions and activity data in the category 1B2ai

YEAR	CRUDE OIL PRODUCED AND TRANSPORTED [Mt]	NMVOC [kt]
1990	13.65	0.8248
1995	13.66	0.8262
2000	9.36	0.5760
2005	10.69	0.6145
2010	10.09	0.5604
2011	9.94	0.5550
2012	8.43	0.4689
2013	9.80	0.5410
2014	8.95	0.4942
2015	9.94	0.5483
2016	9.18	0.5057
2017	9.59	0.5247
2018	9.47	0.5173
2019	9.00	0.4913
2020	9.98	0.5413
2021	8.82	0.4819
2022	9.60	0.5208
1990/2022	**-30%**	**-37%**
2021/2022	**9%**	**8%**

3.8.4.2 Methodological issues

For the calculation of NMVOC emissions is used data from the Statistical Office of the Slovak Republic and directly from producers. Calculation of the fugitive NMVOC emissions is based on EFs provided in the 2006 IPCC GL. These EFs are providing more detailed calculations on Tier 1 as there are provided separately EFs for exploration, production and transport. Also, this change harmonizes emission estimation with GHG emissions. These EFs are shown in ***Table 3.145***. EFs for land exploration and production of crude oil in developed countries are used. Conservative approach was used and the upper limit of EFs is used.

Table 3.145: Overview of emission factors for exploration, production and transport of crude oil

EMISSION	CRUDE OIL PRODUCED [Gg/10^3 m^3 oil]	CRUDE OIL PRODUCED [Gg/10^3 m^3 oil]
NMVOC (high)	0.0045	0.000054
Uncertainty	-100% to 800%	-50% to 200%

3.8.4.3 Completeness

Notation key of NA is used for the emissions of main pollutants except SOx and PCDD/F where notation key NE is used in compliance with the EMEP/EEA GB_{2023}.

The verification process in category **1B2ai** is based on cross-checking the input data from the supplier companies Nafta, a. s. and Transpetrol, a. s. with the statistics from the Ministry of Economy of the Slovak Republic and the Statistical Office of the Slovak Republic.

For the inventory preparation and verification of the currently used methodology, the fugitive emissions were estimated also with the use of data provided directly by (bottom-up approach):

- Nafta, a.s.; is the exclusive company responsible for oil and NG production in Slovakia,
- Statistical Office of the Slovak Republic.

3.8.4.4 Source-specific recalculations

New emissions factors for NMVOC based on the 2019 Refinements to the 2006 IPCC GL were introduced. The results of the recalculations are in ***Table 3.146***.

Table 3.146: *Previous and revised emissions in the category 1B2ai*

YEAR	NMVOC [kt]		
	PREVIOUS	REVISED	CHANGE
1990	1.0625	0.8248	-22%
1991	1.0552	0.8228	-22%
1992	1.0102	0.8103	-20%
1993	1.0326	0.8165	-21%
1994	1.0358	0.8174	-21%
1995	1.0675	0.8262	-23%
1996	0.9976	0.7658	-23%
1997	0.8869	0.6789	-23%
1998	0.8689	0.6739	-22%
1999	0.8586	0.6441	-25%
2000	0.7677	0.5760	-25%
2001	0.7633	0.5845	-23%
2002	0.7441	0.5751	-23%
2003	0.7252	0.5887	-19%
2004	0.7285	0.6050	-17%
2005	0.7153	0.6145	-14%
2006	0.7279	0.6369	-13%
2007	0.7004	0.6094	-13%
2008	0.6565	0.5980	-9%
2009	0.6445	0.5958	-8%
2010	0.6029	0.5604	-7%
2011	0.6051	0.5550	-8%
2012	0.5061	0.4689	-7%
2013	0.5735	0.5410	-6%
2014	0.5234	0.4942	-6%
2015	0.5795	0.5483	-5%
2016	0.5329	0.5057	-5%
2017	0.5434	0.5247	-3%
2018	0.5340	0.5173	-3%
2019	0.5054	0.4913	-3%
2020	0.5480	0.5413	-1%
2021	0.4967	0.4819	-3%

3.8.5 Fugitive emissions oil: Refining/storage (NFR 1B2aiv)

3.8.5.1 Overview

An overall trend of activity data is shown in ***Table 3.147***. Emissions in this category show a decreasing trend which is connected with a decrease in activity.

Table 3.147: *Overview of emissions and activity data in the category 1B2aiv*

YEAR	CRUDE OIL REFINED [Mt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	6.22	0.2177	0.6843	1.5242	0.0124	0.0311	0.0373	0.2551
1995	5.17	0.1809	0.5685	1.2663	0.0103	0.0258	0.0310	0.2119
2000	5.44	0.1905	0.5986	1.3333	0.0109	0.0272	0.0327	0.2231
2005	5.60	0.1959	0.6158	1.3715	0.0112	0.0280	0.0336	0.2295
2010	5.45	0.1909	0.5998	1.3360	0.0109	0.0273	0.0327	0.2236
2011	5.99	0.2097	0.6590	1.4678	0.0120	0.0300	0.0359	0.2456
2012	5.40	0.1890	0.5939	1.3228	0.0108	0.0270	0.0324	0.2214

YEAR	CRUDE OIL REFINED [Mt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2013	5.87	0.2055	0.6458	1.4384	0.0117	0.0294	0.0352	0.2407
2014	5.22	0.1827	0.5742	1.2789	0.0104	0.0261	0.0313	0.2140
2015	5.95	0.2084	0.6550	1.4589	0.0119	0.0298	0.0357	0.2441
2016	5.74	0.2008	0.6312	1.4058	0.0115	0.0287	0.0344	0.2353
2017	5.56	0.1945	0.6113	1.3615	0.0111	0.0278	0.0333	0.2278
2018	5.46	0.1910	0.6003	1.3371	0.0109	0.0273	0.0327	0.2238
2019	5.11	0.1788	0.5620	1.2517	0.0102	0.0255	0.0307	0.2095
2020	6.44	0.2253	0.7082	1.5773	0.0129	0.0322	0.0386	0.2640
2021	5.51	0.1927	0.6058	1.3492	0.0110	0.0275	0.0330	0.2258
2022	5.40	0.1890	0.5940	1.3230	0.0108	0.0270	0.0324	0.2214
1990/2022	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**
2021/2022	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	PCDD/F [g I-TEQ]
1990	0.0187	0.0031	0.0037	0.0006	0.0006	0.0075	0.0330	0.0006	0.0062	0.0075
1995	0.0155	0.0026	0.0031	0.0005	0.0005	0.0062	0.0274	0.0005	0.0052	0.0062
2000	0.0163	0.0027	0.0033	0.0005	0.0005	0.0065	0.0288	0.0005	0.0054	0.0065
2005	0.0168	0.0028	0.0034	0.0006	0.0006	0.0067	0.0297	0.0006	0.0056	0.0067
2010	0.0164	0.0027	0.0033	0.0005	0.0005	0.0065	0.0289	0.0005	0.0055	0.0065
2011	0.0180	0.0030	0.0036	0.0006	0.0006	0.0072	0.0318	0.0006	0.0060	0.0072
2012	0.0162	0.0027	0.0032	0.0005	0.0005	0.0065	0.0286	0.0005	0.0054	0.0065
2013	0.0176	0.0029	0.0035	0.0006	0.0006	0.0070	0.0311	0.0006	0.0059	0.0070
2014	0.0157	0.0026	0.0031	0.0005	0.0005	0.0063	0.0277	0.0005	0.0052	0.0063
2015	0.0179	0.0030	0.0036	0.0006	0.0006	0.0071	0.0316	0.0006	0.0060	0.0071
2016	0.0172	0.0029	0.0034	0.0006	0.0006	0.0069	0.0304	0.0006	0.0057	0.0069
2017	0.0167	0.0028	0.0033	0.0006	0.0006	0.0067	0.0295	0.0006	0.0056	0.0067
2018	0.0164	0.0027	0.0033	0.0005	0.0005	0.0065	0.0289	0.0005	0.0055	0.0065
2019	0.0153	0.0026	0.0031	0.0005	0.0005	0.0061	0.0271	0.0005	0.0051	0.0061
2020	0.0193	0.0032	0.0039	0.0006	0.0006	0.0077	0.0341	0.0006	0.0064	0.0077
2021	0.0165	0.0028	0.0033	0.0006	0.0006	0.0066	0.0292	0.0006	0.0055	0.0066
2022	0.0162	0.0027	0.0032	0.0005	0.0005	0.0065	0.0286	0.0005	0.0054	0.0065
1990/2022	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**	**-13%**
2021/2022	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**

3.8.5.2 Methodological issues

Emission factors used for the calculation of heavy metals and POPs are default EF from EMEP/EEA GB_{2023} (***Table 3.148***).

Table 3.148: *Emission factors in the category 1B2aiv*

T1	UNIT	EF
NOx	kg/Mg crude oil input	0.035
NMVOC	kg/Mg crude oil input	0.11
SOx	kg/Mg crude oil input	0.245
$PM_{2.5}$	kg/Mg crude oil input	0.002
PM_{10}	kg/Mg crude oil input	0.005
TSP	kg/Mg crude oil input	0.006
CO	kg/Mg crude oil input	0.041
Pb	g/Mg crude oil input	0.003
Cd	g/Mg crude oil input	0.0005
Hg	g/Mg crude oil input	0.0006
As	g/Mg crude oil input	0.0001
Cr	g/Mg crude oil input	0.0001
Cu	g/Mg crude oil input	0.0012
Ni	g/Mg crude oil input	0.0053
Se	g/Mg crude oil input	0.0001
Zn	g/Mg crude oil input	0.001
PCDD/F	µg I-TEQ/Mg crude oil input	0.0012

3.8.5.3 Completeness

The data from the NEIS covering fugitive emissions are reported in the chapter on Petroleum refining (NFR **1A1b**), and notation key IE was used. Notation keys for PAHs, HCB and PCBs were used in compliance with EMEP/EEA GB_{2023}.

3.8.5.4 Source-specific recalculations

New emission factors for heavy metals and PCDD/F were introduced based on the EMEP/EEA GB_{2023}. The results of the recalculations are in ***Table 3.149***.

Table 3.149**:** *Previous and revised emissions in the category 1B2aiv*

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0317	0.0187	-41%	0.0317	0.0031	-90%	0.0317	0.0037	-88%
1991	0.0258	0.0152	-41%	0.0258	0.0025	-90%	0.0258	0.0030	-88%
1992	0.0223	0.0131	-41%	0.0223	0.0022	-90%	0.0223	0.0026	-88%
1993	0.0218	0.0128	-41%	0.0218	0.0021	-90%	0.0218	0.0026	-88%
1994	0.0245	0.0144	-41%	0.0245	0.0024	-90%	0.0245	0.0029	-88%
1995	0.0264	0.0155	-41%	0.0264	0.0026	-90%	0.0264	0.0031	-88%
1996	0.0268	0.0158	-41%	0.0268	0.0026	-90%	0.0268	0.0032	-88%
1997	0.0272	0.0160	-41%	0.0272	0.0027	-90%	0.0272	0.0032	-88%
1998	0.0278	0.0164	-41%	0.0278	0.0027	-90%	0.0278	0.0033	-88%
1999	0.0277	0.0163	-41%	0.0277	0.0027	-90%	0.0277	0.0033	-88%
2000	0.0278	0.0163	-41%	0.0278	0.0027	-90%	0.0278	0.0033	-88%
2001	0.0280	0.0165	-41%	0.0280	0.0027	-90%	0.0280	0.0033	-88%
2002	0.0286	0.0169	-41%	0.0286	0.0028	-90%	0.0286	0.0034	-88%
2003	0.0288	0.0170	-41%	0.0288	0.0028	-90%	0.0288	0.0034	-88%
2004	0.0291	0.0171	-41%	0.0291	0.0029	-90%	0.0291	0.0034	-88%
2005	0.0285	0.0168	-41%	0.0285	0.0028	-90%	0.0285	0.0034	-88%
2006	0.0288	0.0169	-41%	0.0288	0.0028	-90%	0.0288	0.0034	-88%
2007	0.0304	0.0179	-41%	0.0304	0.0030	-90%	0.0304	0.0036	-88%
2008	0.0298	0.0175	-41%	0.0298	0.0029	-90%	0.0298	0.0035	-88%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2009	0.0291	0.0171	-41%	0.0291	0.0029	-90%	0.0291	0.0034	-88%
2010	0.0278	0.0164	-41%	0.0278	0.0027	-90%	0.0278	0.0033	-88%
2011	0.0306	0.0180	-41%	0.0306	0.0030	-90%	0.0306	0.0036	-88%
2012	0.0275	0.0162	-41%	0.0275	0.0027	-90%	0.0275	0.0032	-88%
2013	0.0299	0.0176	-41%	0.0299	0.0029	-90%	0.0299	0.0035	-88%
2014	0.0266	0.0157	-41%	0.0266	0.0026	-90%	0.0266	0.0031	-88%
2015	0.0304	0.0179	-41%	0.0304	0.0030	-90%	0.0304	0.0036	-88%
2016	0.0293	0.0172	-41%	0.0293	0.0029	-90%	0.0293	0.0034	-88%
2017	0.0283	0.0167	-41%	0.0283	0.0028	-90%	0.0283	0.0033	-88%
2018	0.0278	0.0164	-41%	0.0278	0.0027	-90%	0.0278	0.0033	-88%
2019	0.0261	0.0153	-41%	0.0261	0.0026	-90%	0.0261	0.0031	-88%
2020	0.0328	0.0193	-41%	0.0328	0.0032	-90%	0.0328	0.0039	-88%
2021	0.0281	0.0165	-41%	0.0281	0.0028	-90%	0.0281	0.0033	-88%

YEAR	As [t]			Cr [t]			Cu [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0317	0.0006	-98%	0.0317	0.0006	-98%	0.0317	0.0075	-76%
1991	0.0258	0.0005	-98%	0.0258	0.0005	-98%	0.0258	0.0061	-76%
1992	0.0223	0.0004	-98%	0.0223	0.0004	-98%	0.0223	0.0053	-76%
1993	0.0218	0.0004	-98%	0.0218	0.0004	-98%	0.0218	0.0051	-76%
1994	0.0245	0.0005	-98%	0.0245	0.0005	-98%	0.0245	0.0058	-76%
1995	0.0264	0.0005	-98%	0.0264	0.0005	-98%	0.0264	0.0062	-76%
1996	0.0268	0.0005	-98%	0.0268	0.0005	-98%	0.0268	0.0063	-76%
1997	0.0272	0.0005	-98%	0.0272	0.0005	-98%	0.0272	0.0064	-76%
1998	0.0278	0.0005	-98%	0.0278	0.0005	-98%	0.0278	0.0065	-76%
1999	0.0277	0.0005	-98%	0.0277	0.0005	-98%	0.0277	0.0065	-76%
2000	0.0278	0.0005	-98%	0.0278	0.0005	-98%	0.0278	0.0065	-76%
2001	0.0280	0.0005	-98%	0.0280	0.0005	-98%	0.0280	0.0066	-76%
2002	0.0286	0.0006	-98%	0.0286	0.0006	-98%	0.0286	0.0067	-76%
2003	0.0288	0.0006	-98%	0.0288	0.0006	-98%	0.0288	0.0068	-76%
2004	0.0291	0.0006	-98%	0.0291	0.0006	-98%	0.0291	0.0069	-76%
2005	0.0285	0.0006	-98%	0.0285	0.0006	-98%	0.0285	0.0067	-76%
2006	0.0288	0.0006	-98%	0.0288	0.0006	-98%	0.0288	0.0068	-76%
2007	0.0304	0.0006	-98%	0.0304	0.0006	-98%	0.0304	0.0071	-76%
2008	0.0298	0.0006	-98%	0.0298	0.0006	-98%	0.0298	0.0070	-76%
2009	0.0291	0.0006	-98%	0.0291	0.0006	-98%	0.0291	0.0068	-76%
2010	0.0278	0.0005	-98%	0.0278	0.0005	-98%	0.0278	0.0065	-76%
2011	0.0306	0.0006	-98%	0.0306	0.0006	-98%	0.0306	0.0072	-76%
2012	0.0275	0.0005	-98%	0.0275	0.0005	-98%	0.0275	0.0065	-76%
2013	0.0299	0.0006	-98%	0.0299	0.0006	-98%	0.0299	0.0070	-76%
2014	0.0266	0.0005	-98%	0.0266	0.0005	-98%	0.0266	0.0063	-76%
2015	0.0304	0.0006	-98%	0.0304	0.0006	-98%	0.0304	0.0071	-76%
2016	0.0293	0.0006	-98%	0.0293	0.0006	-98%	0.0293	0.0069	-76%
2017	0.0283	0.0006	-98%	0.0283	0.0006	-98%	0.0283	0.0067	-76%
2018	0.0278	0.0005	-98%	0.0278	0.0005	-98%	0.0278	0.0065	-76%
2019	0.0261	0.0005	-98%	0.0261	0.0005	-98%	0.0261	0.0061	-76%
2020	0.0328	0.0006	-98%	0.0328	0.0006	-98%	0.0328	0.0077	-76%
2021	0.0281	0.0006	-98%	0.0281	0.0006	-98%	0.0281	0.0066	-76%

YEAR	Ni [t]			Se [t]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0317	0.0330	4%	0.0317	0.0006	-98%
1991	0.0258	0.0268	4%	0.0258	0.0005	-98%
1992	0.0223	0.0232	4%	0.0223	0.0004	-98%
1993	0.0218	0.0227	4%	0.0218	0.0004	-98%
1994	0.0245	0.0255	4%	0.0245	0.0005	-98%
1995	0.0264	0.0274	4%	0.0264	0.0005	-98%
1996	0.0268	0.0278	4%	0.0268	0.0005	-98%
1997	0.0272	0.0282	4%	0.0272	0.0005	-98%
1998	0.0278	0.0289	4%	0.0278	0.0005	-98%
1999	0.0277	0.0288	4%	0.0277	0.0005	-98%
2000	0.0278	0.0288	4%	0.0278	0.0005	-98%
2001	0.0280	0.0291	4%	0.0280	0.0005	-98%
2002	0.0286	0.0298	4%	0.0286	0.0006	-98%
2003	0.0288	0.0300	4%	0.0288	0.0006	-98%
2004	0.0291	0.0303	4%	0.0291	0.0006	-98%
2005	0.0285	0.0297	4%	0.0285	0.0006	-98%
2006	0.0288	0.0299	4%	0.0288	0.0006	-98%
2007	0.0304	0.0316	4%	0.0304	0.0006	-98%
2008	0.0298	0.0310	4%	0.0298	0.0006	-98%
2009	0.0291	0.0302	4%	0.0291	0.0006	-98%
2010	0.0278	0.0289	4%	0.0278	0.0005	-98%
2011	0.0306	0.0318	4%	0.0306	0.0006	-98%
2012	0.0275	0.0286	4%	0.0275	0.0005	-98%
2013	0.0299	0.0311	4%	0.0299	0.0006	-98%
2014	0.0266	0.0277	4%	0.0266	0.0005	-98%
2015	0.0304	0.0316	4%	0.0304	0.0006	-98%
2016	0.0293	0.0304	4%	0.0293	0.0006	-98%
2017	0.0283	0.0295	4%	0.0283	0.0006	-98%
2018	0.0278	0.0289	4%	0.0278	0.0005	-98%
2019	0.0261	0.0271	4%	0.0261	0.0005	-98%
2020	0.0328	0.0341	4%	0.0328	0.0006	-98%
2021	0.0281	0.0292	4%	0.0281	0.0006	-98%

YEAR	Zn [t]			PCDD/F [g I-TEQ]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0317	0.0062	-80%	0.0355	0.0075	-79%
1991	0.0258	0.0051	-80%	0.0289	0.0061	-79%
1992	0.0223	0.0044	-80%	0.0249	0.0053	-79%
1993	0.0218	0.0043	-80%	0.0244	0.0051	-79%
1994	0.0245	0.0048	-80%	0.0274	0.0058	-79%
1995	0.0264	0.0052	-80%	0.0295	0.0062	-79%
1996	0.0268	0.0053	-80%	0.0299	0.0063	-79%
1997	0.0272	0.0053	-80%	0.0304	0.0064	-79%
1998	0.0278	0.0055	-80%	0.0311	0.0065	-79%
1999	0.0277	0.0054	-80%	0.0309	0.0065	-79%
2000	0.0278	0.0054	-80%	0.0310	0.0065	-79%
2001	0.0280	0.0055	-80%	0.0313	0.0066	-79%
2002	0.0286	0.0056	-80%	0.0320	0.0067	-79%
2003	0.0288	0.0057	-80%	0.0322	0.0068	-79%

YEAR	Zn [t]			PCDD/F [g I-TEQ]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2004	0.0291	0.0057	-80%	0.0326	0.0069	-79%
2005	0.0285	0.0056	-80%	0.0319	0.0067	-79%
2006	0.0288	0.0056	-80%	0.0322	0.0068	-79%
2007	0.0304	0.0060	-80%	0.0339	0.0071	-79%
2008	0.0298	0.0058	-80%	0.0333	0.0070	-79%
2009	0.0291	0.0057	-80%	0.0325	0.0068	-79%
2010	0.0278	0.0055	-80%	0.0311	0.0065	-79%
2011	0.0306	0.0060	-80%	0.0341	0.0072	-79%
2012	0.0275	0.0054	-80%	0.0308	0.0065	-79%
2013	0.0299	0.0059	-80%	0.0335	0.0070	-79%
2014	0.0266	0.0052	-80%	0.0298	0.0063	-79%
2015	0.0304	0.0060	-80%	0.0339	0.0071	-79%
2016	0.0293	0.0057	-80%	0.0327	0.0069	-79%
2017	0.0283	0.0056	-80%	0.0317	0.0067	-79%
2018	0.0278	0.0055	-80%	0.0311	0.0065	-79%
2019	0.0261	0.0051	-80%	0.0291	0.0061	-79%
2020	0.0328	0.0064	-80%	0.0367	0.0077	-79%
2021	0.0281	0.0055	-80%	0.0314	0.0066	-79%

3.8.6 Distribution of oil products (NFR 1B2av)

3.8.6.1 Overview

The definition of stationary sources and emissions from their activities included in **1B2av** are presented in following ***Table 3.150***. All data is from the operator–facility data.

Table 3.150: *Activities according to national categorization included in 1B2av*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.40. Gas stations according to projected annual turnover or current annual turnover in m^3/year

An overall trend of activity data is shown in ***Table 3.151***. The emissions in this category show an increasing trend which is connected with an increase in activity.

Table 3.151: *Overview of emissions and activity data in the category 1B2av*

YEAR	PETROL CONSUMED [kt]	DIESEL OIL CONSUMED [kt]	LPG CONSUMED [kt]	BIOFUEL CONSUMED [kt]	NMVOC [kt]
1990	440.58	1 151.45	NO	NO	1.1420
1995	558.63	828.28	NO	NO	1.3532
2000	600.03	729.85	14.47	NO	1.4317
2005	701.03	1 233.48	29.97	NO	1.7318
2010	599.63	1 443.09	27.03	113.67	1.5568
2011	547.72	1 360.71	17.73	118.20	1.4295
2012	548.73	1 473.83	30.07	121.33	1.4510
2013	514.14	1 431.97	32.96	129.36	1.3702
2014	485.38	1 496.71	29.97	145.95	1.3187
2015	493.79	1 691.73	33.71	159.30	1.3691
2016	516.88	1 710.33	38.25	157.53	1.4230
2017	507.45	1 744.56	42.26	172.58	1.4103
2018	511.22	1 795.78	41.95	167.08	1.4254
2019	522.29	1 828.07	39.28	173.33	1.4551
2020	478.67	1 636.00	32.76	187.20	1.3315
2021	488.76	1 811.40	38.92	196.73	1.3823

YEAR	PETROL CONSUMED [kt]	DIESEL OIL CONSUMED [kt]	LPG CONSUMED [kt]	BIOFUEL CONSUMED [kt]	NMVOC [kt]
2022	524.57	1 871.85	37.61	204.25	1.4711
1990/2022	**19%**	**63%**	**-**	**-**	**29%**
2021/2022	**7%**	**3%**	**-3%**	**4%**	**6%**

3.8.6.2 Methodological issues

New emission factors based on the 2019 Refinements to the 2006 IPCC GL and EMEP/EEA GB_{2023} were introduced in this submission. Main source of NMVOC emissions is gasoline distribution. Other sources of NMVOC emission are in ***Table 3.151***. Emission factor for gasoline according to EMEP/EEA GB_{2023} was **EF = 2.2 kg/Mg** and emission factor for other fuels according to the 2019 Refinements to the 2006 IPCC GL was **EF = 0.15 kg/Mg** Tier 1 methodology was used.

3.8.6.3 Completeness

The notation key of NA is used for the emissions of main pollutants except SOx and PCDD/F whereas the notation key NE is used in compliance with the EMEP/EEA GB_{2023}.

3.8.6.4 Source-specific recalculations

Recalculation was made due to new emission factors and sources of NMVOC emissions. The results of the recalculations are in ***Table 3.152***.

***Table 3.152**: Previous and revised emissions in the category 1B2av*

YEAR	NMVOC [kt]		
	PREVIOUS	REVISED	CHANGE
1990	3.1841	1.1420	-64%
1991	2.6873	1.0831	-60%
1992	2.4791	1.1020	-56%
1993	2.4575	1.2143	-51%
1994	2.6085	1.2974	-50%
1995	2.7738	1.3532	-51%
1996	2.8028	1.3683	-51%
1997	2.8945	1.4741	-49%
1998	3.0844	1.6114	-48%
1999	2.9848	1.6132	-46%
2000	2.6887	1.4317	-47%
2001	2.9627	1.6618	-44%
2002	3.0457	1.5524	-49%
2003	3.1389	1.5833	-50%
2004	3.3192	1.5349	-54%
2005	3.9290	1.7318	-56%
2006	3.6588	1.5562	-57%
2007	4.1848	1.6373	-61%
2008	4.3178	1.6811	-61%
2009	3.9993	1.5774	-61%
2010	4.3668	1.5568	-64%
2011	4.0887	1.4295	-65%
2012	4.3479	1.4510	-67%
2013	4.2168	1.3702	-68%
2014	4.3160	1.3187	-69%
2015	4.7571	1.3691	-71%
2016	4.8460	1.4230	-71%
2017	4.9337	1.4103	-71%

YEAR	NMVOC [kt]		
	PREVIOUS	REVISED	CHANGE
2018	5.0320	1.4254	-72%
2019	5.1259	1.4551	-72%
2020	4.6693	1.3315	-71%
2021	6.6693	1.3823	-79%

3.8.7 Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other) (NFR 1B2b)

3.8.7.1 Overview

An overall trend of activity data is shown in ***Table 3.153***. Emissions in this category show an increasing trend which is connected with an increase in activity. This category is key for emissions of NMVOC.

Table 3.153: *Overview of emissions and activity data in the category 1B2b*

YEAR	PRODUCTION [mil. m³]	PROCESSING [mil. m³]	TRANSMISSION AND STORAGE [mil. m³]	DISTRIBUTION [mil. m³]	OTHER [mil. m³]	NMVOC [kt]
1990	444.00	444.00	73 600.00	6 666.00	1.00	2.1714
1995	344.00	344.00	73 600.00	6 485.00	159.40	2.0264
2000	173.00	173.00	68 600.00	7 136.00	524.30	1.6874
2005	147.00	147.00	73 900.00	7 399.00	50.00	1.7565
2010	94.03	94.03	65 302.00	6 098.00	3 435.21	1.5101
2011	89.68	89.68	68 093.00	5 630.00	2 414.64	1.5513
2012	90.70	90.70	45 470.00	5 289.00	2 917.23	1.0993
2013	93.59	93.59	52 780.00	5 820.00	3 757.48	1.2578
2014	86.06	86.06	46 500.00	4 535.00	3 807.59	1.1100
2015	84.57	84.57	55 800.00	4 639.00	4 017.26	1.2956
2016	87.89	87.89	60 600.00	4 716.00	3 969.67	1.3969
2017	87.29	87.29	64 200.00	4 901.25	4 246.87	1.4708
2018	84.15	84.15	59 700.00	4 777.99	3 724.15	1.3731
2019	73.60	73.60	69 060.00	4 841.46	3 129.80	1.5433
2020	65.26	65.26	56 980.00	5 003.88	2 783.82	1.2897
2021	65.33	65.33	40 361.57	5 471.00	4 368.00	0.9680
2022	55.61	55.61	25 772.86	4 463.69	3 997.00	0.6517
1990/2022	**-87%**	**-87%**	**-65%**	**-33%**	**399600%**	**-70%**
2021/2022	**-15%**	**-15%**	**-36%**	**-18%**	**-8%**	**-33%**

For the calculation of NMVOC emissions is used data from the Statistical Office of the Slovak Republic and directly from producers. Calculation of the fugitive NMVOC emissions is based on EFs provided in the 2006 IPCC GL. These EFs are providing more detailed calculations on Tier 1 as there are provided separately EFs for exploration, production, processing, transmission, distribution and storage of natural gas. Also, this change harmonizes emission estimation with GHG emissions. These EFs are shown in ***Table 3.154***. EFs for land exploration and production of crude oil in developed countries are used. Conservative approach was used and the upper limit of EFs is used.

Table 3.154: *Overview of emission factors for exploration, production, processing, transmission, distribution and storage of natural gas*

T1	PRODUCTION [Gg/10⁶ m³ NG]	GATHERING [Gg/10⁶ m³ NG]	PROCESSING [Gg/10⁶ m³ NG]	TRANSMISSION [Gg/10⁶ m³ NG]	DISTRIBUTION [Gg/10⁶ m³ NG]	OTHER (STORAGE) [Gg/10⁶ m³ NG]
NMVOC	0.00061	0.00077	0.00006	0.00002	0.000009	0.000004

3.8.7.3 Completeness

Notation keys were used in compliance with EMEP/EEA GB$_{2023}$.

3.8.7.4 Source-specific recalculations

Recalculations of NMVOC emissions are according to the new emission factors in the 2019 Refinements to the 2006 IPCC GL. The results of the recalculations are in ***Table 3.155***.

Table 3.155: *Previous and revised emissions in the category 1B2b*

YEAR	NMVOC [kt]		
	PREVIOUS	REVISED	CHANGE
1990	1.0747	2.1714	102%
1991	0.9353	1.9803	112%
1992	0.8982	1.9274	115%
1993	0.8728	1.8932	117%
1994	0.9051	1.9419	115%
1995	0.9699	2.0264	109%
1996	0.9447	1.9862	110%
1997	0.8957	1.8788	110%
1998	0.9078	1.9524	115%
1999	0.8805	1.9411	120%
2000	0.7710	1.6874	119%
2001	0.7806	1.6624	113%
2002	0.7387	1.5839	114%
2003	0.8124	1.7183	112%
2004	0.7865	1.7583	124%
2005	0.7856	1.7565	124%
2006	0.7767	1.6783	116%
2007	0.6960	1.5716	126%
2008	0.6939	1.6025	131%
2009	0.6044	1.3784	128%
2010	0.6518	1.5101	132%
2011	0.6591	1.5513	135%
2012	0.4965	1.0993	121%
2013	0.5594	1.2578	125%
2014	0.4872	1.1100	128%
2015	0.5525	1.2956	134%
2016	0.5907	1.3969	136%
2017	0.6184	1.4708	138%
2018	0.5815	1.3731	136%
2019	0.6371	1.5433	142%
2020	0.5465	1.2897	136%
2021	0.4383	0.9680	121%

3.8.8 Venting and flaring (oil, gas, combined oil and gas) (NFR 1B2c)

3.8.8.1 Overview

Emissions from flaring in the refinery, technological losses and storage are included in different categories, because they are part of already categorised sources in NEIS (**1A1b**, **1A1c**). Notation key IE is used for the main pollutants and emissions of HMs. For emissions of POPs used notation key NE complied with EMEP/EEA GB$_{2023}$. Flaring is observed in some extent only in NG production. It is not occurring in the distribution, transport and transmission of crude oil and natural gas in Slovakia.

3.8.8.2 Methodological issues

The methodology is described in the appropriate chapter for categories **1A1b** and **1A1c**.

3.8.8.3 Completeness

The notation key of NE is used for the emissions of NH_3 and POPs in compliance with the EMEP/EEA GB_{2023} and IE for the other emissions. Further data analysis is needed to establish a methodology for natural gas venting from each process.

3.8.8.4 Source-specific recalculations

No recalculations in this submission.

3.8.9 Other fugitive emissions from energy production (NFR 1B2d)

3.8.9.1 Overview

In this category post-meter NG fugitive emissions are reported. These emission sources are identified in the 2019 Refinements to the 2006 IPCC GL as fugitive emissions beyond gas meters and from natural gas-fuelled vehicles (***Table 3.156***). The emission factors for appliances and power plants include leakage emissions beyond gas meters, such as internal piping and the end of pipe appliances (e.g. home heating, water heating, stoves, barbecues).

Table 3.156: *Overview of emissions and activity data in the category 1B2d*

YEAR	CNG CARS [vehicles]	APPLIANCES [pcs]	INDUSTRIAL PLANTS [mil. m^3]	NMVOC [kt]
1990	0	0	3 319.38	0.0332
1991	0	0	3 206.84	0.0321
1992	0	0	3 301.06	0.0330
1993	0	0	3 411.92	0.0341
1994	0	0	3 336.04	0.0334
1995	0	0	3 528.17	0.0353
1996	0	0	3 558.66	0.0356
1997	0	0	3 621.23	0.0362
1998	0	0	3 682.14	0.0368
1999	0	0	3 691.63	0.0369
2000	40	0	3 692.88	0.0369
2001	40	0	3 836.01	0.0384
2002	150	0	3 596.92	0.0360
2003	120	0	3 522.86	0.0352
2004	137	0	3 313.56	0.0331
2005	158	0*	3 097.17	0.0310
2006	227	1 448 474	2 909.40	0.1739
2007	251	1 465 307	2 699.61	0.1735
2008	295	1 482 126	2 799.24	0.1762
2009	334	1 498 391	2 333.93	0.1732
2010	289	1 496 033	2 453.04	0.1741
2011	332	1 501 029	2 587.22	0.1760
2012	414	1 505 009	2 470.67	0.1752
2013	1 482	1 506 508	2 470.32	0.1754
2014	1 556	1 509 413	2 123.60	0.1722
2015	1 398	1 510 532	2 136.90	0.1724

2016	1 541	1 514 666	2 165.34	0.1731
2017	1 750	1 514 262	2 214.59	0.1736
2018	1 980	1 519 409	2 279.11	0.1747
2019	2 063	1 522 827	2 365.51	0.1760
2020	2 095	1 527 512	2 416.83	0.1769
2021	2 146	1 529 546	2 707.13	0.1800
2022	2 218	1 532 244	2 087.94	0.1741

*No available data before 2006

3.8.9.2 Methodological issues

Tier 1 methodology described in the 2019 Refinements to the 2006 IPCC GL and NMVOC emissions factor identified in the guidelines are used (***Table 3.157***).

Table 3.157: *Emissions factors of NMVOC according to different sources*

SEGMENT	VALUE	UNCERTAINTY	UNIT
Natural gas-fuelled vehicles	0.000008	70% to 140%	Tonnes/ car
Appliances in commercial and residential sector	0.0001	±60%	Tonnes/ appliance
Leakage at industrial plants and power stations	0.01	±60%	Tonnes/mil. m^3 Non-residential and commercial gas consumed

3.8.9.3 Completeness

Notation keys were used in compliance with EMEP/EEA GB_{2023}.

3.8.9.4 Source-specific recalculations

No recalculations in this submission.

CHAPTER 4: INDUSTRIAL PROCESSES AND PRODUCT USE (NFR 2)

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Last update: 15.3.2024

4.1 OVERVIEW OF THE SECTOR INDUSTRY

The emissions covered by the industry sector originate from industrial processes but also from combined combustion and technology processes, which are united and reported for the basic unit (source). The emissions and facility data reported directly from an operator that is recorded in the NEIS database cannot be in some cases divided into separate combustion and technology emissions.

The reported data involve emissions and activity data from the technological processes in the mineral products industry (**2A**), chemical industry (**2B**), metal production (**2C**), solvent use (**2D**), other product manufacture (**2G**) and other industrial activities (**2H**, **2I**, **2K**). The list of categories according to the NFR structure and Tier level of inventory is presented in ***Table 4.1***.

The national emission inventory of air pollutants is prepared from several sources to cover all potential sources of pollution.

The data sources:

a/ the NEIS database of stationary large and medium sources of air pollution providing facility data for nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOC) sulphur oxides (SOx), ammonia (NH_3), total suspended particles (TSP, PM_{10} and $PM_{2.5}$ are consequently compiled) and carbon monoxide (CO). All data that comes from the database is considered as T3 methodology. The reporting duties are bonded to the national legislative obligations for air pollution sources to report their annual balances of fuels, emissions and all auxiliary data necessary for the compilation of final emissions.

b/ Estimations based on statistical data and emission factors for air pollutants, heavy metals (HMs) and persistent organic pollutants (POPs). Emissions reported using this type of calculation are considered T2 or T1.

Table 4.1: *Overview of reported categories, tier or notation key used in the industrial sector*

NFR		METHODOLOGY/TIER					
	LONGNAME OF CATEGORY	NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TZL	BC	HM	POPs
	MINERAL INDUSTRY						
2A1	Cement production	NK	NK	T3	T1	NK	NK
2A2	Lime production	NK	NK	T3	T1	NK	NK
2A3	Glass production	NK	NK	T3	T1	T2	NK
2A5a	Quarrying and mining of minerals other than coal	T3	NK	T3	NK	NK	NK
2A5b	Construction and demolition	NK	NK	T1	NK	NK	NK
2A5c	Storage, handling and transport of mineral products	NK	NK	NK	NK	NK	NK
2A6	Other mineral products	T3	T3	T3	NK	NK	NK
	CHEMICAL INDUSTRY						
2B1	Ammonia production	T3	T1	T3	NK	NK	NK
2B2	Nitric acid production	T3, NK	T3	NK	NK	NK	NK
2B3	Adipic acid production	NK	NK	NK	NK	NK	NK
2B5	Carbide production	T3, NK	NK	T3, NK	NK	NK	NK
2B6	Titanium dioxide production	NK	NK	NK	NK	NK	NK
2B7	Soda ash production	NK	NK	NK	NK	NK	NK
2B10a	Chemical industry: Other	T3	T3	T3	T1	NK	NK
2B10b	Storage, handling and transport of chemical products	T3	T3	T3	NK	NK	NK
	METAL INDUSTRY						
2C1	Iron and steel production	T3	T3	T3	T1	T1, T2	T2, NK

NFR		METHODOLOGY/TIER					
	LONGNAME OF CATEGORY	NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TZL	BC	HM	POPs
2C2	Ferroalloys production	T3	T3, NK	T3	T1	NK	NK
2C3	Aluminium production	T3	NK	T3	T1	NK	T2, NK
2C4	Magnesium production	NK	NK	NK	NK	NK	NK
2C5	Lead production	T3, NK	NK	T3, NK	NK	T2, NK	T2, NK
2C6	Zinc production	T1, NK	NK	T1, NK	NK	T1, NK	T1, NK
2C7a	Copper production	T3	NK	T3	T1	T2, NK	T2, NK
2C7b	Nickel production	NK	NK	NK	NK	NK	NK
2C7c	Other metal production	T3	T3	T3	NK	NK	NK
2C7d	Storage, handling and transport of metal products	NK	NK	NK	NK	NK	NK
SOLVENTS AND PRODUCT USE							
2D3a	Domestic solvent use including fungicides	T2, NK	NK	NK	NK	T1, NK	NK
2D3b	Road paving with asphalt	T3, NK	NK	T3	NK	NK	T1, NK
2D3c	Asphalt roofing	T3, NK	NK	T3	NK	NK	NK
2D3d	Coating applications	T2+T3, NK	NK	NK	NK	NK	NK
2D3e	Degreasing	T2+T3, NK	NK	NK	NK	NK	NK
2D3f	Dry cleaning	T3, NK	NK	NK	NK	NK	NK
2D3g	Chemical products	T3, NK	NK	NK	NK	T2, NK	T2, NK
2D3h	Printing	T2+T3, NK	NK	NK	NK	NK	NK
2D3i	Other solvent use	T2+T3, NK	NK	NK	NK	T2	NK
2G	Other product use	T2	T2	T2	T2	T2, NK	T2, NK
OTHER INDUSTRIAL ACTIVITIES							
2H1	Pulp and paper industry	NK	NK	T3	T1	NK	NK
2H2	Food and beverages industry	T2, NK	NK	NK	NK	NK	NK
2H3	Other industrial processes	T3	T3	T3	NK	NK	NK
2I	Wood processing	T3	T3	T3	NK	NK	NK
2J	Production of POPs	NK	NK	NK	NK	NK	NK
2K	Consumption of POPs and heavy metals	NK	NK	NK	NK	T1, NK	T1, NK
2L	Other production, consumption, storage, transportation or handling of bulk products	NK	NK	NK	NK	NK	NK

4.2 TRENDS IN THE SECTOR INDUSTRY

Table 4.2 below shows an overall decreasing trend of emissions of air pollutants since 1990 due to the strict air protection legislation. This, together with the advancements and progress of abatement systems led to the reduction of air pollutants as a result of the transposition of European legislation, continual improvement in the national legislation and the endeavour of the industry to implement BAT technologies (if the investments are available).

Table 4.2: *Overview of the emissions in the category 2 – Industry*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	7.1003	46.1937	11.3398	0.2605	2.3378	4.6750	15.4662	0.0372	84.8237
1995	6.7682	44.6241	10.1563	0.2695	2.2857	3.8186	11.8706	0.0818	75.4156
2000	7.9732	39.4156	13.9137	0.2066	2.9472	4.9475	15.1159	0.1084	93.4023
2005	6.7133	39.6327	11.4549	0.2667	1.4781	3.5462	10.3893	0.0906	104.3432
2010	5.9232	29.1201	7.3310	0.1221	0.9559	2.1660	6.7127	0.1161	94.2074

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2011	6.6758	33.3223	9.2230	0.2206	0.9439	2.0670	6.4540	0.1138	107.1259
2012	6.3180	27.5952	8.0566	0.2194	0.9191	1.6643	5.1780	0.1161	105.6835
2013	6.1896	28.3286	7.3835	0.1645	0.9606	2.0140	6.3800	0.1027	105.0621
2014	6.8971	30.1204	8.0188	0.1240	1.0435	2.0355	6.5122	0.1097	119.8514
2015	6.4984	33.3361	9.0880	0.1665	1.1808	3.6496	11.7870	0.1104	119.9171
2016	5.8978	31.6166	10.2831	0.2269	0.9090	1.9103	5.9485	0.1091	121.8027
2017	6.9338	29.7717	11.7132	0.2190	0.9744	2.4382	7.7015	0.1166	124.1939
2018	7.5900	32.0850	9.4025	0.2362	0.8714	1.7901	5.4600	0.1141	111.7930
2019	6.1286	28.0953	7.7212	0.2135	0.8244	1.9039	5.1503	0.1209	73.4620
2020	5.7511	28.2594	6.6518	0.2689	0.8325	2.6611	7.4536	0.1020	70.5006
2021	7.0832	28.0869	7.5909	0.2999	0.8543	2.4206	6.5801	0.1184	106.0956
2022	5.2702	25.6048	4.7001	0.2369	0.6690	1.6786	4.4253	0.1134	70.1133
1990/2022	**-26%**	**-45%**	**-59%**	**-9%**	**-71%**	**-64%**	**-71%**	**205%**	**-17%**
2021/2022	**-26%**	**-9%**	**-38%**	**-21%**	**-22%**	**-31%**	**-33%**	**-4%**	**-34%**

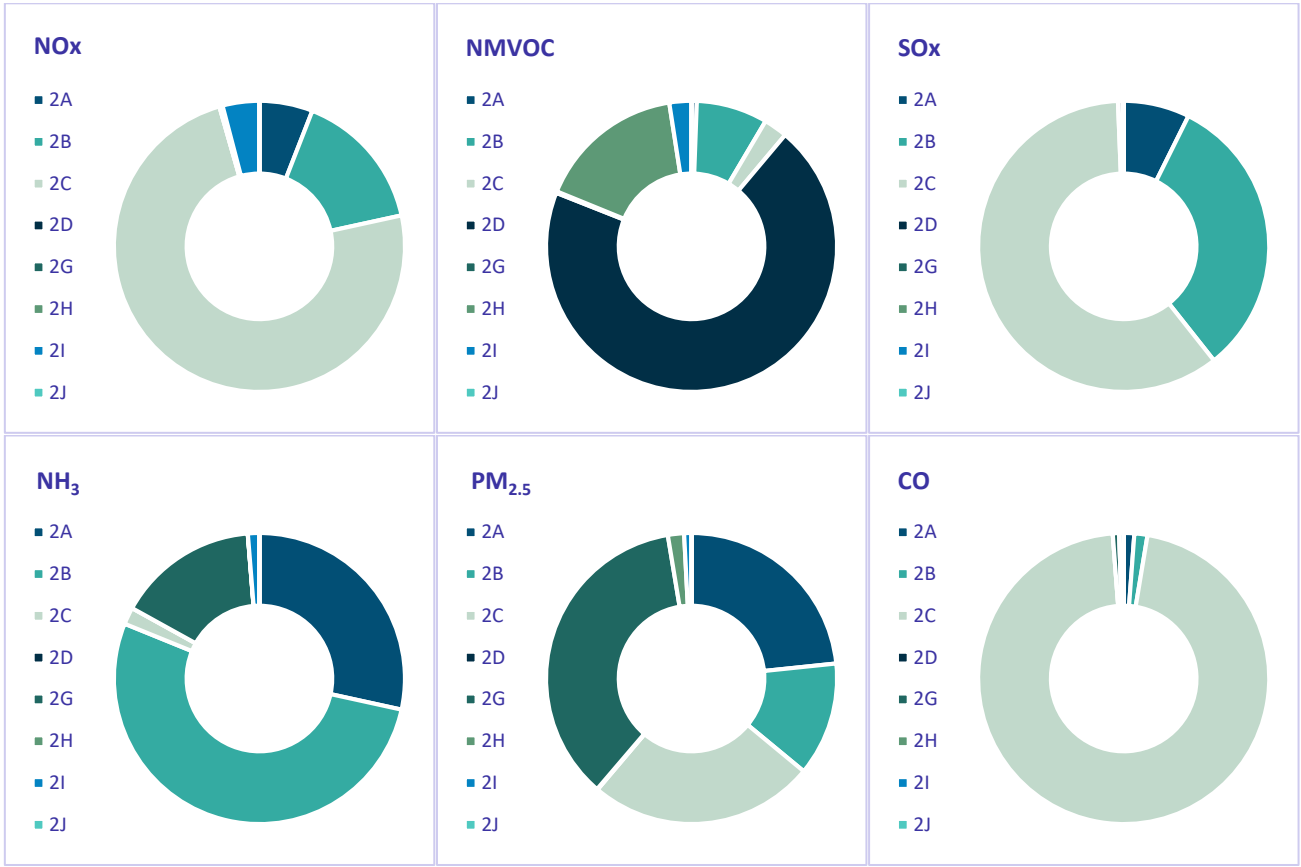
YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	20.7627	0.4293	0.2872	0.7115	1.5477	3.1740	1.3299	0.1629	12.8693
1995	17.7175	0.2975	0.2516	0.5943	1.3400	2.6335	1.0199	0.1643	11.8014
2000	19.0604	0.1256	0.2690	0.5350	0.8480	1.7325	0.9546	0.1696	12.9962
2005	6.3569	0.2069	0.1241	0.5362	0.9881	1.5362	0.2460	0.2569	13.0132
2010	4.9838	0.2538	0.1158	0.4886	1.5432	2.2447	0.2330	0.2901	13.9027
2011	5.0975	0.2558	0.1189	0.4575	1.5877	2.5974	0.2418	0.3014	13.2534
2012	5.2726	0.2599	0.1215	0.4709	1.6025	2.6734	0.2517	0.3166	13.9948
2013	5.7612	0.1514	0.1209	0.4787	1.0202	1.7001	0.2886	0.3180	14.3907
2014	5.5665	0.1502	0.1276	0.4750	1.2328	2.0577	0.2714	0.3271	14.4380
2015	5.4358	0.1455	0.1272	0.4623	1.4971	2.5823	0.2524	0.3210	14.7114
2016	5.6933	0.1498	0.1277	0.4862	1.7206	2.9670	0.2613	0.3226	15.4450
2017	6.1605	0.1582	0.1284	0.5062	1.6844	3.0118	0.2836	0.3298	16.0950
2018	5.5814	0.1470	0.1275	0.4665	1.6961	0.8573	0.2651	0.3296	15.8245
2019	4.4714	0.1298	0.1248	0.3645	1.8216	0.7936	0.2209	0.2720	12.8028
2020	3.2792	0.1122	0.1152	0.2927	1.6839	0.4743	0.1805	0.3429	10.8060
2021	5.4154	0.1540	0.1237	0.4837	1.8871	0.6669	0.2639	0.3728	14.1787
2022	4.4528	0.1349	0.1098	0.3666	1.1128	0.6754	0.2353	0.3882	12.7168
1990/2022	**-79%**	**-69%**	**-62%**	**-48%**	**-28%**	**-79%**	**-82%**	**138%**	**-1%**
2021/2022	**-18%**	**-12%**	**-11%**	**-24%**	**-41%**	**1%**	**-11%**	**4%**	**-10%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [t]	PCB [t]
1990	36.2308	0.6067	0.6066	0.6066	0.0742	12.8284	0.1195	19.4713
1995	30.4406	0.2939	0.2936	0.2936	0.0361	10.5499	0.0975	17.6517
2000	32.1912	0.0083	0.0024	0.0024	0.0013	9.6324	0.1080	18.3708
2005	33.6390	0.0119	0.0035	0.0035	0.0019	10.9501	0.1048	21.5445
2010	27.3131	0.0124	0.0037	0.0037	0.0020	10.5515	0.0744	21.7213
2011	30.8575	0.0124	0.0037	0.0037	0.0020	9.9112	0.0876	20.0066
2012	32.8146	0.0122	0.0036	0.0036	0.0020	10.4361	0.0943	21.1447
2013	31.1698	0.0123	0.0036	0.0036	0.0020	10.8622	0.0918	22.4980
2014	37.1533	0.0127	0.0037	0.0037	0.0021	11.6648	0.1137	22.9581
2015	36.8139	0.0129	0.0038	0.0038	0.0021	11.1699	0.1122	21.7904
2016	37.2952	0.0131	0.0039	0.0039	0.0021	11.8736	0.1114	23.0773
2017	37.6749	0.0132	0.0039	0.0039	0.0021	12.1887	0.1124	23.8256

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [t]	PCB [t]
2018	37.1200	0.0131	0.0039	0.0039	0.0021	12.0346	0.1098	23.5218
2019	35.3413	0.0133	0.0039	0.0039	0.0022	9.7059	0.1040	18.6663
2020	27.0467	0.0115	0.0034	0.0034	0.0019	8.2705	0.0755	16.1544
2021	8.5398	0.0125	0.0037	0.0037	0.0021	11.8546	0.0963	23.1954
2022	5.8181	0.0060	0.0018	0.0018	0.0011	9.1435	0.0567	18.4065
1990/2022	**-84%**	**-99%**	**-100%**	**-100%**	**-98%**	**-29%**	**-53%**	**-5%**
2021/2022	**-32%**	**-52%**	**-50%**	**-50%**	**-45%**	**-23%**	**-41%**	**-21%**

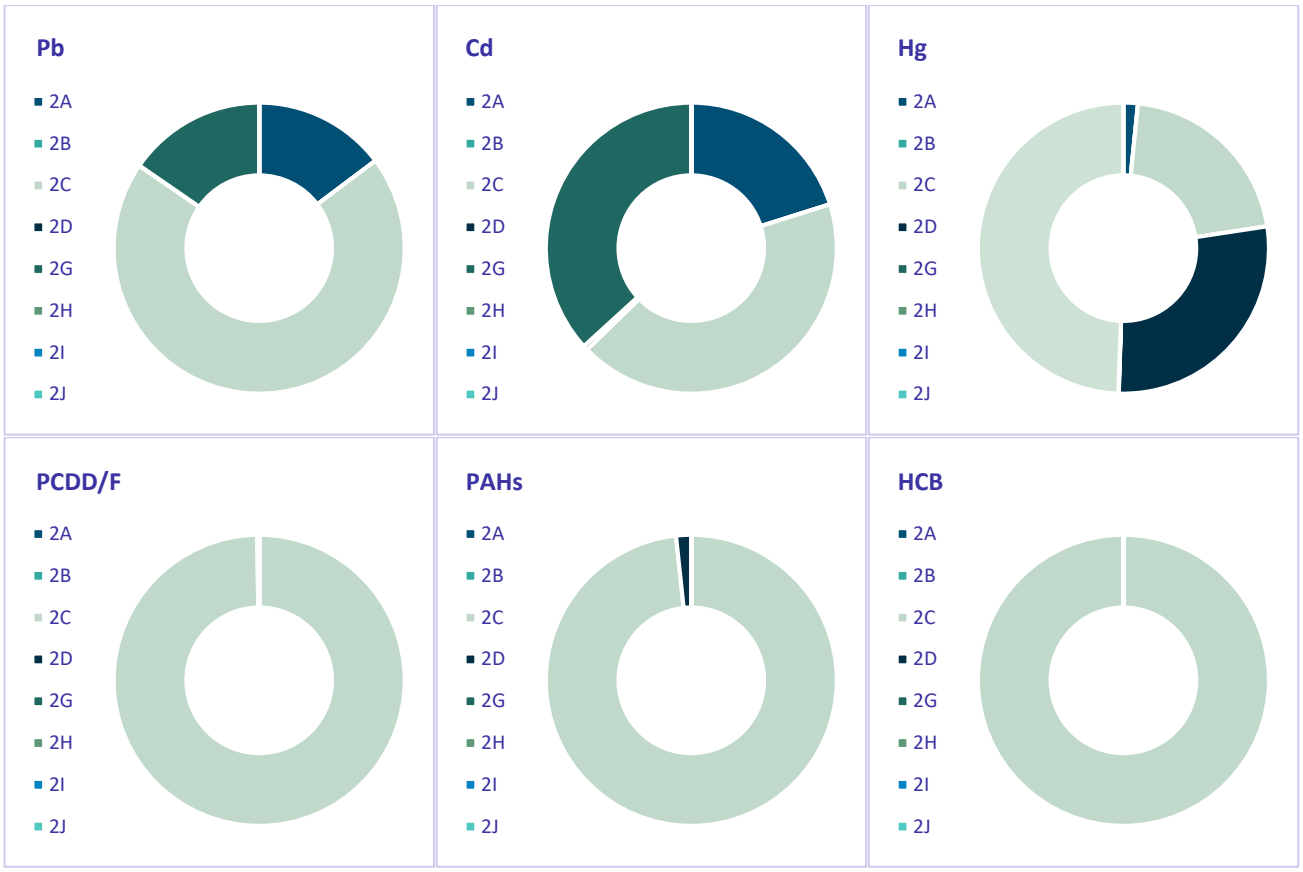
As shown in ***Figure 4.1***, the main contributor to NOx emissions in the industry sector is Iron and steel production (**2C1**). The most significant decrease was recorded in the period 2001-2009, since then, emissions have had a fluctuating trend. Solvents use contributes by an average of 78% to NMVOC emissions. The emission trend shows a decreasing trend due to stricter limits and technical requirements for solvent use. SOx emissions have a decreasing trend until 2009 in the sector industry, and since then emissions are fluctuating. The most important industrial category for these emissions is Metal production **2C**. Emissions of NH_3 have a long-term slightly decreasing trend. The fluctuations between 2004-2014 were caused by fluctuations in the Urine production industry. The main contributor to these emissions is subsector **2B** – Chemical production. Emissions of PMs have a continuously decreasing trend. These emissions are mostly emitted by the subsectors **2C** and **2G**. The fluctuation of CO emissions in the industry sector is connected with activity in the category of Iron and steel production (**2C1**).

Figure 4.1: *Share of emissions of main pollutants in category 2 – Industry in 2022*



Metal production categories emitted most of the emissions of heavy metals and persistent organic pollutants. Emissions of these pollutants have in general decreasing trend (except Cr and Se, as abatement efficiency is not available). This trend is connected to the installation of abatement technologies in the Metal industry and the improvement of the technological processes (***Figure 4.2***).

Figure 4.2: *Share of emissions of heavy metals and POPs in category 2 – Industry in 2022*



4.3 RECALCULATIONS, IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

The industry sector undertakes continuing improvements. Several issues were corrected during this reporting cycle in categories **2A1**, **2A2**, **2A5b**, **2B2**, **2B5**, **2C2** (due to the correction of activity data to more accurate values), **2C7a** (due to correction in calculations of several heavy metals in historical years and PCDD/F for miscalculation) and **2H2** (completion of activity data, in few subparts activity data were corrected in units within calculations and few corrections).

4.4 MINERAL INDUSTRY (NFR 2A)

4.4.1 Overview

The category covers these NFR activities: Cement production (**2A1**), Lime production (**2A2**), Glass production (**2A3**), Quarrying and mining of minerals other than coal (**2A5a**), Construction and demolition (**2A5b**), Other Mineral Products (**2A6**). Category **2A5c** is reported as IE.

Most of the producers, which are important concerning the release of emissions in the sector, belong to international concerns and operate in several states. The Slovak Republic produces a moderate range of mineral

products and does not belong to a significant world producer of mineral commodities. The mining and quarrying sector is not a significant contributor to the country's economy.

Emissions of main pollutants decreased from the year 1990 significantly, with exception of SOx and NH_3, which have an increasing trend, as well as heavy metals (***Table 4.3***).

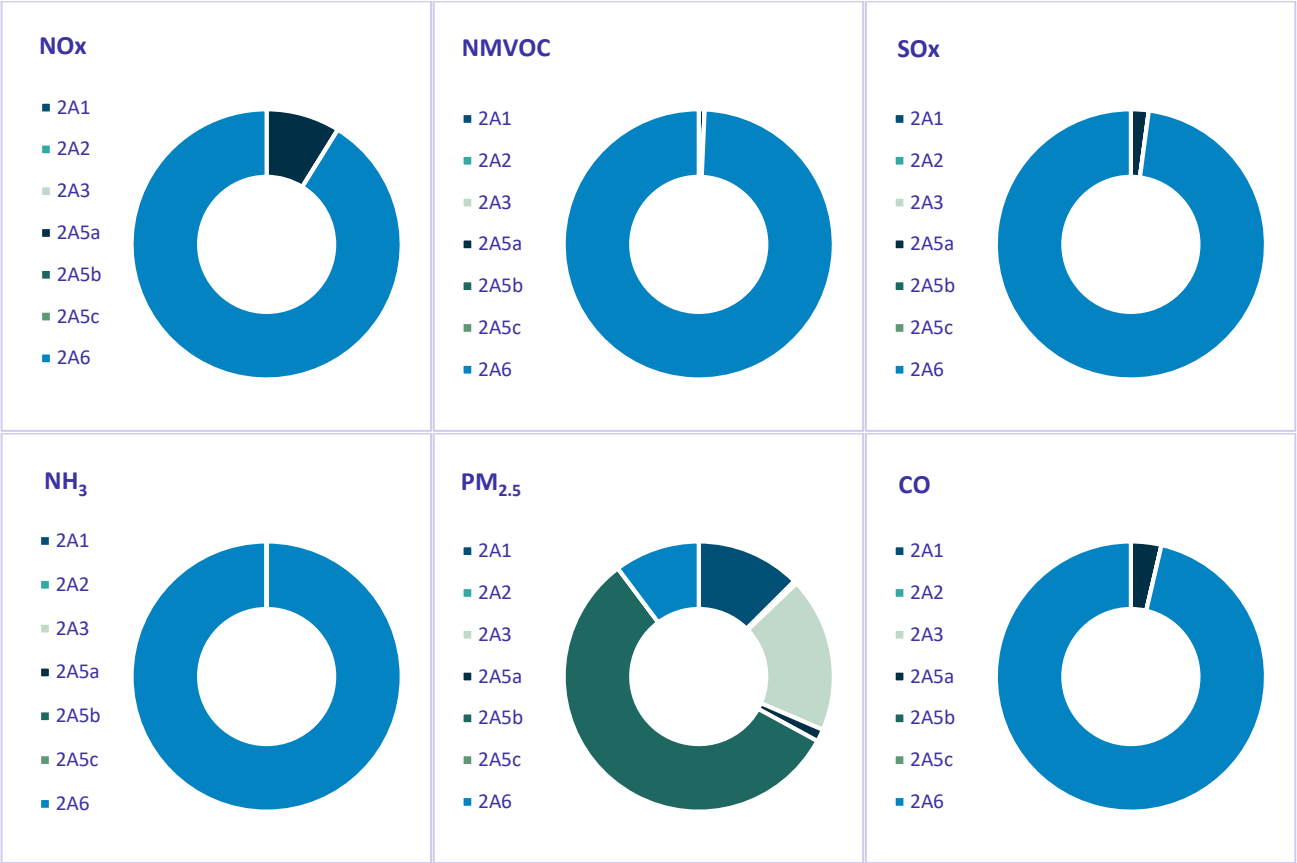
Table 4.3: *Overview of emissions in the category 2A*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.3486	0.1733	0.1915	0.0007	0.3913	1.5852	5.2822	0.0024	1.3184
1995	0.3515	0.1744	0.1932	0.0007	0.2895	0.6449	2.0453	0.0019	1.3286
2000	0.4595	0.0805	0.2510	0.0001	0.3894	1.0087	3.1525	0.0030	1.1154
2005	0.4547	0.1583	0.4992	0.0041	0.3773	1.7916	6.0106	0.0012	1.7897
2010	0.3263	0.0536	0.3319	0.0129	0.2069	1.1171	3.9141	0.0008	0.4707
2011	0.2935	0.0519	0.3009	0.0137	0.2082	0.9759	3.2877	0.0009	0.4372
2012	0.2678	0.0608	0.3299	0.0227	0.1289	0.4945	1.7221	0.0008	0.3037
2013	0.2160	0.0598	0.3123	0.0214	0.1673	0.8003	2.6533	0.0011	0.3252
2014	0.2078	0.0501	0.3121	0.0210	0.1833	0.7709	2.5717	0.0017	0.2742
2015	0.2328	0.0742	0.3639	0.0248	0.3393	2.4445	8.1369	0.0014	0.3337
2016	0.2585	0.1176	0.4312	0.0228	0.1620	0.8479	2.8139	0.0015	0.5467
2017	0.2946	0.1265	0.4350	0.0234	0.1801	1.3160	4.4599	0.0006	0.5958
2018	0.3183	0.1485	0.4528	0.0241	0.1398	0.7650	2.5761	0.0005	0.8134
2019	0.2938	0.1292	0.4271	0.0220	0.1584	1.0263	3.4639	0.0008	0.7771
2020	0.2906	0.0883	0.4510	0.0276	0.2451	1.8953	6.3667	0.0007	0.7034
2021	0.3245	0.1317	0.4080	0.0753	0.2160	1.5915	5.3558	0.0006	0.7855
2022	0.3123	0.1483	0.3454	0.0674	0.1562	1.0215	3.4644	0.0006	0.8216
1990/2022	**-10%**	**-14%**	**80%**	**8978%**	**-60%**	**-36%**	**-34%**	**-75%**	**-38%**
2021/2022	**-4%**	**13%**	**-15%**	**-11%**	**-28%**	**-36%**	**-35%**	**3%**	**5%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.2725	0.0058	0.0007	0.0140	0.0179	0.0016	0.0116	0.0724	0.0863
1995	0.3054	0.0072	0.0007	0.0173	0.0221	0.0017	0.0143	0.0895	0.0904
2000	0.3019	0.0070	0.0007	0.0168	0.0214	0.0017	0.0139	0.0869	0.0905
2005	0.4540	0.0139	0.0008	0.0337	0.0430	0.0020	0.0279	0.1742	0.1035
2010	0.5021	0.0182	0.0007	0.0439	0.0560	0.0017	0.0363	0.2272	0.0885
2011	0.5094	0.0185	0.0007	0.0446	0.0570	0.0017	0.0369	0.2309	0.0895
2012	0.4657	0.0193	0.0009	0.0466	0.0594	0.0021	0.0385	0.2409	0.1114
2013	0.4710	0.0195	0.0010	0.0471	0.0601	0.0023	0.0390	0.2436	0.1230
2014	0.4597	0.0190	0.0010	0.0460	0.0587	0.0022	0.0380	0.2378	0.1184
2015	0.4507	0.0187	0.0010	0.0451	0.0575	0.0024	0.0373	0.2331	0.1265
2016	0.4531	0.0188	0.0011	0.0453	0.0578	0.0025	0.0375	0.2344	0.1307
2017	0.4651	0.0192	0.0011	0.0465	0.0593	0.0025	0.0385	0.2406	0.1333
2018	0.4684	0.0194	0.0011	0.0468	0.0598	0.0025	0.0388	0.2423	0.1336
2019	0.3705	0.0153	0.0009	0.0370	0.0473	0.0022	0.0307	0.1916	0.1155
2020	0.5471	0.0226	0.0011	0.0547	0.0698	0.0025	0.0453	0.2830	0.1304
2021	0.5698	0.0236	0.0012	0.0570	0.0727	0.0027	0.0472	0.2947	0.1429
2022	0.6563	0.0272	0.0018	0.0656	0.0837	0.0041	0.0543	0.3395	0.2172
1990/2022	**141%**	**369%**	**152%**	**369%**	**369%**	**152%**	**369%**	**369%**	**152%**
2021/2022	**15%**	**15%**	**52%**	**15%**	**15%**	**52%**	**15%**	**15%**	**52%**

Shares of NO_X, NMVOC, SO_X, NH_3, $PM_{2.5}$, and CO emissions in 2022 NFR categories included in the mineral industry are shown in ***Figure 4.3***.

Figure 4.3: *Shares of emissions of the main pollutants in 2A in 2022*



4.4.2 Cement Production (NFR 2A1)

4.4.2.1 Overview

Cement manufacturing is a highly energy-demanding process based on several stages (quarrying a mixture of limestone and clay; grinding the limestone and clay; burning the slurry or powder to a high temperature in a kiln, to produce clinker; blending and grinding the clinker with gypsum to make cement). The chemical base of the process is the thermal decomposition of calcium carbonate at about 900°C (calcination) on calcium oxide CaO and carbon dioxide CO_2. Then the CaO reacts at high temperatures (1 400 – 1 500˚C) with silica, alumina, and ferrous oxide to form the silicates, aluminates and ferrites of calcium. This partial fusion forms nodules of clinker. The burning process takes place typically in a rotary kiln.

The manufacture of cement is a strongly regulated process by legislative limits for pollution. The primary fuel used is usually finely ground coal dust, products based on coal dust (coal, stern pellets) petroleum coke, and pyrolysis. All four cement producers (large point sources) in the Slovak Republic have the approval to utilize alternative fuels (refuse-derived fuel – RDF and used tires, sludge, fly ash, beef and bone meal or similarly categorized fuel waste) and raw materials for energy and resource recovery. The plant provides a yearly report on types and amounts of alternative fuel used.

Emission trends are shown in ***Table 4.4***.

Table 4.4: *Activity data and emissions in the category 2A1*

YEAR	CLINKER PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	2835.75	0.0773	0.1824	0.4489	0.0023
1995	2235.75	0.0610	0.1438	0.3539	0.0018
2000	2313.71	0.0954	0.2251	0.5541	0.0029
2005	2352.68	0.0370	0.0872	0.2149	0.0011
2010	1653.59	0.0256	0.0598	0.1423	0.0008
2011	2433.86	0.0307	0.0716	0.1704	0.0009

YEAR	CLINKER PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
2012	2126.12	0.0276	0.0644	0.1534	0.0008
2013	2161.32	0.0365	0.0852	0.2027	0.0011
2014	2415.34	0.0574	0.1340	0.3190	0.0017
2015	2506.12	0.0458	0.1068	0.2542	0.0014
2016	2599.39	0.0495	0.1154	0.2748	0.0015
2017	2698.82	0.0207	0.0484	0.1151	0.0006
2018	2695.74	0.0170	0.0396	0.0944	0.0005
2019	2854.64	0.0275	0.0643	0.1531	0.0008
2020	2945.23	0.0214	0.0500	0.1191	0.0006
2021	2937.74	0.0189	0.0441	0.1051	0.0006
2022	3041.27	0.0196	0.0456	0.1087	0.0006
1990/2022	**7%**	**-75%**	**-75%**	**-76%**	**-75%**
2021/2022	**4%**	**3%**	**3%**	**3%**	**3%**

4.4.2.2 Methodological issues

Activities listed within this category are shown in ***Table 4.5.***

Table 4.5: *Activities according to national categorization included in 2A1*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.2. Manufacture of cement with a projected production capacity in t/d

Emission data is compiled in the NEIS, therefore, the individual-specific EF could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**.

Emission factors used for the reconstruction of historical years 1990-1999 were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 4.6***). Share of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from 2005-2009.

Table 4.6: *Emission factors for calculation of historical years*

	TSP [g/t CLINKER PRODUCED]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]
EF	158.30	17%	41%	3.00%

*EMEP/EEA GB_{2023}

4.4.2.3 Completeness

Pollutants originating from combustion actives were reported under the category **1A2f**, as these pollutants cannot be separated in the NEIS database in the whole time series. Therefore, notation key IE was used for these pollutants and only particulate matter emissions were reported within this category.

4.4.2.4 Source-specific recalculations

The correction of activity data (clinker produced ***Table 4.7***) was performed for the year 2021. In terms of emission no recalculation was done.

Table 4.7: *Previous and revised emissions in the category 2A1*

YEAR	AD - CLINKER PRODUCED [kt]		
	PREVIOUS	REVISED	CHANGE
2021	3170.29	2937.74	-7%

4.4.3 Lime Production (NFR 2A2)

4.4.3.1 Overview

The production of lime during the year 2022 in The Slovak Republic was operated by 5 companies in 7 stationary sources. All sources are covered by the NEIS database.

Production of lime, which is chemically calcium oxide (CaO), is performed by the thermal decomposition of limestone at the temperatures of 1 040 – 1 300°C. Production is therefore highly energy-demanding process. Hydrated lime ($Ca(OH)_2$) is also produced by Slovak operators.
Relevant rising emissions from this manufacturing, their trends and activity data (***Table 4.8***) are presented in the following figures.

Table 4.8: *Activity data and emissions in the category 2A2*

YEAR	LIME PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	1076.00	0.0083	0.0993	0.8279	0.0000
1995	803.00	0.0062	0.0741	0.6179	0.0000
2000	753.59	0.0056	0.0666	0.5552	0.0000
2005	913.08	0.0054	0.0644	0.5365	0.0000
2010	822.36	0.0040	0.0480	0.3999	0.0000
2011	856.05	0.0024	0.0288	0.2398	0.0000
2012	797.33	0.0022	0.0265	0.2206	0.0000
2013	716.54	0.0008	0.0096	0.0798	0.0000
2014	727.63	0.0021	0.0247	0.2059	0.0000
2015	680.20	0.0009	0.0102	0.0854	0.0000
2016	663.02	0.0006	0.0075	0.0628	0.0000
2017	640.06	0.0006	0.0073	0.0612	0.0000
2018	668.99	0.0007	0.0080	0.0667	0.0000
2019	586.05	0.0006	0.0071	0.0594	0.0000
2020	515.35	0.0005	0.0061	0.0512	0.0000
2021	677.83	0.0006	0.0067	0.0560	0.0000
2022	688.95	0.0006	0.0070	0.0586	0.0000
1990/2022	**-36%**	**-93%**	**-93%**	**-93%**	**-93%**
2021/2022	**2%**	**5%**	**5%**	**5%**	**5%**

4.4.3.2 Methodological issues

Activities listed within this category are shown in ***Table 4.9***.

Table 4.9: *Activities according to national categorization included in 2A2*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.3. Manufacture of lime with a designed production capacity of cement clinker in t/d

Emission data is compiled in the NEIS, therefore, the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**.
Emission factors used for the reconstruction of historical years 1990–1999 were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 4.10***). Share of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from 2005-2009.

Table 4.10: *Emission factors for calculation of historical years*

	TSP [g/t LIME PRODUCED]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]
EF	769.44	1%	12%	0.46%

*EMEP/EEA GB_{2023}

4.4.3.3 Completeness

Pollutants originating from combustion actives were reported under the category **1A2f**, as these pollutants cannot be separated in the NEIS database in the whole time series. Therefore, notation key IE was used for these pollutants and only particulate matter emissions were reported within this category.

4.4.3.4 Source-specific recalculations

In this submission, the correction of activity data (lime produced ***Table 4.11***) was performed for the year 2021. The value was harmonized with GHG inventory activity data. In terms of emission no recalculation was done, because the emissions are separately compiled by NEIS database.

Table 4.11: *Previous and revised emissions in the category 2A2*

YEAR	AD - LIME PRODUCED [kt]		
	PREVIOUS	REVISED	CHANGE
2021	879.71	677.83	-23%

4.4.4 Glass Production (NFR 2A3)

4.4.4.1 Overview

The emission from glass production is covered in the registry of the NEIS (4 companies: Johns Mansville Slovakia, Rona, Vetropack, R-Glass). Emission factors are given for process and combustion emissions together since they are recorded as united in annual data sets. It is not straightforward to separate these processes.
The basic raw material for glass production is silica (SiO_2). Limestone ($CaCO_3$), dolomite ($CaMg(CO_3)_2$), soda ash (Na_2CO_3), potash (K_2CO_3), Pb_3O_4, Al_2O_3, and colouring agents are used in the glass production process. The main emissions that originated during the manufacturing are sulphur oxides (SOx), nitrogen oxides (NOx) and carbon dioxide (CO_2). However, other pollutants are also occurring: emissions of particulate matter (PMs) from handling raw materials, emissions of heavy metals produced by the melting process or presented in the PM; carbon monoxide (CO), or nitrous oxide (N_2O). DIOX emissions were balanced for the first time in this submission. Reported emissions, their trends and activity data from glass production are presented below in ***Table 4.12***.

Table 4.12: *Activity data and emissions in the category 2A3*

YEAR	CONTAINER GLASS [kt]	GLASS FIBRE [kt]	LEAD CRYSTAL GLASS [kt]	WATER GLASS [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	48.26	93.08	13.26	78.69	0.0856	0.0894	0.0941	0.0001
1995	59.67	92.88	13.23	78.52	0.0897	0.0936	0.0985	0.0001
2000	57.96	93.94	13.38	79.41	0.1196	0.1248	0.1314	0.0001
2005	116.14	82.25	11.72	69.54	0.0512	0.0535	0.0563	0.0000
2010	151.45	44.19	6.29	37.36	0.0106	0.0110	0.0115	0.0000
2011	153.95	44.19	6.29	37.36	0.0113	0.0118	0.0124	0.0000
2012	160.58	103.83	NO	36.70	0.0079	0.0082	0.0087	0.0000
2013	162.43	134.63	NO	35.32	0.0117	0.0122	0.0128	0.0000
2014	158.51	125.45	NO	35.99	0.0165	0.0172	0.0181	0.0000
2015	155.42	151.18	NO	35.19	0.0187	0.0195	0.0205	0.0000
2016	156.25	156.08	NO	40.90	0.0292	0.0305	0.0321	0.0000
2017	160.38	157.46	NO	42.51	0.0216	0.0225	0.0237	0.0000
2018	161.53	155.98	NO	43.63	0.0445	0.0464	0.0488	0.0000
2019	127.75	148.16	NO	36.34	0.0301	0.0314	0.0331	0.0000
2020	188.66	128.42	NO	35.24	0.0320	0.0335	0.0352	0.0000
2021	196.48	155.62	NO	34.03	0.0270	0.0282	0.0297	0.0000
2022	226.30	121.87	NO	33.00	0.0290	0.0303	0.0319	0.0000
1990/2022	**369%**	**31%**	**-**	**-58%**	**-66%**	**-66%**	**-66%**	**-66%**
2021/2022	**15%**	**-22%**	**-**	**-3%**	**7%**	**7%**	**7%**	**7%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.2725	0.0058	0.0007	0.0140	0.0179	0.0016	0.0116	0.0724	0.0863
1995	0.3054	0.0072	0.0007	0.0173	0.0221	0.0017	0.0143	0.0895	0.0904

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2000	0.3019	0.0070	0.0007	0.0168	0.0214	0.0017	0.0139	0.0869	0.0905
2005	0.4540	0.0139	0.0008	0.0337	0.0430	0.0020	0.0279	0.1742	0.1035
2010	0.5021	0.0182	0.0007	0.0439	0.0560	0.0017	0.0363	0.2272	0.0885
2011	0.5094	0.0185	0.0007	0.0446	0.0570	0.0017	0.0369	0.2309	0.0895
2012	0.4657	0.0193	0.0009	0.0466	0.0594	0.0021	0.0385	0.2409	0.1114
2013	0.4710	0.0195	0.0010	0.0471	0.0601	0.0023	0.0390	0.2436	0.1230
2014	0.4597	0.0190	0.0010	0.0460	0.0587	0.0022	0.0380	0.2378	0.1184
2015	0.4507	0.0187	0.0010	0.0451	0.0575	0.0024	0.0373	0.2331	0.1265
2016	0.4531	0.0188	0.0011	0.0453	0.0578	0.0025	0.0375	0.2344	0.1307
2017	0.4651	0.0192	0.0011	0.0465	0.0593	0.0025	0.0385	0.2406	0.1333
2018	0.4684	0.0194	0.0011	0.0468	0.0598	0.0025	0.0388	0.2423	0.1336
2019	0.3705	0.0153	0.0009	0.0370	0.0473	0.0022	0.0307	0.1916	0.1155
2020	0.5471	0.0226	0.0011	0.0547	0.0698	0.0025	0.0453	0.2830	0.1304
2021	0.5698	0.0236	0.0012	0.0570	0.0727	0.0027	0.0472	0.2947	0.1429
2022	0.6563	0.0272	0.0018	0.0656	0.0837	0.0041	0.0543	0.3395	0.2172
1990/2022	**141%**	**369%**	**152%**	**369%**	**369%**	**152%**	**369%**	**369%**	**152%**
2021/2022	**15%**	**15%**	**52%**	**15%**	**15%**	**52%**	**15%**	**15%**	**52%**

4.4.4.2 Methodological issues

Activities listed within this category are shown in ***Table 4.13***.

Table 4.13: *Activities according to national categorization included in 2A3*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.7. Manufacture of glass, glass products, including glass fibre with projected melting capacity in t/d

Emission data is compiled in the NEIS database therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**.

Emission factors used for the reconstruction of historical years 1990–1999 were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 4.14***). Share of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from 2005-2009.

Table 4.14: *Emission factors for calculation of historical years*

	TSP [g/t GLASS PRODUCED]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]
EF	403.28	91%	95%	0.06%

*EMEP/EEA GB_{2023}

HMs

Heavy metals are reported by the Tier 2/Tier 1 method.

The emissions of heavy metals are processed by the national emission factors presented in ***Table 4.15***. The methodology distinguishes several types of products.

Table 4.15: *Emission factors of heavy metals in 2A3*

EF [g/t [PRODUCT]/TYPE OF PRODUCT	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
T1 method			0.003			0.007			0.37
T2 Container glass	2.9	0.12	-	0.29	0.37	-	0.24	1.5	-
T2 Glass Fibre	-	-	-	-	-	-	-	-	-
T2 Lead crystal glass	10	-	-	-	-	-	-	-	-
T2 Water glass	-	-	-	-	-	-	-	-	-

4.4.4.3 Completeness

Pollutants originating from combustion actives were reported under the category **1A2f**, as these pollutants cannot be separated in the NEIS database in the entire time series. Therefore, notation key IE was used for these pollutants and only particulate matter emissions were reported within this category.

4.4.4.4 Source-specific recalculations

No recalculation was made.

4.4.5 Quarrying and Mining of Minerals Other than Coal (NFR 2A5a)

4.4.5.1 Overview

In the territory of the Slovak Republic was occurring surface and underground quarrying and mining locations for various materials during the year 2022 (lignite, oil and natural gas are not included in the category). Amongst them are metallic ores (Fe, Au, Ag, Pb, Zn – surface ore mining is not occurring), magnesite ore and building material (building stones, sandstones and sand, brick raw materials), limestone for cement and lime production, but also some other raw material (bentonite, perlite, talc and others). The emission rising from the extractions of these minerals is mainly particulate matter. The other air pollutants are related to technological units and equipment necessary for quarrying, handling and processing of the material. Reported emissions from this category and their trends (***Table 4.16***) are presented in the following figures.

Table 4.16: *Overview of emissions in the category 2A5a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0080	0.0002	0.0068	0.0018	0.0213	0.1772	0.0218
1995	0.0086	0.0002	0.0073	0.0019	0.0230	0.1912	0.0235
2000	0.0139	0.0002	0.0055	0.0036	0.0430	0.3579	0.0374
2005	0.0214	0.0005	0.0144	0.0037	0.0446	0.3715	0.0431
2010	0.0254	0.0012	0.0200	0.0030	0.0359	0.3036	0.0350
2011	0.0202	0.0012	0.0065	0.0028	0.0330	0.2752	0.0272
2012	0.0221	0.0013	0.0071	0.0023	0.0277	0.2307	0.0236
2013	0.0295	0.0006	0.0085	0.0025	0.0304	0.2531	0.0340
2014	0.0270	0.0007	0.0075	0.0025	0.0296	0.2463	0.0449
2015	0.0292	0.0007	0.0106	0.0024	0.0293	0.2443	0.0320
2016	0.0302	0.0008	0.0092	0.0022	0.0270	0.2246	0.0391
2017	0.0367	0.0010	0.0079	0.0024	0.0262	0.2159	0.0423
2018	0.0289	0.0009	0.0055	0.0021	0.0250	0.2080	0.0359
2019	0.0303	0.0009	0.0062	0.0020	0.0242	0.2020	0.0382
2020	0.0323	0.0009	0.0065	0.0020	0.0241	0.2011	0.0270
2021	0.0328	0.0010	0.0079	0.0021	0.0253	0.2110	0.0277
2022	0.0276	0.0010	0.0074	0.0023	0.0276	0.2303	0.0300
1990/2022	**246%**	**538%**	**9%**	**30%**	**30%**	**30%**	**37%**
2021/2022	**-16%**	**6%**	**-7%**	**9%**	**9%**	**9%**	**8%**

4.4.5.2 Methodological issues

Activities listed within this category are shown in ***Table 4.17***

Table 4.17: *Activities according to national categorization included in 2A5a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.10. Surface mining of ores
3.10. Quarries and related stone processing
3.11. Mining and processing of silicate raw materials and other raw materials for the production of construction materials. Or mining and processing of other materials used in the industry except for sand and gravel in the wet state.

Emission data is compiled in the NEIS database therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**.

For Quarries and related stone processing for emission calculation, it can be used the official bulletin of the Ministry of Environment (***Table 4.18***).

Table 4.18: *Emission factors for stone processing*

PROCESS - EQUIPMENT	EF FOR TSP IN G/T PROCESSED STONE							
	HUMIDITY IN %							
	0-0.5	0.5-1	1-1.5	1.5-2	2-3	3-4	4-5	5-7
Drilling of rock	9	6	4	3	2	1	0.5	0.2
Loading of cargo	0.2	0.2	0.1	0.1	0.1	0.1	0	0
Unloading of cargo	0.2	0.2	0.1	0.1	0.1	0.1	0	0
Primary crushing	15	10	6.5	4.3	2.4	1.1	0.5	0.2
Primary sorting	14	9	6.2	4.1	2.2	1	0.5	0.2
Transporting on conveyor belts	2	1.4	0.9	0.6	0.3	0.15	0.007	0.002
Secondary crushing	28	19	13	8.5	4.6	2.1	1	0.3
secondary sorting	27	18	12	8	4.4	2	1	0.3
Transporting on conveyor belts	4	2.7	1.8	1.2	0.7	0.2	0.14	0.04
Tertiary crushing	53	36	24	16	8.8	4	1.8	0.5
Tertiary sorting	51	35	23	15	8.5	3.8	1.7	0.5
Transporting on conveyor belts	8	5.5	3.7	2.5	1.4	0.6	0.3	0.1
Tertiary fine crushing (under 4 mm)	640	429	288	193	106	48	21	6.5
Tertiary fine sorting	604	405	271	182	100	45	20	6.1
Transporting on conveyor belts	33	22	15	10	5.5	2.5	1.1	0.3

Historical years 1990-1999 were recalculated due to a change of IEF for all rising pollutants. The average IEF of the years 2000-2004 was replaced with a weighted average of these years. Share of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from 2005-2009 (***Table 4.19***).

Table 4.19: *Emission factors for calculation of historical years in 2A5a*

	NOx [g/GJ ENERGY]	NMVOC [g/GJ ENERGY]	SOx [g/GJ ENERGY]	TSP [g/GJ ENERGY]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/GJ ENERGY]
EF	136.34	2.77	115.13	3 020.65	1%	12%	371.80

4.4.5.3 Completeness

All rising pollutants were reported.

4.4.5.4 Source-specific recalculations

No recalculation was made.

4.4.6 Construction and Demolition (NFR 2A5b)

4.4.6.1 Overview

The chapter covers the emissions of particulate matter originating from the activities of building highway roads and housing construction and demolition. The overall trends of activity data for affected areas and emissions are shown in ***Table 4.20***.

Table 4.20: *Overview of activity data in 2A5b*

YEAR	AF. AREA OF HIGHWAYS AND EXPRESSWAYS [m²]	AF. AREA OF NEW BUILDINGS FOR ADMINISTRATION [m²]	AF. AREA OF COMPLETED FLATS [m²]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	789248.57	343411.83	2585482.60	0.1074	1.0737	3.5836
1995	NO	283364.71	637201.09	0.0191	0.1905	0.6323
2000	36000.00	223317.59	1805396.92	0.0416	0.4165	1.3863
2005	1618920.00	130400.00	2155845.12	0.1393	1.3926	4.6558
2010	1504692.00	64800.00	1586802.10	0.0880	0.8799	2.9428
2011	416628.00	84000.00	1363224.20	0.0735	0.7348	2.4540
2012	0.00	76000.00	1421360.20	0.0302	0.3023	1.0068
2013	510480.00	19200.00	1447613.70	0.0601	0.6009	2.0080
2014	207360.00	77600.00	2314000.00	0.0504	0.5040	1.6812
2015	2038680.00	34736.80	2288000.00	0.2222	2.2219	7.4311
2016	344160.00	186400.00	2418000.00	0.0645	0.6453	2.1526
2017	1017360.00	43200.00	2483000.00	0.1189	1.1893	3.9747
2018	NO	52800.00	2782000.00	0.0626	0.6259	2.0858
2019	518400.00	97600.00	2873000.00	0.0883	0.8832	2.9482
2020	1857600.00	36000.00	3055000.00	0.1762	1.7621	5.8916
2021	1107900.00	63200.00	2873000.00	0.1458	1.4582	4.8730
2022	144000.00	52000.00	3016000.00	0.0888	0.8881	2.9617
1990/2022	**-82%**	**-85%**	**17%**	**-17%**	**-17%**	**-17%**
2021/2022	**-87%**	**-18%**	**5%**	**-39%**	**-39%**	**-39%**

4.4.6.2 Methodological issues

The emissions are reported in the category according to the methodology of EMEP/EEA GB_{2023} in a division of Non-residential construction, Construction of apartments and Road construction. The construction of family houses was not included yet due to missing activity data.

Table 4.21: *EF used for the calculations in category 2A5b*

$EF_{GB2019\text{ - division}}$	$PM_{2.5}$ [kg/m²]	PM_{10} [kg/m²]	TSP[kg/m²]
Road construction	0.23	2.3	7.7
Non-residential construction	0.1	1	3.3
Construction of apartments	0.03	0.3	1

In this submission, parameters of the area affected (A), construction duration (d), control efficiency of applied emission reduction measures (CE), Thornthwaite precipitation-evaporation index (PE) and soil silt content (s) were taken into calculation following the ***Equation 4.1***.

Equation 4.1: *Tier 1 approach to estimating total fugitive PM emissions*

$$E_{PM_s} = EF_{PM_s} \times A_{affected} \times d \times (1 - CE) \times \left(\frac{24}{PE}\right) \times \left(\frac{s}{9\%}\right)$$

Where:

E PMs = PMs emission (kg PMs)

EF PMs = the emission factor for this pollutant emission (kg PMs/[m² x year])

A affected = area affected by construction activity (m²)

d = duration of construction (year)

CE = efficiency of emission control measures (-)

PE = Thornthwaite precipitation-evaporation index (-)

s = soil silt content (%)

The parameters used for the calculation are listed in ***Table 4.22*** and ***Table 4.23***.

Table 4.22: *Parameters used for the calculations in category 2A5b*

PARAMETER	d	CE	s	$A_{affected}$
Road construction	0.83	0.5	20%	36000*
Non-residential construction	0.83	0.5	20%	0.8
Construction of apartments	0.75	0	20%	1.3

*m^2/km

Thornthwaite precipitation-evaporation index was calculated using ***Equation 4.2***.

Equation 4.2: *Thornthwaite precipitation-evaporation index calculation*

$$PE\ index = 3.16 \sum_{i=0}^{12} \left(\frac{P_i}{1.8\ T_i + 22} \right)$$

Where:

P_i - monthly precipitation (in mm)

T_i - mean temperature (in °C)

The Thornthwaite precipitation-evaporation index was calculated using parameters and the index in ***Table 4.23***.

Table 4.23: *Parameters used for the calculations of Thornthwaite precipitation-evaporation index*

PARAMETER	P_I	T_I	PE
1990	72.47	10.00	73.39
1995	72.16	10.00	73.04
2000	67.92	10.00	68.29
2005	78.17	10.00	79.83
2010	104.58	10.00	110.32
2011	54.67	10.00	53.65
2012	62.25	10.00	61.99
2013	72.00	10.00	72.86
2014	77.83	10.00	79.45
2015	59.92	10.00	59.41
2016	77.00	10.00	78.51
2017	68.92	10.00	69.40
2018	56.08	10.00	55.20
2019	70.67	10.00	71.36
2020	73.83	10.00	74.92
2021	63.42	10.00	63.28
2022	51.58	10.00	50.30

4.4.6.3 Completeness

All rising pollutants were reported.

4.4.6.4 Source-specific recalculations

Recalculation was made for the year 2021. The value of Area of completed flats [mil.m^2] was updated due to the correction of Statistical Office SR. Emissions of TSP, $PM_{2.5}$ and PM_{10} were consequently revised.

Table 4.24: *Previous and revised emissions and activity data in the category 2A5b*

YEAR	AD - CONSTRUCTED FLOOR SPACE OF NEW FLATS AND BUILDINGS [mil.m^2]			TSP [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	4.25	4.04	-5%	5.0045	4.8730	-3%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2021	0.1498	0.1458	-3%	1.4977	1.4582	-3%

4.4.7 Storage, Handling and Transport of Mineral Products (NFR 2A5c)

4.4.7.1 Overview

The category is reported by notation key NA and IE for TSP and PMs because the emissions from handling are already included in outputs from individual technologies and it would be double-counting if reported in this category separately by T1.

4.4.8 Other Mineral Products (NFR 2A6)

4.4.8.1 Overview

The category covers other industrial activities of the mineral industry not covered in described NFR categories. Reported emissions under the category and their trends are presented below (***Table 4.25***). The increase in emissions in 2021 was caused by the failure of the automatic burner for burning furnace gases on the Envirotec L2 filter device, which resulted in the opening of the emergency chimney and the release of emissions into the air.

Table 4.25: *Overview of emissions in the category 2A6*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.3406	0.1731	0.1847	0.0007	0.1110	0.1191	0.1505	1.2966
1995	0.3428	0.1742	0.1859	0.0007	0.1117	0.1199	0.1515	1.3050
2000	0.4456	0.0803	0.2455	0.0001	0.1236	0.1327	0.1677	1.0779
2005	0.4333	0.1578	0.4848	0.0041	0.1408	0.1494	0.1757	1.7465
2010	0.3009	0.0524	0.3119	0.0129	0.0757	0.0825	0.1141	0.4357
2011	0.2734	0.0507	0.2944	0.0137	0.0877	0.0959	0.1359	0.4100
2012	0.2457	0.0595	0.3228	0.0227	0.0587	0.0654	0.1020	0.2801
2013	0.1865	0.0591	0.3039	0.0214	0.0558	0.0622	0.0969	0.2912
2014	0.1807	0.0494	0.3046	0.0210	0.0545	0.0614	0.1012	0.2293
2015	0.2036	0.0735	0.3534	0.0248	0.0494	0.0568	0.1014	0.3016
2016	0.2283	0.1168	0.4220	0.0228	0.0159	0.0221	0.0670	0.5076
2017	0.2579	0.1254	0.4271	0.0234	0.0158	0.0223	0.0693	0.5535
2018	0.2895	0.1476	0.4473	0.0241	0.0130	0.0200	0.0724	0.7775
2019	0.2636	0.1283	0.4208	0.0220	0.0098	0.0162	0.0682	0.7389
2020	0.2583	0.0874	0.4445	0.0276	0.0128	0.0194	0.0685	0.6764
2021	0.2917	0.1308	0.4001	0.0753	0.0215	0.0288	0.0809	0.7578
2022	0.2846	0.1473	0.3380	0.0674	0.0160	0.0228	0.0732	0.7916
1990/2022	**-16%**	**-15%**	**83%**	**8978%**	**-86%**	**-81%**	**-51%**	**-39%**
2021/2022	**-2%**	**13%**	**-16%**	**-11%**	**-26%**	**-21%**	**-9%**	**4%**

4.4.8.2 Methodological issues

Activities listed within this category are shown in ***Table 4.26***.

Table 4.26: *Activities according to national categorization included in 2A6*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.4. Production of magnesium oxide from magnesite and production of alkaline refractory materials with a projected production capacity t/d
3.6. Installations for melting of mineral substances including the processing of melt materials and production of mineral fibres with a melting capacity projected in t/d
3.8. Manufacture of ceramic products by firing, roofing tiles, bricks, tiles, stoneware or porcelain:
-with a projected production capacity in t/d or
-with a kiln capacity in m^3 and with a setting density per kiln exceeding 300 kg/m 3
3.9. Production of lightweight non-metallic mineral products with a projected production capacity of m^3/d
3.12. Production of unfired masonry materials and precast units with a projected production capacity of m^3/h

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.13. Industrial production of concrete, mortar or other building materials with a projected production capacity in m^3/h
3.99. Other industrial production and processing of non-metallic mineral products - division by point 2.99
4.32. Production and processing of carbon materials:
a) production of charcoal with a projected production in kg/d
b) production of soot
c) burning carbonaceous materials, including impregnation
d) mechanical processing of carbonaceous materials

Emission data is compiled in the NEIS database therefore the individual-specific EF could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**.

Industrial production of concrete for emission calculation can be used in the official bulletin of the Ministry of Environment:

LFS - large fraction of stones

FFS - fine fraction of stones

Emission factors from the Bulletin of the Ministry of Environment are shown in ***Table 4.27*** (valid for 2000-2022). Emission factors for the historical years were calculated as a weighted average of IEF of the period 2000-2004. Share of PM2.5 and PM10 in TSP are calculated using average shares from 2005-2009 (***Table 4.28***).

Table 4.27: *Emission factors provided by Bulletin of MoE*

PROCESS	EF	
	TSP	PM_{10}
	g/m^3	
Transport and loading of LFS into boxes - fugitive emissions	3.8	1.8
Transport and loading of FFS into boxes - fugitive emissions	1	0.5
loading of LFS into underground storage or transport equipment - fugitive emissions	3.8	1.8
loading of FFS into underground storage or transport equipment - fugitive emissions	1	0.5
Transport of LFS to mixing drum or convoy or above-ground storage	3.8	1.8
Transport of FFS to mixing drum or convoy or above-ground storage	1	0.5
transport of cement into the silo (abated)	0.1	0.1
transport of ash or cinder (abated)	0.2	0.1
filling the stock over mixing drum with FFS	3.8	1.8
filling the stock over mixing drum with LFS	1	0.5
filling the drum with solid material - abated	0.2	0.1
average humidity and batching of materials	19.7	9.5

Table 4.28: *Emission factors for calculation of historical years in 2A6*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/GJ]
EF	159.01	80.81	86.22	0.35	70.26	74%	79%	605.28

4.4.8.3 Completeness

All rising pollutants were reported.

4.4.8.4 Source-specific recalculations

No recalculation was made.

4.5 CHEMICAL PRODUCTS (NFR 2B)

4.5.1 Overview

The category covers the NFR activities: Ammonia production (**2B1**), Nitric acid production (**2B2**), Adipic acid production (**2B3**), Carbide production (**2B5**), Titanium dioxide production (**2B6**), Soda ash production (**2B7**), Chemical industry: Other (**2B10a**), Storage, handling and transport of chemical products (**2B10b**).

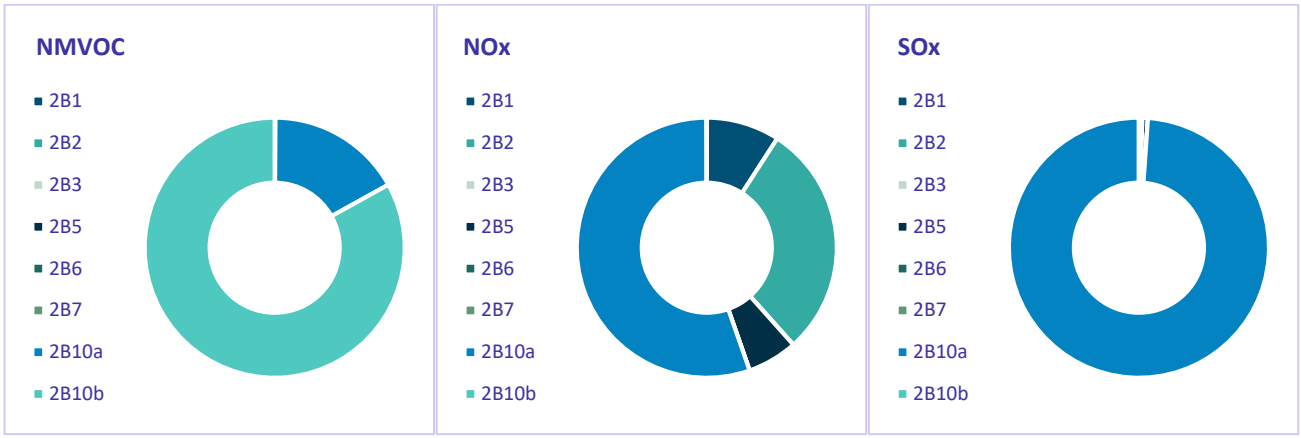
Emissions from this category have a general decreasing trend, except for the emissions of SOx (***Table 4.29***). It was caused by stricter legislation and the adoption of emissions limits for the main pollutants. Emissions of NOx originate mostly from category **2B10a** which includes the production of various organic and inorganic compounds, fertilizers etc.

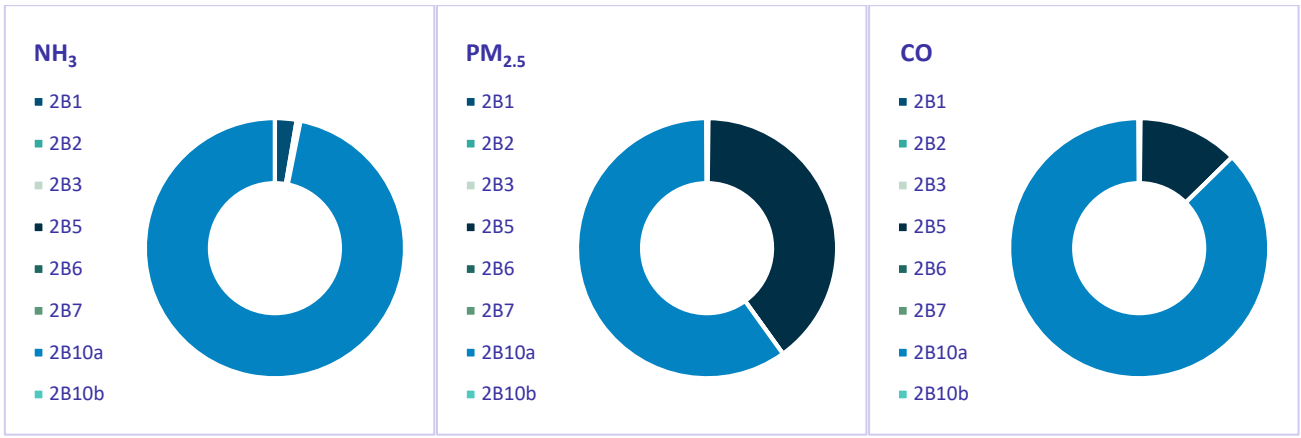
Not all are occurring in the territory of Slovakia. Shares of released emissions of main air pollutants in 2022. NFR categories included are provided in the figure below (***Figure 4.4***).

Table 4.29: *Overview of emissions in category 2B*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	1.0829	6.0322	1.6193	0.2449	0.2095	0.3308	0.5077	0.0034	4.1970
1995	1.2687	5.8719	1.5772	0.2368	0.3545	0.5731	0.9131	0.0033	4.1210
2000	1.2470	5.9168	0.9387	0.1699	0.3386	0.5499	0.8822	0.0027	5.0582
2005	1.0212	3.1771	1.0770	0.2241	0.2083	0.3384	0.5437	0.0017	1.5312
2010	0.6434	1.9941	1.2018	0.0684	0.0843	0.1411	0.2328	0.0009	1.0593
2011	1.1640	2.2196	1.3395	0.1668	0.1235	0.1982	0.3126	0.0016	0.9440
2012	0.9922	1.8870	1.2745	0.1548	0.1415	0.2314	0.3738	0.0014	1.6484
2013	1.0765	2.1398	1.4026	0.1061	0.1549	0.2543	0.4124	0.0014	1.2780
2014	0.9613	1.9304	1.2950	0.0639	0.1357	0.2248	0.3679	0.0011	1.3369
2015	1.0176	2.2004	1.3706	0.0945	0.1455	0.2375	0.3834	0.0014	1.2545
2016	1.0487	2.0332	1.5099	0.1574	0.1154	0.1920	0.3166	0.0012	1.1543
2017	1.1728	2.0977	1.4116	0.1457	0.1224	0.2026	0.3331	0.0013	1.2053
2018	1.2158	2.1072	1.3936	0.1626	0.1188	0.1947	0.3163	0.0013	1.1725
2019	1.0795	1.9449	1.3327	0.1400	0.1342	0.2223	0.3674	0.0010	1.0253
2020	1.0160	2.0983	1.2662	0.2032	0.1229	0.2051	0.3403	0.0012	1.2007
2021	1.0212	2.2056	1.1903	0.1812	0.1272	0.2114	0.3493	0.0013	1.2051
2022	0.8252	2.0276	1.5051	0.1249	0.0846	0.1401	0.2306	0.0009	1.0211
1990/2022	**-24%**	**-66%**	**-7%**	**-49%**	**-60%**	**-58%**	**-55%**	**-73%**	**-76%**
2021/2022	**-19%**	**-8%**	**26%**	**-31%**	**-33%**	**-34%**	**-34%**	**-31%**	**-15%**

Figure 4.4: *Shares of emissions in 2B in 2022*





4.5.2 Ammonia production (NFR 2B1)

4.5.2.1 Overview

Ammonia is made from nitrogen and hydrogen by fine-tuned versions of the process developed by Haber and Bosch $N_2 + 3H_2 = 2NH_3$. In principle, the reaction between hydrogen and nitrogen is easy. However, to get a respectable yield of ammonia in a chemical plant a catalyst and extreme pressures of up to 600 atmospheres and a temperature of 400°C are needed. Emission trends and activity data from this category are shown in ***Table 4.30***. The emissions of particulate matter from this source decreased significantly in 2004 due to abatement technology installation.

Table 4.30: *Activity data and emissions in the category 2B1*

YEAR	AMMONIA PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	360.00	0.2136	0.0038	0.0011	0.0036	0.0212	0.0354	0.0590	0.0702
1995	383.80	0.2277	0.0041	0.0012	0.0038	0.0226	0.0377	0.0629	0.0748
2000	403.00	0.2182	0.0049	0.0015	0.0040	0.0320	0.0533	0.0888	0.0161
2005	426.35	0.2711	0.0045	0.0013	0.0043	0.0039	0.0066	0.0109	0.1064
2010	233.56	0.1274	0.0017	0.0007	0.0023	0.0021	0.0035	0.0058	0.0427
2011	455.48	0.2496	0.0033	0.0014	0.0046	0.0041	0.0068	0.0113	0.0837
2012	377.30	0.2037	0.0027	0.0011	0.0038	0.0033	0.0056	0.0093	0.0683
2013	474.91	0.2436	0.0032	0.0013	0.0047	0.0040	0.0066	0.0111	0.0776
2014	346.27	0.1799	0.0024	0.0010	0.0035	0.0029	0.0049	0.0082	0.0573
2015	476.94	0.2279	0.0030	0.0012	0.0048	0.0037	0.0062	0.0104	0.0764
2016	403.96	0.2017	0.0026	0.0011	0.0040	0.0033	0.0055	0.0092	0.0676
2017	458.88	0.2253	0.0029	0.0012	0.0046	0.0037	0.0061	0.0102	0.0755
2018	516.74	0.2354	0.0030	0.0012	0.0052	0.0037	0.0061	0.0102	0.0787
2019	491.95	0.1449	0.0022	0.0008	0.0049	0.0024	0.0040	0.0066	0.0490
2020	545.23	0.1540	0.0023	0.0008	0.0055	0.0025	0.0042	0.0070	0.0519
2021	580.51	0.1647	0.0023	0.0009	0.0058	0.0027	0.0045	0.0075	0.0554
2022	462.12	0.0753	0.0020	0.0065	0.0046	0.0002	0.0003	0.0004	0.0018
1990/2022	**28%**	**-65%**	**-47%**	**485%**	**28%**	**-99%**	**-99%**	**-99%**	**-97%**
2021/2022	**-20%**	**-54%**	**-11%**	**625%**	**-20%**	**-94%**	**-94%**	**-94%**	**-97%**

4.5.2.2 Methodological issues

Activities listed within this category are shown in ***Table 4.31***.

Table 4.31: *Activities according to national categorization included in 2B1*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.27 Ammonia production

Emission data is compiled in the NEIS database therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**.

Emissions of NH_3 were calculated using the Tier 1 emission factor from the EMEP/EEA GB_{2023}. Historical years were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.32***). Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from 2005-2009.

Table 4.32 *Emission factors for calculation of historical years and NH_3 and CO emissions in 2B1*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	NH_3*[g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/t]
EF	593.41	10.67	3.10	10	163.77	36%	60%	194.97

*EMEP/EEA GB_{2023} – Tier 1

4.5.2.3 Completeness

All rising pollutants were reported.

4.5.2.4 Source-specific recalculations

No recalculation was made.

4.5.3 Nitric acid production (NFR 2B2)

4.5.3.1 Overview

NOx emissions have had an overall increasing trend since 1990 due to the increase in the production of nitric acid (***Table 4.33***). Significant increases and subsequent decreases in NH_3 emissions between 2006/2007 were recorded due to temporal malfunction on the source. A decrease in 2022 was caused by single-source starting to use new technology to produce Nitric acid.

Table 4.33: *Activity data and emissions in the category 2B2*

YEAR	NITRIC ACID PRODUCED [kt]	NOx [kt]	NH_3 [kt]
1990	400.54	0.1741	0.0039
1995	398.80	0.1733	0.0039
2000	407.22	0.1770	0.0040
2005	497.68	0.2163	0.0048
2010	510.97	0.3313	0.0026
2011	593.75	0.3711	0.0034
2012	550.51	0.3299	0.0035
2013	611.65	0.3609	0.0012
2014	580.09	0.3446	0.0011
2015	634.31	0.3251	0.0009
2016	568.55	0.3128	0.0039
2017	646.23	0.3407	0.0041
2018	575.32	0.3955	0.0038
2019	571.27	0.3673	0.0010
2020	580.24	0.2717	0.0010
2021	636.32	0.2906	0.0015
2022	523.76	0.2417	0.0049
1990/2022	**31%**	**39%**	**27%**
2021/2022	**-18%**	**-17%**	**232%**

4.5.3.2 Methodological issues

The definition of activities covered by category **2B2** is provided in ***Table 4.34***. The characteristic of involved industrial activity is wider, but in fact, only nitric acid is reported under **2B2**. Nitric acid is currently produced in three industrial plants situated in the Slovak Republic (owned by a single operator).

Table 4.34: *Activities according to national categorization included in 2B2*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.22 Production of inorganic acids

Since 2005, N_2O, NH_3 and NOx emissions are monitored by nitric acid producers with medium-pressure and high-pressure plants. Nitric acid is produced by using two technologies: two medium-pressure plants and one high-pressure plant. In September 2010, technology was changed to medium- and high-pressure technologies by a single producer. The secondary YARA catalyst was introduced. The second plant was using un-modified technology. At the end of 2012, the second medium-pressure plant was bought by the new owner (who already owned the second plant). The plant was modernized in the same way as the other.
Emission data is compiled in the NEIS, therefore the individual specific EF were used for sources recorded in the database.
For a reconstruction of historical years before 2000 (data in the NEIS are recorded since 2000), a rounded weighted average of IEF of available data was used (excluding the year of malfunction), therefore implied emission factor for this period for nitrogen oxides was **IEF (NOx) = 434.60 g/t** and for ammonia: **IEF (NH_3) = 9.74 g/t**.

4.5.3.3 Completeness

All rising pollutants were reported.

4.5.3.4 Source-specific recalculations

No recalculation of emissions was made. However, the correction of activity data for years 2018 – 2021 was done. The numbers were corrected since more precise values were obtained. The correction does not affect the emissions since the emissions are taken directly from NEIS. The overview of recalculations is displayed in table below (***Table 4.35***).

Table 4.35: *Previous and revised activity data in the category 2B2*

YEAR	AD - NITRIC ACID PRODUCED [kt]		
	PREVIOUS	REVISED	CHANGE
2018	529.76	575.32	9%
2019	528.71	571.27	8%
2020	520.28	580.24	12%
2021	576.21	636.32	10%

4.5.4 Adipic acid production (NFR 2B3)

4.5.4.1 Overview

Adipic acid is not produced in the Slovak Republic, therefore notation key NO was used.

4.5.5 Carbide production (NFR 2B5)

4.5.5.1 Overview

The production of calcium carbide in the Slovak Republic started in 1992. The production of the other specified activities under national legislation (e.g. other inorganic compounds such as sodium, calcium, silicon, phosphorus or silicon carbide) is not occurring in the Slovak Republic.

Calcium carbide is manufactured by heating the mixture of lime and carbon (the reaction of CaO and coke) to 2000 to 2100°C in a submerged arc furnace. At those temperatures, the lime is reduced by carbon to calcium carbide and carbon monoxide (according to the reaction: $CaO + 3C \rightarrow CaC_2 + CO$). Since 2015, calcined anthracite is used instead of other bituminous coal.

The main emissions from the production of calcium carbide (CaC_2) are dust. However, the reported emissions in the category cover all sub-processes of manufacturing as they are together in the data set under the category. Relevant rising emissions from this manufacturing, their trends and activity data (***Table 4.36***) are presented. The emissions trend is slightly decreasing except for NMVOC, which increased significantly in 2019 and 2021 due to increased combustion of natural gas in process of carbide production.

Table 4.36: *Activity data and emissions in the category 2B5*

YEAR	CARBIDE PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	NO	NO	NO	NO	NO	NO	NO	NO
1995	84.30	0.1968	0.0000	0.0144	0.1502	0.2503	0.4172	0.0638
2000	88.82	0.3865	0.0000	0.0250	0.1586	0.2644	0.4406	0.0679
2005	97.03	0.0688	0.0000	0.0089	0.1114	0.1856	0.3093	0.0660
2010	98.26	0.0561	0.0000	0.0027	0.0326	0.0543	0.0905	0.2789
2011	107.40	0.0565	0.0000	0.0027	0.0310	0.0516	0.0860	0.2791
2012	100.48	0.0522	0.0000	0.0043	0.0605	0.1008	0.1681	0.3169
2013	81.79	0.0433	0.0000	0.0058	0.0725	0.1208	0.2013	0.3324
2014	74.30	0.0505	0.0000	0.0053	0.0707	0.1179	0.1965	0.2972
2015	56.18	0.0502	0.0000	0.0067	0.0617	0.1028	0.1713	0.2817
2016	67.95	0.0590	0.0000	0.0083	0.0462	0.0770	0.1284	0.3341
2017	71.64	0.0580	0.0000	0.0083	0.0482	0.0803	0.1338	0.2139
2018	70.15	0.0535	0.0000	0.0079	0.0436	0.0726	0.1210	0.1890
2019	60.47	0.0600	0.0002	0.0083	0.0767	0.1279	0.2132	0.1688
2020	47.61	0.0716	0.0000	0.0067	0.0547	0.0912	0.1520	0.1464
2021	48.48	0.0607	0.0001	0.0073	0.0508	0.0847	0.1412	0.1597
2022	36.12	0.0516	0.0000	0.0102	0.0338	0.0563	0.0938	0.1276
1990/2022	-	-	-	-	-	-	-	-
2021/2022	**-26%**	**-15%**	**-55%**	**40%**	**-34%**	**-34%**	**-34%**	**-20%**

4.5.5.2 Methodological issues

The definition of activities covered by category **2B5** is provided in ***Table 4.37***. The characteristic of involved industrial activity is wider, but the only activity of calcium carbide production belongs to the occurring production activities.

Table 4.37: *Activities according to national categorization included in 2B5*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.25 Production of non-metals, metal oxides or other inorganic compounds such as sodium, calcium, silicon, phosphorus, calcium carbide, silicon carbide

Emission data is compiled in the NEIS, therefore, the individual-specific EF were used for sources recorded in the database. Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from 2005-2009 (***Table 4.38***).

Table 4.38: *Emission factors for calculation of historical years in 2B5*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/t]
EF	2 334.16	0.12	171.03	4 949.16	36%	60%	757.16

4.5.5.3 Completeness

All rising pollutants were reported. The notation key was used in compliance with EMEP/EEA GB_{2023}. In the years 1990 and 1991, notation key NO was used, because production started in 1992.

4.5.5.4 Source-specific recalculations

The correction of activity data for years 2019, 2020 and 2021 was done. The numbers were corrected since more precise values were obtained. The change does not affect the emissions since the emissions are separately compiled in NEIS. The overview of recalculations is presented in ***Table 4.39***.

Table 4.39: *Previous and revised activity data in the category 2B5*

YEAR	AD - CARBIDE PRODUCTION [kt]		
	PREVIOUS	REVISED	CHANGE
2019	69.71	60.47	-13%
2020	56.77	47.61	-16%
2021	57.03	48.48	-15%

4.5.6 Titanium dioxide production (NFR 2B6)

4.5.6.1 Overview

Titanium dioxide is not produced in the Slovak Republic and NO notation key was used.

4.5.7 Soda ash production (NFR 2B7)

4.5.7.1 Overview

Soda ash is not produced in the Slovak Republic and NO notation key was used.

4.5.8 Chemical industry: Other (NFR 2B10a)

4.5.8.1 Overview

The category included various activities of the chemical industry. The overview of emissions and activity data is provided in ***Table 4.40.*** Emissions of air pollutants show a decreasing tendency in the long term.

Table 4.40: *Overview of emissions in the category 2B10a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.6952	2.9146	1.6182	0.2373	0.1882	0.2954	0.4488	0.0034	4.1268
1995	0.6708	2.8125	1.5615	0.2290	0.1817	0.2851	0.4331	0.0033	3.9823
2000	0.4653	3.2955	0.9122	0.1619	0.1480	0.2322	0.3528	0.0027	4.9742
2005	0.4649	1.3922	1.0667	0.2149	0.0930	0.1463	0.2234	0.0017	1.3587
2010	0.1286	0.6126	1.1984	0.0635	0.0497	0.0833	0.1365	0.0009	0.7377
2011	0.4867	0.8527	1.3355	0.1589	0.0884	0.1398	0.2152	0.0016	0.5813
2012	0.4064	0.6851	1.2691	0.1475	0.0777	0.1250	0.1965	0.0014	1.2631
2013	0.4287	0.7083	1.3955	0.1001	0.0785	0.1269	0.2000	0.0014	0.8680
2014	0.3862	0.5724	1.2887	0.0593	0.0621	0.1020	0.1632	0.0011	0.9824
2015	0.4142	0.5748	1.3627	0.0888	0.0801	0.1285	0.2017	0.0014	0.8963
2016	0.4751	0.5024	1.5005	0.1495	0.0659	0.1095	0.1790	0.0012	0.7526
2017	0.5485	0.5574	1.4021	0.1370	0.0705	0.1162	0.1890	0.0013	0.9156
2018	0.5312	0.5058	1.3845	0.1536	0.0715	0.1159	0.1850	0.0013	0.9041
2019	0.5072	0.4504	1.3236	0.1341	0.0550	0.0903	0.1475	0.0010	0.8067
2020	0.5186	0.4384	1.2586	0.1968	0.0656	0.1096	0.1812	0.0012	1.0015
2021	0.5050	0.4493	1.1821	0.1739	0.0736	0.1221	0.2005	0.0013	0.9892
2022	0.4565	0.3415	1.4884	0.1153	0.0506	0.0835	0.1363	0.0009	0.8909

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990/2022	-34%	-88%	-8%	-51%	-73%	-72%	-70%	-73%	-78%
2021/2022	-10%	-24%	26%	-34%	-31%	-32%	-32%	-31%	-10%

4.5.8.2 Methodological issues

The definition of activities covered by category **2B10a** is provided in ***Table 4.41***.

Table 4.41: *Activities according to national categorization included in 2B10a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.6 Production of synthetic rubbers
4.7 Production of basic plastic materials based on synthetic and natural polymers excluding synthetic rubber
4.8 Production of simple hydrocarbons (linear or cyclic, saturated or unsaturated, aliphatic or aromatic)
4.9 Production of halogenated organic compounds
4.10 Production of organic compounds containing oxygen
4.11 Production of organic compounds containing sulphur
4.12 Production of organic compounds containing nitrogen excluding carbamide
4.13 Production of organic compounds containing phosphorus
4.14 Production of organometallic compounds
4.15 Production of plant protection products or biocides
4.16 Production of auxiliary agents for the rubber industry
4.17 Production and processing of viscose
4.21 Production of inorganic gases and compounds except for ammonia
4.23 Production of inorganic hydroxides
4.26 Production of inorganic salts excluding fertilizers
4.28 Production of carbamide
4.29 Production of phosphorous-, nitrogen- or potassium-based fertilisers (simple or compound fertilisers excluding carbamide)
4.30 Production of inorganic pigments, refining bleaching preparations
4.31 Production of industrial explosives
4.32 Production and processing of carbon materials: a) production of charcoal with a projected production in kg/d b) production of soot c) burning carbonaceous materials, including impregnation d) mechanical processing of carbonaceous materials
4.34 Production of soaps, detergents and cosmetics with a production capacity in kg/h: a) detergents b) cosmetics
4.99 Other unspecified chemical production including the raw materials and intermediate products processing a) the part of technology is the fuel combustion with a rated thermal input in MW b) share of emission mass flow of air pollutant before abatement and emission mass flow of air pollutant, that is noted in annex 3 for existing installations: AP with carcinogenic effects, organic vapour, other air pollutants

Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from 2005-2009 (***Table 4.42***).

Table 4.42: *Emission factors for calculation of historical years in 2B10a*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/GJ]
EF	352.13	1476.34	819.68	120.20	227.33	42%	66%	1.8%	2090.38

*Tier 1 EMEP/EEA GB_{2023}

4.5.8.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}.

4.5.8.4 Source-specific recalculations

No recalculation was made.

4.5.9 Storage, handling and transport of chemical products (NFR 2B10b)

4.5.9.1 Overview

The chapter covers the emissions rising from sources with the activity: distribution storages for pumping and individual pumping equipment for fuels, greases, petrochemicals and other organic liquids. Released air pollutants and their trends are presented in ***Table 4.43***.

Table 4.43: *Overview of emissions in the category 2B10b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0001	3.1138	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
1995	0.0001	3.0553	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
2000	0.0001	2.6163	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
2005	0.0001	1.7804	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
2010	0.0001	1.3799	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2011	0.0001	1.3636	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2012	0.0001	1.1992	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2013	0.0001	1.4284	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2014	0.0001	1.3556	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2015	0.0001	1.6226	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2016	0.0000	1.5281	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2017	0.0002	1.5373	0.0000	NO	0.0000	0.0000	0.0000	0.0002
2018	0.0001	1.5985	0.0000	NO	0.0000	0.0001	0.0001	0.0006
2019	0.0002	1.4921	0.0000	NO	0.0001	0.0001	0.0001	0.0008
2020	0.0002	1.6576	0.0000	NO	0.0001	0.0001	0.0001	0.0008
2021	0.0002	1.7539	0.0000	NO	0.0001	0.0001	0.0001	0.0008
2022	0.0002	1.6840	0.0000	NO	0.0001	0.0001	0.0001	0.0009
1990/2022	**162%**	**-46%**	**76%**	**-**	**4603%**	**4603%**	**4604%**	**6677%**
2021/2022	**-4%**	**-4%**	**-12%**	**-**	**-1%**	**-1%**	**-1%**	**5%**

4.5.9.2 Methodological issues

Activities listed within this category are shown in ***Table 4.44***.

Table 4.44: *Activities according to national categorization included in 2B10b*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.5 Distribution storages for pumping and individual pumping equipment for fuels, greases, petrochemicals and other organic liquids having a vapour pressure according to the Annex. 3 second part of section 2.2, except for liquefied hydrocarbon gases and compressed natural gas diesel, according to installed aggregated storage capacity in m^3 or a projected or real annual turnover in m^3 according to which is higher.

Emissions in this category are from the NEIS database for the period 2000-2022. Historical years were linearly extrapolated.

4.5.9.3 Completeness

All rising pollutants were reported. The notation key was used in compliance with EMEP/EEA GB_{2023}.

4.5.9.4 Source-specific recalculations

No recalculations in this submission.

4.6 METAL PRODUCTION (NFR 2C)

4.6.1 Overview

Metal production is an important sector in the national economy.

The category covers the NFR activities: Iron and steel production (2C1), Ferroalloys production (2C2), Aluminium production (2C3), Magnesium production (2C4), Lead production (2C5), Copper production (2C7a), Other Metal production (2C7c) and Storage, handling and transport of metal products (2C7d). Emissions in this category have a decreasing trend (*Table 4.45*) due to stricter legislation and the adoption of emission limits as well as BAT technologies in this industry.

Table 4.45: *Overview of emissions in the category 2C*

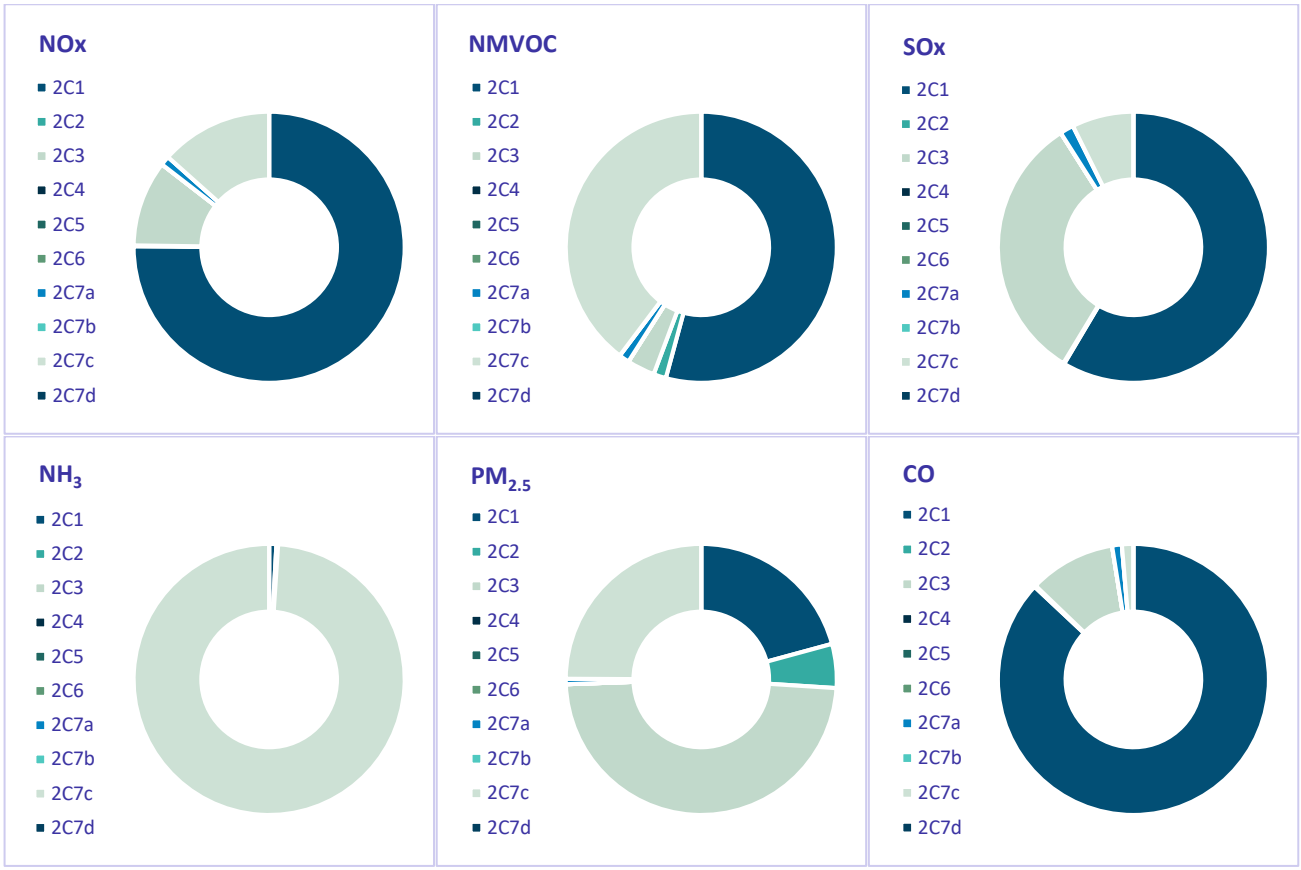
YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	5.3556	0.3482	9.5119	0.0077	1.5525	2.3511	8.7088	0.0208	78.8745
1995	4.8373	0.3181	8.3694	0.0075	1.3862	2.1099	7.9009	0.0167	69.3173
2000	6.0021	0.2698	12.7058	0.0081	1.9146	2.8538	10.0320	0.0366	86.6576
2005	4.9041	0.7772	9.8522	0.0057	0.6272	0.8993	2.8102	0.0071	100.1900
2010	4.8614	0.6605	5.7673	0.0036	0.3977	0.5721	2.0893	0.0059	91.8471
2011	5.0363	0.7585	7.5523	0.0036	0.3393	0.5206	2.2781	0.0039	105.1633
2012	4.8798	0.6933	6.4198	0.0045	0.3725	0.5703	2.5268	0.0038	103.1368
2013	4.7659	0.6278	5.6372	0.0044	0.3879	0.5995	2.7311	0.0041	102.9434
2014	5.1730	0.7683	6.3798	0.0043	0.4737	0.7180	3.1047	0.0050	117.3026
2015	5.0144	0.7944	7.3183	0.0038	0.4520	0.6812	2.8878	0.0044	117.4430
2016	4.4131	0.8945	8.3043	0.0032	0.3889	0.5891	2.4564	0.0037	119.4836
2017	5.2364	0.8599	9.8269	0.0030	0.4120	0.6187	2.5230	0.0043	121.6738
2018	5.6975	0.8715	7.5161	0.0031	0.3594	0.5388	2.1970	0.0046	108.9585
2019	4.3915	0.6607	5.9332	0.0040	0.2629	0.3494	0.9330	0.0041	70.7878
2020	4.1945	0.6909	4.9104	0.0051	0.2328	0.2800	0.3658	0.0037	67.8873
2021	5.4491	0.8601	5.9676	0.0048	0.2423	0.2962	0.4431	0.0038	103.1417
2022	3.8989	0.6722	2.8227	0.0045	0.1685	0.2077	0.3175	0.0029	67.4273
1990/2022	**-27%**	**93%**	**-70%**	**-41%**	**-89%**	**-91%**	**-96%**	**-86%**	**-15%**
2021/2022	**-28%**	**-22%**	**-53%**	**-7%**	**-30%**	**-30%**	**-28%**	**-24%**	**-35%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	20.4632	0.4196	0.2038	0.6972	1.5284	3.1534	1.3089	0.0903	9.0824
1995	17.3194	0.2641	0.1671	0.5766	1.3156	2.5534	0.9858	0.0746	8.1779
2000	18.3403	0.0890	0.1839	0.5172	0.8178	1.4653	0.9079	0.0825	8.9934
2005	5.2889	0.1563	0.0390	0.5011	0.9325	1.1513	0.1753	0.0826	7.0866
2010	4.3882	0.1870	0.0302	0.4442	1.4849	2.1420	0.1676	0.0628	6.9609
2011	4.0686	0.1886	0.0338	0.4116	1.5200	2.2541	0.1597	0.0703	6.4790
2012	4.1822	0.1904	0.0360	0.4228	1.5302	2.2688	0.1633	0.0755	6.6722
2013	4.4960	0.0877	0.0353	0.4298	0.9438	1.2057	0.1958	0.0742	7.1468
2014	4.4133	0.0845	0.0419	0.4274	1.1597	1.6176	0.1811	0.0891	7.0735
2015	4.2147	0.0793	0.0413	0.4154	1.4238	2.0979	0.1607	0.0877	6.7641
2016	4.4318	0.0835	0.0416	0.4390	1.6461	2.4611	0.1665	0.0880	7.1066
2017	4.6382	0.0876	0.0421	0.4574	1.6034	2.3616	0.1775	0.0891	7.4267
2018	4.3200	0.0779	0.0412	0.4177	1.6199	0.3579	0.1684	0.0871	6.9408
2019	3.3821	0.0616	0.0384	0.3256	1.7593	0.3333	0.1338	0.0802	5.4627
2020	2.4736	0.0458	0.0287	0.2370	1.6082	0.2826	0.1004	0.0597	4.0254
2021	4.3875	0.0790	0.0374	0.4252	1.8045	0.3548	0.1700	0.0779	7.0196
2022	3.1110	0.0575	0.0231	0.2990	1.0147	0.2346	0.1273	0.0485	4.9822
1990/2022	**-85%**	**-86%**	**-89%**	**-57%**	**-34%**	**-93%**	**-90%**	**-46%**	**-45%**
2021/2022	**-29%**	**-27%**	**-38%**	**-30%**	**-44%**	**-34%**	**-25%**	**-38%**	**-29%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [t]	PCB [t]
1990	36.2050	0.6066	0.6066	0.6066	0.0741	12.4963	0.1195	18.9415
1995	30.4281	0.2934	0.2934	0.2934	0.0359	10.3806	0.0975	17.1153
2000	32.1864	0.0077	0.0022	0.0022	0.0011	9.5126	0.1080	17.8307
2005	33.6304	0.0111	0.0032	0.0032	0.0016	10.8661	0.1048	21.0057
2010	26.9623	0.0114	0.0033	0.0033	0.0016	10.4849	0.0744	21.1782
2011	30.4855	0.0114	0.0033	0.0033	0.0016	9.8373	0.0876	19.4672
2012	32.4441	0.0112	0.0032	0.0032	0.0016	10.3636	0.0943	20.6039
2013	31.1630	0.0114	0.0033	0.0033	0.0016	10.7557	0.0918	21.9567
2014	37.1470	0.0117	0.0034	0.0034	0.0017	11.5113	0.1137	22.4163
2015	36.8028	0.0120	0.0034	0.0034	0.0017	11.0712	0.1122	21.2480
2016	37.2869	0.0122	0.0035	0.0035	0.0017	11.7023	0.1114	22.5342
2017	37.6663	0.0121	0.0035	0.0035	0.0017	12.0576	0.1124	23.2818
2018	37.1101	0.0122	0.0035	0.0035	0.0017	11.8577	0.1098	22.9772
2019	35.3311	0.0122	0.0035	0.0035	0.0017	9.5412	0.1040	18.1209
2020	27.0366	0.0106	0.0030	0.0030	0.0015	8.1028	0.0755	15.6085
2021	8.5280	0.0115	0.0033	0.0033	0.0016	11.6510	0.0963	22.6512
2022	5.8058	0.0050	0.0014	0.0014	0.0007	8.9899	0.0567	17.8634
1990/2022	**-84%**	**-99%**	**-100%**	**-100%**	**-99%**	**-28%**	**-53%**	**-6%**
2021/2022	**-32%**	**-56%**	**-56%**	**-56%**	**-56%**	**-23%**	**-41%**	**-21%**

The major contributors of emissions of main pollutants, heavy metals and POPs are Iron and steel production. Shares of released emissions of air pollutants in 2022 included in NFR categories **2C** are presented in ***Figure 4.5***.

Figure 4.5: *Shares of emissions in 2C in 2022*



4.6.2 Iron and steel production (NFR 2C1)

4.6.2.1 Overview

An overview of the activity data, emissions and trends is shown in ***Table 4.46***. The emission of most of the pollutants shows decrease trend in 2022 (after the reconstruction) compared to the years 2020 and 2021. In 2020, one of the blast furnaces was under reconstruction and in 2021 started to operate in full operation again. The decrease in emissions of PCDD/F from 2021 ongoing was caused by new abatement technology to reduce these emissions from sinter production with an efficiency of 98.9%.

The figures below show the emission trend of the pollutants for which **2C1** is a key category. Emissions show an overall decreasing trend due to the installation of abatement technologies (***Table 4.46***).

There is one major producer of sinter, pig iron and steel from primary raw materials and two smaller producers of steel from secondary raw materials in the Slovak Republic.

Table 4.46: *Trends in emissions of air pollutants and activity data in 2C1*

YEAR	SINTER PRODUCED [kt]	PIG IRON PRODUCED (DRY ESP) [kt]	STEEL PRODUCED – BASIC OXYGEN FURNACE (DRY ESP) [kt]	STEEL PRODUCED – BASIC OXYGEN FURNACE (WSV) [kt]	STEEL PRODUCED – ELECTRIC FURNACE [kt]
1990	3982.00	3561.00	1685.12	1876.38	310.73
1995	3251.00	3207.00	1516.93	1690.47	314.64
2000	3598.90	3166.38	1652.45	1867.54	316.36
2005	3494.50	3681.42	1850.11	2388.01	356.90
2010	2480.14	3648.84	2050.13	2351.65	331.25
2011	2920.13	3346.41	1794.40	2166.62	374.22
2012	3141.77	3519.76	2009.26	2226.93	372.40
2013	3060.35	3616.85	1998.74	2345.51	711.34
2014	3790.90	3862.62	2114.37	2325.11	527.85
2015	3740.27	3738.49	2059.96	2250.98	315.05
2016	3712.50	3986.68	2225.58	2373.86	293.80
2017	3747.75	4107.94	2235.21	2477.75	356.80
2018	3659.90	4036.85	2345.02	2296.82	380.30
2019	3468.10	3184.55	1821.11	1789.91	327.78
2020	2516.40	2753.36	1821.03	1298.34	279.95
2021	3208.70	4013.94	2221.20	2339.40	370.29
2022	1891.40	3153.00	1917.98	1640.70	365.53
1990/2022	**-53%**	**-11%**	**14%**	**-13%**	**18%**
2021/2022	**-41%**	**-21%**	**-14%**	**-30%**	**-1%**

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.2673	0.2250	7.7837	0.0011	1.1899	1.8822	8.0395	0.0043	64.0501
1995	2.9719	0.2047	7.0798	0.0010	1.0823	1.7120	7.3124	0.0039	58.2577
2000	4.0544	0.1578	11.0293	0.0007	1.3392	2.1182	9.0476	0.0048	72.0819
2005	2.6012	0.5416	7.4668	0.0000	0.3871	0.6021	2.3878	0.0014	78.0150
2010	2.2977	0.4037	3.8171	0.0000	0.1815	0.3135	1.7197	0.0007	71.3394
2011	2.2507	0.4809	4.6387	0.0000	0.1950	0.3448	2.0300	0.0007	84.3314
2012	2.5147	0.5077	4.4449	0.0000	0.2128	0.3790	2.2720	0.0008	83.4974
2013	2.7281	0.4807	3.5912	0.0000	0.2320	0.4129	2.4985	0.0008	85.3261
2014	3.2091	0.5369	3.6345	0.0000	0.2742	0.4820	2.8250	0.0010	98.9535
2015	3.0538	0.5460	4.8942	0.0000	0.2620	0.4560	2.6219	0.0009	97.6335
2016	2.7957	0.4971	4.4276	0.0000	0.2148	0.3825	2.2128	0.0008	96.7478
2017	3.2859	0.5143	6.2832	0.0000	0.2156	0.3857	2.2470	0.0008	100.8391
2018	3.5863	0.5405	4.4805	0.0000	0.1830	0.3283	1.9362	0.0007	89.0361

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2019	2.3250	0.3580	2.9195	0.0000	0.0788	0.1337	0.6737	0.0003	52.2224
2020	2.5272	0.3661	2.4107	0.0000	0.0311	0.0436	0.0920	0.0001	51.6441
2021	3.8258	0.5117	3.1983	0.0000	0.0494	0.0708	0.1803	0.0002	86.3580
2022	2.9289	0.3645	1.6522	0.0000	0.0350	0.0500	0.1321	0.0001	58.6566
1990/2022	**-10%**	**62%**	**-79%**	**-96%**	**-97%**	**-97%**	**-98%**	**-97%**	**-8%**
2021/2022	**-23%**	**-29%**	**-48%**	**15%**	**-29%**	**-29%**	**-27%**	**-29%**	**-32%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	19.7015	0.0902	0.2027	0.5258	0.8239	1.5349	0.9446	0.0903	9.0824
1995	16.5822	0.0806	0.1662	0.4677	0.7375	1.3722	0.8233	0.0746	8.1779
2000	18.3350	0.0884	0.1839	0.5168	0.8142	1.4591	0.9079	0.0825	8.9934
2005	4.4864	0.0794	0.0383	0.4343	0.3975	0.2150	0.1709	0.0826	7.0866
2010	4.3877	0.0777	0.0286	0.4270	0.3888	0.2238	0.1676	0.0628	6.9609
2011	4.0680	0.0730	0.0321	0.3934	0.3603	0.2245	0.1597	0.0703	6.4790
2012	4.1815	0.0748	0.0344	0.4046	0.3705	0.2392	0.1633	0.0755	6.6720
2013	4.4956	0.0851	0.0344	0.4264	0.3961	0.2472	0.1958	0.0742	7.1466
2014	4.4128	0.0809	0.0407	0.4227	0.3903	0.2710	0.1811	0.0891	7.0734
2015	4.2142	0.0744	0.0397	0.4089	0.3740	0.2608	0.1607	0.0877	6.7641
2016	4.4312	0.0777	0.0398	0.4313	0.3934	0.2690	0.1665	0.0880	7.1066
2017	4.6377	0.0821	0.0404	0.4501	0.4114	0.2754	0.1775	0.0891	7.4267
2018	4.3198	0.0771	0.0394	0.4177	0.3829	0.2708	0.1684	0.0871	6.9408
2019	3.3818	0.0607	0.0363	0.3256	0.2998	0.2306	0.1338	0.0802	5.4627
2020	2.4732	0.0450	0.0267	0.2370	0.2190	0.1848	0.1004	0.0597	4.0254
2021	4.3871	0.0782	0.0353	0.4251	0.3888	0.2551	0.1700	0.0779	7.0196
2022	3.1104	0.0570	0.0220	0.2988	0.2748	0.1825	0.1273	0.0485	4.9821
1990/2022	**-84%**	**-37%**	**-89%**	**-43%**	**-67%**	**-88%**	**-87%**	**-46%**	**-45%**
2021/2022	**-29%**	**-27%**	**-38%**	**-30%**	**-29%**	**-28%**	**-25%**	**-38%**	**-29%**

YEAR	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCB [kg]
1990	35.2527	10.6024	0.1195	18.9415
1995	29.1714	9.4646	0.0975	17.1152
2000	32.1754	9.4995	0.1080	17.8307
2005	31.9584	10.8470	0.1048	21.0056
2010	23.8794	10.4653	0.0744	21.1779
2011	27.2235	9.8178	0.0876	19.4669
2012	29.1814	10.3443	0.0943	20.6036
2013	29.6216	10.7361	0.0918	21.9565
2014	34.9817	11.4911	0.1137	22.4161
2015	33.8493	11.0506	0.1122	21.2478
2016	33.7630	11.6814	0.1114	22.5339
2017	34.3126	12.0367	0.1124	23.2816
2018	33.6310	11.8368	0.1098	22.9769
2019	31.2261	9.5202	0.1040	18.1205
2020	23.1289	8.0846	0.0755	15.6082
2021	4.5459	11.6313	0.0963	22.6508
2022	3.7236	8.9812	0.0567	17.8632
1990/2022	**-89%**	**-15%**	**-53%**	**-6%**
2021/2022	**-18%**	**-23%**	**-41%**	**-21%**

4.6.2.2 Methodological issues

Activities defined in national legislation involved in the category are presented in ***Table 4.47***.

Table 4.47: *Activities according to national categorization included in 2C1*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.1 Treatment, roasting and sintering of ferrous metal ores and manipulation with these materials in powder form
2.2 Production of pig iron in a blast furnace with a projected production capacity in t/h
2.3 Production of steel, for instance, converters, Siemens-Martin furnaces, double-heart tandem furnaces, electric furnaces, and März-Böhler furnaces with projected production capacity in t/h
2.5 Secondary metallurgical production and processing of ferrous metals (for instance rolling mills, press, smitheries, hardening furnaces and other facilities for thermal processing) a) rolling mills with projected production of crude steel in t/h b) operation of smitheries with projected thermal energy - 20 MW and projected power in kilojoules per hammer - ≤ 20 MW and projected power in kilojoules per hammer

The category covers sources of several companies operating in the Slovak Republic (for the year 2022).
Cat. 2.1: U.S. Steel Košice, a.s
Cat. 2.2: U.S. Steel Košice, a.s
Cat. 2.3: U.S. Steel Košice, a.s; Železiarne Podbrezová a.s.
Cat. 2.5: U.S. Steel Košice, a.s., Železiarne Podbrezová a.s.
Pig iron and steel are produced mainly in blast furnaces and by the EAF processes. The plant with blast furnaces is one complex with many energy-related installations (coke ovens, heating plant, manufacturing of steel products, etc.).
Emissions of main pollutants, PMs and CO are compiled within the NEIS database, therefore the individual specific EF were used for sources recorded in the database.
Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.48***). Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009. Emissions of BC were calculated using EMEP/EEA GB_{2023} emission factor thought the entire time series.

Table 4.48: *Emission factors for calculation of historical years in 2C1*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	NH_3 [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/t]
EF	843.79	58.12	2010.13	0.28	2076.19	15%	23%	0.36%	16540.89

*Tier 1 EMEP/EEA GB_{2023}

Heavy metals and POPs

The information on abatement technologies installed on the source was obtained from an integrated permit from 2006 granted based on Act no. 39/2013 Coll. on Integrated Prevention and Control of Environmental Pollution and Amendments to Certain Acts. The exact year of installation of the abatement technology was obtained from the environmental reports available online on the website of the operator.
U.S. Steel Košice operates Oceliareň 1 and Oceliareň 2. The sources do not have the same abatement technology installed. Emissions from Oceliareň 1 are abated by dry ESP and Oceliareň 2 by wSV. For both of the sources, abatement technology was already installed in the nineties, but the exact year is not known. Abatement technology in Oceliareň 1 was reconstructed in the year 2006 and Oceliareň 2 in 2003. The same company operates technology for sinter production. This source has installed Dry ESP technology since 2003 and in 2021 abatement for the reduction of PCDD/F was added (injection of active carbon).
Sources of information are environmental reports and annual reports of a single company. All three activities: sinter production, pig iron production, and steel production in BOF refer to a single company in the Slovak Republic. Other steel production operators use EAF to produce steel. Emissions factors used for calculation are shown in ***Table 4.49***.

Table 4.49: *Emission factor for heavy metals and POPs used in calculations for iron and steel production*

A	T	P	AT	Pb [g/t]	Hg [g/t]	Cd [g/t]	As [g/t]	Cr [g/t]	Cu [g/t]
Sinter production	-	1990-2002	None	3.5	0.004	0.049	0.018	0.016	0.033
Sinter production	-	2003-2020	Dry ESP	0.0099	0.000011	0.009	0.00005	0.0013	0.03
Sinter production		2021-2022	Dry ESP + active carbon inj.	0.0099	0.000011	0.009	0.00005	0.0013	0.03
Pig iron production	-	1990-2002	Dry ESP Upper EFs	0.000006	0.000000010	0.000056	0.0000003	0.000003	0.015
Pig iron production	-	2003-2022	Dry ESP default EFs	0.000009	0.000000015	0.000084	0.0000005	0.000006	0.15
Steel production	Basic oxygen furnace	1990-2005	Dry ESP Upper EFs	0.025	0.0003	0.0009	0.002	0.002	NE
Steel production	Basic oxygen furnace	2006-2022	Dry ESP default EFs	0.015	0.00025	0.0006	0.0015	0.0013	0.02
Steel production	Basic oxygen furnace	1990-2001	wSV Upper EFs	3	0.036	0.0028	0.24	0.4	0.46
Steel production	Basic oxygen furnace	2002-2022	wSV Default EFs	1.8	0.03	0.0018	0.18	0.16	0.02
Steel production	Electric furnace	1990-2022	Fabric filter retrofitted-upper Efs	0.3	0.02	0.0018	0.0015	0.02	0.02

A	T	P	AT	Ni [g/t]	Se [g/t]	Zn [g/t]	PCDD/F [µg/t]	PAHs [g/t]	HCB [mg/t]	PCBs [mg/t]
Sinter production	-	1990-2002	None	0.09	0.02	0.06	8	0.3	0.03	0.09
Sinter production	-	2003-2020	Dry ESP	0.00025	0.02	0.06	8	0.3	0.03	0.09
Sinter production		2021-2022	Dry ESP + active carbon inj.	0.00025	0.02	0.06	0.0873	0.3	0.03	0.09
Pig iron production	-	1990-2002	Dry ESP Upper EFs	NE	NE	0.073	0.002	2.5	NE	2.5
Pig iron production	-	2003-2022	Dry ESP default EFs	NE	NE	0.073	0.002	2.5	NE	2.5
Steel production	Basic oxygen furnace	1990-2005	Dry ESP Upper EFs	NE	NE	NE	0.69	0.1	NE	2.5
Steel production	Basic oxygen furnace	2006-2022	Dry ESP default EFs	0.0005	NE	0.023	0.69	0.1	NE	2.5
Steel production	Basic oxygen furnace	1990-2001	wSV Upper EFs	0.3	NE	4.5	0.69	0.1	NE	2.5
Steel production	Basic oxygen furnace	2002-2022	wSV Default EFs	0.06	NE	2.7	0.69	0.1	NE	2.5
Steel production	Electric furnace	1990-2022	Fabric filter retrofitted-upper Efs	0.075	NE	0.45	3	0.48	NE	2.5

A-Activity, T-Technology, P-Period, AT-Abatement technology

4.6.2.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB$_{2023}$.

4.6.2.4 Source-specific recalculations

No recalculation was made in this submission.

4.6.3 Ferroalloys production (NFR 2C2)

4.6.3.1 Overview

Ferroalloys are produced by the reduction reaction of iron ore and added metal and/or metalloid oxides or other materials in arc furnaces and submerged arc furnaces. As shown emissions of all rising pollutants gave a decreasing trend due to the installation of abatement technologies. Activity data, emissions and trends are presented in ***Table 4.50***.

There is noticeable decrease in amount of production for the last reported year 2022. Values of emission are therefore lower (NOx, SOx). But in some cases, on the contrary, there is an increase (CO).

Table 4.50: *Activity data and emissions in the category 2C2*

YEAR	FERROALLOYS PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	169.00	0.4317	0.0376	0.2914	0.0000	0.1543	0.1956	0.2175	0.0154	2.8995
1995	134.80	0.3443	0.0300	0.2325	0.0000	0.1231	0.1560	0.1735	0.0123	2.3127
2000	94.73	0.5886	0.0241	0.1150	0.0000	0.2957	0.3749	0.4167	0.0296	2.7839
2005	108.72	0.0065	0.0121	0.0119	NO	0.0294	0.0373	0.0414	0.0029	0.5220
2010	96.83	0.0190	0.0152	0.0260	0.0000	0.0245	0.0311	0.0346	0.0025	0.0506
2011	75.05	0.0311	0.0089	0.0363	0.0000	0.0173	0.0220	0.0244	0.0017	0.0784
2012	102.87	0.0257	0.0091	0.0311	0.0000	0.0143	0.0181	0.0202	0.0014	0.0782
2013	65.68	0.0298	0.0100	0.0319	0.0000	0.0173	0.0219	0.0244	0.0017	0.1076
2014	47.20	0.0215	0.0159	0.0259	0.0000	0.0180	0.0228	0.0253	0.0018	0.1026
2015	95.62	0.0232	0.0176	0.0304	0.0000	0.0159	0.0201	0.0224	0.0016	0.0943
2016	106.27	0.0120	0.0165	0.0226	0.0000	0.0096	0.0121	0.0135	0.0010	0.1051
2017	129.48	0.0081	0.0195	0.0124	0.0000	0.0113	0.0144	0.0160	0.0011	0.1025
2018	113.69	0.0107	0.0245	0.0173	0.0000	0.0142	0.0180	0.0200	0.0014	0.1273
2019	105.52	0.0081	0.0143	0.0195	0.0000	0.0115	0.0146	0.0162	0.0012	0.0907
2020	88.60	0.0047	0.0124	0.0134	0.0000	0.0086	0.0109	0.0121	0.0009	0.0752
2021	115.73	0.0046	0.0096	0.0079	0.0000	0.0084	0.0106	0.0118	0.0008	0.0823
2022	35.43	0.0039	0.0101	0.0033	0.0000	0.0088	0.0112	0.0125	0.0009	0.1144
1990/2022	**-79%**	**-99%**	**-73%**	**-99%**	**-59%**	**-94%**	**-94%**	**-94%**	**-94%**	**-96%**
2021/2022	**-69%**	**-15%**	**5%**	**-58%**	**-2%**	**5%**	**5%**	**5%**	**5%**	**39%**

4.6.3.2 Methodological issues

Activities of cast iron and cast iron products according to national legislation were separated into the individual category **2C2** (***Table 4.51***).

Table 4.51: *Activities according to national categorization included in 2C2*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.4 Ferrous metal foundries – production of cast iron and cast iron products with a projected production capacity in t/d

Emissions of main pollutants, PMs and CO are compiled within the NEIS database, therefore the individual specific EF were used for sources recorded in the database. Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009 (***Table 4.52***). Emissions of BC were calculated using EMEP/EEA GB_{2023} emission factor thought the entire time series.

Table 4.52: *Emission factors for calculation of historical years*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	NH_3 [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/t]
EF	2 554.18	222.64	1 724.52	0.13	1 286.72	71%	90%	10%	17 156.55

*Tier 1 EMEP/EEA GB_{2023}

4.6.3.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB$_{2023}$.

4.6.3.4 Source-specific recalculations

The activity data for the year 2020 was corrected since more precise value of ferroalloys production was obtained. Previous number 115.72 kt was updated to 88.60 kt of ferroalloys (decrease of 23%) ***Table 4.53***. This change did not affect the emissions.

Table 4.53: *Previous and revised activity data in the category 2C2*

YEAR	ACTIVITY DATA - FERROALLOYS PRODUCED [kt]		
	PREVIOUS	REVISED	CHANGE
2020	115.72	88.60	-23%

4.6.4 Aluminium production (NFR 2C3)

4.6.4.1 Overview

Aluminium is produced by the electrolysis of alumina dissolved in the cryolite-based melt (t = 950°C). The main additives to cryolite (Na_3AlF_6) are aluminium fluoride (AlF_3) and CaF_2. In Slovakia, the plants for aluminium production use a modern technology where the majority of HF and other fluorides escaped from the electrolytic cells and are absorbed and adsorbed on alumina. Alumina is used subsequently in the electrolytic process. The anodes are made from graphite. So-called pre-baked anodes for aluminium products are made in separate plants. Due to this technology, emissions are much lower than in the Søderberg process.

There is only one source producing aluminium in the Slovak Republic. Emissions of the main pollutants have a decreasing trend due to the depression in production. PAHs have decreased due to the change of technology in the year 1996 for the production of aluminium from the Søderberg process (SP) to pre-baked anodes (PBA) (***Table 4.54***).

Table 4.54: *Activity data and emissions in the category 2C3*

YEAR	Al - SP [kt]	Al – PBA [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]	PAHs [t]
1990	67.40	NO	0.2258	0.0016	0.7164	0.0484	0.0545	0.0591	0.0011	5.7010	1.8939
1995	32.60	NO	0.1092	0.0008	0.3465	0.0234	0.0263	0.0286	0.0005	2.7575	0.9161
2000	NO	109.81	0.2916	0.0029	1.1785	0.0944	0.1063	0.1152	0.0022	7.8868	0.0132
2005	NO	159.20	0.6886	0.1461	1.3099	0.1194	0.1343	0.1457	0.0027	12.9913	0.0191
2010	NO	163.00	0.5196	0.0355	1.3825	0.1206	0.1353	0.1471	0.0028	13.4722	0.0196
2011	NO	162.84	0.5497	0.0312	2.2302	0.0629	0.0706	0.0767	0.0014	13.5448	0.0195
2012	NO	160.66	0.5141	0.0283	1.3916	0.0701	0.0787	0.0855	0.0016	13.3409	0.0193
2013	NO	163.30	0.5130	0.0260	1.3879	0.0681	0.0764	0.0831	0.0016	13.3071	0.0196
2014	NO	167.67	0.4927	0.0538	2.0785	0.0975	0.1094	0.1189	0.0022	14.0622	0.0201
2015	NO	171.33	0.4430	0.0873	1.6566	0.0811	0.0910	0.0990	0.0019	14.2394	0.0206
2016	NO	173.64	0.4425	0.1152	2.8449	0.0835	0.0937	0.1018	0.0019	18.0049	0.0208
2017	NO	173.49	0.5510	0.0487	2.4411	0.1050	0.1178	0.1281	0.0024	16.5521	0.0208
2018	NO	173.72	0.5378	0.0361	2.0605	0.1082	0.1213	0.1319	0.0025	16.4582	0.0208
2019	NO	174.79	0.4974	0.0453	2.0394	0.1175	0.1318	0.1433	0.0027	15.5812	0.0210
2020	NO	151.69	0.4991	0.0473	1.8154	0.1168	0.1310	0.1424	0.0027	13.1902	0.0182
2021	NO	164.15	0.4941	0.0367	2.1134	0.1220	0.1368	0.1487	0.0028	14.1074	0.0197
2022	NO	71.93	0.3999	0.0223	0.9129	0.0816	0.0915	0.0995	0.0019	6.9537	0.0086
1990/2022	-	-	**77%**	**1333%**	**27%**	**69%**	**68%**	**68%**	**69%**	**22%**	**-100%**
2021/2022	-	**-56%**	**-19%**	**-39%**	**-57%**	**-33%**	**-33%**	**-33%**	**-33%**	**-51%**	**-56%**

4.6.4.2 Methodological issues

Activities of aluminium production according to national legislation were separated into the individual category **2C3**. Emissions of main pollutants, PMs and CO are compiled within the NEIS database, therefore the individual specific EF were used for sources recorded in the database. In the submission 2020, emissions from aluminium production were allocated in category **2C7c**. These emissions were during the 2021 submission removed from the **2C7c** category and allocated to the **2C3** category.

Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009 (***Table 4.55***). Emissions of BC were calculated using EMEP/EEA GB_{2023} emission factor throughout time series.

Table 4.55: *Emission factors for calculation of historical years*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/t]
EF	3 350.77	23.11	10 629.29	876.41	82%	92%	2.3%	84 584.75

POPs

POPs were calculated using Tier 2 emission factors from EMEP/EEA GB_{2019} for primary aluminium production (***Table 4.56***).

Table 4.56: *Emission factors of PAHs calculation for primary aluminium production in 2C3*

TECHNOLOGY	PERIOD	B(a)P [g/t]	B(b)F [g/t]	B(k)F [g/t]	I()P [g/t]	PAHs [g/t]
Søderberg anodes	1990-1995	9	9	9	1.1	28.1
Pre-baked anodes	1996-2022	0.07	0.02	0.02	0.01	0.12

4.6.4.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2023}.

4.6.4.4 Source-specific recalculations

In this submission, no recalculation was made in category 2C3.

4.6.5 Magnesium production (NFR 2C4)

4.6.5.1 Overview

Emissions from magnesite clinker production were reallocated into category **2C7c** to comply with the emission inventory of GHG. From this submission, notation key NO will be used for all the emissions in this category.

4.6.6 Lead production (NFR 2C5)

4.6.6.1 Overview

The production, regeneration and disposal of electric accumulators and cells occurring in the Slovak Republic in the period 2011-2022. Therefore this activity was included in category **2C5**. The trends of emissions from production and activity data are presented in ***Table 4.57***.

Table 4.57: *Activity data and emissions in the category 2C5*

YEAR	LEAD PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO[kt]
1990	NO	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO	NO	NO

YEAR	LEAD PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO[kt]
2011	0.05	0.0213	0.0002	0.0163	0.0001	0.0002	0.0005	0.0012
2012	0.20	0.0174	0.0002	0.0137	0.0000	0.0002	0.0005	0.0011
2013	0.26	0.0062	0.0004	0.0450	0.0001	0.0004	0.0010	0.0014
2014	0.29	0.0076	0.0005	0.0579	0.0001	0.0005	0.0012	0.0017
2015	0.32	0.0054	0.0004	0.0270	0.0001	0.0003	0.0007	0.0012
2016	0.29	0.0082	0.0007	0.0299	0.0001	0.0003	0.0008	0.0016
2017	0.30	0.0085	0.0008	0.0314	0.0001	0.0004	0.0009	0.0017
2018	0.05	0.0027	0.0001	0.0303	0.0001	0.0002	0.0005	0.0008
2019	0.07	0.0076	0.0005	0.0621	0.0001	0.0005	0.0012	0.0020
2020	0.13	0.0076	0.0005	0.0620	0.0001	0.0005	0.0012	0.0021
2021	0.16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2022	0.40	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1990/2022	-	-	-	-	-	-	-	-
2021/2022	**158%**	**-8%**	**-8%**	**-7%**	**-2%**	**-2%**	**-2%**	**-8%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCB [kg]
1990	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO	NO
2011	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
2012	0.0002	0.0000	0.0000	0.0001	0.0000	0.0007	0.0000
2013	0.0003	0.0000	0.0000	0.0001	0.0000	0.0008	0.0000
2014	0.0003	0.0000	0.0000	0.0001	0.0000	0.0009	0.0000
2015	0.0004	0.0000	0.0000	0.0001	0.0000	0.0010	0.0000
2016	0.0003	0.0000	0.0000	0.0001	0.0000	0.0009	0.0000
2017	0.0003	0.0000	0.0000	0.0001	0.0000	0.0010	0.0000
2018	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
2019	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
2020	0.0001	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000
2021	0.0002	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000
2022	0.0004	0.0000	0.0000	0.0001	0.0000	0.0013	0.0000
1990/2022	-	-	-	-	-	-	-
2021/2022	**158%**	**158%**	**158%**	**158%**	**158%**	**158%**	**158%**

4.6.6.2 Methodological issues

Activities defined in national legislation involved in the category are presented in ***Table 4.58***.

Table 4.58: *Activities according to national categorization included in 2C5*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.39 Production, regeneration and disposal of electric accumulators and cells

HMs and POPs

HMs and POPs were balanced using Tier 2/Tier 1 emission factors for Secondary lead production -current technology level from EMEP/EEA GB_{2023} (***Table 4.59***).

Table 4.59: Emission factors of HMs and POPs for secondary lead production in 2C5

TECHNOLOGY	Pb [g/t]	Cd [g/t]	Hg [g/t]*	As [g/t]	Zn [g/t]	PCDD/F [µg I-TEQ/t]	PCBs [µg/t]
Current technology	1.1	0.05	0.1	0.3	0.05	3.2	2.6

*Tier 1

4.6.6.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB$_{2023}$.

4.6.6.4 Source-specific recalculations

No recalculation was made.

4.6.7 Zinc production (NFR 2C6)

4.6.7.1 Overview

The category is reported with notation key NO except for the period 2012-2014 when activity data were recorded. The overview of emissions is shown in ***Table 4.60***.

Table 4.60: Activity data and emissions in the category 2C6

YEAR	ZINC PRODUCTION [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	Pb [t]	Cd [t]	Hg [t]
1990	NO	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO	NO	NO
2011	NO	NO	NO	NO	NO	NO	NO	NO
2012	0.04	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	0.02	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2015	NO	NO	NO	NO	NO	NO	NO	NO
2016	NO	NO	NO	NO	NO	NO	NO	NO
2017	NO	NO	NO	NO	NO	NO	NO	NO
2018	NO	NO	NO	NO	NO	NO	NO	NO
2019	NO	NO	NO	NO	NO	NO	NO	NO
2020	NO	NO	NO	NO	NO	NO	NO	NO
2021	NO	NO	NO	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO	NO	NO	NO
1990/2022	-	-	-	-	-	-	-	-
2021/2022	-	-	-	-	-	-	-	-

YEAR	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCBs [kg]
1990	NO	NO	NO	NO
1995	NO	NO	NO	NO
2000	NO	NO	NO	NO
2005	NO	NO	NO	NO
2010	NO	NO	NO	NO
2011	NO	NO	NO	NO
2012	0.0000	0.0002	0.0002	0.0000
2013	0.0000	0.0002	0.0002	0.0000
2014	0.0000	0.0001	0.0001	0.0000
2015	NO	NO	NO	NO
2016	NO	NO	NO	NO

YEAR	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCBs [kg]
2017	NO	NO	NO	NO
2018	NO	NO	NO	NO
2019	NO	NO	NO	NO
2020	NO	NO	NO	NO
2021	NO	NO	NO	NO
2022	NO	NO	NO	NO
1990/2022	-	-	-	-
2021/2022	-	-	-	-

4.6.7.2 Methodological issues

Tie 1 methodology from EMEP/EEA GB$_{2023}$ was used to calculate emissions from this source. Emission factors are displayed in ***Table 4.61***.

Table 4.61: *Emission factors in the category 2C6*

	SOx [g/t]	PM$_{2.5}$ [g/t]	PM$_{10}$ [g/t]	TSP [g/t]	Pb [g/t]	Cd [g/t]	Hg [g/t]	As [g/t]	Zn [g/t]	PCDD/F [µg I-TEQ/t]	PCBs [g/t]
EF	1350	12	13	0.2	16	0.04	0.04	0.03	5	5	2

4.6.7.3 Completeness

All rising pollutants were reported. Notation keys were used following the EMEP/EEA GB$_{2019}$. For the period 1990-2013 and 2015-2022, notation key NO was used.

4.6.7.3 Source-specific recalculations

No recalculation was made.

4.6.8 Copper production (NFR 2C7a)

4.6.8.1 Overview

Pollutants released during copper production are particulate matter (PM), sulphur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (non-methane VOC and methane (CH_4)), carbon monoxide (CO), carbon dioxide (CO_2), nitrous oxide (N_2O), trace elements, and selected persistent organic pollutants (POPs). The POPs are mostly dioxins and furans, which are emitted from shaft furnaces, converters, and flame furnaces.

Emissions of air pollutants were excluded from the category **2C7c** – Other Metal Production although the definition of activity according to the categorization of the Annex No 6 of decree no 410/2012 coll. as amended does not divide for the specific type of metal production only general: Treatment of non-ferrous metals ores and manipulation with these materials in powder form.

Activity data, emissions and trends are shown in ***Table 4.62***. The emission trend of these pollutants is decreasing due to the activity within the category which shows 48% decrease.

Table 4.62: *Activity data and emissions in the category 2C7a*

YEAR	PRIMARY COPPER [kt]	SECONDARY COPPER [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	PM$_{2.5}$ [kt]	PM$_{10}$ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	19.04	19.04	0.0161	0.0036	0.0098	0.0048	0.0061	0.0145	0.0000	1.4800
1995	8.38	25.13	0.0141	0.0031	0.0087	0.0042	0.0053	0.0128	0.0000	1.3023
2000	NO	0.22	0.0000	0.0000	0.0004	0.0000	0.0001	0.0001	0.0000	0.0001
2005	NO	33.44	0.0047	0.0036	0.0112	0.0075	0.0095	0.0106	0.0000	1.7321
2010	NO	68.51	0.0416	0.0843	0.0944	0.0116	0.0146	0.0682	0.0000	3.0990
2011	NO	72.49	0.0383	0.0733	0.0842	0.0093	0.0118	0.0360	0.0000	2.6989
2012	NO	72.49	0.0386	0.0467	0.0701	0.0071	0.0089	0.0280	0.0000	1.7787
2013	NO	34.23	0.0393	0.0066	0.0236	0.0027	0.0034	0.0051	0.0000	0.2434

YEAR	PRIMARY COPPER [kt]	SECONDARY COPPER [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2014	NO	48.09	0.0169	0.0048	0.0252	0.0019	0.0025	0.0027	0.0000	0.1995
2015	NO	65.61	0.0246	0.0165	0.0827	0.0086	0.0109	0.0121	0.0000	1.4275
2016	NO	78.29	0.0373	0.0171	0.0938	0.0078	0.0099	0.0110	0.0000	1.5884
2017	NO	74.50	0.0212	0.0137	0.0767	0.0067	0.0085	0.0094	0.0000	1.2507
2018	NO	77.31	0.0508	0.0088	0.0209	0.0010	0.0013	0.0015	0.0000	0.9727
2019	NO	91.22	0.0449	0.0094	0.0231	0.0012	0.0015	0.0017	0.0000	1.0432
2020	NO	86.83	0.0942	0.0143	0.0307	0.0029	0.0037	0.0041	0.0000	1.4668
2021	NO	88.48	0.0621	0.0176	0.0478	0.0020	0.0026	0.0029	0.0000	0.8360
2022	NO	46.24	0.0436	0.0083	0.0464	0.0011	0.0014	0.0015	0.0000	0.7837
1990/2022	-	**143%**	**171%**	**134%**	**372%**	**-78%**	**-78%**	**-90%**	**-78%**	**-47%**
2021/2022	-	**-48%**	**-30%**	**-53%**	**-3%**	**-47%**	**-47%**	**-49%**	**-47%**	**-6%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	PCDD/F [g I-TEQ]	PCBs [kg]
1990	0.7617	0.3294	0,0010	0.1714	0,7045	1.6185	0.3643	0.9523	0.0001
1995	0.7372	0.1835	0,0008	0.1089	0,5780	1.1812	0.1624	1.2567	0.0001
2000	0.0053	0.0005	0.0000	0.0004	0.0035	0.0062	0.0000	0.0110	0.0000
2005	0.8026	0.0769	0.0008	0.0669	0.5351	0.9363	0.0043	1.6721	0.0001
2010	0.0005	0.1093	0.0016	0.0172	1.0961	1.9182	0.0000	3,4254	0.0003
2011	0.0005	0.1156	0.0017	0.0182	1.1598	2.0296	0.0000	3,6243	0.0003
2012	0.0005	0.1156	0.0017	0.0182	1.1598	2.0296	0.0000	3,6243	0.0003
2013	0.0001	0.0025	0.0008	0.0033	0.5477	0.9585	0.0000	1.5404	0.0001
2014	0.0001	0.0036	0.0011	0.0047	0.7695	1.3466	0.0000	2.1642	0.0002
2015	0.0002	0.0049	0.0015	0.0064	1.0497	1.8371	0.0000	2.9524	0.0002
2016	0.0002	0.0058	0.0018	0.0076	1.2526	2.1921	0.0000	3.5230	0.0003
2017	0.0002	0.0055	0.0017	0.0072	1.1921	2.0861	0.0000	3.3527	0.0003
2018	0.0002	0.0007	0.0018	NO	1.2369	0.0871	0.0000	3.4789	0.0003
2019	0.0002	0.0008	0.0021	NO	1.4595	0.1028	0.0000	4.1047	0.0003
2020	0.0002	0.0008	0.0020	NO	1.3893	0.0978	0.0000	3.9073	0.0003
2021	0.0002	0.0008	0.0020	NO	1.4157	0.0997	0.0000	3.9816	0.0003
2022	0.0001	0.0004	0.0011	NO	0.7399	0.0521	0.0000	2.0809	0.0002
1990/2022	**-100%**	**-100%**	**3%**	**-**	**5%**	**-97%**	**-100%**	**119%**	**95%**
2021/2022	**-48%**	**-48%**	**-48%**	**-**	**-48%**	**-48%**	**-48%**	**-48%**	**-48%**

4.6.8.2 Methodological issues

Emissions from copper production were excluded from category **2C7c** and reallocated into this category. Emissions data for the period 2000-2022 originate from the NEIS database. Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009 (***Table 4.63***).

Table 4.63: *Emission factors for calculation of historical years in 2C7a*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/t]
EF	422.07	93.54	258.25	381.14	33%	42%	38 862.82

Heavy metals and POPs

Far calculation of heavy metals and POPs, Tier 2/Tier 1 EF from EMEP/EEA GB_{2019} were used (***Table 4.64***). To use a higher Tier method, it was necessary to contact only the Slovak copper production plant. The operator has provided the information needed for the change of the methodology.

From the provided information it is clear that the source started to use technology for secondary copper production in the year 1990, but the data before 2000 are very unclear due to a lack of documentation. It was

assumed that both technologies were used. Copper mining was active in Slovakia until the year 1999. The exact amount of primary or secondary copper is not known, therefore, in the year 1990, it was assumed that 50% of copper was produced using primary sources and 50% using secondary. The ratio is decreasing for primary copper production by 5% per year until 1999. On the contrary, the ratio of secondary copper production is increasing by the same percentage until 1999. In 1999, the former operator sold the company and the new operator started to produce copper only from secondary sources. This information comes from an integrated permit for the operation of the source from 2005.
The efficiency of the abatement technology is partly country-specific (***Table 4.65***).

Table 4.64: *Emission factor for heavy metals and POPs in the category 2C7a*

TECHNOLOGY	PERIOD	Pb [g/t]	Cd [g/t]	Hg [g/t]	As [g/t]	Cr [g/t]	Cu [g/t]	Ni [g/t]	PCDD/F [µg I-TEQ/t]	PCBs [µg/t]
T1 Copper production	1990-2021	-	-	0.023	-	16	-	-	-	0.9
T2 Primary production	1990-1999	16	15	0.031	7	21	57	19	0.01	-
T2 Secondary production	1990-2022	24	2.3	-	2	-	28	0.13	50	-

Table 4.65: *Efficiency of the abatement technology*

ABATEMENT	PERIOD	Pb [g/t]*	Cd [g/t]	As [g/t]	Cu [g/t]	Ni [g/t]*	PCDD/F [µg I-TEQ/t]
State of art fabric filter	2006-2012	99.97%	30.64%	87.47%	0%	99.97%	0%
State of art fabric filter	2013-2017	99.99%	96.79%	95.14%	0%	99.99%	10%
State of art fabric filter	2018-2022	99.99%	99.60%	100.00%	96%	99.99%	10%

*Default values from EMEP/EEA GB_{2023}

4.6.8.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2023}.

4.6.8.4 Source-specific recalculations

Emissions of Hg and Cr were recalculated in historical time series (1990 – 1999). The emission factor was corrected in calculation of primary production (the value of 0.023 [g/t] was replaced by 0.031 [g/t]). The emissions of PCDD/F were also recalculated due to the error in calculation for the years 2006 – 2012. Reduction of 10% was applied in the calculation, which should have been in practice only from 2013 as shown in table ***4.65***. Result of recalculations is presented in following table (***Table 4.66***).

Table 4.66: *Previous and revised emissions in the category 2C7a*

YEAR	Hg [t]			Cr [t]			YEAR	PCDD/F [g I-TEQ]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE		PREVIOUS	REVISED	CHANGE
1990	0.0009	0.0010	17%	0.6093	0.7045	16%	2006	1.9855	2.2061	11%
1991	0.0013	0.0015	16%	0.8748	0.9978	14%	2007	2.1623	2.4026	11%
1992	0.0016	0.0019	14%	1.1403	1.2828	13%	2008	2.3616	2.6240	11%
1993	0.0013	0.0015	12%	0.9143	1.0143	11%	2009	1.8848	2.0943	11%
1994	0.0010	0.0011	10%	0.6884	0.7529	9%	2010	3.0829	3.4254	11%
1995	0.0008	0.0008	9%	0.5361	0.5780	8%	2011	3.2618	3.6243	11%
1996	0.0015	0.0016	7%	1.0193	1.0830	6%	2012	3.2618	3.6243	11%
1997	0.0015	0.0016	5%	1.0367	1.0853	5%	2013	1.5404	1.5404	0%
1998	0.0011	0.0012	3%	0.7981	0.8230	3%	2014	2.1642	2.1642	0%
1999	0.0001	0.0001	2%	0.0375	0.0381	2%	2015	2.9524	2.9524	0%

4.6.9 Nickel production (NFR 2C7b)

4.6.9.1 Overview

The category is reported with notation key NO. This production is not occurring in the Slovak Republic. The notation key for fuel was changed from NA to NO likewise in **2B1** where the use of the NO key for fuels was advised by the TERT.

4.6.10 Other Metal Production (NFR 2C7c)

4.6.10.1 Overview

The trends of emission from other metal production are presented in ***Table 4.67***. An increasing trend of emissions is connected to the increase in activity data. The decrease in emissions of PMs is connected to the installation of abatement technologies.

Table 4.67: *Overview of emissions in the category 2C7c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	1.4147	0.0804	0.7105	0.0065	0.1551	0.2127	0.3782	4.7439
1995	1.3978	0.0795	0.7020	0.0065	0.1532	0.2102	0.3737	4.6872
2000	1.0674	0.0850	0.3825	0.0074	0.1854	0.2544	0.4523	3.9049
2005	1.6031	0.0738	1.0524	0.0056	0.0838	0.1161	0.2247	6.9296
2010	1.9835	0.1218	0.4472	0.0036	0.0595	0.0775	0.1198	3.8859
2011	2.1452	0.1638	0.5467	0.0036	0.0547	0.0712	0.1103	4.5086
2012	1.7692	0.1012	0.4682	0.0045	0.0682	0.0854	0.1207	4.4407
2013	1.4495	0.1041	0.5576	0.0044	0.0677	0.0845	0.1191	3.9577
2014	1.4252	0.1562	0.5577	0.0043	0.0819	0.1009	0.1315	3.9832
2015	1.4644	0.1266	0.6274	0.0037	0.0843	0.1028	0.1318	4.0471
2016	1.1174	0.2479	0.8855	0.0032	0.0731	0.0905	0.1164	3.0357
2017	1.3616	0.2628	0.9821	0.0030	0.0733	0.0920	0.1217	2.9278
2018	1.5092	0.2614	0.9065	0.0031	0.0530	0.0695	0.1069	2.3633
2019	1.5085	0.2332	0.8696	0.0040	0.0537	0.0672	0.0969	1.8481
2020	1.0616	0.2504	0.5782	0.0050	0.0733	0.0903	0.1141	1.5089
2021	1.0625	0.2845	0.6001	0.0048	0.0605	0.0753	0.0994	1.7581
2022	0.5226	0.2671	0.2078	0.0044	0.0420	0.0536	0.0719	0.9190
1990/2022	**-63%**	**232%**	**-71%**	**-32%**	**-73%**	**-75%**	**-81%**	**-81%**
2021/2022	**-51%**	**-6%**	**-65%**	**-7%**	**-31%**	**-29%**	**-28%**	**-48%**

4.6.10.2 Methodological issues

Activities defined in national legislation involved in the category are presented in ***Table 4.68***. In this submission, emissions from the source magnesite clinker production were reallocated in this category.

Table 4.68: *Activities according to national categorization included in 2C7c*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.6 Treatment of non-ferrous metals ores and manipulation with these materials in powder form.
2.7 Production of non-ferrous metals and their mutual alloys and production of ferroalloys from crude ores, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes.
2.8 Melting of non-ferrous metals including the alloyage, remelting and refining of metal scrap with a projected melting capacity in t/d: a) for lead and cadmium b) for other non-ferrous metal
2.9 Surface treatment of metals, coating application and related activities except for organic solvents use and powder coating a) Surface treatment - by using electrolytic processes with a projected volume of baths in m^3 b) Surface treatment - by using chemical processes with a projected volume of baths in m^3

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
c) Surface treatment - application of metal or alloy layers and metal coatings and their alloys except for crude steel in the melt with a projected capacity in kg/h
d) Surface treatment - application of metal or alloy layers, using flame, electric arc, plasma or another method with projected capacity in kg/h
e) Surface treatment - application of protective coating from molten metals with the input of crude steel with a projected application capacity in t/h
f) Surface treatment - anodic oxidation of aluminium materials
g) Surface treatment - application of non-metallic coatings like enamels and other similar surface treatments, with a projected capacity of application in m^2/h
h) Related activities - abrasive cleaning (blasting), excluding cassette equipment, with a projected capacity of processed material in m^2/h
i) Related activities - thermal cleaning:
- with the volume of the combustion chamber in m^3 or
- with operation hours per year
j) Related activities - electrolytic-plasma cleaning, degreasing and polishing with a projected capacity in dm^2/h

Emissions data for the period 2000-2022 originate from the NEIS database. Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009 (***Table 4.69***).

Table 4.69: *Emission factors for calculation of historical years in 2C7c*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/GJ]
EF	288 777.33	16 416.56	145 029.48	1 335.22	77 206.78	41%	56%	968 333.68

4.6.10.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2023}.

4.6.10.4 Source-specific recalculations

No recalculations in this submission.

4.6.11 Storage, handling and transport of metal products (NFR 2C7d)

4.6.11.1 Overview

Activities of storage, handling and transport of metal products are usually involved in individual sources. Emissions of air pollutants are from this reason reported with notation key IE.

4.7 SOLVENTS (NFR 2D) AND OTHER PRODUCT USE (NFR 2G)

The chapter provides information on the emission inventory of NMVOC for the sector solvents, which covers NFR categories **2D3a**, **2D3b**, **2D3c**, **2D3d**, **2D3e**, **2D3f**, **2D3g**, **2D3h**, **2D3i** and **2G**. Categories **2D3b** and **2D3c** are relevant emissions of PMs, TSP, BC and PCDD/F and sources of **2D3c** are emitted besides CO emissions. In the category **2D3i**, emissions of lubricant consumption in transport were added. The categories included in the emission balance are listed in ***Table 4.70***.

Table 4.70: *Categories included in Solvents*

NFR CODE	LONGNAME
2D3a	Domestic solvent use including fungicides
2D3b	Road paving with asphalt
2D3c	Asphalt roofing
2D3d	Coating applications
2D3e	Degreasing
2D3f	Dry cleaning
2D3g	Chemical products
2D3h	Printing

NFR CODE	LONGNAME
2D3i	Other solvent use
2G	Other product use

4.7.1 Overview

Concerning air protection, the most important emissions rising from the categories of so-called solvents are non-methane volatile organic compounds (NMVOC). They are part of many different substances, which are used in industry and human activities. The wide scale of substances contains NMVOC: pure solvents (individual organic compounds) or many different mixtures used in industry, dry-cleaning agents, cleaning detergents, paints, paint thinners, glues, cosmetics and toiletries, a variety of household products or car care products, fuels, hydraulic fluids and others. However, fuels are not the primary objective of this chapter. Their versatility leads to more difficulty tracking the fluxes and some categories are estimated, especially for domestic use.
Emissions released from this subsector are listed in ***Table 4.71***. Shares of released emissions of NMVOC in 2022 included in NFR categories **2D** are presented in ***Figure 4.6***. Following ***Recommendation No SK-2D3e-2023-0001***, the activity and emission data were checked (additional QC procedure by the person independent on the inventory was made) and inconsistencies between NFR and IIR were removed.

Figure 4.6: *The share in NMVOC emissions of individual categories in 2D and 2G in 2022*

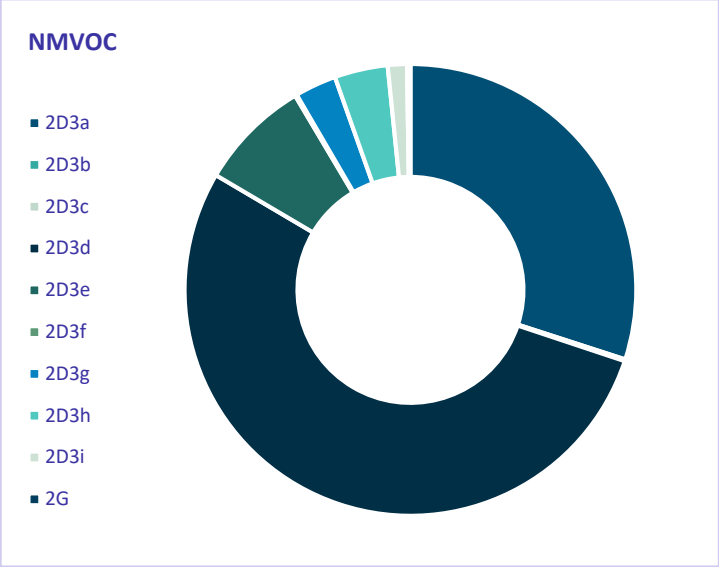


Table 4.71: *Overview of emissions in the category 2D*

YEAR	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	Pb [t]	Cd [t]	Hg [t]
1990	38.5027	0.0147	0.0990	0.1254	0.2920	0.0020	0.0002	0.0002	0.0298
1995	35.8277	0.0139	0.0495	0.0626	0.1403	0.0010	0.0001	0.0002	0.0301
2000	29.6027	0.0150	0.0477	0.0600	0.0834	0.0007	0.0002	0.0002	0.0303
2005	30.7325	0.0223	0.0039	0.0062	0.0165	0.0001	0.0002	0.0003	0.0303
2010	22.4157	0.0271	0.0014	0.0026	0.0087	0.0000	0.0003	0.0004	0.0306
2011	26.1459	0.0259	0.0016	0.0030	0.0108	0.0000	0.0003	0.0003	0.0304
2012	21.1965	0.0278	0.0015	0.0026	0.0088	0.0000	0.0003	0.0004	0.0305
2013	21.0883	0.0273	0.0015	0.0028	0.0104	0.0000	0.0003	0.0004	0.0305
2014	22.5021	0.0279	0.0011	0.0023	0.0095	0.0000	0.0003	0.0004	0.0305
2015	25.6429	0.0301	0.0005	0.0020	0.0129	0.0000	0.0003	0.0004	0.0306
2016	23.9248	0.0316	0.0007	0.0015	0.0066	0.0000	0.0004	0.0004	0.0306
2017	21.7249	0.0326	0.0005	0.0012	0.0059	0.0000	0.0004	0.0004	0.0307
2018	24.1538	0.0338	0.0005	0.0011	0.0052	0.0000	0.0004	0.0005	0.0307
2019	20.5470	0.0224	0.0004	0.0010	0.0051	0.0000	0.0004	0.0005	0.0308

YEAR	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	Pb [t]	Cd [t]	Hg [t]
2020	20.8513	0.0211	0.0005	0.0011	0.0051	0.0000	0.0003	0.0005	0.0308
2021	19.8864	0.0220	0.0005	0.0016	0.0090	0.0000	0.0004	0.0006	0.0307
2022	17.8903	0.0234	0.0005	0.0015	0.0087	0.0000	0.0004	0.0007	0.0307
1990/2022	**-54%**	**59%**	**-100%**	**-99%**	**-97%**	**-100%**	**139%**	**227%**	**3%**
2021/2022	**-10%**	**6%**	**-5%**	**-4%**	**-4%**	**-5%**	**6%**	**6%**	**0%**

YEAR	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	PCDD/F [g I-TEQ]	PAHs [t]
1990	0.0003	0.0009	0.0001	0.0066	0.0001	3.6898	0.0257	0.3319
1995	0.0002	0.0005	0.0001	0.0034	0.0001	3.4896	0.0120	0.1681
2000	0.0002	0.0004	0.0001	0.0024	0.0001	3.7594	0.0043	0.1185
2005	0.0003	0.0004	0.0001	0.0018	0.0001	5.6020	0.0079	0.0823
2010	0.0004	0.0004	0.0002	0.0014	0.0002	6.7983	0.0074	0.0644
2011	0.0004	0.0004	0.0002	0.0016	0.0002	6.4890	0.0088	0.0717
2012	0.0004	0.0004	0.0002	0.0016	0.0002	6.9798	0.0072	0.0703
2013	0.0004	0.0005	0.0002	0.0022	0.0002	6.8365	0.0060	0.1045
2014	0.0005	0.0006	0.0002	0.0032	0.0002	6.9937	0.0055	0.1515
2015	0.0005	0.0005	0.0002	0.0021	0.0002	7.5426	0.0103	0.0967
2016	0.0005	0.0007	0.0002	0.0035	0.0002	7.9169	0.0074	0.1692
2017	0.0005	0.0006	0.0002	0.0028	0.0002	8.1600	0.0077	0.1289
2018	0.0006	0.0007	0.0002	0.0037	0.0002	8.4633	0.0090	0.1748
2019	0.0006	0.0007	0.0002	0.0034	0.0002	6.9608	0.0093	0.1624
2020	0.0006	0.0007	0.0002	0.0035	0.0002	6.5433	0.0093	0.1656
2021	0.0008	0.0008	0.0003	0.0042	0.0002	6.8394	0.0108	0.2014
2022	0.0008	0.0007	0.0003	0.0033	0.0002	7.2661	0.0114	0.1514
1990/2022	**189%**	**-21%**	**219%**	**-50%**	**66%**	**97%**	**-56%**	**-54%**
2021/2022	**5%**	**-12%**	**6%**	**-23%**	**1%**	**6%**	**5%**	**-25%**

4.7.1 Domestic Solvent Use Including Fungicides (NFR 2D3a)

4.7.1.1 Overview

Emissions of NMVOCs have increasing character in this category due to the trend in activity data. Emissions, their trend and activity data are shown in ***Table 4.72***.

Table 4.72: *Activity data and emissions in the category 2D3a*

YEAR	INHABITANTS	NMVOC [kt]	Hg [t]
1990	5297774	4.6887	0.0297
1995	5363676	4.7589	0.0300
2000	5400679	4.4477	0.0302
2005	5387285	4.6860	0.0302
2010	5431024	3.6796	0.0304
2011	5394251	4.7223	0.0302
2012	5407579	5.8156	0.0303
2013	5413393	4.0732	0.0303
2014	5418649	3.8580	0.0303
2015	5423800	4.4401	0.0304
2016	5430798	5.3332	0.0304
2017	5437754	6.4964	0.0305
2018	5446771	6.3239	0.0305
2019	5457873	6.1607	0.0306
2020	5459781	6.4473	0.0306

YEAR	INHABITANTS	NMVOC [kt]	Hg [t]
2021	5434712	5.6022	0.0304
2022	5428792	5.3771	0.0304
1990/2022	**2%**	**15%**	**2%**
2021/2022	**0%**	**-4%**	**0%**

4.7.1.2 Methodological issues

This category is performed by the combination of Tier 2a and Tier 2b methods. Activity data were taken from the Statistical Office of the Slovak Republic. Activity data deal with the import, export and production of the following sources:

- Perfumes and toilet waters.
- Hair lacquers.
- Pre-shave, shaving or aftershave preparations.
- Personal deodorants and antiperspirants.
- Polishes, creams and similar preparations, for footwear or leather.
- Polishes, creams and similar preparations, for the maintenance of wooden furniture, floors or other woodwork.
- Soap in forms excluding bars, cakes or moulded shapes, paper, wadding, felt and non-wovens impregnated or coated with soap/detergent, flakes, granules or powders.
- Windscreen wipers, defrosters and demisters for motorcycles or motor vehicles.
- Insecticides.
- Fungicides.
- Herbicides, anti-sprouting products and plant-growth regulators.

NMVOC emissions from most sources were calculated using the Tier 2a method. Solvent contents and emission factors were taken from EMEP/EEA GB_{2019} (***Table 4.73***). Emissions from the insecticides, fungicides and herbicides were calculated using the Tier 2b method, emission factors were taken from EMEP/EEA GB_{2019} (***Table 4.74***). In 2022, a decrease is reported in NMVOC emissions (-0.22 kt), mainly from the use from the use of perfumes and toilet waters (-26%).

Table 4.73: *Used solvent contents and emissions factors (per t of solvent) for Tier 2a method according to the EMEP/EEA GB_{2019}*

SOURCE	SOLVENT CONTENT [%]	EF NMVOC [kg/t]
Perfumes and toilet waters	80	950
Hair lacquers	90	950
Pre-shave, shaving or aftershave preparations	80	950
Personal deodorants and antiperspirants	50	950
Polishes, creams and similar preparations, for footwear or leather	45	950
Polishes, creams and similar preparations, for the maintenance of wooden furniture, floors or other woodwork	80	950
Soap in forms excluding bars, cakes or moulded shapes, paper, wadding, felt and non-wovens impregnated or coated with soap/detergent, flakes, granules or powders	5	950
Windscreen wipers, defrosters and demisters for motorcycles or motor vehicles	50	500

Table 4.74: *Used solvent contents and emissions factors (per t of product) for Tier 2b method according to the EMEP/EEA GB_{2019}*

SOURCE	EF NMVOC [kg/t]
Insecticides	150
Fungicides	150
Herbicides, anti-sprouting products and plant-growth regulators	150

Historical data: The emissions are taken from the Statistical Office of the Slovak Republic for the years 1999 to 2022. The historical data (1990–1998) were extrapolated using the surrogate method. The number of inhabitants served as a driver of the extrapolation. Activity data used for the calculation are displayed in ***Table 4.75***.

Table 4.75: *Activity data (**consumption = production + import – export**) in the category 2D3a*

YEAR	PERFUMES AND TOILET WATERS	HAIR LACQUERS	PRE-SHAVE, SHAVING OR AFTERSHAVE PREPARATIONS	PERSONAL DEODORANTS AND ANTIPERSPIRANTS
1999	0.888	0.409	1.160	2.163
2000	0.890	0.410	1.162	2.166
2001	0.887	0.409	1.158	2.159
2002	0.887	0.409	1.159	2.159
2003	0.887	0.409	1.159	2.161
2004	0.889	0.409	1.161	2.163
2005	0.890	0.410	1.162	2.166
2006	0.891	0.411	1.164	2.169
2007	0.892	0.411	1.166	2.172
2008	0.894	0.412	1.168	2.177
2009	0.897	0.413	1.171	2.183
2010	0.865	0.264	0.855	1.858
2011	1.580	0.164	1.065	1.596
2012	0.662	0.514	2.735	1.800
2013	0.653	0.097	0.665	1.822
2014	0.529	0.117	0.736	1.853
2015	0.948	0.249	0.840	1.768
2016	0.880	0.216	1.002	2.439
2017	1.282	0.775	1.421	3.265
2018	1.155	0.952	1.306	2.940
2019	1.105	0.805	1.135	2.587
2020	1.267	0.722	1.277	2.385
2021	2.050	0.559	0.832	1.359
2022	1.516	0.584	0.457	1.248

YEAR	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR FOOTWEAR OR LEATHER	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR THE MAINTENANCE OF WOODEN FURNITURE, FLOORS OR OTHER WOODWORK	SOAP IN FORMS EXCLUDING BARS, CAKES OR MOULDED SHAPES, PAPER, WADDING, FELT AND NON-WOVENS IMPREGNATED OR COATED WITH SOAP/DETERGENT, FLAKES, GRANULES OR POWDERS
1999	0.132	0.199	1.656
2000	0.061	0.203	2.351
2001	0.150	0.192	2.590
2002	0.164	0.144	3.370
2003	0.133	0.136	3.583
2004	0.103	0.268	2.879
2005	0.092	0.413	3.266
2006	0.085	0.461	2.678
2007	0.152	0.433	2.681
2008	0.180	0.504	1.671
2009	0.143	0.337	1.669
2010	0.202	0.145	1.246
2011	0.236	0.613	1.337
2012	0.264	0.549	5.065
2013	0.288	0.649	3.902

YEAR	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR FOOTWEAR OR LEATHER	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR THE MAINTENANCE OF WOODEN FURNITURE, FLOORS OR OTHER WOODWORK	SOAP IN FORMS EXCLUDING BARS, CAKES OR MOULDED SHAPES, PAPER, WADDING, FELT AND NON-WOVENS IMPREGNATED OR COATED WITH SOAP/DETERGENT, FLAKES, GRANULES OR POWDERS
2014	0.292	0.721	3.286
2015	0.238	0.655	3.275
2016	0.170	1.154	3.508
2017	0.258	0.722	3.158
2018	0.170	0.717	3.305
2019	0.136	0.772	3.316
2020	0.116	0.764	4.769
2021	0.153	0.710	4.205
2022	0.867	0.824	4.047

YEAR	WINDSCREEN WIPERS, DEFROSTERS AND DEMISTERS FOR MOTORCYCLES OR MOTOR VEHICLES	INSECTICIDES	FUNGICIDES	HERBICIDES, ANTI-SPROUTING PRODUCTS AND PLANT-GROWTH REGULATORS
1999	0.032	1.551	1.929	4.568
2000	0.031	1.554	1.932	4.574
2001	0.045	1.548	1.925	4.559
2002	0.061	1.549	1.926	4.560
2003	0.066	1.550	1.927	4.563
2004	0.094	1.552	1.929	4.568
2005	0.120	1.554	1.932	4.574
2006	0.365	1.556	1.934	4.580
2007	0.133	1.558	1.938	4.588
2008	0.679	1.562	1.942	4.598
2009	0.346	1.566	1.947	4.610
2010	0.500	1.189	1.376	3.317
2011	0.139	1.187	1.904	4.564
2012	0.138	1.260	2.189	4.114
2013	0.282	1.291	1.604	5.446
2014	0.166	1.487	1.321	4.169
2015	0.081	2.082	2.044	4.230
2016	0.466	1.963	2.310	4.572
2017	0.433	1.586	2.478	4.677
2018	0.594	1.714	1.985	5.102
2019	0.707	1.967	2.340	6.105
2020	0.526	1.722	2.369	7.739
2021	0.719	1.838	2.144	4.715
2022	0.978	1.833	1.763	5.416

4.7.1.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB$_{2019}$.

4.7.1.4 Source-specific recalculations

No recalculation was made.

4.7.2 Road Paving with Asphalt (NFR 2D3b)

4.7.2.1 Overview

The numbers of operators vary around 50 installations, yearly. The operators ensure the obligation of regular emission monitoring and yearly emission balance in line with national legislation by way of continuous or

discontinuous monitoring or by the approved way of determining the yearly emissions. The yearly emission balances are reported under the fees decisions (Act No 401/1998 on air pollution charges as amended). Discontinuous monitoring can be performed solely by the authorized and accredited person in line with national requirements. The category reports NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC and PCDD/PCDF emissions. The emissions show a decreasing overall trend (***Table 4.76***).

Table 4.76: *Activity data and emissions in the category 2D3b*

YEAR	ASPHALT USED [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	PCDD/F [g I-TEQ]
1990	366.80	0.0705	0.0163	0.0218	0.1874	0.0009	0.0257
1995	170.99	0.0328	0.0076	0.0102	0.0873	0.0004	0.0120
2000	60.96	0.0117	0.0022	0.0030	0.0258	0.0001	0.0043
2005	112.99	0.0191	0.0001	0.0014	0.0117	0.0000	0.0079
2010	105.65	0.0144	0.0001	0.0008	0.0069	0.0000	0.0074
2011	125.30	0.0182	0.0001	0.0011	0.0088	0.0000	0.0088
2012	102.25	0.0149	0.0001	0.0008	0.0070	0.0000	0.0072
2013	85.95	0.0152	0.0001	0.0010	0.0086	0.0000	0.0060
2014	79.20	0.0137	0.0001	0.0010	0.0082	0.0000	0.0055
2015	147.30	0.0201	0.0001	0.0015	0.0124	0.0000	0.0103
2016	105.80	0.0189	0.0001	0.0007	0.0058	0.0000	0.0074
2017	109.99	0.0187	0.0001	0.0006	0.0054	0.0000	0.0077
2018	128.39	0.0199	0.0000	0.0006	0.0047	0.0000	0.0090
2019	132.50	0.0165	0.0000	0.0005	0.0046	0.0000	0.0093
2020	132.95	0.0151	0.0000	0.0005	0.0046	0.0000	0.0093
2021	154.80	0.0208	0.0001	0.0010	0.0084	0.0000	0.0108
2022	163.13	0.0210	0.0001	0.0010	0.0081	0.0000	0.0114
1990/2022	**-56%**	**-70%**	**-100%**	**-96%**	**-96%**	**-100%**	**-56%**
2021/2022	**5%**	**1%**	**-3%**	**-3%**	**-3%**	**-3%**	**5%**

4.7.2.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. No small sources are on the territory of the SR, thus data from the NEIS covers all activity. The category uses the Tier 3 method.

Table 4.77: *Industrial activities included in 2D3b according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.5 Manufacturing of bituminous mixtures with the projected production capacity of the mixture in tonnes/hour.

The sources are considered mixed and have inseparable combustion and technological emissions at release because the NFR code assignment is associated with the entire source coding (3.5). However, most of the sources use natural gas (NG) as a fuel, therefore NOx, SOx and CO are assumed of having the combustion origin. And it is also assumed that VOC, TSP and PMs do not create a significant part of released emissions from NG. The allocation of NOx, SOx and CO emissions into the template was done manually (not in the environment of the database).

Calculations: Most of the operators in the category (approx. 70 %) report their emissions by way of mass flow multiplied by the number of operational hours per related year. Mass balance is determined by authorized measurement according to ISO standard procedures.

Equation 4.3: *Calculation No 1*

$$E\ [t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where

q = Mass flow

t = Number of operational hours for the related year

The rest of the operators (approx. 30 %) report the emissions by the calculation:

Equation 4.4: *Calculation No 2*

$$E\ [t] = (1 - \eta/100) \times EF\ [kg/M\ of\ AD] \times AD\ [M\ of\ AD] \times 10^{-3}$$

Where

EF = Emission Factor

AD = Activity Data (M of AD = Quantity of related Activity Data).

In the case of activity data is fuel, because of mixed sources (combined combustion and technological process), the emissions are performed by the calculation:

Equation 4.5: *Other calculations*

$$E\ [t] = (1 - \eta/100) \times EF\ [kg/t] \times AD\ [t] \times 10^{-3}$$

$$E_{Total} = (1 - 1 - \eta/100) \times EF[kg/mil.m^3] \times AD\ [th.m^3]$$

Where

EF = Emission Factor

AD = Quantity of fuel

For EF please see **ANNEX IV: Chapter A4.6**.

Abatement: The abatement techniques with individual effectiveness are also in the registry of the NEIS and final emissions are calculated concerning abatements at individual technologies. The overview of different types of separators is presented in **ANNEX IV: Chapter A4.7**.

Calculation of PMs: The compilation of PMs is performed in the environment of the NEIS database. The algorithm for calculation of PM_{10} and $PM_{2.5}$ is applicable only for data 2005 and newer due to the database structure. Emissions are calculated from the values of TSP as their fraction according to Interim Study 2008[1] prepared for SHMÚ with the base of GAINS methodology published by IIASA[2].

Activity data: Some information can be found in the NEIS. The production is independently obtained from the Research Institute of Engineering Constructions which is authorized by the Slovak Association for Asphalt roads (SAAV) for collecting and verification of data. The activity data is in the form of annual reports of produced and used asphalt and asphalt mixtures in the road construction sector.

POPs: Emissions of PCDD/F were calculated using UNEP Toolkit for Asphalt mixing:

EF (PCDD/F) = 0.00007 [mg/Mg Asphalt]

Historical data: The emissions are taken from the NEIS for the years 2005 to 2022.

The national emission factors are used for the calculation of historical data. The EFs were calculated as a weighted average from the values of implied emission factors, which were calculated for every available year in the period 2000-2004 and related yearly consumption of asphalt. PMs were calculated as an average of share from TSP in previous years 2005–2009.

EF (NMVOC) = 0.19 [g/Mg Asphalt]

EF (TSP) = 0.51 [g/Mg Asphalt]

EF ($PM_{2.5}$) = 8.71% of EF (TSP)

EF (PM_{10}) = 11.65% of EF (TSP)

4.7.2.3. Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.2.4 Source-specific recalculations

No recalculation was made.

[1] SHMU, ECOSYS: *Návrh výpočtu tuhých znečisťujúcich látok s aerodynamickým priemerom menších ako 10 a 2.5 µm (PM_{10} a $PM_{2.5}$),* Bratislava, August 2008, Interim report.

[2] Z. KLIMONT, J. COFALA, I. BERTOK, M. AMANN, C. HEYES, F. GYARFAS: *Modelling Particulate Emissions in Europe (A Framework to Estimate Reduction Potential and Control Costs)*, 2002, IIASA Interim Report. IIASA, Laxenburg, Austria: IR-02-076Z., available at: http://pure.iiasa.ac.at/6712

4.7.3 Asphalt Roofing (NFR 2D3c)

4.7.3.1 Overview

The category reports NMVOC, $PM_{2.5}$, PM_{10}, TSP and BC emissions. Emissions have an overall decreasing trend (***Table 4.78***). Two operators were identified that produce asphalt shingles. One operator operated in the period 1990-2014 and the second in 2013-2022.

Table 4.78: *Activity data and emissions in the category 2D3c*

YEAR	ASPHALT USED FOR ROOFING [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	130.17	0.0467	0.0827	0.1036	0.1046	0.0011
1995	65.92	0.0237	0.0419	0.0525	0.0530	0.0005
2000	46.47	0.0163	0.0454	0.0570	0.0575	0.0006
2005	32.28	0.0058	0.0038	0.0047	0.0048	0.0000
2010	25.26	0.0024	0.0014	0.0017	0.0017	0.0000
2011	28.10	0.0024	0.0015	0.0019	0.0019	0.0000
2012	27.59	0.0023	0.0014	0.0018	0.0018	0.0000
2013	40.99	0.0029	0.0014	0.0018	0.0018	0.0000
2014	59.42	0.0026	0.0011	0.0013	0.0013	0.0000
2015	37.91	0.0010	0.0004	0.0005	0.0005	0.0000
2016	66.37	0.0020	0.0006	0.0008	0.0008	0.0000
2017	50.56	0.0013	0.0004	0.0006	0.0006	0.0000
2018	68.53	0.0021	0.0004	0.0005	0.0005	0.0000
2019	63.68	0.0019	0.0004	0.0005	0.0005	0.0000
2020	64.96	0.0022	0.0004	0.0006	0.0006	0.0000
2021	78.96	0.0022	0.0004	0.0005	0.0006	0.0000
2022	59.39	0.0021	0.0004	0.0005	0.0005	0.00001
1990/2022	**-54%**	**-95%**	**-100%**	**-100%**	**-100%**	**-100%**
2021/2022	**-25%**	**-5%**	**-6%**	**-6%**	**-6%**	**-6%**

4.7.3.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.79: *Industrial activities included in 2D3c according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.37 Production of waterproofing materials and floor coverings with a projected amount of raw materials processed in kg/h.

No small sources are on the territory of SR thus the Tier 3 method is used.

$$E_{TOTAL} = E_{NEIS}$$

The category code is associated with the sources, therefore some emissions from technological processes are inseparable from the combustion processes. Mix source of combustion and non-combustion emissions. NFR code is assigned to the source. The source in the NEIS database is a technological facility (installation) or a particular part of the facility (installation). Source uses fuel directly in the technological process. Therefore source's output/discharge emissions compiled by the NEIS or based on measurements contain the fractions of non- and combustion emissions that are inseparable.

Activity data: Provided activity data (used asphalt) is obtained from statistics and are harmonized with GHG emission inventory.

Historical data: The emissions are taken from the NEIS for the years 2005 to 2022.

The national emission factors are used for the calculation of historical data. The EFs were calculated as a weighted average from the values of implied emission factors, which were calculated for every available year of the period 2000-2004 and the related consumption of asphalt used for roofing from statistics. PMs were

calculated as an average share of TSP in the period 2005-2009. BC is calculated according to EF from EMEP/EEA GB$_{2019}$.

EF (NMVOC) = 358.89 [g/Mg Asphalt Use for Roofing]
EF (TSP) = 1 088.76 [g/Mg Asphalt Use for Roofing]
EF ($PM_{2.5}$) = 79% of EF (TSP)
EF (PM_{10}) = 99% of EF (TSP)
EF (BC) = 0.013% of EF ($PM_{2.5}$)

4.7.3.3 Completeness

All pollutants are covered. Emissions of CO were reallocated from this category to category **1A2gviii**, as they originate from the combustion of fuels. Notation keys were used following the EMEP/EEA GB$_{2019}$.

4.7.3.4 Source-specific recalculation

No recalculation was made.

4.7.4 Coating Applications (NFR 2D3d)

4.7.4.1 Overview

The category reports NMVOC emissions. Emissions have an overall decreasing trend (***Table 4.80***).

Table 4.80: *Activity data and emissions in the category 2D3d*

YEAR	COATINGS APPLIED [kt]	NMVOC [kt]
1990	NE	16.2918
1995	NE	16.0548
2000	47.26	12.6172
2005	65.75	14.6252
2010	129.30	13.5736
2011	93.24	11.0852
2012	89.07	10.7094
2013	99.00	11.4733
2014	110.69	13.3619
2015	152.01	15.1841
2016	117.59	13.1636
2017	117.42	11.1261
2018	143.87	12.0145
2019	91.67	9.3340
2020	98.32	10.7841
2021	88.65	10.7074
2022	83.66	9.5709
1990/2022	**-**	**-34%**
2021/2022	**-6%**	**-11%**

4.7.4.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. Small sources on the territory of SR not covered by the NEIS are calculated from statistical data. A combination of T2+T3 is used.

Table 4.81: *Industrial activities included in 2D3d according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.1 Paint shops in the automotive industry with a projected consumption of organic solvents in tonnes/year
6.2 Surface coating of road vehicles with a total projected consumption of organic solvents in tonnes/year: a) in automotive manufacturing of small series b) surface coating of road vehicles in cases where the activity is performed by unautomated technological units

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
c) car repair – vehicle spraying in car paint shops)
6.3 Surface coating with a projected consumption of organic solvents in tonnes/year: a) of metal and plastics, including the ships covering, aircraft and railway trackage vehicle; textile, fabric, film and paper coating b) on winding wire c) on reel strips of metallic materials
6.9 Industrial wood processing: a) mechanical processing of wooden lumps with projected processing capacity in v m^3/day b) mechanical processing of disintegrated wooden mass such as sawdust, shavings, and chips with a projected processing capacity in v m^3/day c) production of agglomerated materials with projected consumption of polycondensed adhesives in tonnes of dry matter/year Processing and surface treatment using organic solvents including associated activities, such as deburring, according to a projected consumption of organic solvents in tonnes/year: a) adhesive application b) wood and plastic lamination c) coating application d) impregnation

Emissions: Decree No 410/2012 Coll. as amended defined limit >= 0.6 t/yr. for the obligation of solvents evidence and registering into the NEIS as a medium source of air pollution. The cat. 6.9 in Slovak legislation covers more activities concerning wood processing as defined in the NFR. Therefore, the mechanical processing of wood is included. Yearly numbers of operators vary around 450 and cover large and medium sources. Emissions taken from the NEIS database are processed by the system and abatement of environmental technology, recovery fluxes or separators are already taken into account in final emissions. Emission calculations:

$$E_{TOTAL} = E_{SMALL\ SOURCES} + E_{NEIS}$$

Calculations in the NEIS: Reporting of solvents in the NEIS evidence is performed in Balance sheets of organic solvents for individual releases. The quantity of VOC is calculated by the equations:

Equation 4.6: *Equation a)*

$$E\ [t] = c[mg/m^3] \times V[th.m^3] \times 10^{-6}$$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

Equation 4.7: *Equation b)*

$$E\ [t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where

q = mass flow

t = number of operational hours for the related year

Equation 4.8: *Equation c) Direct and indirect balance in case of unambiguous emission dependence*

$$E = O1 + F$$

Where

O1 = Emissions released by outputs

F = Fugitive emissions are differently calculated for direct and indirect emissions

Calculations of Small Sources: Small sources were balanced. The balance is performed by a top-down approach. The statistical data is processed and total solvents consumption is calculated according to the scheme of the interim studies on the specific solvent content of solvent-based substances (**ANNEX IV: Chapter A4.8**). For the small sources, the assumption of no separator technology is used, thus the conversion of solvents to the air is considered 100%.

Small sources calculation:

$$Production + Import - Export = Total\ Product\ Consumption$$
$$Total\ Product\ Consumption \rightarrow Calculation\ of\ Total\ Solvents\ Consumption$$

$$Total\ Solvents\ Consumption - Industrial\ Solvents\ Consumption = Small\ Sources$$

Adjustment for VOC content: The calculation of VOC emission reduction is based on the implementation of the VOC reduction regarding Directive 2004/42/CE on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC. Our specific VOC content used in the calculation is related to the period before (the scheme is presented in **ANNEX IV: Chapter A4.8**).

Historical data: The emissions are taken from the NEIS for the years 2005 to 2022. Due to the absence of statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

Table 4.82: *Statistical activity data of total product consumption in t*

YEAR	SB	WB
2001	32 009	21 231
2002	36 099	23 569
2003	33 595	26 342
2004	40 746	26 516
2005	35 395	30 356
2006	47 038	31 443
2007	37 268	37 450
2008	37 402	76 942
2009	38 083	62 771
2010	51 429	77 875
2011	45 838	47 400
2012	45 410	43 655
2013	46 748	52 248
2014	52 626	58 059
2015	54 251	97 764
2016	51 658	65 932
2017	43 334	74 089
2018	45 025	98 840
2019	40 382	51 293
2020	43 890	54 429
2021	46 557	42 088
2022	45 348	38 313

Table 4.83: *2D3d - Emission of NMVOC (t) in the division of Small sources and Industrial sources*

YEAR	EM SS	EM NEIS
2005	12 410	2 215
2006	14 927	2 720
2007	10 436	2 858
2008	13 157	2 745
2009	13 201	2 368
2010	10 908	2 666
2011	8 071	3 014
2012	7 338	3 371
2013	8 438	3 036
2014	10 158	3 204
2015	11 843	3 342
2016	9 674	3 490
2017	7 468	3 658
2018	8 157	3 857

YEAR	EM SS	EM NEIS
2019	5 184	4 150
2020	7 549	3 235
2021	7 466	3 241
2022	6 315	3 256

4.7.4.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB$_{2019}$.

4.7.4.4 Source-specific recalculations

No recalculation was made.

4.7.5 Degreasing (NFR 2D3e)

4.7.5.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.84***). The peak of recorded emissions in 2011 relates to the activity data from statistics, namely the decrease of exported solvents and increased amount of imported.

Table 4.84: *Activity data and emissions in the category 2D3e*

YEAR	SOLVENTS USED [kt]	NMVOC [kt]
1990	10.73	10.5242
1995	9.42	9.2301
2000	8.10	7.9361
2005	7.00	6.8824
2010	3.85	3.7372
2011	8.92	8.8211
2012	3.14	3.0365
2013	4.25	4.1564
2014	3.91	3.8076
2015	4.71	4.6319
2016	4.09	4.0113
2017	2.73	2.6479
2018	4.49	4.4097
2019	3.94	3.8703
2020	2.31	2.2590
2021	2.21	2.1246
2022	1.51	1.4332
1990/2022	**-86%**	**-86%**
2021/2022	**-32%**	**-33%**

4.7.5.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. Small sources on the territory of SR not covered by the NEIS are calculated from statistical data. A combination of T2 + T3 is used.

Table 4.85: *Industrial activities included in 2D3e according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.4. Degreasing and cleaning of metal surfaces, electro components, plastics and other materials including the removal of old coatings by organic solvents with a projected consumption in tonnes/year:
a) organic solvents according to § 26 paragraph. 1
b) other organic solvents

Decree No 410/2012 Coll. as amended defined the limit >= 0.6 t/yr. for the obligation of solvent evidence and registering into the NEIS as a medium source of air pollution. Emissions taken from the NEIS database are processed by the system and abatement of environmental technology, recovery fluxes or separators are already taken into account in final emissions.

$$E_{TOTAL} = E_{SMALL\ SOURCES} + E_{NEIS}$$

Calculations in the NEIS: Please, see methods of Calculations in the NEIS in **ANNEX IV Chapter A4.1-A4.5.**

Calculations of Small Sources: The calculation of small sources is balanced likewise in 2D3d. The balance is performed by a top-down approach. The statistical data are processed and total solvents consumption is calculated but without the step of calculating the VOC-specific content because the specific pure solvents that are used for these purposes in SR (for VOC used for degreasing activities are Trichlorethylene, Tetrachlorethylene (perchloroethylene), 1-propanol (propanol) and 2-propanol (i-propanol) and Acetone are balanced). For the small sources, the assumption of no separator technology is used and the conversion of solvents used to the air is 100%.

Small sources calculation:

$$Production + Import - Export = Total\ Product\ Consumption$$
$$Total\ Product\ Consumption \rightarrow Calculation\ of\ Total\ Solvents\ Consumption$$
$$Total\ Solvents\ Consumption - Industrial\ Solvents\ Consumption = Small\ Sources$$

Table 4.86: *2D3e- Emission of NMVOC (t) in the division of small sources and industrial sources*

YEAR	EM SS	EM NEIS
2005	6 680	202
2006	6 866	178
2007	5 742	193
2008	5 418	162
2009	4 864	121
2010	3 627	110
2011	8 700	121
2012	2 934	102
2013	4 060	96
2014	3 719	89
2015	4 542	90
2016	3 918	94
2017	2 536	112
2018	4 312	97
2019	3 785	85
2020	2 193	66
2021	2 051	74
2022	1 363	70

4.7.5.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB$_{2019}$.

4.7.5.4 Source-specific recalculations

No recalculation was made.

4.7.6 Dry Cleaning (NFR 2D3f)

4.7.6.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.87***).

Table 4.87: *Activity data and emissions in the category 2D3f*

YEAR	SOLVENTS USED [kt]	NMVOC [kt]
1990	0.09	0.0642
1995	0.08	0.0595
2000	0.07	0.0548
2005	0.07	0.0500
2010	0.06	0.0455
2011	0.06	0.0468
2012	0.05	0.0401
2013	0.04	0.0395
2014	0.05	0.0439
2015	0.05	0.0429
2016	0.04	0.0409
2017	0.04	0.0364
2018	0.04	0.0361
2019	0.04	0.0334
2020	0.03	0.0224
2021	0.02	0.0199
2022	0.03	0.0232
1990/2022	**-72%**	**-64%**
2021/2022	**10%**	**17%**

4.7.6.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.88: *Industrial activities included in 2D3f according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.5. Dry cleaning of textiles, bleaching and dyeing of fabrics and other fibrous materials such as linen, cotton, and jute, by: a) a projected consumption of organic solvents in tonnes/year b) a projected amount of bleached or dyed textiles or fibres in tonnes/day

The number of operators has declined from 127 to approximately 100 in the recent 10 years which is the driver of the decline. No small sources are on the territory of SR, because Decree defined limit = 0 for the obligation of solvents evidence and registering into the NEIS as a medium source of air pollution.

$$E_{TOTAL} = E_{NEIS}$$

Calculations in the NEIS: Reporting of solvents in the NEIS evidence is performed in Balance sheets of organic solvents for individual releases. The quantity of VOC is calculated by the equations:

Equation 4.9: *Equation a)*

$$E\ [t] = c[mg/m^3] \times V[th.m^3] \times 10^{-6}$$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

Equation 4.10: *Equation b)*

$$E\ [t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where

q = mass flow

t = number of operational hours for the related year

Equation 4.11: *Equation c) Direct and indirect balance in case of unambiguous emission dependence*

$$E = O1 + F$$

Where
O1 = Emissions released by outputs
F = Fugitive emissions are differently calculated for direct and indirect emissions
Historical data: The emissions are taken from the NEIS for the years 2005 to 2022. Due to the absence of statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.6.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB$_{2019}$.

4.7.6.4 Source-specific recalculations

No recalculation was made.

4.7.7 Chemical Products (NFR 2D3g)

4.7.7.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.89***). The most remarkable decline was in 2006.

Table 4.89: *Activity data and emissions in the category 2D3g*

YEAR	SOLVENTS USED [kt]	ASPHALT USED [kt]	NMVOC [kt]	Cd [t]	As [t]	Cr [t]	Ni [t]	Se [t]	PAHs [t]
1990	7.27	130.17	4.2144	0.0000	0.0001	0.0008	0.0065	0.0001	0.3319
1995	8.21	65.92	3.4669	0.0000	0.0000	0.0004	0.0033	0.0000	0.1681
2000	9.14	46.47	2.7194	0.0000	0.0000	0.0003	0.0023	0.0000	0.1185
2005	10.21	32.28	2.7519	0.0000	0.0000	0.0002	0.0016	0.0000	0.0823
2010	10.51	25.26	0.6295	0.0000	0.0000	0.0002	0.0013	0.0000	0.0644
2011	9.02	28.10	0.7138	0.0000	0.0000	0.0002	0.0014	0.0000	0.0717
2012	9.41	27.59	0.7165	0.0000	0.0000	0.0002	0.0014	0.0000	0.0703
2013	8.77	40.99	0.6870	0.0000	0.0000	0.0002	0.0020	0.0000	0.1045
2014	9.03	59.42	0.7091	0.0000	0.0000	0.0004	0.0030	0.0000	0.1515
2015	9.33	37.91	0.5895	0.0000	0.0000	0.0002	0.0019	0.0000	0.0967
2016	9.97	66.37	0.5772	0.0000	0.0000	0.0004	0.0033	0.0000	0.1692
2017	10.08	50.56	0.5635	0.0000	0.0000	0.0003	0.0025	0.0000	0.1289
2018	9.76	68.53	0.5674	0.0000	0.0000	0.0004	0.0034	0.0000	0.1748
2019	9.38	63.68	0.5044	0.0000	0.0000	0.0004	0.0032	0.0000	0.1624
2020	8.39	64.96	0.4253	0.0000	0.0000	0.0004	0.0032	0.0000	0.1656
2021	7.85	78.96	0.5070	0.0000	0.0000	0.0005	0.0039	0.0000	0.2014
2022	8.26	59.39	0.5329	0.0000	0.0000	0.0004	0.0030	0.0000	0.1514
1990/2022	**14%**	**-50%**	**-87%**	**-54%**	**-54%**	**-54%**	**-54%**	**-54%**	**-54%**
2021/2022	**5%**	**-25%**	**5%**	**-25%**	**-25%**	**-25%**	**-25%**	**-25%**	**-25%**

4.7.7.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.90: *Industrial activities included in 2D3g according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.19 Manufacture of paints, varnishes, inks, glues and adhesives with projected consumption of organic solvents in tonnes/year
4.20 Manufacture of pharmaceutical products with a projected consumption of organic solvents in tonnes/year
4.33 Manufacturing and processing of rubber: a) with a projected consumption of organic solvents in tonnes/year b) production of raw rubber compounds c) processing of the rubber compounds with a projected capacity in kg/hour

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.38 Industrial Plastics Processing:
a) fibre production with a projected capacity in tonnes/year
b) production of films and other products with a projected amount of processed polymer in kg/hour
c) the processing of polyester resins with the addition of styrene or epoxy resins with amines, such as the production of boats, trucks, and car parts, with a projected consumption of raw materials in kg/day
d) the processing of amino and phenolic resins with a projected consumption of raw materials in kg/day
e) production of polyurethane products with a projected consumption of organic solvents in tonnes/year
f) manufacturing expanded plastic, such as polystyrene foam, with a projected consumption of organic blowing agents in tonnes/year
6.10 Manufacturing and processing of leather:
a) manufacture of leather with projected quantities for tonne/day
b) treatment of the leather, except footwear and shoe production, coating and other applications on the leather, with a projected consumption of organic solvents in tonnes/year
6.11 Manufacturing of footwear with a projected consumption of organic solvents in tonnes/year

No small sources occur on the territory of the SR. However, the limit threshold for reporting into the NEIS is not 0, but there is an assumption of no existence of SS for these kinds of products and activities. Thus facility data from the NEIS is used.

$$E_{TOTAL} = E_{NEIS}$$

Emissions of HMs and PAHs were calculated using the Tier 2 method for Asphalt blowing from the EMEP/EEA GB$_{2019}$. The emission factors used for the calculation are listed in ***Table 4.91***.

Table 4.91: *Emission factors for HMs and PAHs*

	Cd [g/t]	As [g/t]	Cr [g/t]	Ni [g/t]	Se [g/t]	PAHs [g/t]
EF	0.0001	0.0005	0.006	0.05	0.0005	2.55

Calculations in the NEIS: Reporting of solvents in the NEIS evidence is performed in Balance sheets of organic solvents for individual releases. The quantity of VOC is calculated by the equations:

Equation 4.12: *Equation a)*

$$E\ [t] = c[mg/m^3] \times V[th.m^3] \times 10^{-6}$$

Where
c = concentration of air pollutant
V = quantity/volume of released waste gas

Equation 4.13: *Equation b)*

$$E\ [t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where
q = mass flow
t = number of operational hours for the related year

Equation 4.14: *Equation c) Direct and indirect balance in case of unambiguous emission dependence*

$$E = O1 + F$$

Where
O1 = Emissions released by outputs
F = Fugitive emissions are differently calculated for direct and indirect emissions

The activities of 6.10 were included here according to guidebook **2D3g** Table 3-13 manufacturing of shoes and similarly 6.11 according to the EMEP/EEA GB$_{2019}$ Table 3-14 Leather tanning instead of 2D3i, where the activities were before.
The other emissions are recorded from sources in the NEIS categorization, but emissions are assumed to not relate to technology (NOx, SOx, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO) were allocated to the **1A2gviii** to be in line with EMEP/EEA GB$_{2019}$.

Historical data: The emissions are taken from the NEIS for the years 2005 to 2022. Due to the absence of any statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.7.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB$_{2019}$.

4.7.7.4 Source-specific recalculations

No recalculation was made.

4.7.8 Printing (NFR 2D3h)

4.7.8.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.92***).

Table 4.92: *Activity data and emissions in the category 2D3h*

YEAR	SOLVENTS USED [kt]	NMVOC [kt]
1990	4.48	2.1784
1995	4.60	1.8269
2000	4.72	1.4754
2005	4.47	1.4178
2010	4.87	0.5250
2011	5.28	0.5129
2012	5.17	0.6804
2013	4.35	0.4905
2014	5.01	0.5291
2015	5.08	0.5604
2016	5.46	0.5581
2017	6.07	0.6018
2018	5.74	0.5220
2019	5.16	0.3623
2020	3.99	0.6416
2021	4.67	0.6694
2022	4.74	0.6840
1990/2022	**6%**	**-69%**
2021/2022	**1%**	**2%**

4.7.8.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. Small sources on the territory of SR not covered by the NEIS are calculated from the statistical data. A combination of T2 + T3 is used.

Table 4.93: *Industrial activities included in 2D3h according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.7. Polygraphy according to a projected consumption of organic solvents in tonnes /year:
a) publication rotogravure
b) other rotogravure
c) headset web offset printing
d) flexography
e) varnishing and laminating technology
f) rotary screen printing on textiles, paperboard
g) other printing techniques, such as cold offset, sheet-fed equipment and other

Emission calculations:

$$E_{TOTAL} = E_{SMALL\ SOURCES} + E_{NEIS}$$

The methods of Calculations in the NEIS can be found in **ANNEX IV Chapter A4.1-A4.5**.
Calculations of Small Sources: Small sources were balanced. The balance is performed by a top-down approach. The statistical data are processed and total solvents consumption is calculated. From the total balance of **2D3d**, the printing inks have been separated and allocated into **2D3h** as small sources.
Small sources calculation:

$$Production + Import - Export = Total\ Product\ Consumption$$
$$Total\ Product\ Consumption \rightarrow Calculation\ of\ Total\ Solvents\ Consumption$$
$$Total\ Solvents\ Consumption - Industrial\ Solvents\ Consumption = Small\ Sources$$

Historical data: The emissions are taken from the NEIS for the years 2005 to 2022. Due to the absence of any statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.8.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.8.4 Source-specific recalculations

No recalculation was made.

4.7.9 Other Solvent Use (NFR 2D3i)

4.7.9.1 Overview

The category reports NMVOC emissions. Emissions of NMVOC from the NEIS database are shown in ***Table 4.94***. Emissions in this category calculated from lubricant consumption in transport are presented in ***Table 4.95***.

Table 4.94: *Overview of emissions of NMVOC in the category 2D3i*

YEAR	SOLVENT USED [kt]	NMVOC [kt]
1990	0.56	0.4239
1995	0.54	0.3741
2000	0.51	0.3243
2005	0.39	0.2942
2010	0.42	0.2085
2011	0.47	0.2232
2012	0.39	0.1809
2013	0.39	0.1504
2014	0.35	0.1761
2015	0.42	0.1729
2016	0.48	0.2195
2017	0.78	0.2328
2018	0.88	0.2581
2019	0.96	0.2635
2020	0.82	0.2545
2021	0.74	0.2329
2022	0.75	0.2460
1990/2022	**33%**	**-42%**
2021/2022	**2%**	**6%**

Table 4.95: *Emissions from lubricant consumption in transport*

YEAR	SOx [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0147	0.0002	0.0002	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	3.6898
1995	0.0139	0.0001	0.0002	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	3.4896
2000	0.0150	0.0002	0.0002	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	3.7594

YEAR	SOx [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2005	0.0223	0.0002	0.0003	0.0001	0.0003	0.0002	0.0001	0.0001	0.0001	5.6020
2010	0.0271	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.7983
2011	0.0259	0.0003	0.0003	0.0002	0.0004	0.0002	0.0002	0.0002	0.0001	6.4890
2012	0.0278	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.9798
2013	0.0273	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.8365
2014	0.0279	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.9937
2015	0.0301	0.0003	0.0004	0.0002	0.0005	0.0003	0.0002	0.0002	0.0001	7.5426
2016	0.0316	0.0004	0.0004	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	7.9169
2017	0.0326	0.0004	0.0004	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	8.1600
2018	0.0338	0.0004	0.0005	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	8.4633
2019	0.0224	0.0004	0.0005	0.0003	0.0006	0.0004	0.0002	0.0003	0.0002	6.9608
2020	0.0211	0.0003	0.0005	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	6.5433
2021	0.0220	0.0004	0.0006	0.0002	0.0007	0.0003	0.0003	0.0003	0.0002	6.8394
2022	0.0238	0.0004	0.0007	0.0003	0.0008	0.0004	0.0003	0.0003	0.0002	7.2661
1990/2022	**59%**	**139%**	**246%**	**166%**	**263%**	**166%**	**219%**	**219%**	**166%**	**97%**
2021/2022	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**

4.7.9.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. Small sources on the territory of SR not covered by the NEIS are calculated from the statistical data. A combination of T2 + T3 is used. Activities included in this category are listed in ***Table 4.96***.

Table 4.96: *Industrial activities included in 2D3i according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.35 Industrial extraction of vegetable oil and animal fat and vegetable oil refining with a projected consumption of organic solvents in tonnes/year
6.6. Adhesive coating - bonding of materials other than wood, wood products and agglomerated materials, leather and footwear production with a projected consumption of organic solvents in tonnes/year

Emission calculations in the industry:

$$E_{TOTAL} = E_{SMALL\ SOURCES} + E_{NEIS}$$

The methods of Calculations in the NEIS can be found in **ANNEX IV Chapter A4.1-A4.5**.
Historical data: The emissions are taken from the NEIS for the years 2000 to 2022. Due to the absence of statistical data before 2001 as well as data in the NEIS before 2000, the historical data are extrapolated with a linear trend.
Emission calculations in transport are based on the model COPERT.

4.7.9.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB$_{2019}$.

4.7.9.4 Source-specific recalculation

No recalculation was made in this submission.

4.7.10 Other Product Use (NFR 2G)

4.7.10.1 Overview

In this category, emissions arising from tobacco combustion and the use of fireworks are reported. Tobacco smoke contains many toxicologically significant chemicals and groups of chemicals, including polycyclic aromatic hydrocarbons (benzopyrene), tobacco-specific nitrosamines, aldehydes, carbon monoxide, hydrogen cyanide, nitrogen oxides, benzene, toluene, phenols, aromatic amines (nicotine, ABP (4-Aminobiphenyl)). The

chemical composition of smoke depends on puff frequency, intensity, volume, and duration at different stages of cigarette consumption[3].

Fireworks produce smoke and dust that may contain residues of heavy metals, sulfur-coal compounds and some low-concentration toxic chemicals. These by-products of fireworks combustion will vary depending on the mix of ingredients of a particular firework. This activity is no significant contributor to national totals.

Emissions in this sector were reported for the first time in previous submissions. ***Table 4.97*** below shows a significant increase in emissions in this category from 1990 due to an increase in tobacco and fireworks use. In ***Table 4.97*** emission trend of NMVOC is shown.

Table 4.97: *Overview of emissions in the category Other Product Use 2G*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0012	0.0032	0.0001	0.0028	0.0181	0.0181	0.0181	0.0081	0.0371
1995	0.0087	0.0232	0.0004	0.0199	0.1293	0.1293	0.1293	0.0582	0.2647
2000	0.0097	0.0257	0.0016	0.0220	0.1433	0.1433	0.1433	0.0645	0.2961
2005	0.0119	0.0316	0.0024	0.0271	0.1761	0.1762	0.1762	0.0792	0.3649
2010	0.0161	0.0431	0.0004	0.0370	0.2404	0.2404	0.2404	0.1082	0.4915
2011	0.0160	0.0425	0.0020	0.0365	0.2372	0.2372	0.2373	0.1067	0.4888
2012	0.0164	0.0436	0.0024	0.0374	0.2433	0.2433	0.2433	0.1095	0.5021
2013	0.0144	0.0380	0.0031	0.0325	0.2118	0.2119	0.2119	0.0953	0.4394
2014	0.0153	0.0404	0.0027	0.0346	0.2254	0.2254	0.2254	0.1014	0.4662
2015	0.0155	0.0410	0.0030	0.0352	0.2289	0.2289	0.2289	0.1030	0.4740
2016	0.0155	0.0409	0.0031	0.0350	0.2281	0.2281	0.2281	0.1026	0.4727
2017	0.0167	0.0439	0.0041	0.0376	0.2448	0.2448	0.2449	0.1101	0.5090
2018	0.0162	0.0428	0.0031	0.0367	0.2390	0.2390	0.2390	0.1075	0.4948
2019	0.0172	0.0457	0.0028	0.0392	0.2551	0.2551	0.2552	0.1148	0.5271
2020	0.0143	0.0383	0.0010	0.0329	0.2139	0.2139	0.2139	0.0962	0.4387
2021	0.0168	0.0448	0.0018	0.0384	0.2497	0.2497	0.2497	0.1123	0.5136
2022	0.0163	0.0433	0.0026	0.0371	0.2417	0.2417	0.2418	0.1087	0.4994
1990/2022	**1247%**	**1238%**	**2456%**	**1238%**	**1238%**	**1238%**	**1238%**	**1238%**	**1246%**
2021/2022	**-3%**	**-3%**	**50%**	**-3%**	**-3%**	**-3%**	**-3%**	**-3%**	**-3%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
1990	0.0268	0.0037	0.0000	0.0000	0.0005	0.0188	0.0028	0.0107
1995	0.0925	0.0260	0.0000	0.0002	0.0018	0.0782	0.0165	0.0436
2000	0.4180	0.0294	0.0000	0.0007	0.0083	0.2654	0.0303	0.1530
2005	0.6138	0.0364	0.0000	0.0010	0.0122	0.3828	0.0411	0.2212
2010	0.0932	0.0483	0.0000	0.0002	0.0019	0.1009	0.0276	0.0549
2011	0.5192	0.0484	0.0000	0.0009	0.0103	0.3415	0.0436	0.1959
2012	0.6244	0.0498	0.0000	0.0011	0.0124	0.4023	0.0482	0.2314
2013	0.7939	0.0439	0.0001	0.0013	0.0158	0.4919	0.0516	0.2845
2014	0.6932	0.0464	0.0001	0.0012	0.0138	0.4377	0.0491	0.2524
2015	0.7700	0.0472	0.0001	0.0013	0.0153	0.4818	0.0523	0.2782
2016	0.8080	0.0471	0.0001	0.0014	0.0161	0.5032	0.0537	0.2908
2017	1.0569	0.0509	0.0001	0.0018	0.0210	0.6475	0.0649	0.3750
2018	0.7925	0.0493	0.0001	0.0013	0.0158	0.4966	0.0542	0.2867
2019	0.7184	0.0524	0.0001	0.0012	0.0143	0.4579	0.0530	0.2638
2020	0.2582	0.0433	0.0000	0.0004	0.0051	0.1890	0.0313	0.1070
2021	0.4578	0.0508	0.0000	0.0008	0.0091	0.3092	0.0425	0.1768
2022	0.6851	0.0496	0.0000	0.0012	0.0136	0.4363	0.0504	0.2514

[3] U.S. Dept. of Health and Human Services, 1981: The Health Consequences of Smoking: The Changing Cigarette

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
1990/2022	2456%	1255%	2456%	2456%	2456%	2222%	1679%	2250%
2021/2022	50%	-2%	50%	50%	50%	41%	19%	42%

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	0.0001	0.0001	0.0000	0.0000	0.0000	0.0002
1995	0.0005	0.0005	0.0002	0.0002	0.0002	0.0012
2000	0.0005	0.0006	0.0002	0.0002	0.0002	0.0013
2005	0.0007	0.0007	0.0003	0.0003	0.0003	0.0016
2010	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2011	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2012	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2013	0.0008	0.0009	0.0004	0.0004	0.0004	0.0019
2014	0.0008	0.0009	0.0004	0.0004	0.0004	0.0021
2015	0.0008	0.0009	0.0004	0.0004	0.0004	0.0021
2016	0.0008	0.0009	0.0004	0.0004	0.0004	0.0021
2017	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2018	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2019	0.0009	0.0010	0.0004	0.0004	0.0004	0.0023
2020	0.0008	0.0009	0.0004	0.0004	0.0004	0.0019
2021	0.0009	0.0010	0.0004	0.0004	0.0004	0.0023
2022	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
1990/2022	1238%	1238%	1238%	1238%	1238%	1238%
2021/2022	-3%	-3%	-3%	-3%	-3%	-3%

4.7.10.2 Methodological issues

Activity data about amounts of fireworks and tobacco and import/export data from the Statistical Office of the Slovak Republic were used. There was no production of fireworks in the Slovak Republic in the whole time series. Following ***Recommendation No SK-2G-2022-0001***, the activity data was checked and the data for tobacco combustion for the years 2005 and 2007 was reconsidered and replaced by the value calculated as a trend. For calculations of fireworks used ***Equation 4.15*** for the period 1991-2022 was used:

Equation 4.15: *Amount of product used in the Slovak Republic in a particular year*

$$Product\ total\ = Product\ import\ total - Product\ export\ total$$

There was a single producer of tobacco products, which operated until 2008; therefore, production data are confidential. Operator produced cigarettes until the year 2004 and cigars and cigarillos until the year 2008, hence ***Equation 4.15*** was used for cigarettes for the period 2005-2022 and cigars and cigarillos for the period 2009-2022. For the previous periods, it was assumed that the production was equal to export and only import data entered into calculations. For the next submission, obtaining confidential data about the production of tobacco products was planned. ***Table 4.98*** shows the results of these calculations.

Table 4.98: *Activity data used in the category Other Product Use*

YEAR	TOBACCO COMBUSTED [kt]	FIREWORKS USED [kt]
1990	0.67	0.03
1995	4.79	0.12
2000	5.30	0.53
2005	6.52	0.78
2010	8.90	0.12
2011	8.78	0.66
2012	9.01	0.80
2013	7.84	1.01
2014	8.35	0.88

YEAR	TOBACCO COMBUSTED [kt]	FIREWORKS USED [kt]
2015	8.47	0.98
2016	8.45	1.03
2017	9.06	1.35
2018	8.85	1.01
2019	9.45	0.92
2020	7.92	0.33
2021	9.25	0.58
2022	8.95	0.87

Emission factors for the calculations originate from the Tier 2 methodology in EMEP/EEA GB$_{2019}$ (***Table 4.99, 4.100***). **Condensable component of PMs** is included in emission factors for tobacco combustion, for the use of fireworks is this information unknown.

Table 4.99: *Emission factors in the category Other Product Use – Use of fireworks*

POLLUTANT	NOx	SOx	PM$_{2.5}$	PM$_{10}$	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]
Value	260	3020	51.94	99.92	109.83	7150	784	1.48	0.057	1.33	15.6	444	30	260

Table 4.100: *Emission factors in the category Other Product Use – Tobacco combustion*

POLLUTANT	NOx	NMVOC	NH$_3$	PM$_{2.5}$	PM$_{10}$	TSP	BC	CO	Cd	Cu	Ni
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[% of PM$_{2.5}$]	[kg/t]	[g/t]	[g/t]	[g/t]
Value	1.8	4.84	4.15	27	27	27	0.45	55.1	5.4	5.4	2.7

POLLUTANT	PCDD/F	B(a)P	B(b)F	B(k)F	I()P	PAHs
Unit	[µg I-TEQ/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]
Value	0.1	0.111	0.045	0.045	0.045	0.246

4.7.10.3 Completeness

All rising pollutants were reported.

4.7.10.4 Source-specific recalculations

No recalculation was made.

4.8 OTHER PROCESSES (NFR 2H)

The chapter is divided into 3 industrial activities: Pulp and paper industry (**2H1**), Food and beverages industry (**2H2**) and other industrial processes (**2H3**). An overview of emissions and their trends are listed in ***Table 4.101***. Emissions of PMs and NH$_3$ have a decreasing trend due to the installation of abatement technologies on the plants during the time series. Emissions of NOx, NMVOC, SOx and CO have a substantially increasing trend, but this category does not belong among key categories for the Slovak Republic. NMVOC emissions from category **2H2** were calculated for the first time in previous submissions, therefore data were revised.

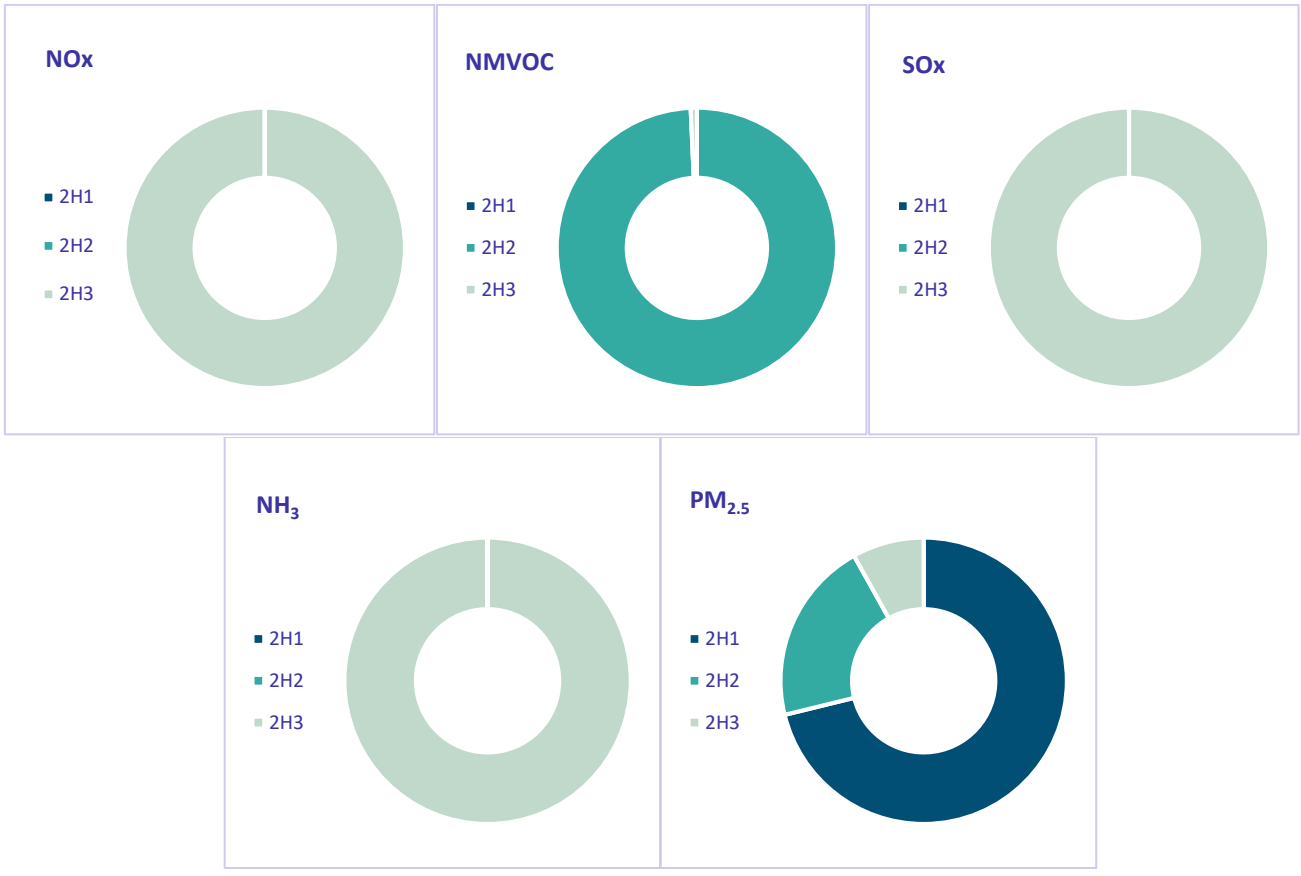
Table 4.101: *Overview of emissions in the category 2H*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH$_3$ [kt]	PM$_{2.5}$ [kt]	PM$_{10}$ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0002	0.8344	0.0000	0.0018	0.0183	0.0682	0.1673	0.0005	0.0000
1995	0.0003	2.1188	0.0000	0.0021	0.0291	0.1089	0.2671	0.0007	0.0000
2000	0.0001	3.3908	0.0000	0.0059	0.0389	0.1454	0.3565	0.0010	0.0000
2005	0.0007	4.3544	0.0000	0.0000	0.0547	0.2133	0.5295	0.0013	0.0001
2010	0.0001	3.7341	0.0000	0.0000	0.0146	0.0545	0.1336	0.0003	0.0001
2011	0.0002	3.8948	0.0000	0.0000	0.0265	0.1020	0.2525	0.0006	0.0001
2012	0.0003	3.5193	0.0000	0.0000	0.0232	0.0897	0.2223	0.0005	0.0001

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2013	0.0001	4.1994	0.0000	0.0000	0.0305	0.1189	0.2953	0.0007	0.0001
2014	0.0009	4.4347	0.0012	0.0000	0.0171	0.0655	0.1617	0.0004	0.0000
2015	0.0014	4.0806	0.0020	0.0000	0.0102	0.0377	0.0923	0.0002	0.0001
2016	0.0021	4.3466	0.0030	0.0000	0.0095	0.0342	0.0832	0.0002	0.0014
2017	0.0021	4.3741	0.0030	0.0000	0.0106	0.0384	0.0935	0.0002	NO
2018	0.0021	4.0572	0.0031	0.0000	0.0101	0.0363	0.0883	0.0002	NO
2019	0.0021	4.1997	0.0030	0.0000	0.0095	0.0337	0.0859	0.0002	NO
2020	0.0014	3.9757	0.0020	0.0000	0.0129	0.0477	0.1167	0.0003	NO
2021	0.0007	4.2102	0.0011	0.0000	0.0134	0.0496	0.1215	0.0003	NO
2022	0.0024	4.1939	0.0035	0.0000	0.0120	0.0440	0.1075	0.0002	NO
1990/2022	**875%**	**403%**	**99843%**	**-98%**	**-34%**	**-36%**	**-36%**	**-51%**	-
2021/2022	**228%**	**0%**	**228%**	**52%**	**-10%**	**-11%**	**-12%**	**-22%**	-

Shares of NOx, NMVOC, SOx, NH_3 and $PM_{2.5}$ emissions in 2022 included in NFR categories are shown in ***Figure 4.7***.

Figure 4.7: *Shares of emissions in 2H in 2022*



4.8.1 Pulp and paper industry (NFR 2H1)

4.8.1.1 Overview

Pulp and paper production consists of three major processing steps: pulping, bleaching and paper production. The type of pulping and the amount of bleaching used depends on the nature of the feedstock and the desired qualities of the end product.

Several companies were operating during the year 2022 in the pulp and paper industry in the Slovak Republic. Among them only one is categorized as a medium source, the rest are large sources. In ***Table 4.102*** can be seen that emissions of all pollutants decreased in general since the year 1990.

Table 4.102: Activity data and emissions in the category 2H1

YEAR	PULP PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	179.23	0.0175	0.0654	0.1604	0.0005
1995	283.87	0.0277	0.1036	0.2541	0.0007
2000	388.64	0.0383	0.1431	0.3508	0.0010
2005	492.58	0.0518	0.2019	0.5012	0.0013
2010	592.09	0.0120	0.0447	0.1094	0.0003
2011	622.76	0.0234	0.0901	0.2231	0.0006
2012	635.18	0.0204	0.0790	0.1959	0.0005
2013	637.44	0.0276	0.1077	0.2675	0.0007
2014	649.37	0.0137	0.0524	0.1294	0.0004
2015	691.78	0.0069	0.0250	0.0609	0.0002
2016	680.46	0.0064	0.0230	0.0557	0.0002
2017	692.87	0.0076	0.0274	0.0666	0.0002
2018	666.82	0.0071	0.0255	0.0618	0.0002
2019	636.44	0.0067	0.0241	0.0583	0.0002
2020	713.39	0.0102	0.0377	0.0921	0.0003
2021	765.02	0.0109	0.0409	0.1004	0.0003
2022	721.28	0.0085	0.0313	0.0764	0.0002
1990/2022	**302%**	**-51%**	**-52%**	**-52%**	**-51%**
2021/2022	**-6%**	**-22%**	**-23%**	**-24%**	**-22%**

4.8.1.2 Methodological issues

Activities assigned in this category are listed in ***Table 4.103***.

Table 4.103: Activities according to national categorization included in 2H1

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.18 Manufacture of pulp and derivatives thereof, including the treatment of waste to products of this manufacture
4.36 Production and refinement of paper, and cardboard with projected output in t/d

Emission data is compiled in the NEIS database, therefore, the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and the detailed methodology of the NEIS are presented in **ANNEX IV.** The following table presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.
Historical years from 1990-1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009. The emission of BC was calculated using the Tier 1 emission factor from EMEP/EEA GB_{2023} (***Table 4.104***).

Table 4.104: Emission factors for calculation of historical years and BC in 2H1

	$PM_{2.5}$ %TSP	PM_{10} %TSP	TSP [g/t]	BC %$PM_{2.5}$
EF	11%	41%	895.06	2.60%

4.8.1.3 Completeness

Heavy metals, PCDD/F and HCB are reported with notation key NA, other POPs are reported using notation key NE in complying with the EMEP/EEA GB_{2023}. Combustion emissions (NOx, NMVOC, SOx, NH_3, CO) were allocated to the category **1A2d**, therefore, notation key IE was used.

4.8.1.4 Source-specific recalculations

No recalculation was made.

4.8.2 Food and beverages industry (NFR 2H2)

4.8.2.1 Overview

Food manufacturing may involve the heating of fats and oils and foodstuffs containing them, the baking of cereals, flour and beans, fermentation in the making of bread, the cooking of vegetables and meats, and the drying of residues. These processes may occur in sources varying in size from domestic households to manufacturing plants.

Alcoholic beverage is produced by the fermentation of sugar, which comes from fruit, cereals or other vegetables. Sugar is converted by yeast into ethanol. Before fermentation, materials are specifically processed, for example, in the manufacture of beer, cereals are allowed to germinate, then roasted and boiled before fermentation. To make spirits, the fermented liquid is then distilled. Alcoholic beverages, particularly spirits and wine, may be stored for many years before consumption.

Emissions from this combustion were reported in category **1A2e**. In this category, only process emissions were reported (***Table 4.105***).

Table 4.105: *Activity data and emissions in the category 2H2*

YEAR	BREAD TYPICAL EUROPE [kt]	WHITE BREAD [kt]	CAKES, BISCUITS AND BREAKFAST CEREALS [kt]	MEAT, FISH AND POULTRY [kt]	SUGAR [kt]	MARGARINE ADN SOLID COOKING FATS [kt]	ANIMAL FEED [kt]	COFEE ROASTING [kt]
1990	20.78	0.69	15.34	27.70	27.31	3.23	89.05	0.54
1995	53.57	1.77	39.54	71.42	70.41	8.34	229.57	1.39
2000	86.40	2.85	63.77	115.18	113.55	13.45	370.24	2.25
2005	110.04	3.63	81.22	146.71	144.63	17.13	471.57	6.58
2010	99.62	2.60	69.63	147.54	148.34	8.86	136.37	1.90
2011	95.83	2.81	71.78	137.07	177.92	8.20	110.75	2.10
2012	93.42	2.74	66.94	120.52	138.43	7.17	170.19	2.20
2013	89.11	2.60	67.57	105.81	176.89	15.06	252.29	2.01
2014	91.30	2.60	65.22	105.81	199.58	13.89	214.47	2.03
2015	89.74	2.62	72.28	111.79	171.19	13.55	234.04	2.23
2016	87.18	2.88	39.10	125.36	197.12	13.92	213.44	2.35
2017	87.61	2.63	40.60	152.41	187.72	14.02	272.23	2.50
2018	83.71	2.56	38.44	171.34	150.28	13.59	257.50	2.22
2019	84.98	2.50	34.89	167.77	155.77	14.01	282.46	2.43
2020	86.05	1.77	31.32	152.22	148.80	13.88	281.11	2.29
2021	83.50	1.36	52.06	162.62	158.67	13.71	220.44	2.45
2022	85.57	9.05	66.44	167.19	141.53	12.04	260.17	2.53
1990/2022	**312%**	**1219%**	**333%**	**504%**	**418%**	**272%**	**192%**	**367%**
2021/2022	**2%**	**566%**	**28%**	**3%**	**-11%**	**-12%**	**18%**	**3%**

YEAR	WINE UNSPECIFIED COLOUR [10^3hl]	BEER INCLUDING DE-ALCOHOLIZIED [10^3hl]	SPIRITS UNSPECIFIED SORT [10^3hl]	OTHER SPIRITS [10^3hl]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	73.08	732.38	17.39	11.12	0.8118	0.0004	0.0014	0.0035
1995	188.41	1 888.14	44.84	28.67	2.0930	0.0009	0.0036	0.0091
2000	303.86	3 045.16	72.32	46.23	3.3755	0.0005	0.0018	0.0045
2005	387.02	3 878.63	92.11	58.88	4.3014	0.0021	0.0083	0.0209
2010	442.22	3 001.63	79.58	57.95	3.6406	0.0014	0.0057	0.0142
2011	495.60	2 973.17	78.00	61.24	3.8681	0.0015	0.0060	0.0149
2012	371.90	2 998.38	77.76	51.89	3.4852	0.0012	0.0049	0.0121
2013	416.13	2 961.11	88.83	46.12	4.1727	0.0016	0.0065	0.0162
2014	384.41	2 727.39	92.62	45.63	4.4035	0.0018	0.0073	0.0181

YEAR	WINE UNSPECIFIED COLOUR [10^3hl]	BEER INCLUDING DE-ALCOHOLIZIED [10^3hl]	SPIRITS UNSPECIFIED SORT [10^3hl]	OTHER SPIRITS [10^3hl]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
2015	358.58	2 491.48	87.08	52.08	4.0470	0.0020	0.0079	0.0198
2016	364.68	2 283.41	91.54	51.67	4.3099	0.0017	0.0069	0.0173
2017	414.76	2 399.34	94.51	78.75	4.3497	0.0020	0.0079	0.0197
2018	370.11	2 092.58	101.59	79.68	4.0342	0.0020	0.0080	0.0200
2019	395.06	2 017.91	105.17	79.97	4.1722	0.0016	0.0064	0.0199
2020	423.99	2 501.31	94.58	66.76	3.9481	0.0018	0.0073	0.0182
2021	361.34	2 270.48	107.15	83.41	4.1774	0.0015	0.0059	0.0147
2022	357.34	2 361.28	111.98	83.80	4.1641	0.0025	0.0100	0.0249
1990/2022	**389%**	**222%**	**544%**	**654%**	**413%**	**605%**	**605%**	**605%**
2021/2022	**-1%**	**4%**	**5%**	**0%**	**0%**	**69%**	**69%**	**69%**

4.8.2.2 Methodological issues

Emissions were calculated using Tier 2 emission factors from the EMEP/EEA GB_{2023}. Activity data were obtained from the national PRODCOM database and Import/export statistics for the period 2005-2022. Historical data were extrapolated using GDP as surrogate data.

Emission data of PMS was compiled in the NEIS database, therefore, the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and the detailed methodology of the NEIS are presented in **ANNEX IV**. The following table presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Historical years from 1990-1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009. The emission of BC was calculated using the Tier 1 emission factor from EMEP/EEA GB_{2023} (***Table 4.106***).

Table 4.106: *Emission factors for calculation of NMVOC in the category 2H2*

	NMVOC [kg/t] [kg/hl]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	TSP [g/t]
Bread typical Europe	4.5	10.00%	40.00%	19.94
White bread	4.5			
Cakes, biscuits and breakfast cereals	1			
Meat, fish and poultry	0.3			
Sugar	10			
Margarine and solid cooking fats	10			
Animal feed	1			
Coffee roasting	0.55			
Wine unspecified colour	0.08			
Beer including de-alcoholized	0.035			
Spirits unspecified sort	15			
Other spirits	0.4			

4.8.2.3 Completeness

All rising pollutants were reported. Notation keys were used following EMEP/EEA GB_{2023}.

4.8.2.4 Source-specific recalculations

Recalculations were made due to the completion of activity data, few updates and minor errors in calculation. Minor changes were made by correction of activity data for year 2021 in cereals from statistic. Updated value of margarins and cooking fats was obtained for the year 2021 from statistics. Updated value was used for

roasting of coffee in year 2021 according statistics and extrapolated of historical data using GDP as surrogate data. Poultry meat activity data were supplemented in timeline except years 2015, 2016, 2020, 2021. More visible change is in spirits where activity data were corrected in units and data were completed throughout the timeline. As well as for wine unspecified and beer. The changes are shown in the following table.

Table 4.107: *Previous and revised activity data and emissions in the category 2H2*

YEARS	AD – FOOD PRODUCED [kt]			NMVOC [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	177.08	403.52	128%	0.52	0.81	56%
1995	456.53	1040.30	128%	1.34	2.09	56%
2000	736.29	1677.77	128%	2.16	3.38	56%
2005	937.81	2140.70	128%	2.75	4.30	57%
2010	577.45	1592.92	176%	2.30	3.64	58%
2011	561.15	1574.86	181%	2.54	3.87	52%
2012	558.09	1557.39	179%	2.18	3.49	60%
2013	666.37	1754.52	163%	2.70	4.17	54%
2014	648.65	1741.39	168%	2.89	4.40	52%
2015	697.44	1674.69	140%	2.63	4.05	54%
2016	681.35	1673.57	146%	2.83	4.31	52%
2017	760.90	1794.72	136%	2.81	4.35	55%
2018	695.59	1775.45	155%	2.39	4.03	69%
2019	745.09	1823.86	145%	2.48	4.17	68%
2020	767.29	1762.85	130%	2.46	3.95	61%
2021	793.21	1811.77	128%	2.55	4.18	64%

4.8.3 Other industrial processes (NFR 2H3)

4.8.3.1 Overview

This category includes various sources such as body shops, grain silos, galvanic lines etc. ***Table 4.108*** shows the emission trend in this category. Most of the emissions show an increasing trend, but this category is not significant for emission totals in the Slovak Republic. The significant increase in emissions of NH_3 in 2021 was caused by a new source –the fermentation hall for biodegradable waste, which started operation in 2021.

Table 4.108: *Overview of emissions in the category 2H3*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0002	0.0225	0.0000	0.0018	0.0004	0.0014	0.0034	0.0000
1995	0.0003	0.0258	0.0000	0.0021	0.0005	0.0016	0.0039	0.0000
2000	0.0001	0.0153	0.0000	0.0059	0.0001	0.0005	0.0012	0.0000
2005	0.0007	0.0530	0.0000	0.0000	0.0008	0.0030	0.0074	0.0001
2010	0.0001	0.0935	0.0000	0.0000	0.0012	0.0041	0.0100	0.0001
2011	0.0002	0.0268	0.0000	0.0000	0.0017	0.0059	0.0145	0.0001
2012	0.0003	0.0341	0.0000	0.0000	0.0016	0.0059	0.0143	0.0001
2013	0.0001	0.0267	0.0000	0.0000	0.0013	0.0048	0.0116	0.0001
2014	0.0009	0.0312	0.0012	0.0000	0.0016	0.0058	0.0142	0.0000
2015	0.0014	0.0336	0.0020	0.0000	0.0014	0.0048	0.0116	0.0001
2016	0.0021	0.0367	0.0030	0.0000	0.0014	0.0043	0.0102	0.0014
2017	0.0021	0.0243	0.0030	0.0000	0.0010	0.0031	0.0073	NO
2018	0.0021	0.0231	0.0031	0.0000	0.0010	0.0028	0.0065	NO
2019	0.0021	0.0275	0.0030	0.0000	0.0011	0.0033	0.0076	NO
2020	0.0014	0.0275	0.0020	0.0000	0.0009	0.0027	0.0064	NO
2021	0.0007	0.0328	0.0011	0.0000	0.0010	0.0028	0.0064	NO
2022	0.0024	0.0298	0.0035	0.0000	0.0010	0.0027	0.0062	NO

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990/2022	875%	32%	99843%	-98%	145%	95%	84%	-
2021/2022	228%	-9%	228%	52%	1%	-2%	-3%	-

4.8.3.2 Methodological issues

Activities listed in ***Table 4.109*** were reported in this category.

Table 4.109: *Activities according to national categorization included in 2H3*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	
5.99	Other plants and technologies of waste treatment
6.99	Other industrial technologies, manufacturing, and processing equipment not specified in points 1 to 5

Total category emissions represent a negligible part of national totals of emissions (less than 0.05% for every emission). Method and activity data won't be further investigated. Historical data from 1990-1999 were calculated using a weighted average of implied emission factors for the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009 (***Table 4.110***). Activity data for the calculation of implied emission factors are the total energy used in this category.

Table 4.110: *Emission factors for calculation of historical years 2H3*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	$PM_{2.5}$ %TSP	PM_{10} %TSP	TSP [g/GJ]	CO [g/GJ]
EF	441.18	40 599.77	6.23	3 314.83	12%	41%	6 090.68	73.27

4.8.3.3 Completeness

Notation keys are reported in compliance with the EMEP/EEA GB_{2023}. The notation key for the CO in the period 2017-2022 is NO.

4.8.31.4 Source-specific recalculations

No recalculation was made. However, there is a negligible change (less than 1%) due to the rounding in calculations for the year 1999 for all reported emissions.

4.9 WOOD PROCESSING (NFR 2I)

4.9.1 Overview

The present chapter addresses emissions of dust from the processing of wood. This includes the manufacture of plywood, reconstituted wood products and engineered wood products. This source category is only important for particulate emissions.

Emission trends in this category, where emissions decrease in general. An overview of emissions and their trends are presented in ***Table 4.111***.

Table 4.111: *Overview of emissions in the category 2I*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.3117	0.2996	0.0023	0.0026	0.0492	0.1962	0.4900	0.3966
1995	0.3017	0.2901	0.0022	0.0025	0.0477	0.1899	0.4744	0.3840
2000	0.2549	0.1294	0.0016	0.0006	0.0747	0.1865	0.4660	0.2749
2005	0.3207	0.4017	0.0018	0.0058	0.0306	0.1213	0.3026	0.4673
2010	0.0759	0.2189	0.0025	0.0002	0.0104	0.0382	0.0939	0.3387
2011	0.1658	0.2091	0.0023	NO	0.0075	0.0300	0.0751	0.0925
2012	0.1614	0.1947	0.0022	NO	0.0081	0.0323	0.0808	0.0924
2013	0.1167	0.1756	0.0011	NO	0.0066	0.0262	0.0656	0.0761

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2014	0.5389	0.3945	0.0000	0.0001	0.0071	0.0285	0.0713	0.4715
2015	0.2167	0.5026	0.0000	0.0083	0.0045	0.0178	0.0446	0.4119
2016	0.1600	0.2590	0.0000	0.0083	0.0044	0.0175	0.0437	0.1440
2017	0.2112	0.5449	0.0000	0.0093	0.0041	0.0165	0.0412	0.2100
2018	0.3401	0.7039	0.0000	0.0096	0.0038	0.0152	0.0379	0.3539
2019	0.3445	0.5681	0.0001	0.0082	0.0040	0.0160	0.0399	0.3448
2020	0.2344	0.5166	0.0001	0.0002	0.0045	0.0180	0.0450	0.2705
2021	0.2709	0.7482	0.0001	0.0002	0.0052	0.0207	0.0518	0.4497
2022	0.2151	0.6291	0.0002	0.0030	0.0055	0.0220	0.0549	0.3439
1990/2022	**-31%**	**110%**	**-92%**	**18%**	**-89%**	**-89%**	**-89%**	**-13%**
2021/2022	**-21%**	**-16%**	**42%**	**1342%**	**6%**	**6%**	**6%**	**-24%**

4.9.2 Methodological issues

The definition of activities covered by category **2I** is provided in ***Table 4.112***. The activity is involved in **2D3d**, where only VOC is balanced. Other rising emissions (NOx, SOx, NMVOC, NH_3, TSP, $PM_{2.5}$, PM_{10}, CO) are reported here.

Table 4.112: *Activities according to national categorization included in 2I*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.9 Industrial wood processing:
a) mechanical processing of wooden lumps with projected processing capacity in v m^3/day
b) mechanical processing of disintegrated wooden mass such as sawdust, shavings, and chips with a projected processing capacity in v m^3/day
c) production of agglomerated materials with projected consumption of polycondensed adhesives in t of dry matter/year
Processing and surface treatment using organic solvents including associated activities, such as deburring, according to a projected consumption of organic solvents in tonnes/year:
a) adhesive application
b) wood and plastic lamination
c) coating application
d) impregnation

Historical years from 1990-1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Shares of $PM_{2.5}$ and PM_{10} in TSP are calculated using average shares from the period 2005-2009 (***Table 4.113***). Activity data for the calculation of implied emission factors is the total energy used in this category.

Table 4.113: *Emission factors for calculation of historical years in 2I*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	$PM_{2.5}$ %TSP	PM_{10} %TSP	TSP [g/GJ]	CO [g/GJ]
EF	533 488.04	512 899.12	3 938.45	4 388.26	10%	40%	838 858.63	678 981.14

4.9.3 Completeness

Notation keys are reported in compliance with the EMEP/EEA GB_{2023}.

4.9.4 Source-specific recalculations

No recalculation was made.

4.10 PRODUCTION OF POPS (NFR 2J)

4.10.1 Overview

This activity is not occurring in the Slovak Republic, therefore notation key NO was used.

4.11 CONSUMTION OF POPS AND HEAVY METALS (NFR 2K)

4.11.1 Overview

The present chapter deals with emissions from the consumption of POPs and heavy metals. These are used in e.g. refrigerators, air conditioning equipment and electrical equipment. Category reports the emissions of Hg and PCBs. The trend of emissions and activity data are presented in ***Table 4.114***.

Table 4.114: *Activity data and emissions in the category 2K*

YEAR	INHABITANTS	Hg [t]	PCBs [kg]
1990	5 297 774	0.0530	0.5298
1995	5 363 676	0.0536	0.5364
2000	5 400 679	0.0540	0.5401
2005	5 387 285	0.0539	0.5387
2010	5 431 024	0.0543	0.5431
2011	5 394 251	0.0539	0.5394
2012	5 407 579	0.0541	0.5408
2013	5 413 393	0.0541	0.5413
2014	5 418 649	0.0542	0.5419
2015	5 423 800	0.0542	0.5424
2016	5 430 798	0.0543	0.5431
2017	5 437 754	0.0544	0.5438
2018	5 446 771	0.0545	0.5447
2019	5 454 147	0.0545	0.5454
2020	5 458 827	0.0546	0.5459
2021	5 441 991	0.0544	0.5442
2022	5 431 026	0.0543	0.5431
1990/2022	**3%**	**3%**	**3%**
2021/2022	**0%**	**0%**	**0%**

4.11.2 Methodological issues

Emission of Hg and PCB are calculated by the Tier 1 method according to EMEP/EEA GB$_{2019}$. Activity data were obtained from the ŠÚ SR – number national population - Mid-year population.

$$E = Inhabitants * EF_{Default}$$

Other pollutants (NO_X, NMVOC, SO_X, NH_3, PMs, TSP, BC, CO, POPs) are reported in compliance with EMEP/EEA Guidebook with notation key NA, as well as fuels, and with notation key NE for heavy metals and HCB.
A simple equation was needed to balance the emissions of Hg and PCBs from this source category:

$$E = EF\ GB_{2023} \times AD(\text{ŠÚ}\ SR)$$

The emission factors used for the calculation are shown in ***Table 4.115***.

Table 4.115: *Emission factors in the category 2K*

	Hg [g/capita]	PCBs [g/capita]
EF	0.01	0.1

4.11.3 Completeness

Notation keys were used in compliance with the EMEP/EEA GB$_{2023}$.

4.11.4 Source-specific recalculations

No recalculations in this submission.

4.12 OTHER PRODUCTION, CONSUMPTION, STORAGE, TRANSPORTATION OR HANDLING OF BULK PRODUCTS (NFR 2L)

4.12.1 Overview

The category is reported with notation key NO. This production is not occurring in the Slovak Republic.

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Last update: 15.3.2024

This chapter was prepared by the sectoral expert involved in the National Inventory System of the Slovak Republic:

INSTITUTE	CHAPTER	SECTORAL EXPERT
SLOVAK HYDROMETEOROLOGICAL INSTITUTE	ALL CHAPTERS	KRISTÍNA TONHAUZER

The anthropogenic activities in the agriculture sector significantly contribute to the concentration changes of some gases in the atmosphere. Ammonia emitted from agriculture is considered the most relevant gas from planning abatements to reduce their influence on the environment. Sources of ammonia (NH_3), particulate matter (PM), total suspended particulate (TSP), the non-methane volatile organic compound (NMVOC) and nitrogen oxides (NOx) emissions are analysed according to the EMEP/EEA GB_{2023} when principles of good practice in agriculture are taken into account. The emissions of NH_3, NOx, PM, TSP, and NMVOC can be reduced if effective measures are implemented in agricultural practice. The abatements were implemented for the conditions of the Slovak Republic. The absence of sufficient data about the storage and application of manure resulted in the fact that the emissions were evaluated in the same way as usual. Slovak agricultural inventory takes advantage of parallel inventory preparation and reporting of greenhouse gases (GHG) and air pollutants ensuring efficiency and consistency in the compilation of emission inventories because of a wide range of substances using common datasets and inputs. Therefore, a link is established between the NH_3, NOx and N_2O emission estimates following the N-flow concepts in the agricultural emission inventories. Consequently, consistency between the two inventories is a principle of the emission estimate.

The emissions balance is compiled annually based on sectoral statistics and in recent years based on the regionalisation of agricultural areas in the Slovak Republic. The Ministry of Agriculture and Rural Development of the Slovak Republic publishes annual statistics in the Green Report 2023, part agriculture and food. Activity data are also available in the Statistical Yearbooks. Sector Agriculture is prepared in cooperation with the National Agricultural and Food Centre - the Research Institute for Animal Production in Nitra (NPPC - VÚŽV). The NPPC - VÚŽV provided activity data and parameters, improved the methodology and ensured QA/QC activities in animal inventory in categories **3B** and **3D**. Activity data on the number of livestock and animal productions are provided annually by the Statistical Office of the Slovak Republic (ŠU SR). The Central Control and Testing Institute in Agriculture (UKSÚP) provided the soil data to the SHMÚ annually, based on the cooperation agreement between both institutions.

5.1 OVERVIEW OF THE SECTOR AGRICULTURE

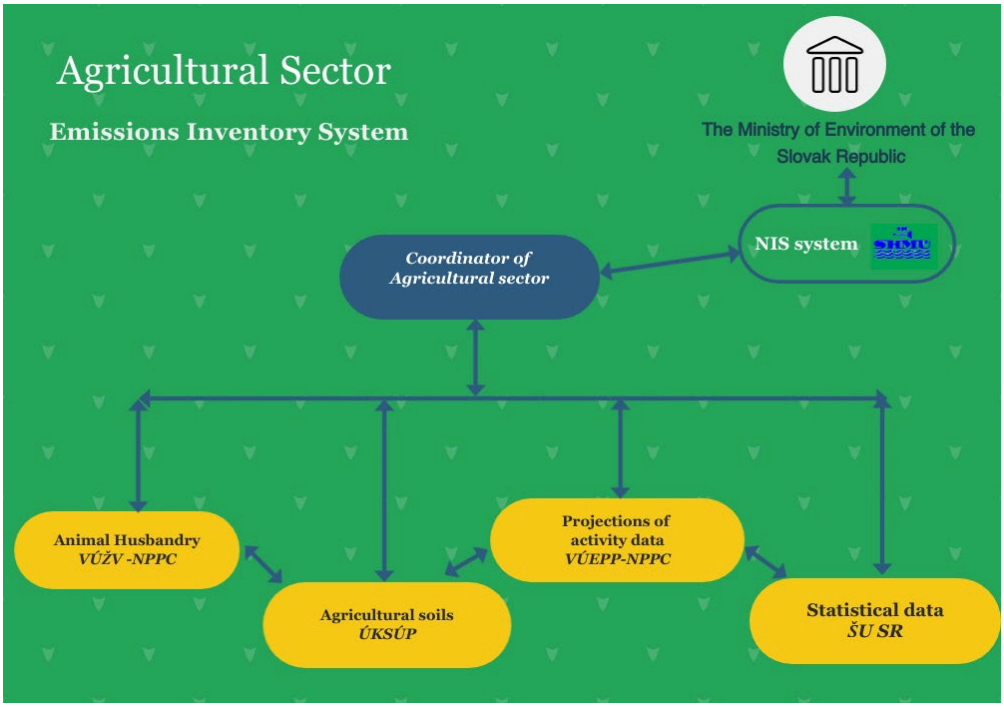
Agriculture, according to preliminary data, achieved a positive financial result before taxation in the year 2022, The Sector in 2022 was very successful with total profit of approximately €347 million. Compared to 2021, its value almost doubled. In comparison with the five-year average for the years 2017-2021, the financial result for the year 2022 was almost three times higher, primarily influenced by a significant increase in revenues from the sale of own products of animal origin (+22.5%) and plant origin (+16.0%). Revenues from the sale of own products accounted for an average of 56% of the total revenues of agricultural primary production enterprises. The subsidies from the Common Agricultural Policies (CAP) a significant role in the economy of agricultural enterprises, without which the majority of businesses would operate at a loss. The overall volume of financial support to Slovak agriculture decreased by 7.5% year-on-year, amounting to €737 million, of which 57% was provided from EU funds. The proportion of total support to revenues within agriculture decreased annually to 17.5%, with direct payments accounting for 6.6% of that.

Crop production had the continuing dominant share in the economy compared to animal production (60% to 40%). Decrease in the production of most commodities of crop production mainly due to the decrease in harvesting areas and the decrease or stagnation of harvests per hectare, except for sunflower, soybean, sugar

beet, fruit and vegetables. The number of livestock decreased in all species with an impacts decrease of animal products except slaughter poultry (1.8%), cattle (9.8%) and pigs (3.9%) (Green Report 2023).

The emissions inventory in agriculture is prepared in cooperation with the National Agricultural and Food Centre - the Research Institute for Animal Production in Nitra (the NPPC - VÚŽV). The NPPC - VÚŽV provided activity data and parameters, improved the methodology and ensured QA/QC activities in animal inventory in the NFR categories ***3B*** and ***3D***. Activity data on the number of livestock and animal productions are provided annually by the Statistical Office of the Slovak Republic (ŠU SR). The Central Control and Testing Institute in Agriculture (UKSÚP) provided the soil data to the SHMÚ annually, based on the cooperation agreement between both institutions. Emission Inventory System in the Slovak ***Agriculture sector*** is described in ***Figure 5.1***. In 2022, Submission, the mitigation measures were included repeatedly in the emission inventory. The information on mitigation measures was available from 2006. More information is available in **Chapter 5.9.4** and **ANNEX VI**.

Figure 5.1: *Emission Inventory System in the Slovak Agriculture sector*



Slovak farmers adapted to changes in Agriculture after 1990. They invested in the development of their farms to avoid bankruptcy, and to be self-competitiveness in this sector. The EU policy supported the used tools as the base of transformation. The EU policy and measures transformed into the Slovak legal system. Farmers had to follow new strict criteria like more balanced feeding rations changing of housing systems, and new storage capacity for organic waste, which was supported by Decree No 410/2012 Coll. and Nitrates Directive and subsidies from the Common agriculture policies.[1]

Table 5.1: *Overview of the GHG gases and Tiers reported in the Agriculture sector according to the CRF categories in 2022*

CATEGORY (CODE AND NAME)	TIER/POLLUTANTS
3B1a Dairy cattle	NH_3-T3, NOx-T2, PM-T1, NMVOC-T2, TSP-T1
3B1b Non-dairy cattle	NH_3-T3, NOx-T2, PM-T1, NMVOC-T2, TSP-T1
3B2 Sheep	NH_3-T3, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B3 Swine	NH_3-T3, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4d Goats	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1

[1] http://www.mpsr.sk/index.php?start&navID=78&id=1325%20 (in Slovak)

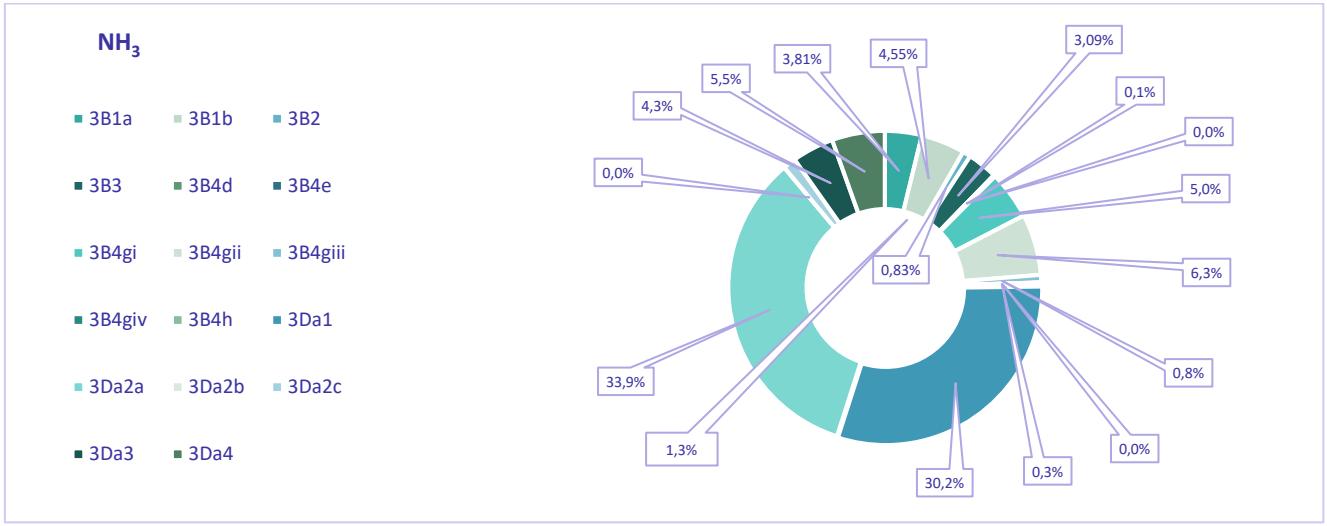
CATEGORY (CODE AND NAME)	TIER/POLLUTANTS
3B4e Horses	NH_3-T3, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4gi Laying hens	NH_3-T3, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4gii Broilers	NH_3-T3, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4giii Turkeys	NH_3-T3, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4giv Other poultry	NH_3-T3, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4h Other animals - Rabbits	NH_3-T1, NOx-T1,PM-T1, NMVOC-T1, TSP-T1
3Da1 Inorganic N-fertilizers	NH_3-T2,NOx-T1
3Da2 Animal manure applied to the soil	NH_3-T3, NMVOC-T2,NOx-T2
3Da3 Urine and dung deposited by grazing animals	NH_3-T2, NMVOC-T2, NOx-T2
3Da4 Crop residues applied to soils	NH_3-T1
3Dc Farm-level agricultural operations including storage, handling, and transport of agricultural products	PMs-T2, TSP-T1
3De Cultivated Crops	NMVOC-T1

5.2 EMISSION TRENDS

5.2.1 Ammonia (NH_3)

Sector agriculture is a dominant contributor to NH_3 emissions, with a share of 83.8% of the national total in 2022. The largest share of ammonia emissions was generated by **3D** Agricultural soils, which produced 16.77kt (76%) of NH_3 within the sector in 2022. The significant source of NH_3 emissions is the Inorganic N-fertilizers with a share of 35%, followed by the Animal manure applied to soils category representing 34% of the total NH_3 emissions. Emissions from **3B1** Cattle, **3B3** Swine and **3B2** Sheep produced 3.30kt of NH_3 (15%) in the sector in 2022. ***Figure 5.2*** shows the distribution of significant categories of ammonia from agriculture for 2022.

Figure 5.2: *NH_3 emissions per subsectors in %*



Agricultural NH_3 emissions have decreased by 60% since 1990, and 8% compared to the previous year (***Table 5.2*** and ***Figure 5.3***). The main drivers of this drop were the significant decrease in the emissions in manure management, due to the dramatic reduction in livestock population. More information on the reduction of the number of livestock is available in **Chapter 5.8.3**. In addition, ammonia abatement measures implemented since 2006 made complementary emission reductions. More information is available in **ANNEX VI**. The emission from agricultural soils had the continuing dominant share compared to emissions from animal production (76% to 24%), which correlated with the overall economic and production situation in the agricultural sector.

Figure 5.3: *NH_3 emission trend by sectors*

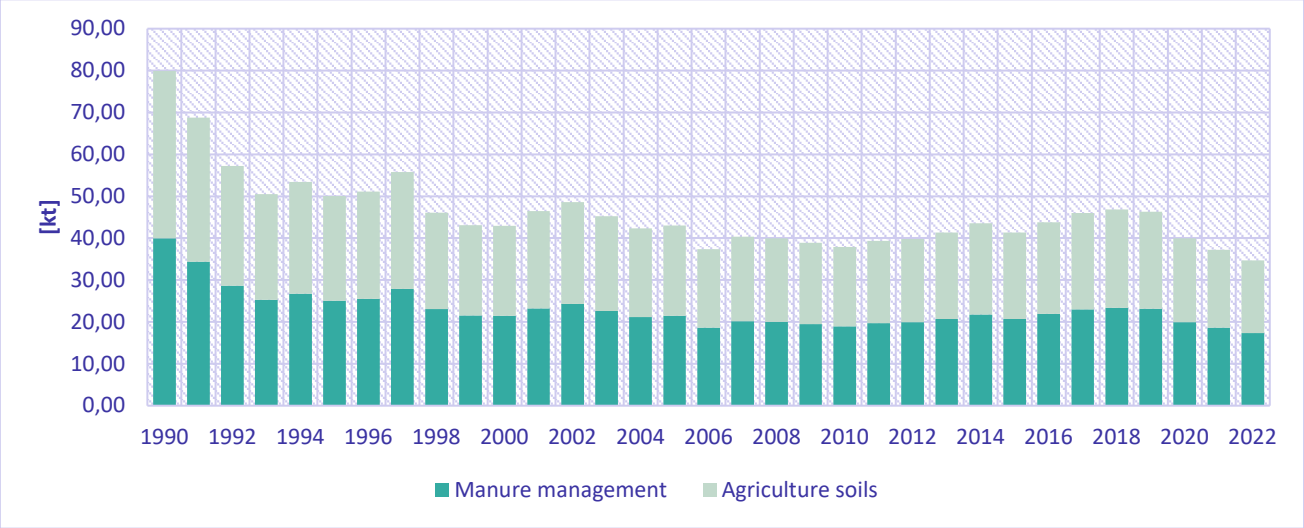


Table 5.2: *NH_3 emission time-series by sub-sectors in kt*

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	16.76	39.96	56.72
1995	11.88	25.04	36.92
2000	10.16	21.46	31.62
2005	9.14	21.50	30.64
2010	7.71	18.93	26.64
2011	7.14	19.69	26.84
2012	7.40	19.91	27.32
2013	7.09	20.67	27.76
2014	7.42	21.78	29.21
2015	7.48	20.67	28.15
2016	7.05	21.89	28.94
2017	7.26	23.02	30.27
2018	7.63	23.41	31.04
2019	7.22	23.16	30.39
2020	6.26	19.96	26.22
2021	5.77	18.61	24.38
2022	5.72	17.35	23.07
1990/2022	**-66%**	**-57%**	**-59%**
2005/2022	**-37%**	**-19%**	**-25%**

5.2.2 Particulate Matters

In 2022, agriculture accounted for 1.5% (0.30 kt) of $PM_{2.5}$, 15% (3.49 kt) of PM_{10} and 12.4% (3.7 kt) of the national total, TSP emissions. The Agriculture sector is no key source of particulate matter. The contribution of the **3Dc** was 13% (2.8 kt) to the total PM_{10} emissions from the sector.

$PM_{2.5}$, PM_{10}, and TSP emissions from agriculture have decreased in the 2005-2022 period (***Table 5.4*** and ***Figure 5.5***) as a result of the decreasing emissions from **3B** Manure management and decreasing partial emissions from **3D** Agricultural Soils. In 3D Agricultural Soils is visible increase of emissions due to increase sowing areas of oil plants and wheat. Overall trend of PM_{10} emissions from Agriculture are shown in ***Figure 5.4***.

Figure 5.4: *PM_{10} emission trends by sectors*

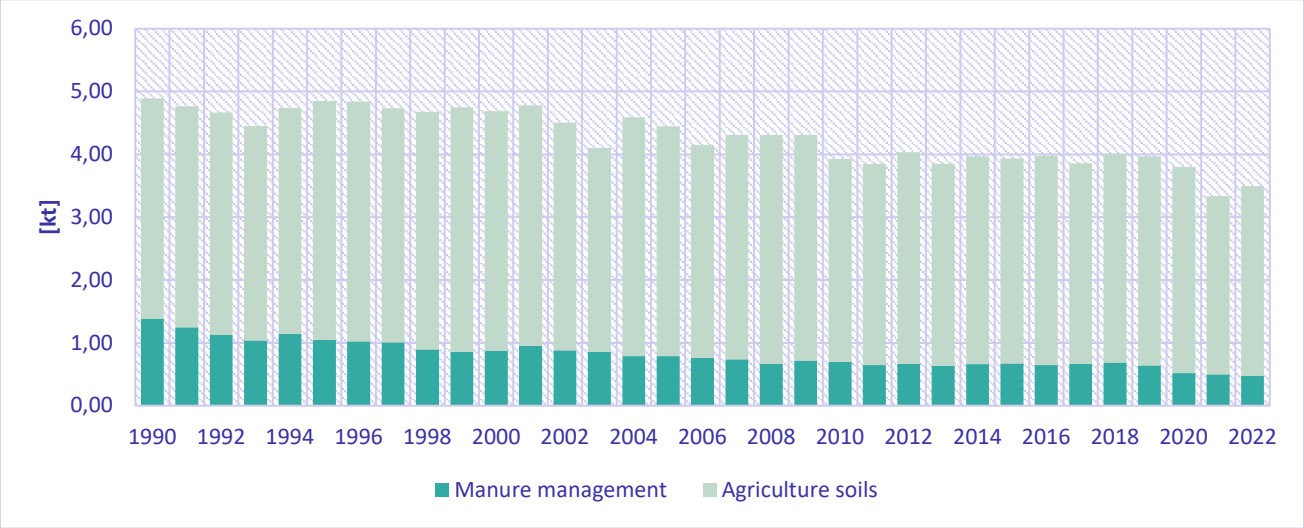


Figure 5.5: *$PM_{2.5}$ emission trends by sectors*

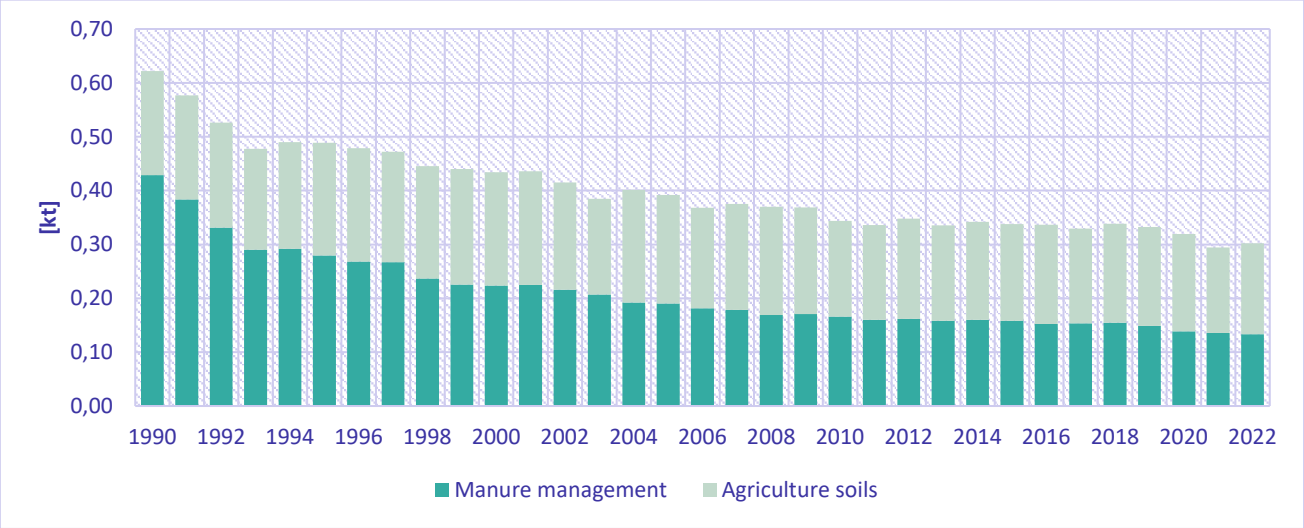


Table 5.3: *TSP emission time-series by sub-sectors in kt*

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	4.784	2.414	7.198
1995	3.839	2.580	6.419
2000	3.040	2.728	5.768
2005	2.728	2.733	5.461
2010	2.469	2.639	5.108
2011	2.303	2.598	4.902
2012	2.378	2.617	4.995
2013	2.243	2.592	4.836
2014	2.302	2.608	4.910
2015	2.370	2.583	4.953
2016	2.276	2.606	4.882
2017	2.312	2.603	4.915
2018	2.394	2.636	5.029
2019	2.213	2.609	4.822
2020	1.701	2.605	4.306

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
2021	1.623	2.024	3.647
2022	1.561	2.097	3.658
1990/2022	**-67%**	**-13%**	**-49%**
2005/2022	**-43%**	**-23%**	**-33%**

5.2.3 Non-methane volatile organic compounds (NMVOC)

In 2022, Agricultural NMVOC emissions consisted of 5.79 kt and 6.9% share of the national total (***Table 5.4***). The primary agricultural source of MNVOC emissions is the **3B** Manure management accounting for 6.7% of national total NMVOC emission (5.79 kt). NMVOC emissions from animal husbandry mainly originate from silage feeding and partly digested fat, carbohydrate and protein decomposition in the rumen and the manure. Consequently, Cattle farming is the most important source of agricultural NMVOC emissions (70%), while cultivated crops were an insignificant source with a share of 0.1% of total NMVOC emissions in 2022. NMVOC emissions have decreased by 73.5% over the period 1990-2022, as a result of the dropping of animal livestock and implemented mitigation measures in ammonia emissions after 2006.

5.4 Table: *NMVOC emission time-series by sub-sectors in kt*

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	22.168	0.137	22.305
1995	12.519	0.146	12.665
2000	10.549	0.156	10.704
2005	9.300	0.159	9.460
2010	7.679	0.164	7.843
2011	7.555	0.162	7.717
2012	7.497	0.161	7.658
2013	7.327	0.162	7.489
2014	7.210	0.161	7.372
2015	7.408	0.161	7.568
2016	7.075	0.165	7.240
2017	7.187	0.165	7.352
2018	6.787	0.167	6.954
2019	6.574	0.164	6.738
2020	6.127	0.164	6.291
2021	5.968	0.128	6.097
2022	5.786	0.135	5.921
1990/2022	**-74%**	**-2%**	**-73%**
2005/2022	**-38%**	**-15%**	**-37%**

5.2.4 Nitrogen oxides (NOx)

In 2022, Agricultural NOx emissions consisted of 6.55 kt and a share of 12% of the national total Agricultural NOx emissions have decreased by 51.5% since 1990 (***Table 5.5***). The primary drivers of this drop are the significant .decrease in the emissions from cattle and swine, due to the dramatic decline in livestock population. Focusing on the period between 2016 - 2022, NOx emissions from the agricultural sector decreased due to decrease of inorganic fertilizer use.

Table 5.5: NOx emission time-series by sub-sectors in kt

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	0.325	13.194	13.520
1995	0.202	5.794	5.996
2000	0.185	5.925	6.110
2005	0.175	6.256	6.432
2010	0.144	6.420	6.565
2011	0.137	6.995	7.132
2012	0.140	6.171	6.311
2013	0.137	6.697	6.834
2014	0.144	7.054	7.198
2015	0.143	6.897	7.039
2016	0.137	7.011	7.149
2017	0.140	6.849	6.989
2018	0.148	7.195	7.342
2019	0.145	7.214	7.359
2020	0.137	6.968	7.105
2021	0.124	6.940	7.064
2022	0.122	6.431	6.553
1990/2022	**-63%**	**-51%**	**-52%**
2005/2022	**-31%**	**3%**	**2%**

5.3 CATEGORY-SPECIFIC IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

According to the Final Review Report, 2023 of the second phase of the review of national air pollution emission inventories, recommendations in the Agriculture sector were received:

3B4h Manure Management - Other Animals, NO_X, NH_3, NMVOC, $PM_{2.5}$, PM_{10}

The TERT recommends that Slovakia calculate the emissions for **3B4h** in future submissions to improve the completeness of its inventory. (

3B Manure Management, NH_3 - The TERT recommends that Slovakia include a summary of information on mitigation measures used in Slovakia and include explanation for the decrease in emission in the IIR of the next submission.

3B1 Manure Management – Cattle, NMVOC - The TERT recommends that Slovakia correct the identified issues (missing the $Frac_{silage}$, store parameter) and recalculates the emissions in the next submission.

3B1a Manure Management – Dairy Cattle, NH_3 -The TERT recommends that Slovakia include a description of trends and explain outliers in the next submission. Furthermore, the TERT recommends that Slovakia describe in detail the measures considered and how data on the use has been collected. The TERT recommends that Slovakia explain the reasons for the uneven trend in the implied emission factor for dairy cattle by explaining which parameters are changed in the IIR of the next submission.

3B3 Manure Management – Swine, NO_X, NH_3 - The TERT recommends that Slovakia correct the error in the activity data reported for 2011 in the NFR in the next submission.

3B4e Manure Management – Horses, NH_3 - The TERT recommends that Slovakia explain the reasons for the uneven trend in the implied emission factor for horses in the IIR of their next submission.

3D Agricultural Soils - NO_X, NH_3, The TERT recommends that Slovakia clarify in the IIR which areas are reported in the NFR as activity data and which areas are used in the calculations of the emissions in the next submission.

3Da2a Animal manure applied to soils - NH_3, The TERT recommends that Slovakia include a summary of information on mitigation measures used in Slovakia and include explanations for the decrease in emission in the IIR of the next submission.

3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products – PM_{10}, $PM_{2.5}$, TSP The TERT recommends that Slovakia report the used emission factors with the same amount of decimal places as given in the 2019 EMEP/EEA Guidebook in the next submission.

3De Cultivated crops, NMVOC The TERT recommends that Slovakia estimate emissions from barley and oats in the next submission either by using the Tier 1 emission factors or by developing country-specific emission factors for these crops

5.4 SOURCE SPECIFIC QA/QC AND VERIFICATION

QA/QC procedures in the Agriculture sector are linked to the QA/QC Plans for the NIS SR (at the sectoral level) and follow basic QA/QC rules and activities as defined in the EMEP/EEA GB_{2023}.

The QC checks (e.g., consistency check between NFR data and national statistics) were done during the NFR and IIR compilation, the General QC questionnaire was filled in and archived by QA/QC manager.

An opportunity to cross-check the activity data and emissions with the air pollution inventory to ensure consistency between the two inventories provided. In the last two years, the QA/QC procedures had significantly improved. QA/QC provides an additional opportunity to crosscheck the activity data and emissions with the GHGs inventory to ensure consistency between the two inventories. In the last two years, the QA/QC procedures had significantly improved.

The QA/QC extended by check of activity data for rounding errors, compared to the original data sources.

- Check the correct use of the units in the calculation sheets.
- Check the reasons for data gaps and provide explanations.
- Cross-check the data sources of the activity data if possible (e.g., total annual milk yield per cow, amount of wool, harvested area).
- Check the recalculation differences.
- Check for errors between the calculation sheets and the templates.

5.5 CATEGORY-SPECIFIC RECALCULATIONS

Recalculations made in the agriculture sector were provided and implemented in line with the Improvement Plan reflecting recommendations made during previous reviews.

Table 5.6: *Overview of these recalculations and corrections implemented in the 2024 submission*

	CATEGORY	YEAR	POLLUTION	DESCRIPTION	REFERENCES
15. FEBRUARY 2024					
1	3 Agriculture	1990-2021	NH_3, NO_x	Implementation of the IPCC 2019 Refinement and Implementation of 2023 EMEP/EEA Guideline	**5.5**
2	3B3 Swine	1990-2021	NO_x, NH_3	Revision of AWMS in swine category due to implementation of the IPCC 2019 Refinement. Share of biogas facilities was implemented into market swine and breeding swine. In addition, implementation of tier 2 approach for emissions estimation of poultry.	**5.8.3**
3	3B1 Manure management-Cattle,3B2 Manure management-Sheep, 3B3 Manure management – Swine,	1990-2021	NH_3, NO_x	Revision of straw in swine, horses, cattle, poultry in line with EMEP/EEA Guidebook 2023	**5.8.4**
4	3B1 Manure management - Cattle	1990-2021	NMVOC	NMVOC in Cattle categories were recalculated base of recommendation number SK-3B1-2023-0001	**5.8.6**

5	3B3 Manure management - Swine	1990-2021	NMVOC	Changes in distribution of swine lead to revision of swine categories. Number of market swine are increase compare to the breeding swine, this numbers are decreased.	**5.8.6**
6	3B Manure management	1990-2021	PM_{10}, $PM_{2.5}$	PM_{10}, $PM_{2.5}$ were recalculated in all animal subcategories, number of livestock were taken into account, which wasn't in line with Tier 1 approach 2023 EMEP/EEA Guidebook.	**5.8.5**
7	3B Manure management	1990-2021	TSP	TSP were recalculated in Cattle, Sheep, Swine, Horses and Goats subcategories, number of livestock were taken into account, which wasn't in line with Tier 1 approach 2023 EMEP/EEA Guidebook.	**5.8.5**
8	3B4h Manure management-Other animals	1990-2021	NO_X, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	For 3B4h Manure management - Other animals and NO_X, NMVOC, NH_3, $PM_{2.5}$, PM10 for all years, was implemented based on a Tier 1 method available in the 2023 EMEP/EEA Guidebook.	**5.8.4**
9	3B2 Manure management-Sheep, 3B4d Manure management - Goats	1990-2021	NH_3, NO_x	Nitrogen excretion values by animals (Nrate) have been updated based on new 2019 IPCC RF. Nrate is used in calculating nitrogen excretion (NEX) for all non-key animal categories (goats and sheep) in category 3.B. The value depends on the weight of the raised livestock.	**5.8.4**
10	3B4gi Manure management - Laying hens 3B4gii Manure management - Broilers, 3B4giii Manure management - Turkeys, 3B4giv Manure management - Other poultry	1990-2021	NH_3, NO_x	A new tier 2 methodological approach for poultry was implemented based on the revised IPCC 2019 Refinement. Completely new nitrogen excretion rates were calculated for poultry categories as defined by the Statistical Office of the Slovak Republic. Broilers were disaggregated into breeding and finishing. During the implementation of tier 2, a revision of animal weights laying hens, ducks, and geese was also carried out.	**5.8.4**
11	3B4gi Manure management - Laying hens 3B4gii Manure management - Broilers, 3B4giii Manure management - Turkeys, 3B4giv Manure management – Other poultry	1998	TSP	The emissions was recalculated due to correction of number of livestock which was not in line with officially statistical data provided by the Statistical Office of the Slovak Republic.	**5.8.5**
12	3Da2a, Animal Manure Applied to Soils	1990-2021	NH_3, NO_x	Recalculations of emissions was based on changes in 3.B Manure management recalculations.	**5.8.4**
13	3Da3, Urine and dung deposited by grazing animals	1990-2021	NH_3, NO_x	Recalculations of emissions was based on changes in 3.B Manure management recalculations.	**5.8.4**
14	3Da4 Crop residues applied to soils	1990-2021	NH_3	New category of emissions was implemented base on implementation of new 2023 IPCC Guideline	**5.9.8**
15	3Df Use of pesticides	1990-2021	HCB	Recalculation of HCB estimation due to correction of the units that were used when reporting in the template	**5.12.3**

In February 2024, various revisions and recalculations were undertaken in different categories pertaining to agricultural activities and pollution emissions. Agriculture, particularly livestock management, saw significant updates spanning several years from 1990 to 2022. Notable pollutants such as NH_3, NO_x, NMVOC, PM_{10}, $PM_{2.5}$, TSP, and HCB were addressed across diverse segments of the agricultural sector. The revisions were primarily driven by the implementation of updated guidelines such as the IPCC 2019 Refinement and the 2023 EMEP/EEA Guidebook and correction identified issues.

5.6 NATIONAL CIRCUMSTANCES AND TIME-SERIES CONSISTENCY

Slovak farmers have adapted to changes in agriculture since. They invested in the development of their farms to avoid bankruptcy and to be self-competitive in this sector. The EU policy supported the used tools as the base of transformation. The EU policy and measures were transformed into the Slovak legal system. Farmers

had to follow new strict criteria like changing of housing systems, a decrease in pasture time, and new storage capacity for organic waste, which was supported by Decree No 389/2005 Coll. and Nitrates Directive. These measures are well advanced and copy the practices used in Western European countries. Therefore, default parameters for Western Europe are used in inventory. The most significant animals in regard to emissions in Slovakia are cattle and swine.

Cattle breeding in the Slovak Republic is comparable with the Western European countries, which is documented by a high milk yield of dairy cattle and high daily weight gains of non-dairy cattle. To maintain a high milk yield and high daily gains, food rich in proteins and cereals is important. Dairy cows in three Slovak regions (Bratislava, Trnava, and Nitra) produce 22-25 litres/day. In other regions, milk productivity is 16-18 litres/day. Lower milk production relates to feeding. In this case, pasture is included in the feeding ratio. It is typical for semi-intensive farming in regions Košice, Prešov, Banská Bystrica or Žilina. These circumstances are documented in ***Figures 5.6*** and ***5.7***. Highly productive dairy cows (milked 25 litres/day) need to be fed 8 kg of cereals with excellent digestibility and high nutrition. An annual increase in milk productivity is evidence of increasing productivity of animal production. Balanced and sustainable farming in Slovakia has an impact on the high value of AGEI (304 MJ/head/day) (***Figure 5.6***).

Figure 5.6: *Trend in average gross energy intake (MJ/day) in different Slovak regions*

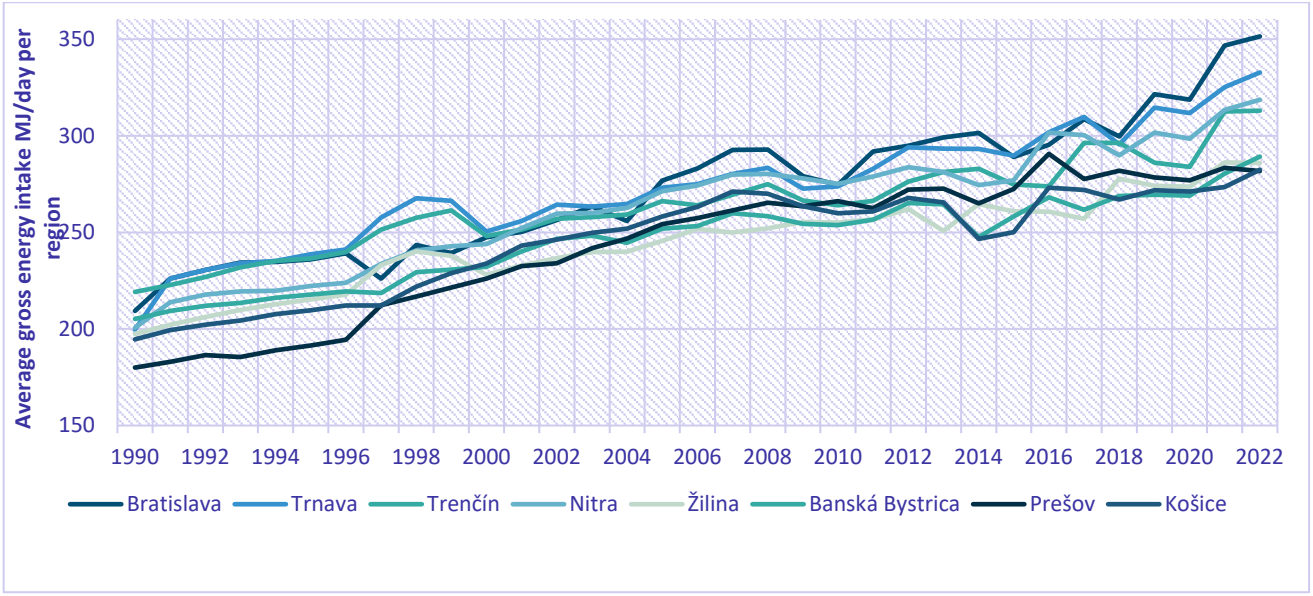
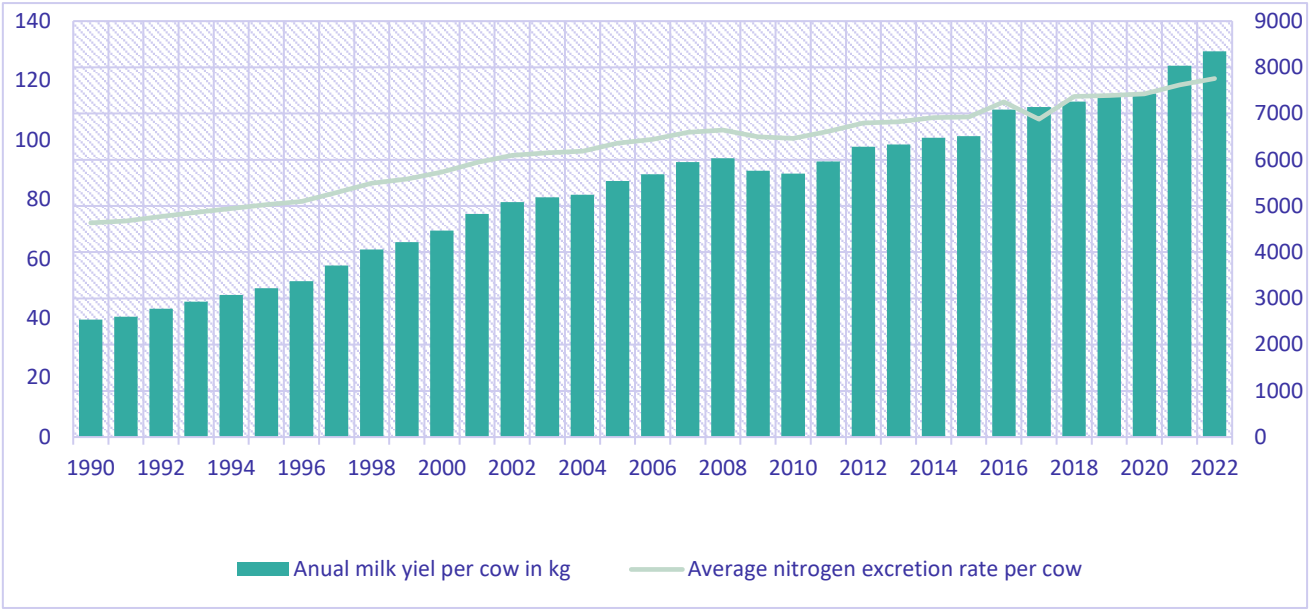
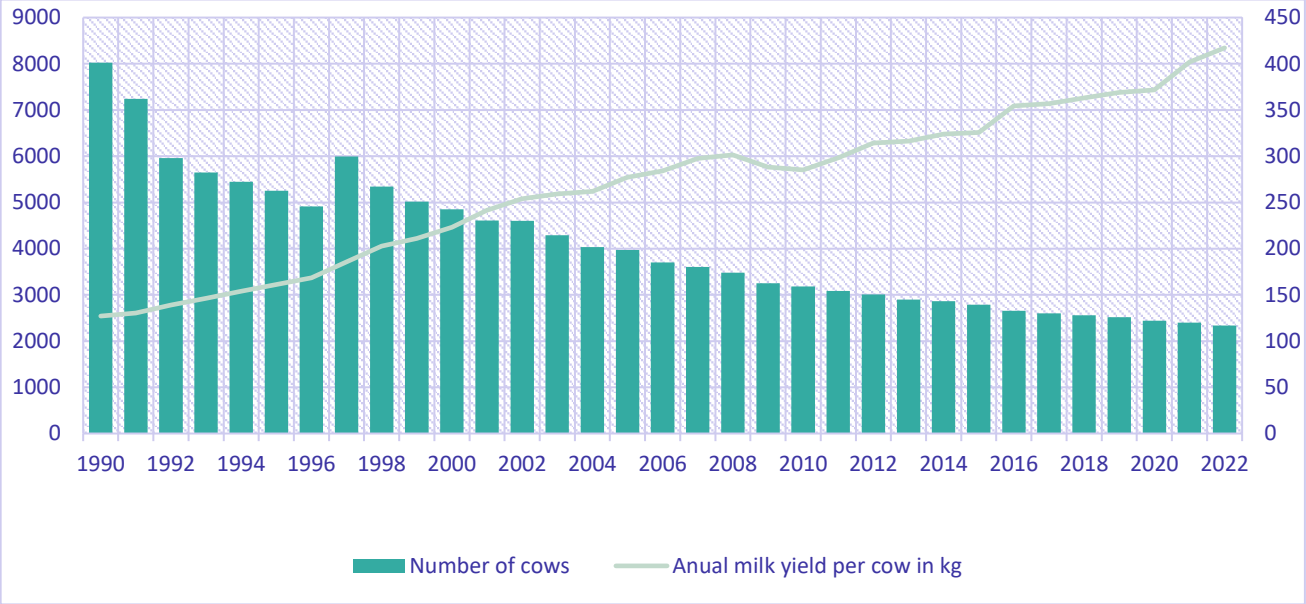


Figure 5.7: *Correlation of milk production (kg/day/head) and nitrogen excretion rate (kg N/y/head)*



The number of dairy cows decreased according to data from the ŠÚ SR by 69% in 2022 compared to 1990 (***Figure 5.8)***. Milk production increased up to 216% in 2022 compared to 1990, despite the continuously decreasing number of dairy cows. The main reason for this trend is the increase in average performance. The high-performance average is the result of good animal husbandry, breeding conditions, new synergy with technologies and animal genetics. All factors contribute together to achieving milk yields of up to 8 000 kg of milk per head per year.

Figure 5.8: *Trend in dairy cattle population and dairy milk production (kg/head/day)*

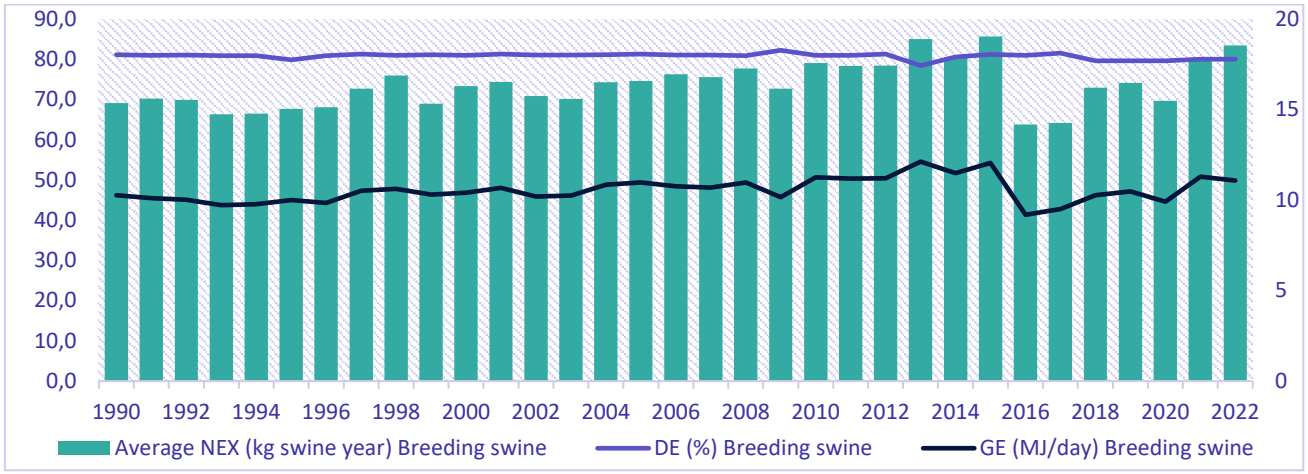


The pig farming system in the Slovak Republic is divided into two types - breeding and market pigs. Breeding pigs are bred for reproduction purposes. Fattening pigs are bred mainly for the production of pork meat and fat. Pigs are housed in the Slovak conditions for the whole year. Housing technology and diet can significantly affect the production of greenhouse gases. Stall conditions can be very variable. Pigs are bred in intensive farming on rosette floors, which is one of the low emission technics. Another part of pigs, mainly in semi-intensive farming, are reared on straw. Deep bedding is used mostly at micro and small farms. Diet has a significant impact on emissions production. The main component of the feeding is cereals (barley, triticale, wheat about 80-90%). Complementary feed ingredients are soybean scrap, rapeseed scrap, and beer brewing waste. The resultant feeding rations have a high nutritional value and are easily digestible (***Figures 5.9*** and ***5.10***).

Trends in breeding swine

Very dynamical trend is visible in breeding swine. The decrease and increase in crude proteins have impact on the nitrogen excretion rate and gross energy intake. Pig breeding in Slovakia has problems mainly due to risk of persistent morbidity - African swine fever and other economic reasons, which lead to decreasing numbers of breeding pigs after 2016. Low purchase prices create pressure to decrease of numbers of pigs, but overall effectivity of breeding systems increase continually after 2016 and 2018 decreases.

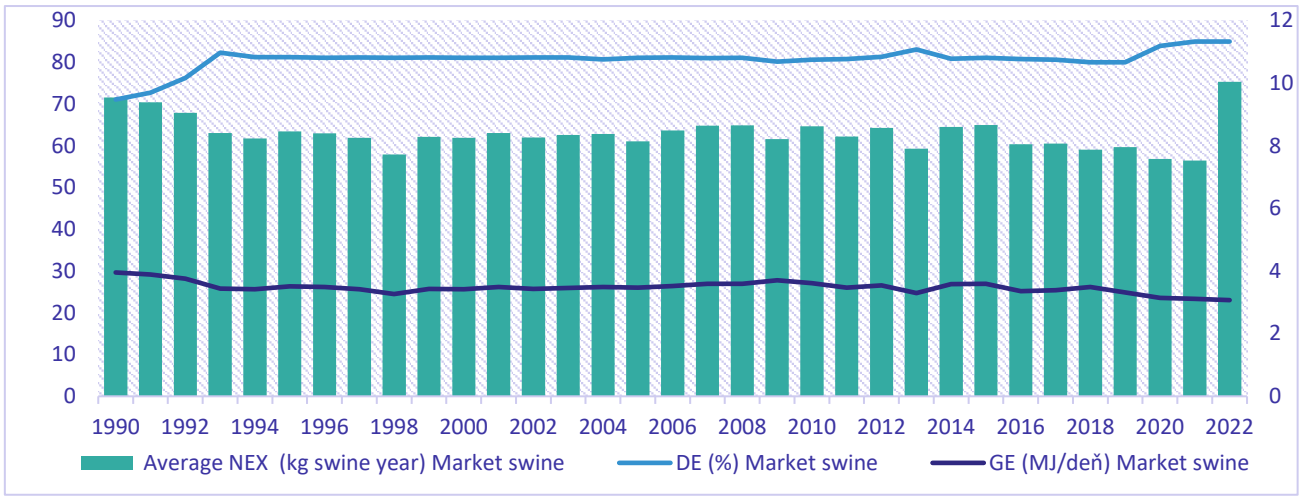
Figure 5.9: *Trend of feed digestibility, nitrogen excretion rate and gross energy intake of breeding swine in the Slovak Republic in 1990-2022*



Trends in market swine

After 1990, the digestibility of feeding dose increased significantly due to the increase of cereals, vitamins, dietary fibre, crude proteins and amino acids. These changes affect the increase in pig performance. After 1994 to 2021 is visible almost stable level of digestibility except 2013 where is visible smoot increase of digestibility which have influence to increase of number of market pigs by almost 10% compared to the previous year. In 2022, visible increase of digestibility of feeding gross energy intake and Nitrogen excretion rate. Base of data published in Green report 2023. The sector has been a recovered. Presented values were estimated by VÚŽV and correlated with increase of pig performance in that year.

Figure 5.10: *Trend of feed digestibility, nitrogen excretion rate and gross energy intake of market swine in the Slovak Republic in 1990 - 2022*



5.7 UNCERTAINTIES

Uncertainty analysis was provided for the first time in the 2020 Submission. Tier 1 and default uncertainties (EMEP/EEA Guideline) were used in the total assessment evaluated by Approach 1.

5.8 MANURE MANAGEMENT (NFR 3B)

Emitted gas: NH_3, NMVOC, NOx, TSP, PM_{10}, $PM_{2.5}$

Methods: T1 and T2

Emissions factors: D, CS

Key sources: Yes

Significant subcategories: Cattle, Swine, Poultry

The emissions of NH_3, NOx, TSP NMVOC and PM were estimated from category **3B** Manure management. NOx and NH_3 emissions from Sector **3** Agriculture were estimated according to the EMEP/EEA GB_{2023} as a Tier 2 approach for dairy cattle, non-dairy cattle, sheep, swine, goats, horses and poultry. The nitrogen excretion rate for the swine category is calculated based on the nitrogen content of the feed according to the IPCC 2019 RF methodology.

The detailed Tier 2 method was used to calculate NMVOC emissions for dairy cows and non-dairy cattle (key sources of emission). The other animal categories were calculated by the Tier 1 approach, and the EMEP/EEA GB_{2023} was considered. The TSP, PM_{10}, and $PM_{2.5}$ were calculated by the EMEP/EEA GB_{2023}. The Tier 1 approach was used for all animal species because the Tier 2 methodology is unavailable.

5.8.1 Animal Waste management Systems

Allocation of manure into AWMS is based on survey on manure management practices used. A questionnaire survey in farms was performed in the cooperation with the NPPC-VÚŽV and other research institutions during the year 2014. Farmers reported the total produced amount of solid and liquid manure and amount of manure, which was processed in anaerobic digesters by regions. This survey defined more accurately numbers of days on pasture for cattle, sheep, goats and horses. Manure left on pasture was estimated based on this data. Time-series was completed by extrapolation. In 2024 submission new data was implemented in poultry and swine categories, this survey was provided by Research Institute of Animal Production in Nitra.

Allocation according to the climatic conditions is 100% for cool temperate dry climate for all animals based on the IPCC 2019 RF and climate data for the Slovak Republic.

Western Europe default value for nitrogen excretion was used, more information is in the Chapter 5.6.

5.8.2 Nitrogen Excretion Rate

Nitrogen Excretion rate – cattle– a country-specific nitrogen excretion rate was used for the cattle category, based on the Tier 2 approach. The approach was implemented to estimations faecal, urinary, and total manure N excretions. The approach was implemented for each subcategory of cattle based on statistical inputs - milk yield, the weight of the animal and daily gain. The method estimates the average annual requirements of crude protein for maintenance, lactation, pregnancy and daily gain. Milk yield, daily gain and share of proteins in milk on the regional level were taken from the Statistical Office of the Slovak Republic. The calculation model is in line with the enteric fermentation model same activity data was implemented. The methodology was developed in the National Agricultural and Food Centre – The Research Institute for Animal Production in Nitra. Additional information on the usability of maintenance and pregnancy was taken into account. Parameters are documented in ***Table 5.7.***

Table 5.7: *Additional parameters for estimation of nitrogen excretion rate:*

PARAMETER	UNITS*	SOURCES
Crude protein per litre of milk	85g per litre	P.Petrikovič – A Sommer Nutrition for cattle
Share of protein in calf meat	21.5%	Keresteš, J. at all. Biotechnology nutrition and health
Usability for maintenance	2%	P.Petrikovič – A Sommer Nutrition for cattle
Usability for pregnancy	20%	P.Petrikovič – A Sommer Nutrition for cattle

PARAMETER	UNITS*	SOURCES
Nitrogen overage -dairy cattle	25%	Expert judgement
Nitrogen overage - other cattle	20%	Expert judgement
Share of protein in beef meat	21%	Keresteš, J. at all. Biotechnology nutrition and health
The conversion factor from CP to N	6.25	2006 IPCC GL p.10.58
Time without milking	60 days	https://www.plis.sk/
Crude protein for pregnancy begin part of pregnancy	680g/day	P.Petrikovič – A Sommer Nutrition for cattle
Crude protein for pregnancy begin part of pregnancy	765 g/day	P.Petrikovič – A Sommer Nutrition for cattle

*consistent in all time-series

The nitrogen excretion rate was determined for the whole time-series with methods according to the publication *P. Petrikovič – A. Sommer: Nutrition for Cattle.*[2] The complex of crude protein contains the amount of protein nitrogen and non-protein nitrogen estimated with the Kjeldahl method. Crude protein is multiplied by a conversion factor of **6.25** to dietary nitrogen.

The calculation method is based on a reverse estimation of nitrogen excretion from the average parameters of animal production (milk yield and daily gain, body weight) of the cattle. Parameters multiplied with tabular values of crude protein from individual physiological activities. Subsequently, the partial crude protein from activities is summed to the total crude protein. Total crude protein was recalculated to nitrogen.

Dairy cattle:

$$CP_{m-Total} = \left[(4.93 * H^{0.75} * U_m) - \left(\frac{CP_m}{100} * U_m\right)\right]$$

$$CP_{l-Total} = \left[(MY * CP_l) - \left(\frac{MY * 1000}{100 * SP_l}\right)\right]$$

$$CP_{p-Total} = \frac{C_{p1}+C_{p2}}{100} * U_p$$

$$Total_{CP} \frac{\frac{(CP_{m-Total}+CP_{l-Total})*\text{lactation period}}{1000} + \frac{(CP_{m-Total}+CP_{p-Total})*\text{time without milking}}{1000}}{\text{intervening period}} * 365$$

$$N_{intake\,(T)} = \left(\frac{\frac{Total_{Cp}}{100}}{6.25}\right)$$

$$NEX_{(T)} = N_{intake\,(T)} + \left(N_{intake\,(T)} * O_N\right)$$

Non-dairy cattle:

$$CP_{m-Total} = \left[(4.93 * H^{0.75} * U_m) - \left(\frac{CP_m}{100} * U_m\right)\right]$$

$$CP_{dg-Total} = \left[\left(200 + (4.43 * H^{0.75})\right) * dg\right] * SP_m$$

$$Total_{CP} = \frac{(CP_{m-Total} + CP_{dg-Total})}{1000} * 365$$

$$N_{intake\,(T)} = \left(\frac{\frac{Total_{Cp}}{100}}{6.25}\right)$$

$$NEX_{(T)} = N_{intake\,(T)} + \left(N_{intake\,(T)} * O_N\right)$$

Where: $CP_{m-Total}$ = crude protein for maintenance in g per day, $H^{0.75}$ = metabolic body size, **H =** average body weight in kg, U_m = Usability for maintenance in %, **MY** = milk yield in kg/day $CP_{l-Total}$ = crude protein for lactation g per day, $CP_{p-Total}$ = crude protein for pregnancy in g per day, $CP_{dg-Total}$ = crude protein for daily gain in g per day, dg = daily gain of animal in kg, **4.93** factor for maintenance, **4.43** factor crude protein per daily gain, SP_l = share of proteins in milk in %, SP_m = share of proteins in meat in %, **lactation period** = period of milk production in days, **intervening period** = is a figure indicating the time elapsed between two calves in days, $Total_{CP}$ = total calculated crude protein in kg, $NEX_{(T)}$ = annual N excretion rates, kg N animal^{-1} year^{-1}, **6.25** = conversion from kg of dietary protein to kg dietary N, kg feed protein (kg N)$^{-1}$,O_N = share of overage of nitrogen in N, $N_{INTAKE\,(T)}$ = daily N consumed per animal of category T , C_{p1} = crude protein for pregnancy begin part of pregnancy C_{p2}= crude protein for pregnancy final part of pregnancy

Nitrogen Excretion rate for swine, poultry – a country-specific nitrogen excretion rate was used for the swine, poultry categories, based on the Tier 2 method from the IPCC 2019 RF. The nitrogen excretion rates were developed based on the nitrogen content of the feed. The amounts of the nitrogen-containing feed ingredients in the diet were determined for the whole time-series. Feeding rations for different subcategories of pigs were estimated with the model "Software for Feeding Ration Optimization" developed by the NPPC-VÚŽV.

[2] Perikovič, P., Sommer, A., 2002, Nitrition for Cattle, The Research Insitute for Animal Production, ISBN: 80-88872-21-9 in Slovak, online: http://old.agroporadenstvo.sk/zv/hd/ziviny_hd/ziviny21.htm http://old.agroporadenstvo.sk/zv/hd/ziviny_hd/ziviny23.htm

The nitrogen intakes were determined from the crude protein content of each feed ingredient in the feeding ration for all subcategories of swine. The value of gross energy intake is consistent with the value used in category **3B13**. Data on dry matter intake intake were taken according to the publication *P. Petrikovič at all: Nutrition for Pigs* and *J. Zelenka at all: Nutrition for Poultry*. Experimental feeding rations were compiled with "The Animal Optimization Software" from Agrokonzulta Žamberk. Ltd. (CZ). This software uses the feed database, and Nutrition Standards developed at the NPPC-VÚŽV. The nitrogen intakes were determined from the crude protein content of each feed ingredient in the diet for all subcategories of swine and the gross energy intake of the swine.

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

Where: $N_{INTAKE\ (T)}$ = daily N consumed per animal of category T, kg N/head/day, DMI_i=dry matter intake per day during a specific growth stage, (kg DMI animal day^{-1}), **18.45** = conversion factor for dietary GE/kg of dry matter MJ/kg, **CP** = percent crude protein in diet %, **6.25** = conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg/N).

The values of the annual nitrogen excretions that are retained by animals and their sources are summarized in **Tables 5.8 - 5.12**. The results for swine for 2019 were presented in **Tables 5.10-5.11**. Sheep are also significant contributors to emissions, but data about crude protein were unavailable. The N-excretion rates were calculated according to Equation 10.32 of the IPCC 2019 RF:

$$NEX_{(T)} = N_{intake\ (T)} * (1 - N_{retention})$$

Where: $NEX_{(T)}$ = annual N excretion rates in kg N/head/yr, $N_{INTAKE\ (T)}$ = the annual N intake per head of animal of species/category T, kg N /head/yr, $N_{RETENTION\ (T)}$ = fraction of annual N intake that is retained by the animal of species (according to the Table 10.20 of the IPCC 2019 RF).

Table 5.8: *Country-specific regional parameters for swine for the period for 1990*

1990		A	B	C	D	E	F	G	H
SOWS	CP (%)	15.70	15.70	15.80	15.70	15.70	15.60	15.70	15.50
	N-intake (kg N animal/day)	0.083	0.082	0.083	0.082	0.085	0.084	0.083	0.082
	N_{EX} (kgN/animal/year)	21.10	21.00	21.10	21.10	21.60	21.50	21.20	21.00
GILTS PREGNANT	CP (%)	12.86	13.33	13.63	13.54	13.54	14.00	13.38	13.44
	N-intake (kg N animal/day)	0.049	0.053	0.055	0.054	0.054	0.057	0.053	0.054
	N_{EX} kg N/animal/year)	12.40	13.60	14.00	13.90	13.90	14.50	13.60	13.70
GILTS UNPREGNANT	CP (%)	12.86	13.33	13.63	13.54	13.54	14.00	13.38	13.44
	N-intake (kg N animal/day)	0.039	0.043	0.044	0.044	0.044	0.046	0.043	0.043
	N_{EX} (kg N/animal/year)	10.00	10.90	11.30	11.20	11.20	11.70	11.00	11.00
HOGS	CP (%)	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
	N-intake (kg N animal/day)	0.052	0.051	0.053	0.054	0.052	0.054	0.053	0.052
	N_{EX} (kg N/animal/year)	13.20	18.70	19.50	19.50	19.10	19.50	19.20	19.10
PIGLETS	CP (%)	12.90	13.30	13.60	13.50	13.50	14.00	13.40	13.40
	N-intake (kg N animal/day)	0.012	0.013	0.014	0.014	0.014	0.014	0.013	0.013
	N_{EX} (kg N/animal/year)	3.10	3.40	3.50	3.50	3.50	3.60	3.40	3.40
PIGS 21-50 kg	CP (%)	12.90	13.30	13.60	13.50	13.50	14.00	13.40	13.40
	N-intake (kg N animal/day)	0.023	0.025	0.026	0.025	0.025	0.027	0.025	0.025
	N_{EX} (kg N/animal/year)	5.80	6.40	6.60	6.50	6.50	6.80	6.40	6.40
FATTENING PIGS UP TO 20 kg	CP (%)	14.70	14.30	15.20	14.80	14.40	14.30	14.70	14.10
	N-intake (kg N animal/day)	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
	N_{EX} (kg N/animal/year)	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
FATTENING PIGS 21-50 kg	CP (%)	14.30	15.00	14.10	14.50	12.60	14.30	12.70	13.70
	N-intake (kg N animal/day)	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
	N_{EX} (kg N/animal/year)	8.20	8.20	8.10	8.20	8.20	8.20	8.20	8.20
	CP (%)	14.70	14.30	15.20	14.80	14.40	14.30	14.70	14.10

1990		A	B	C	D	E	F	G	H
FATTENING PIGS 50-80 kg	N-intake (kg N animal/day)	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
	N_{EX} (kg N/animal/year)	12.00	12.00	11.90	12.00	12.00	12.00	12.00	12.10
FATTENING PIGS 80-110 kg	CP (%)	14.70	14.30	15.20	14.80	14.40	14.30	14.70	14.100
	N-intake (kg N animal/day)	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
	N_{EX} (kg N/animal/year)	15.00	15.10	15.00	15.00	15.10	15.10	15.00	15.10
FATTENING PIGS FROM 110 kg	CP (%)	14.70	14.30	15.20	14.80	14.40	14.30	14.70	14.10
	N-intake (kg N animal/day)	0.066	0.066	0.065	0.066	0.066	0.066	0.066	0.066
	N_{EX} (kg N/animal/year)	16.80	16.90	16.70	16.80	16.80	16.90	16.80	16.90

Regions: A: Bratislava, B: Trnava, C: Trenčín, D: Nitra, E: Žilina, F: Banská Bystráca, G: Prešov, H: Košice

Table 5.9: *Country-specific regional parameters for swine for the period for 2022*

2022		A	B	C	D	E	F	G	H
Sows	CP (%)	17.3%	16.9%	16.6%	16.5%	16.1%	16.5%	16.8%	15.9%
	N-intake (kg N animal/day)	0.07	0.08	0.07	0.07	0.06	0.07	0.06	0.06
	NEX (kg N/animal/year)	19.7	21.9	21.1	21.0	20.7	22.8	21.5	21.1
Gilts pragnant	CP (%)	13.6%	14.0%	12.4%	13.0%	13.6%	13.3%	13.8%	12.8%
	N-intake (kg N animal/day)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	NEX (kg N/animal/year)	12.45	12.45	12.45	12.45	12.45	12.45	12.45	12.45
Gilts unpregnant	CP (%)	13.6%	14.0%	12.4%	13.0%	13.6%	13.3%	13.8%	12.8%
	N-intake (kg N animal/day)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	NEX (kg N/animal/year)	15.11	15.11	15.11	15.11	15.11	15.11	15.11	15.11
Hogs	CP (%)	15.9%	15.9%	15.9%	15.9%	15.9%	15.9%	15.9%	15.9%
	N-intake (kg N animal/day)	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	NEX (kg N/animal/year)	27.08	27.08	27.08	27.08	27.08	27.08	27.08	27.08
Pigs 21-50 kg	CP (%)	13.6%	14.0%	12.4%	13.0%	13.6%	13.3%	13.8%	12.8%
	N-intake (kg N animal/day)	0.024	0.025	0.022	0.023	0.024	0.024	0.025	0.023
	NEX (kg N/animal/year)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Fattening pigs up to 20 kg	CP (%)	14.3%	15.0%	14.1%	14.5%	12.6%	14.3%	12.7%	13.7%
	N-intake (kg N animal/day)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	NEX (kg N/animal/year)	4.84	4.84	4.84	4.84	4.84	4.84	4.84	4.84
Fattening pigs 21-50 kg	CP (%)	14.3%	15.0%	14.1%	14.5%	12.6%	14.3%	12.7%	13.7%
	N-intake (kg N animal/day)	0.0448	0.0448	0.0448	0.0448	0.0448	0.0448	0.0448	0.0612
	NEX (kg N/animal/year)	9.4312	9.4312	9.4312	9.4312	9.4312	9.4312	9.4312	9.4312
Fattening pigs 50-80 kg	CP (%)	14.3%	15.0%	14.1%	14.5%	12.6%	14.3%	12.7%	13.7%
	N-intake (kg N animal/day)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	NEX (kg N/animal/year)	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80
Fattening pigs 80-110 kg	CP (%)	14.3%	15.0%	14.1%	14.5%	12.6%	14.3%	12.7%	13.7%
	N-intake (kg N animal/day)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	NEX (kg N/animal/year)	17.72	17.72	17.72	17.72	17.72	17.72	17.72	17.72
Fattening pigs from 110 kg	CP (%)	14.3%	15.0%	14.1%	14.5%	12.6%	14.3%	12.7%	13.7%
	N-intake (kg N animal/day)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	NEX (kg N/animal/year)	18.67	18.67	18.67	18.67	18.67	18.67	18.67	18.67

Table 5.10: *Country specific regional parameters for poultry*

2022		A	B	C	D	E	F	G	H
Breeding broilers	N retention (%)	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
	N-intake (kg N animal/day)	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	NEX (kg N/animal/year)	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898
Ducks	N retention (%)	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	N-intake (kg N animal/day)	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

2022		A	B	C	D	E	F	G	H
Breeding broilers	N retention (%)	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
	N-intake (kg N animal/day)	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	NEX (kg N/animal/year)	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898
	NEX (kg N/animal/year)	1.295	1.295	1.295	1.295	1.295	1.295	1.295	1.295
Fattening broilers	N retention (%)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	N-intake (kg N animal/day)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	NEX (kg N/animal/year)	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739
Geese	N retention (%)	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	N-intake (kg N animal/day)	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
	NEX (kg N/animal/year)	1.739	1.739	1.739	1.739	1.739	1.739	1.739	1.739
Laying hens including cocks	N retention (%)	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
	N-intake (kg N animal/day)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	NEX (kg N/animal/year)	0.794	0.794	0.794	0.794	0.794	0.794	0.794	0.794
Turkeys	N retention (%)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	N-intake (kg N animal/day)	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	NEX (kg N/animal/year)	3.529	3.529	3.529	3.529	3.529	3.529	3.529	3.529

REGIONS: A: Bratislava, B: Trnava, C: Trenčín, D: Nitra, E: Žilina, F: Banská Bystrica, G: Prešov, H: Košice

Nitrogen Excretion Rate - Other animals – the calculation is based on the determination of body weight. All animals have their specific body weight. This parameter was estimated and is country-specific. The body weight parameter is consistent across the time-series and specific for animal species. The NPPC-VÚŽV provided a specific body mass for animals. Annual nitrogen excretion rates were calculated for sheep, goats, horses and poultry. N-excretion rates were calculated based on the IPCC 2019 RF, Equation 10.30.

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

Where: N_{EX} = annual N-excretion for each livestock spices respectively category in kg N per animal; $N_{RATE(T)}$ = default N-excretion rate in kg N (100 kg/animal mass)/day (IPCC 2019 RF), **TAM** = country-specific animal mass for each livestock species/category in kg per animal.

Direct emissions from manure management systems were estimated according to the following equation:

Table 5.11: *Country-specific regional parameters for dairy cattle in 1990*

CATEGORIES	N_{EX}	BODY MASS	LIQUID	SOLID	PASTURE	ANAEROBIC DIGESTER
	[kg N head/year]	[kg]	[%]			
Dairy cows Bratislava region	82.63	589	42.85	56.86	0.29	NO
Dairy cows Trnava region	78.69	589	18.57	79.79	1.64	NO
Dairy cows Trenčín region	74.60	589	7.12	86.92	5.97	NO
Dairy cows Nitra region	75.83	589	16.56	82.62	0.82	NO
Dairy cows Žilina region	66.06	589	5.93	75.34	18.73	NO
Dairy cows Banská Bystrica region	71.65	589	10.67	77.88	11.44	NO
Dairy cows Prešov region	62.65	589	4.06	80.43	15.51	NO
Dairy cows Košice region	69.36	589	2.41	86.29	11.30	NO

Table 5.12: *Country-specific regional parameters for dairy cattle in 2022*

CATEGORIES	N_{EX}	BODY MASS	LIQUID	SOLID	PASTURE	ANAEROBIC DIGESTER
	[kg N head/year]	[kg]	[%]			
Dairy cows Bratislava region	130	599	0.00	99.53	0.47	0.00
Dairy cows Trnava region	131	599	8.11	76.94	1.40	13.55
Dairy cows Trenčín region	125	599	7.58	77.23	6.23	8.95
Dairy cows Nitra region	128	599	16.49	80.41	0.69	2.40
Dairy cows Žilina region	109	599	5.89	56.72	30.69	6.70
Dairy cows Banská Bystrica region	112	599	13.95	68.61	11.73	5.70
Dairy cows Prešov region	108	599	6.35	70.33	20.65	2.67
Dairy cows Košice region	107	599	3.04	76.64	11.77	8.55

Table 5.13: *Country specific regional parameters for poultry in 1990 - 2022*

CATEGORIES	N_{EX}	Body mass	Pasture	Manure poultry without litter	Poultry manure with litter
	kg N head/year	*kg*	%		
Laying hens including cocks	0.79	2	-	75%	25%
Fattening broilers	0.90	1.02	-		100%
Breeding broilers	0.74	1.02	-		100%
Turkeys	3.53	3.28	-		100%
Geese	1.30	1.53	50%	50%	
Ducks	1.74	2.05	50%	50%	

Table 5.14: *N_{EX} and share (%) for different domestic livestock and share in AWMS in 2022*

CATEGORIES		N_{EX}	LIQUID	SOLID	PASTURE	OTHER (LITTER)
		N kg/head	*%*			
NON-DAIRY CATTLE	Suckler cows	47.43	-	45.21	54.79	-
	Calves in 6 month (milk type)	19.96	-	-	100.00	-
	Heifer (milk type)	39.43	-	97.56	2.44	-
	Heifer (pregnant) (milk type)	59.20	-	97.55	2.45	-
	Fattening (milk type)	46.14	10.00	90.00	-	-
	Oxen (milk type)	97.94	-	100.00	-	-
	Breeding bull (milk type)	66.21	-	100.00	-	-
	Calves in 6 month (beef type)	21.56	-	100.00	60.00	-
	Heifer (beef type)	38.18	-	45.21	54.79	-
	Heifer (pregnant) (beef type)	54.52	-	45.21	54.79	-
	Fattening (beef type)	51.75	20.00	80.00	-	-
	Oxen (beef type)	69.51	-	100.00		-
	Breeding bull (beef type)	43.35	-	75.34	24.66	-
	2022*	40.47	2.46	71.17	26.37	-
SHEEP	Mature ewes (milk type)	7.884	-	49.59	50.41	-
	Mature ewes (beef type)	9.20	-	45.20	54.80	-
	2022*	8.35	-	48.03	51.97	-
	Growing lambs (milk type)	4.27	-	49.59	50.41	-
	Growing lambs pregnant (milk type)	6.24	-	49.59	50.41	-
	Growing lambs (beef type)	7.23	-	45.21	54.79	-
	Growing lambs pregnant (beef type)	8.54	-	45.21	54.79	-
	2022*	5.88		48.08	51.92	-
	Rams (milk type)	10.51	-	83.56	16.44	-

CATEGORIES		N_{EX}	LIQUID	SOLID	PASTURE	OTHER (LITTER)
		N kg/head	*%*			
	Rams (beef type)	11.83	-	83.56	16.44	-
	2022*	10.98		81.63	18.37	-
GOATS	Mature female goats	9.23	-	49.60	50.40	-
	Pregnant goats	7.98	-	49.60	50.40	-
	Other mature goats	3.61	-	49.60	50.40	-
	2022	7.82		49.60	50.40	-
HORSES	Young horses up to 1 year	17.32	70.00	-	30.00	-
	Young horses from 1 to 3 year	39.858	70.00		30.00	
	Castrated horses	66.43	70.00	-	30.00	-
	Stallions	52.20	70.00	-	30.00	-
	Mares	47.45	70.00	-	30.00	-
	2022*	49.78	70.00		30.00	-
Others	Rabbits	4,6	-	68%	32%	-

* weighted average

5.8.2.1 Methodological issues –Method NH_3 and NOx

Emissions of NOx and NH_3 from **3B1** Cattle, **3B2** Sheep and **3B3** Swine and other animals **3B4** were calculated using the Tier 3 method of the EMEP/EEA GB_{2023} and country-specific values whenever possible.

5.8.2.2 Emissions factors NH_3 and NO_x

All animals

The values of the N excretion, housed-period and the proportion of solid, liquid and yard manure were replaced by the country-specific values year by year for all animal species. The input data on regional N-excretion and percentage of liquid, solid and yard manure are presented in ***Tables 5.12 - 5.13***. Solid storage of manure was found as the most frequent AMWS for cattle. The regional differences for horses, goats and poultry categories were not considered.

NH_3 emissions are estimated according to the EMEP/EEA GB_{2023} as the Tier 3 approach for cattle, sheep, goats, swine, horses and poultry in the system Python. For the calculation of the Tier 3 approach was accepted philosophy for ammonia reduction. Ammonia reduction at the various stages of livestock manure production and handling are interdependent and combinations of measures are not simply additive in terms of their combined emission reduction. In the 2022 submission, the Fixed hatch or roof, Covering the surface of the tank with straw and foil, and Slurry/liquid with natural crust cover were implemented into inventory. Implementation of abatements was done according to Approach 2 presented in the 2021 Task force on Emission Inventories and Projections as called Approach 2. Abated emission factors were calculated separately and implemented into the N flow tool in the system Python.

Table 5.15: *Country-specific liquid NH_3 emission factors for the period 2006-2022*

SPECIFIC EFS	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING PIGS	FATTENING PIGS	SHEEP
YEARS	**SOLID [kg NH_3/kg N]**										
2006	0.2482	0.2482	NO	NO	NO	NO	NO	NO	0.1093	0.1095	NO
2007	0.2482	0.2484	NO	NO	NO	NO	NO	NO	0.1093	0.1094	NO
2008	0.2480	0.2479	NO	NO	NO	NO	NO	NO	0.1094	0.1091	NO
2009	0.2475	0.2476	NO	NO	NO	NO	NO	NO	0.1094	0.1091	NO

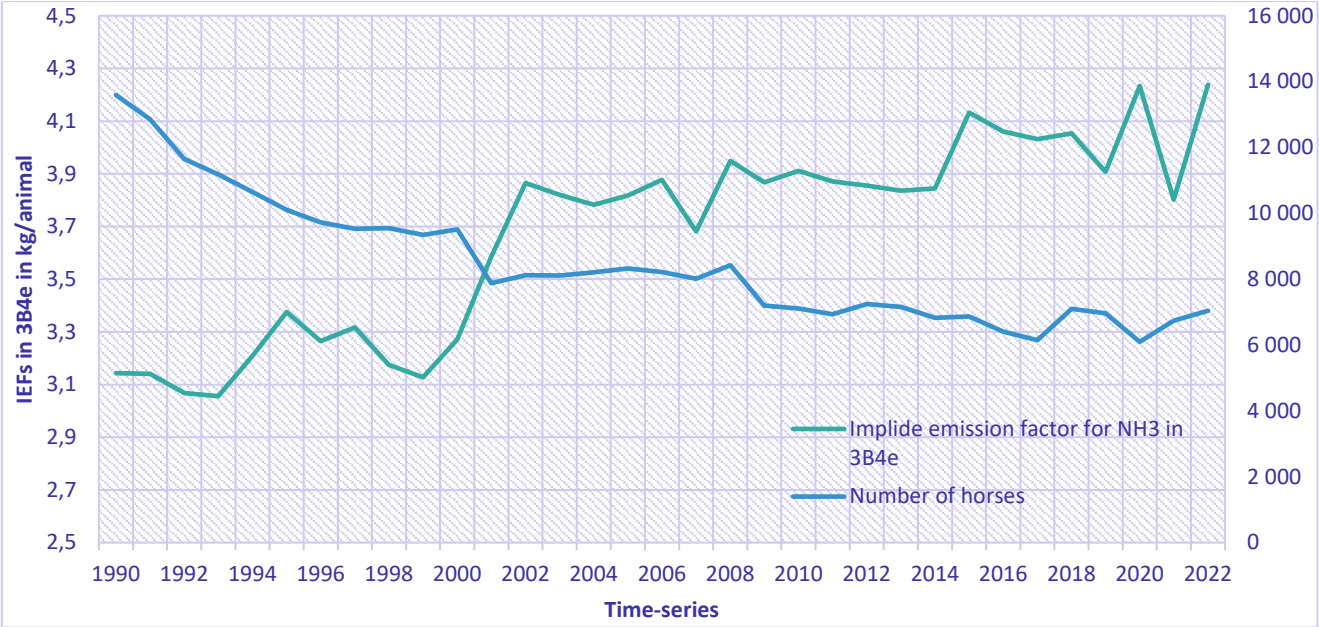
SPECIFIC EFS	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING PIGS	FATTENING PIGS	SHEEP
YEARS	SOLID [kg NH_3/kg N]										
2010	0.2474	0.2477	NO	NO	NO	NO	NO	NO	0.1090	0.1088	NO
2011	0.2468	0.2470	NO	NO	NO	NO	NO	NO	0.1090	0.1087	NO
2012	0.2472	0.2472	NO	NO	NO	NO	NO	NO	0.1091	0.1087	NO
2013	0.2359	0.2351	NO	NO	NO	NO	NO	NO	0.1046	0.1055	NO
2014	0.2356	0.2350	NO	NO	NO	NO	NO	NO	0.1038	0.1051	NO
2015	0.2356	0.2349	NO	NO	NO	NO	NO	NO	0.1038	0.1050	NO
2016	0.2358	0.2352	NO	NO	NO	NO	NO	NO	0.1033	0.1047	NO
2017	0.2355	0.2352	NO	NO	NO	NO	NO	NO	0.1031	0.1045	NO
2018	0.2355	0.2345	NO	NO	NO	NO	NO	NO	0.1031	0.1047	NO
2019	0.2354	0.2346	NO	NO	NO	NO	NO	NO	0.1037	0.1051	NO
2020	0.2360	0.2345	NO	NO	NO	NO	NO	NO	0.1038	0.1050	NO
2021	0.1726	0.1686	NO	NO	NO	NO	NO	NO	0.0781	0.0864	NO
2022	0.1782	0.1830	NO	NO	NO	NO	NO	NO	0.124	0.136	NO

Table 5.16: *Country-specific solid NH_3 emission factors for the period 2006-2022*

SPECIFIC EFS	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING PIGS	FATTENING PIGS	SHEEP
Years	SOLID [kg NH_3/kg N]										
2006	0.302	0.297	0.295	0.079	0.139	0.208	0.208	0.350	0.255	0.250	0.280
2007	0.304	0.303	0.298	0.079	0.160	0.240	0.240	0.350	0.261	0.256	0.278
2008	0.303	0.303	0.299	0.079	0.160	0.240	0.240	0.350	0.264	0.257	0.278
2009	0.303	0.303	0.298	0.079	0.160	0.240	0.240	0.350	0.263	0.259	0.278
2010	0.305	0.304	0.299	0.078	0.160	0.240	0.240	0.350	0.266	0.260	0.278
2011	0.306	0.307	0.299	0.078	0.160	0.240	0.240	0.350	0.265	0.258	0.280
2012	0.305	0.307	0.298	0.078	0.160	0.240	0.240	0.350	0.264	0.256	0.280
2013	0.305	0.308	0.299	0.078	0.160	0.240	0.240	0.350	0.265	0.259	0.280
2014	0.306	0.307	0.298	0.079	0.160	0.240	0.240	0.350	0.265	0.258	0.280
2015	0.306	0.307	0.299	0.079	0.160	0.240	0.240	0.350	0.265	0.259	0.280
2016	0.306	0.307	0.299	0.079	0.160	0.240	0.240	0.350	0.265	0.259	0.280
2017	0.306	0.307	0.299	0.079	0.160	0.240	0.240	0.350	0.266	0.259	0.280
2018	0.307	0.307	0.299	0.079	0.160	0.240	0.240	0.341	0.263	0.258	0.280
2019	0.306	0.307	0.299	0.079	0.160	0.240	0.240	0.332	0.264	0.256	0.274
2020	0.306	0.307	0.299	0.079	0.160	0.240	0.240	0.332	0.264	0.258	0.275
2021	0.2778	0.2810	0.2976	0.0774	0.1600	0.2400	0.2400	0.2940	0.2173	0.2028	0.2558
2022	0.2894	0.2947	0.3126	0.0627	0.1651	0.2515	0.2515	0.3664	0.2586	0.2780	0.2804

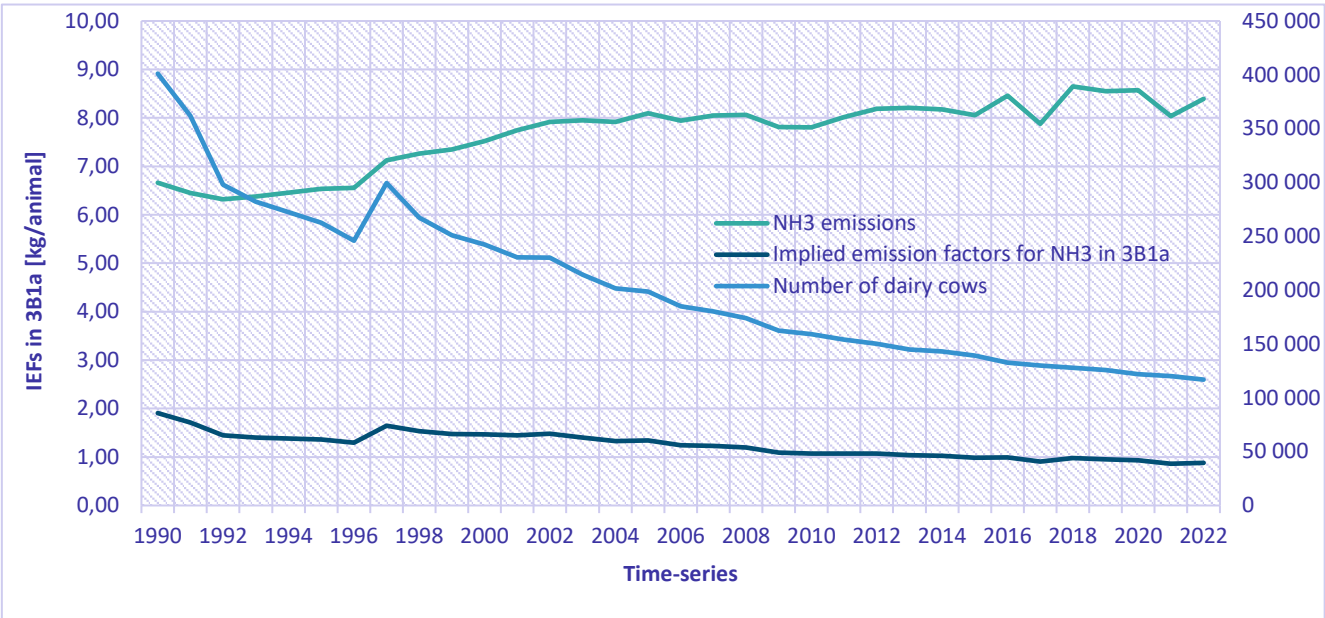
For the remaining input data as well as for the emission factors, standards and default values provided in the EMEP/EEA GB_{2023} were applied.

Figure 5.11: *Trends of implied emission factors and number of horses in the Slovak Republic in 1990 - 2022*



In Slovak horses farms, extensive breeding systems have is prevalent. The repeating increase and decrease is due to export after 1990 and caused an irregular trend in NH_3 emissions. It is noted that most of the parameters in our calculations are static, such as N_{EX}, AWMS, Housing period, and Straw content. The only dynamic changes are observed in the number of livestock, which correlates with emissions. Additionally, after 2018, there have been changes in emission factors as a result of implemented mitigation measures, as indicated in the Annex VI.(**according to the NECD recommendation No A6/SK-3B4e-2023-0001of the SVK NECD Final Review Report 2022**)

Figure 5.12: *Trends of implied emission factors, ammonia emissions and number of dairy cows in the Slovak Republic in 1990 - 2022*



In reflection **of the NECD recommendations No A3/SK-3B1a-2023-0001 of the SVK NECD 2023 Final Review Report and No A4/SK-3B1a-2023-0002 of the SVK NECD Final Review Report 2023**, the trend of NH_3 emissions is correlated with the number of livestock, which has been decreasing due to economic reasons stemming from the transition from a controlled system to a market-oriented one. Since 2004, this decline has continued due to accession to the EU. In recent years, there has been a further decrease in numbers due to low purchase prices of milk. Emissions are primarily correlated with the number of livestock. As a result of the decrease in livestock

numbers, there was an estimated decrease in the weighted average of nitrogen excretion rate in 2017. Implied emission factors have been continually increasing, mainly due to productivity growth and an increase in cow milk yield.

Table 5.17: *Country-specific NH_3 emission factors for 3B1a Dairy cattle and background data for the period 1990-2022*

3B1a DAIRY CATTLE CATEGORY				
YEAR	BODY MASS AVERAGE*	MILK YIELD	N-EXCRETION*	IMPLIED EMISSION FACTOR FOR 3B1a
	[kg/head]	[kg/head/year]	[kg N head/year]	[kg NH_3/head/year]
1990	589.41	6.96	72.09	5.85
1995	590.21	8.83	78.18	6.29
2000	591.02	12.24	89.22	7.17
2005	594.76	15.18	98.93	7.87
2010	597.81	15.62	100.52	7.72
2011	597.86	16.35	102.87	7.94
2012	598.08	17.22	105.70	8.10
2013	598.37	17.34	106.11	8.15
2014	598.50	17.74	107.51	8.13
2015	598.57	17.85	107.74	8.04
2016	598.65	19.41	112.79	7.77
2017	598.70	19.56	106.94	7.94
2018	598.75	19.89	114.64	8.64
2019	598.88	20.22	115.01	8.58
2020	598.89	20.36	115.48	8.61
2021	598.98	20.02	118.57	7.98
2022	597.75	22.86	120.67	7.52

*Weighted average from 8 Slovak regions

5.8.3 Activity data

Primary data sources used for the emissions evaluations were published in the Census of Sowing Areas of Field Crops in the Slovak Republic, the Annual Census of Domestic Livestock in the Slovak Republic, the Statistical Yearbooks 1990 – 2022 and the research results from projects and studies provided by several organizations inside the NPPC-VÚŽV.

Activity data for dairy, non-dairy cattle, sheep and swine are based on bottom-up statistical information at the regional level. The used input parameters were calculated as weighted averages. The ŠÚ SR provides annual livestock numbers at a detailed regional level in Livestock Census annually on 31st December.

Due to a different regionalisation of Slovakia in years 1990 – 1996 (only three regions: Západoslovenský, Stredoslovenský, and Východoslovenský), it was not possible to use time series immediately. The reallocation of older data into new regions (8 districts after 1997) was necessary. Reallocation was based on the following assumptions:

Západoslovenský region (1990 – 1996) is equal to Bratislavský, Nitriansky, Trnavský, Trenčiansky regions (1997 – present);

- Stredoslovenský region (1990 – 1996) is similar to Banskobystrický and Žilinský regions (1997 – present);
- Východoslovenský region (1990 – 1996) is similar to Prešovský and Košický regions (1997 – present).

A reallocation was prepared by using the linear extrapolation tools to reach statistical totals as reported by the ŠÚ SR and time series was extrapolated back to the base year. The ŠÚ SR and the SHMÚ use a standard statistical

approach for data extrapolations. Good statistical practice is described in the EUROSTAT Guidance. After 2017 submission, extrapolated number of swine was reported. The SHMÚ filled the data gap by using a standard statistical approach for extrapolation (linear extrapolation in spreadsheets). In addition, time series 1997 – 2020 of the milk production, wool production and daily gain for cattle and sheep at regional level was provided by the ŠÚ SR in 2016. Activity data used for methane emissions estimation is summarized in Table 5.41. Detailed statistical information is available at the regional level and emissions are estimated by bottom-up method (tier 2). The NPPC-VÚŽV implemented the results of a questionnaire farm survey where a better classification and disaggregation of cattle categories were used. Based on survey data, cattle were divided into dairy and non-dairy. Dairy cattle are estimated separately from non-dairy cattle. Dairy cattle are defined as cows that produce milk only for human consumption (highly productive cows). Suckler cows are defined as cows that are farmed for nutrition of calves (low productive cows). Suckler cows are included in non-dairy cattle category. In addition, non-dairy cattle includes breeding bull, oxen, calves, heifer pregnant, un-pregnant heifers and fattening bulls. This categorization is consistent in whole time series. The number of livestock decreased compared to the previous year in all species. The highest declines were recorded in the swine category (-82%) compared to 1990. The main reason for this decrease is the data gap on self-sufficiency - small household's farmers and morbidity of animals. The same reason was the cause of the decline of poultry (-19%) and horses (-12%).

Between 2005 and 2022, the production of most agricultural crops showed a declining trend. The decrease was recorded for tobacco by -99%, for beans by -88%, for beans -83%, for potato by -70% and rye by 63%. On the contrary, the production of meadows increased by +27.8% and oil plants by +37% , wheat by 10%, soya, leguminous plant and clover during the given period.

Since 2005, livestock numbers have decreased for all farmed species. Between 2005 and 2022, the number of dairy cattle decreased by -41%, pigs by -66%, poultry by -34% and sheep by -6%.

Table 5.18: *Animal population according to the districts for the year 2022*

REGION		A	B	C	D	E	F	G	H
DAIRY CATTLE		4 755	18 934	13 963	18 111	20 588	15 165	17 539	7 855
NON-DAIRY CATTLE	Suckling cows	1 574	2 083	4 320	1 666	9 158	18 620	23 467	12 299
	Calves in 6 month (milk sort)	1 564	10 236	6 017	8 048	7 161	5 354	5 879	2 751
	Heifer (milk sort)	1 187	5 577	4 641	6 732	7 184	5 515	6 589	2 385
	Heifer (pregnant) (milk sort)	1 530	4 427	3 359	6 502	5 140	3 255	3 726	1 418
	Fattening (milk sort)	452	9 640	4 000	7 442	4 362	3 888	3 213	2 214
	Oxen (milk sort)	1	1	8	13	264	54	9	4
	Breeding bull (milk sort)	22	114	93	197	461	305	477	213
	Calves in 6 month (beef sort)	518	1 126	1 862	740	3 186	6 574	7 865	4 307
	Heifer (beef sort)	393	613	1 436	619	3 196	6 772	8 817	3 735
	Heifer (pregnant) (beef sort)	507	487	1039	598	2 287	3 996	4 985	2 219
	Fattening (beef sort)	149	1061	1 238	685	1 940	4 773	4 300	3 466
	Oxen (beef sort)	0	0	2	1	118	66	11	5
	Breeding bull (beef sort)	45	227	187	393	921	611	953	425

REGION		A	B	C	D	E	F	G	H
SHEEP	Mature ewes	1 673	1 713	21 134	6 163	52 643	61 903	39 856	17 594
	Growing lambs	611	502	6 299	1 802	16 758	17 963	12 345	4 666
	Growing lambs (pregnant)	411	96	3 962	1 021	8 307	9 834	5 871	2 144
	Other mature sheep	52	45	628	180	1 524	1 794	1 143	494
SWINE	Breeding swine	4 529	21 778	4 815	6 214	122	1 937	420	1 462
	Fattening swine	14 945	145 563	31 112	120 995	1809	9 398	8 261	7 535
HORSES	Horses (0-1year)	67	16	40	99	19	59	39	45
	Horses (1-3year)	167	74	132	213	117	96	81	142
	Stallions	36	45	149	127	87	56	43	32
	Mares	398	196	339	454	421	618	478	420
	Castrated stallions	177	100	259	169	284	371	206	173
GOATS	Mature goats	260	245	697	327	1 777	1 619	1 422	1 228
	Growing goats (pregnant)	6	6	18	38	449	88	199	45
	Other mature goats	117	92	182	206	248	572	588	579
POULTRY	Laying hens and roosters	655 763	69 742	245 976	1 313 450	376 957	466 492	27 508	166 447
	Breeding broilers	0	69 260	72 447	32 778	69 575	136 230	2	125 553
	Fattening broilers	46 063	312 347	1 039 447	1 155 754	588 893	1 782 985	2 220	405 207
	Turkeys	0	5 744	263	119 411	37 722	18	7	80
	Ducks	0	14 517	9	536	50	360	48	15
	Geese	16	290	9	421	0	26	30	45
	Rabbits	4 390 146							

REGIONS: A: Bratislava, B: Trnava, C: Trenčín, D: Nitra, E: Žilina, F: Banská Bystrica, G: Prešov, H: Košice

In the breeding of cattle in Slovakia, a slight decline in the numbers of individual animal categories was recorded in the year 2022. By the end of 2022, there were 433.2 thousand head of cattle in Slovakia, which was 2.4 thousand head less compared to the previous year (-0.6%). The number of cows reached 190.1 thousand head, showing interannual of 2.0 thousand head (-1.1%). The declining trend in the number of milking cows continued in 2022, with their count reaching only 116.9 thousand head by the end of the year, which is 3.7 thousand head less than in 2021 (-3.2%).

The population of suckling cows increased during the year, reaching 73.2 thousand head by the end of 2022, showing a year-on-year increase of 1.7 thousand head (+2.4%). The share of suckling cows in the total number of cows increased by 1.3 percentage point's year-on-year to 38.6%. In the cattle fattening sector, there were 50.7 thousand head of cattle, an increase of 2.4 thousand head (+4.8%) compared to the previous year. The increase in the number of animals occurred in all weight categories.

Selected reproductive indicators of cattle (excluding households) slightly improved interannual. The number of calves born per 100 cows increased by 0.16 head, and the number of reared calves per 100 cows increased by 0.36 head. Average daily weight gains in cattle fattening increased by 0.006 kg/live weight, reaching 0.771 kg per head per day in 2022. Milk utility increased to 8,016.2 kg of milk per dairy cow per year, an increase of 234.3 kg (+3%).

Despite the interannual reduction in the number of dairy cows, increased utility resulted in an increase in raw cow's milk production by 8.6 thousand tons (+0.9%), reaching a production of 938.4 thousand tons in 2022. Milk producers sold a total of 867.11 thousand tons (+1.0%) of cow's milk. The volume of milk deliveries amounted to 823.94 thousand tons (-0.03%), and direct sales were 43.17 thousand tons (+26.1%).

In the year 2022, the decline in the number of pigs being raised in Slovakia moderated. The total number of pigs reached 380.9 thousand head, showing interannual decrease of 69.3 thousand head (-16.0%). The number of breeding sows decreased by 3.1 thousand head (-11.6%) to reach 24.0 thousand head. The number of pigs in fattening and pre-fattening was lower by 59.1 thousand head (-15.5%) compared to the previous year. The highest number of pigs in fattening was recorded in the second quarter. The interannual increase in the number of pigs was observed only in the category of 50 – 80 kg in the second quarter and in the category above 100 kg in the third quarter.

Productivity showed a slight year-on-year improvement. With a reduced number of litters per sow, the number of piglets born per sow slightly decreased (-0.07 piglet), while the number of piglets born per litter increased compared to the previous year. Piglet mortality slightly increased (+2.2%). Productivity in average daily weight gains in the fattening and pre-fattening of pigs increased, with average daily weight gains reaching 0.636 kg per live weight, which was 0.011 kg (+1.8%) more than in 2021.

The total number of poultry reached 9,340.7 thousand head, representing a decrease of 9.9% compared to the status on December 31, 2021. Among them, the number of hens reached 3,257.4 thousand head, showing a interannual of 5.2%. The proportion of hens in the total poultry population increased to 34.9% (+5.0 percentage points). The number of roosters increased by 17,662 head (+12.1%), while the number of chicks decreased by 1,201,389 head (-17.1%). The number of geese increased by 107 head (+14.7%), whereas the number of ducks decreased by 359 head (-2.3%) compared to the previous year.

Sheep farming in Slovakia has shown a positive trend year-on-year. By the end of the year 2022, there were 301.1 thousand head of sheep, which was an increase of 6.1 thousand head (+2.3%) compared to the previous year. The number of ewes increased by 1.1 thousand head (+0.6%) to reach 202.7 thousand head.

Fertility indicators for ewes improved interannual. The number of lambs born (79.9 per 100 ewes) and raised (74.6 per 100 ewes) increased. The average wool shearing per sheep per year reached 1.84 kg (+2.6%).

5.8.4 Category-specific recalculations

For instance, in the swine category (3B3), adjustments were made to the Animal Waste Management Systems (AWMS) to align with the IPCC 2019 Refinement. Biogas facilities' share was incorporated into market swine and breeding swine. Additionally, a tier 2 approach was introduced for more accurate emissions estimation in poultry.

In specific categories like Manure Management for various animals, including cattle, sheep, and swine, revisions were made to factors such as straw usage and nitrogen excretion values. These updates were based on guidelines outlined in the EMEP/EEA Guidebook of 2023 or corrected in cattle case.

Furthermore, adjustments in livestock distribution impacted emission calculations, particularly in the case of swine, where changes in market swine numbers were noted compared to breeding swine **according to the NECD recommendation No A5/SK-3B3-2023-0001of the SVK NECD Final Review Report 2023**.

For 3B4h Manure management – Rabbits, this emissions was implemented in to the inventory for the first time **according to the NECD recommendation No A1/SK-3B4h-2022-0001 of the SVK NECD Final Review Report 2022**. NO_X, NH_3, for all years, was implemented based on a Tier 1 method available in the 2023 EMEP/EEA Guidebook

Nitrogen excretion values by animals (N_{rate}) have been updated based on new 2019 IPCC RF. N_{rate} is used in calculating nitrogen excretion (N_{EX}) for all non-key animal categories (goats, horses, and sheep) in category 3.B. The value depends on the weight of the raised livestock.

Table 5.19: *Comparison of nitrogen excretion rates*

Rate of nitrogen excretion kg N (1,000 kg of animal weight) $^{-1}$ day $^{-1}$		
Species	**2006 IPCC Guidelines**	**2019 IPCC Refinement**
Sheep	0.85	0.36

Goats	1.28	0.46
Horses	0.26	0.26

The nitrogen excretion rates (N_{EX}) by the tier 2 methodology for pigs and cattle (key emission categories) remain unchanged. A new tier 2 methodological approach for poultry was implemented based on the revised IPCC 2019 Refinement. Completely new nitrogen excretion rates were calculated for poultry categories as defined by the Statistical Office of the Slovak Republic. Broilers were disaggregated into breeding and finishing. During the implementation of tier 2, a revision of animal weights laying hens, ducks, and geese was also carried out. The revision itself was preceded by a survey conducted by the Poultry Union, which represents the majority of poultry breeders in Slovakia. From the analysis, weight averages were calculated and included in the emission calculations. Effect of recalculations is shown in ***Table 5.20***

Table 5.20: *The impact of recalculations of NO_x, and NH_3 emissions in manure management in 1990–2021*

Category	3B - Manure management - NH_3 [kt]		Interannual difference	3B - Manure management - NO_x		Interannual difference
Year of submission	2024	2023		2024	2023	
1990	16.76	17.71	-5.4%	0.33	0.34	-3.6%
1991	14.97	15.96	-6.2%	0.28	0.29	-4.9%
1992	13.52	14.41	-6.2%	0.25	0.26	-4.7%
1993	12.00	12.72	-5.7%	0.21	0.22	-5.1%
1994	12.33	12.71	-3.0%	0.21	0.22	-3.5%
1995	11.88	12.62	-5.9%	0.20	0.22	-8.5%
1996	11.67	12.33	-5.4%	0.20	0.22	-7.2%
1997	11.62	12.13	-4.2%	0.20	0.22	-8.7%
1998	10.38	10.83	-4.2%	0.18	0.20	-8.5%
1999	9.83	10.27	-4.3%	0.18	0.19	-8.1%
2000	10.16	10.36	-1.9%	0.19	0.19	-4.2%
2001	10.88	10.72	1.5%	0.19	0.20	-3.8%
2002	10.26	10.39	-1.3%	0.18	0.19	-5.5%
2003	9.90	9.99	-0.8%	0.18	0.19	-5.0%
2004	9.00	8.97	0.3%	0.17	0.17	-4.6%
2005	9.14	8.90	2.7%	0.18	0.18	-0.7%
2006	8.71	8.46	2.9%	0.16	0.17	-5.5%
2007	8.41	8.07	4.3%	0.16	0.16	-4.9%
2008	7.53	7.20	4.6%	0.14	0.15	-5.5%
2009	8.00	7.40	8.1%	0.15	0.15	2.9%
2010	7.71	7.21	6.9%	0.14	0.15	-3.5%
2011	7.14	6.66	7.2%	0.14	0.14	-3.2%
2012	7.40	6.94	6.6%	0.14	0.15	-3.8%
2013	7.09	6.73	5.4%	0.14	0.14	-2.7%
2014	7.42	7.05	5.2%	0.14	0.15	-2.7%
2015	7.48	6.98	7.2%	0.14	0.15	-2.1%
2016	7.05	6.56	7.6%	0.14	0.14	-1.4%
2017	7.26	6.74	7.6%	0.14	0.14	-1.1%
2018	7.63	6.99	9.1%	0.15	0.15	0.1%
2019	7.22	6.69	8.0%	0.14	0.15	-0.5%
2020	6.26	5.96	5.0%	0.14	0.14	0.0%
2021	5.77	5.41	6.6%	0.12	0.12	4.1%

5.8.5 Particular matters (PM_{10}, $PM_{2.5}$ & TSP)

The significant sources of particular matters are dust from straw, silage and residue of feed. The activity of animals contributes production of emission feathers from poultry residues skin and others. The particular matters have a filterable character.

In 2022, manure management contributed 1.8% and 0.53% to the national total PM emissions given as 5% TSP of the sectorial emissions relates to poultry production. Total $PM_{2.5}$ from manure management decreased from 0.43 kt in 1990 to 0.13 kt in 2022, which is a decrease of -69% compared to a basic year and a decrease of nearly -2% compared to the previous year. Total PM_{10} from manure management decreased from 1.4 kt in 1990 to 0.48 kt in 2022, which is a decrease of 66% compared to 1990 and a decrease of -5% compared to the previous year. Total TSP from manure management decreased from 4.78 kt in 1990 to 1.56 kt in 2022, which is a decrease of 67% and a decrease of -4% compared to the previous year. The decreasing trend in the number of animals influenced the emissions trend.

5.8.5.1 Methodological issues

Emission estimation is based on the Tier 1 methodology of the EMEP/EEA GB_{2023}:

$$E_{Particular\ matters} = AAP_{animal} \text{ x } \mathrm{EF}_{pollutant_animal}$$

Where: AAP*:* annual average population, Number of animals of a particular category that are present, on average, within the year, $\mathrm{EF}_{\mathrm{pollutant_animal}}$ = default emissions factors for pollutants.

5.8.5.2 Emission factors (PM_{10}, $PM_{2.5}$ & TSP)

PM_{10}, $PM_{2.5}$, and TSP emissions from manure management were calculated using the default Tier 1 emissions factors for each category of farm animals (***Table 5.21***). The same emissions factors were used for all years.

Table 5.21: *Default emissions PM and TSP factors*

CATEGORIES	EMISSION FACTOR TSP	EMISSION FACTOR PM_{10}	EMISSION FACTOR $PM_{2.5}$
	[kg/head/year^{-1}]	[kg/head/year^{-1}]	[kg/head/year^{-1}]
Dairy cattle	1.38	0.63	0.41
Calves	0.34	0.16	0.1
Heifers unpregnant	0.59	0.27	0.18
Heifers pregnant	0.59	0.27	0.18
Fattening	0.59	0.27	0.18
Oxen	0.59	0.27	0.18
Suckled cows	0.59	0.27	0.18
Calves	0.34	0.16	0.1
Heifers unpregnant	0.59	0.27	0.18
Heifers pregnant	0.59	0.27	0.18
Fattening	0.59	0.27	0.18
Oxen	0.59	0.27	0.18
Breeding bulls	0.59	0.27	0.18
Sows 180 kg	0.62	0.17	0.01
Piglets	0.27	0.05	0.002
Fattening pigs	1.05	0.14	0.006
Laying hens including cocks	0.19	0.04	0.003
Broilers	0.04	0.02	0.002
Turkeys	0.11	0.11	0.02
Ducks	0.14	0.14	0.02
Geese	0.24	0.24	0.03
Horses	0.48	0.22	0.14

CATEGORIES	EMISSION FACTOR TSP	EMISSION FACTOR PM_{10}	EMISSION FACTOR $PM_{2.5}$
	[kg/head/year^{-1}]	[kg/head/year^{-1}]	[kg/head/year^{-1}]
Goats	0.14	0.06	0.02
Mature ewes	0.14	0.06	0.02
Growing lambs pregnant	1.38	0.63	0.41
Growing lambs unpregnant	0.34	0.16	0.1
Rams	0.59	0.27	0.18
Mature ewes	0.59	0.27	0.18
Growing lambs pregnant	0.59	0.27	0.18
Growing lambs unpregnant	0.59	0.27	0.18
Rams	0.59	0.27	0.18
Rabbits	0.02	0.01	0.004

5.8.5.3 Activity data

The number of livestock describes in **Chapter 5.8.3**.

5.8.5.4 Category-specific recalculations

Between 1990 and 2021, recalculations were made for PM_{10} and $PM_{2.5}$ emissions in all animal subcategories within manure management, deviating from the Tier 1 approach outlined in the 2023 EMEP/EEA Guidebook. Number of places was corrected to number of livestock therefore emissions are higher compare to the previous submission. Additionally, Total Suspended Particulates (TSP) were recalculated for 3B1 Cattle, 3B2 Sheep, 3B3 Swine, 3B4e Horses, and 3B4d Goats subcategories during the same period, again not following the Tier 1 approach. For other animals under manure management (Rabbits), including $PM_{2.5}$, PM_{10}, and TSP, emissions for all years were determined using the Tier 1 method specified in the 2023 EMEP/EEA Guidebook. Furthermore, emissions from specific poultry categories such as Laying Hens, Broilers, Turkeys, and Other Poultry in 1998 were recalculated for TSP due to corrections in the livestock numbers, which were initially inconsistent with the official statistical data provided by the Statistical Office of the Slovak Republic. The recalculation in TSP and PMs emissions from manure management are summarized in ***Table 5.22***.

Table 5.22: *The impact of recalculations of TSP, $PM_{2.5}$, and PM_{10} emissions in manure management in 1990–2021*

Category	3B - Manure management – PM_{10} [kt]		Interannual difference	3B - Manure management - $PM_{2.5}$ [kt]		Interannual difference	3B - Manure management - TSP [kt]		Interannual difference
Year of	2024	2023		2024	2023		2024	2023	
1990	1.383	1.308	5.8%	0.429	0.330	30%	4.784	5.22	-8.3%
1991	1.250	1.185	5.5%	0.383	0.292	31%	4.486	4.91	-8.6%
1992	1.128	1.075	5.0%	0.331	0.254	30%	4.022	4.42	-8.9%
1993	1.039	1.004	3.5%	0.290	0.222	31%	3.836	4.27	-10.1%
1994	1.143	1.112	2.8%	0.292	0.228	28%	3.907	4.33	-9.7%
1995	1.048	1.015	3.3%	0.279	0.216	29%	3.839	4.23	-9.3%
1996	1.021	0.991	3.1%	0.268	0.208	29%	3.730	4.11	-9.3%
1997	1.009	0.976	3.4%	0.267	0.210	27%	3.600	3.92	-8.2%
1998	0.894	0.873	2.4%	0.237	0.187	27%	3.152	3.43	-8.0%
1999	0.855	0.828	3.2%	0.225	0.177	28%	3.031	3.31	-8.4%
2000	0.870	0.842	3.3%	0.223	0.176	27%	3.040	3.30	-7.9%
2001	0.954	0.933	2.3%	0.225	0.180	25%	3.452	3.73	-7.5%
2002	0.882	0.860	2.5%	0.216	0.171	26%	3.142	3.42	-8.1%
2003	0.854	0.830	2.9%	0.207	0.163	27%	3.058	3.30	-7.4%
2004	0.788	0.760	3.8%	0.192	0.151	27%	2.751	2.92	-5.9%
2005	0.788	0.758	3.9%	0.190	0.150	27%	2.728	2.88	-5.3%
2006	0.757	0.727	4.1%	0.181	0.142	28%	2.687	2.83	-5.0%
2007	0.738	0.702	5.1%	0.179	0.140	28%	2.602	2.68	-3.0%
2008	0.666	0.623	6.8%	0.169	0.131	29%	2.359	2.38	-0.8%
2009	0.720	0.678	6.3%	0.171	0.135	27%	2.550	2.55	0.0%

Category	3B - Manure management – PM_{10} [kt]		Interannual difference	3B - Manure management - $PM_{2.5}$ [kt]		Interannual difference	3B - Manure management - TSP [kt]		Interannual difference
Year of	2024	2023		2024	2023		2024	2023	
2010	0.697	0.654	6.6%	0.166	0.129	29%	2.469	2.48	-0.3%
2011	0.647	0.601	7.6%	0.160	0.123	29%	2.303	2.28	1.0%
2012	0.666	0.621	7.3%	0.162	0.125	30%	2.378	2.37	0.5%
2013	0.637	0.595	7.1%	0.159	0.122	30%	2.243	2.25	-0.4%
2014	0.661	0.616	7.4%	0.160	0.123	30%	2.302	2.29	0.6%
2015	0.672	0.627	7.1%	0.158	0.121	31%	2.370	2.36	0.4%
2016	0.644	0.600	7.3%	0.152	0.116	31%	2.276	2.26	0.7%
2017	0.666	0.624	6.7%	0.153	0.117	31%	2.312	2.31	0.0%
2018	0.685	0.645	6.2%	0.155	0.119	30%	2.394	2.41	-0.5%
2019	0.640	0.602	6.4%	0.149	0.113	31%	2.213	2.23	-0.7%
2020	0.518	0.475	9.0%	0.138	0.103	35%	1.701	1.67	1.6%
2021	0.500	0.456	9.6%	0.136	0.100	36%	1.623	1.58	2.6%

5.8.6 NMVOC Emissions

5.8.6.1 Methodological issues

In terms of increased transparency of methodology and activity data of cattle. Estimation of NMVOC was completed by the available parameters time of housing feeding situation – the amount of silage in the ration and gross feed intake. Dairy cattle and non-dairy cattle have been calculated using Tier 2 methodology by EMEP/EEA GB_{2023}.

5.8.6.2 Emissions factors

Dairy cattle

Dairy cattle and non-dairy cattle were calculated using the Tier 2 methodology according to the EMEP/EEA GB_{2023}.

This methodology distinguishes emission factors 'with silage feeding' from cattle categories, and the emission estimate is reliable. **$Frac_{silage}$** used in the Slovak inventory was calculated from the feeding ration as a share of silage from the other ration supplements. **$Frac_{silage}$** were estimated for all cattle subcategories. This parameter was measured and is country-specific. The regional differences were considered. **$Frac_{silage}$** is divided for each region and is across the time-series. Energy from feeding ration was calculated from feeding ration and is country-specific. The regional differences were also considered.

Total NMVOC emissions from Manure management and Enteric fermentation from cattle were estimated based on the detailed classification of animals into the following categories: dairy cattle (high producing dairy cows and non-dairy cattle (suckled cows, calves 6 months, heifers, pregnancy heifers, breeding bull, oxen, fattening) and followed parameters (***Tables 5.23-Table 5.25***).

NMVOC for cattle is based on the following equations [1]:

$$E_{NMVOC\ i} = AAP_{animal} \times \left(E_{NMVOC.silage\ store} + E_{NMVOC.silage\ feeding} + E_{NMVOC.\ house} + E_{MVOC.appl} + E_{NMVOC.graz}\right)$$

$$E_{NMVOC.silage\ store\ i} = MJ \times x_{house} \times \left(EF_{NMVOC.silage\ feeding}\ xFrac_of_max_{silage}\right) \times Frac_{silage_store}$$

$$E_{NMVOC.\ silage\ feeding} = MJ \times x_{hous} \times \left(EF_{NMVOC\ feed\ silage\ i} \times Frac_of_max_{silage}\right)$$

$$E_{NMVOC\ house} = MJ \times x_{house} \times \left(EF_{NMVOC\ silage}\right)$$

$$E_{NMVOC\ manure\ store} = E_{NMVOC\ house} \times x_{house} \times \left(\frac{E_{NH_3\ storage}}{E_{NH_3\ house}}\right)$$

$$E_{NMVOC\ appl} = E_{NMVOC\ house} . x_{house} . \left(\frac{E_{NH_3\ appli}}{E_{NH_3\ house}}\right)$$

$$E_{NMVOC\ graz} = MJ \times (1 - x_{house}) . EF_{NMVOC.graz}$$

Where:

MJ_i: Gross feed intake in MJ year. x_i : Share of time the animals spend in the animal house (%), $Frac_{silage}$: If silage feeding is dominant $Frac_{silage}$ should be equal to 1.0. $Frac_{silage\ store}$: The share of the emission from the silage store compared to the emission from the feeding table in the barn. $E_{NH_3\ applic\ i}$ $E_{NH_3\ house\ i}$ $E_{NH_3\ storage\ i}$. Emissions from ***3B*** Manure Management.

Table 5.23: Overview of parameters in dairy cattle categories

DAIRY CATTLE	BE [MJ/year]	FRACTION OF SILAGE	$E_{Housing_slurry}$ [kt]	$E_{Housing_solid}$ [kt]	$E_{storage_slurry}$ [kt]	$E_{storage\ FYM}$ [kt]	$E_{slurry\ application}$ [kt]	$E_{soild_application}$ [kt]	$E_{pasture}$ [kt]
1990	95 606	0.38	0.38	0.87	0.08	1.02	0.63	5.36	1.21
1991	90 071	0.31	0.31	0.80	0.07	0.94	0.51	4.96	1.10
1992	90 184	0.26	0.26	0.67	0.06	0.79	0.43	4.17	0.93
1993	90 728	0.25	0.25	0.65	0.05	0.76	0.41	4.02	0.89
1994	91 556	0.24	0.24	0.64	0.05	0.75	0.41	3.95	0.88
1995	92 447	0.24	0.24	0.63	0.05	0.74	0.39	3.87	0.86
1996	92 731	0.23	0.23	0.59	0.05	0.70	0.37	3.68	0.82
1997	94 338	0.28	0.28	0.75	0.06	0.89	0.46	4.67	1.03
1998	95 625	0.25	0.25	0.70	0.05	0.82	0.42	4.33	0.96
1999	96 477	0.25	0.25	0.66	0.05	0.78	0.42	4.12	0.91
2000	98 771	0.25	0.25	0.66	0.05	0.78	0.41	4.09	0.91
2001	100 412	0.24	0.24	0.65	0.05	0.76	0.40	4.03	0.89
2002	101 109	0.23	0.23	0.67	0.05	0.79	0.38	4.16	0.91
2003	101 531	0.23	0.23	0.63	0.05	0.73	0.38	3.88	0.86
2004	101 827	0.22	0.22	0.59	0.05	0.69	0.36	3.67	0.81
2005	102 927	0.21	0.21	0.61	0.04	0.71	0.34	3.74	0.82
2006	104 118	0.23	0.23	0.56	0.05	0.58	0.34	3.14	0.78
2007	104 676	0.21	0.21	0.57	0.04	0.59	0.30	3.17	0.78
2008	105 371	0.20	0.20	0.55	0.04	0.57	0.29	3.08	0.75
2009	103 978	0.19	0.19	0.50	0.04	0.52	0.28	2.78	0.69
2010	103 901	0.20	0.20	0.48	0.04	0.51	0.28	2.69	0.67
2011	105 628	0.20	0.20	0.48	0.04	0.51	0.29	2.65	0.66
2012	106 895	0.19	0.19	0.48	0.04	0.51	0.28	2.67	0.67
2013	107 906	0.20	0.20	0.46	0.04	0.48	0.29	2.56	0.64
2014	104 803	0.18	0.18	0.47	0.03	0.48	0.26	2.60	0.64
2015	109 602	0.16	0.16	0.46	0.03	0.47	0.23	2.56	0.63
2016	111 167	0.16	0.16	0.46	0.03	0.47	0.24	2.55	0.63
2017	112 583	0.14	0.14	0.43	0.03	0.44	0.20	2.38	0.58
2018	104 551	0.17	0.17	0.45	0.03	0.46	0.25	2.49	0.61
2019	104 535	0.15	0.15	0.45	0.03	0.46	0.22	2.49	0.61
2020	104 898	0.15	0.15	0.43	0.03	0.44	0.22	2.42	0.59
2021	116 507	0.13	0.13	0.44	0.01	0.37	0.15	2.01	0.60
2022	117 893	0.13	0.13	0.44	0.01	0.40	0.14	1.90	0.59

*all parameters are weighted averages representing aggregation in level SR

Table 5.24: Overview of parameters for non-dairy cattle categories

NON-DAIRY CATTLE	BE [MJ/year]	FRACTION OF SILAGE	$E_{Housing_slurry}$ [kt]	$E_{Housing_solid}$ [kt]	$E_{storage_slurry}$ [kt]	$E_{storage\ FYM}$ [kt]	$E_{slurry\ application}$ [kt]	$E_{soild_application}$ [kt]	$E_{pasture}$ [kt]
1990	45 558	0.25	0.6173	2.1166	0.1329	2.0473	1.0217	10.7673	1.8868
1991	44 203	0.25	0.5178	1.9257	0.1115	1.8680	0.8572	9.8247	1.7783
1992	46 541	0.25	0.4388	1.6435	0.0945	1.5928	0.7264	8.3773	1.5742
1993	46 395	0.25	0.3792	1.3933	0.0816	1.3764	0.6276	7.2392	1.3847
1994	45 463	0.24	0.3431	1.2694	0.0739	1.2682	0.5680	6.6700	1.2919
1995	46 019	0.24	0.3593	1.2711	0.0773	1.2458	0.5947	6.5522	1.2969
1996	45 711	0.25	0.3425	1.2328	0.0737	1.2087	0.5669	6.3568	1.2507
1997	40 483	0.29	0.3612	1.1410	0.0778	1.1753	0.5978	6.1811	1.1284
1998	41 767	0.30	0.3291	1.0400	0.0708	1.0787	0.5447	5.6734	1.0552

NON-DAIRY CATTLE	BE [MJ/year]	FRACTION OF SILAGE	$E_{Housing_slurry}$ [kt]	$E_{Housing_solid}$ [kt]	$E_{storage_slurry}$ [kt]	$E_{storage\ FYM}$ [kt]	$E_{slurry\ application}$ [kt]	$E_{soild_application}$ [kt]	$E_{pasture}$ [kt]
1999	42 762	0.28	0.3360	1.0068	0.0723	1.0446	0.5562	5.4937	1.0233
2000	43 489	0.28	0.3164	0.9887	0.0681	1.0336	0.5237	5.4359	1.0321
2001	43 695	0.28	0.3020	0.9496	0.0648	0.9925	0.4995	5.2384	1.0069
2002	44 186	0.27	0.2835	0.9456	0.0608	0.9970	0.4689	5.2618	1.0367
2003	44 306	0.27	0.2856	0.9242	0.0612	0.9637	0.4723	5.0886	1.0121
2004	44 813	0.27	0.2656	0.8549	0.0569	0.8959	0.4391	4.7349	0.9480
2005	45 349	0.27	0.2543	0.8875	0.0544	0.9372	0.4204	4.9600	0.9618
2006	46 333	0.26	0.2798	0.8567	0.0590	0.7931	0.4208	4.3315	0.9562
2007	46 527	0.26	0.2549	0.8657	0.0538	0.8320	0.3838	4.4469	0.9527
2008	47 247	0.25	0.2734	0.9389	0.0575	0.8645	0.4023	4.6333	0.9276
2009	47 214	0.26	0.2310	0.7745	0.0482	0.7223	0.3372	3.8524	0.8774
2010	48 384	0.23	0.2327	0.7724	0.0484	0.7251	0.3396	3.8283	0.8914
2011	48 585	0.23	0.2346	0.7659	0.0486	0.7257	0.3423	3.9037	0.8835
2012	48 599	0.22	0.2335	0.8041	0.0484	0.7548	0.3404	3.9549	0.9292
2013	49 187	0.23	0.2442	0.7968	0.0462	0.7630	0.3580	3.8838	0.9280
2014	47 343	0.24	0.2191	0.8290	0.0407	0.7708	0.3209	4.0728	0.9678
2015	50 233	0.22	0.1943	0.8249	0.0359	0.7580	0.2847	4.0495	0.9664
2016	50 099	0.22	0.1984	0.8180	0.0366	0.7546	0.2905	4.0098	0.9606
2017	51 499	0.22	0.1887	0.8192	0.0342	0.7449	0.2758	3.9726	0.9523
2018	45 000	0.22	0.2222	0.8591	0.0407	0.7912	0.3267	4.2110	1.0059
2019	44 998	0.22	0.2003	0.8540	0.0367	0.7852	0.2950	4.2016	0.9933
2020	45 200	0.22	0.2038	0.8702	0.0375	0.7945	0.3002	4.2592	1.0056
2021	48 187	0.22	0.1884	0.8561	0.0182	0.6455	0.2228	3.4154	1.0022
2022	48 290	0.22	0.1848	0.8564	0.0197	0.7027	0.2099	3.2783	1.0020

*all parameters are weighted averages representing aggregation in level SR

Table 5.25: *Overview of emissions factors for non-dairy cattle categories*

NMVOC EMISSION FACTORS							
EF_{NMVOC}.silage feeding*	(kg NMVOC kg/MJ feed intake)	0.000200	0.000200	0.000200	0.000200	0.000200	0.000200
EF_{NMVOC} house*	(kg NMVOC kg/MJ feed intake)	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035
EF_{NMVOC} graz *	(kg NMVOC kg/MJ feed intake)	0.000007	0.000007	0.000007	0.000007	0.000007	0.000007

Other animals

NMVOC emissions from other animal categories were calculated using the Tier 1 methodology and emission factors outlined in the EMEP/EEA GB_{2023}. Used emission factors are summarized in ***Table 5.26***. There is no evidence about adding silage into the feeding ratio for other animal categories.

Table 5.26: *Emission factor for another animal without silage feeding*

CATEGORIES	EF WITHOUT SILAGE FEEDING [kg NMVOC/head/year^{-1}]
Sheep	0.169
Sows	1.704
Fattening pigs	0.551
Goats	0.542
Horses	4.275
Laying hens	0.165
Broilers	0.489

CATEGORIES	EF WITHOUT SILAGE FEEDING [kg NMVOC/head/year^{-1}]
Turkeys	0.489
Ducks	0.489
Geese	0.489
Rabbits	0.059

5.8.6.3 Activity data

See **Chapter 5.8.3**.

5.8.6.4 Category-specific recalculations

Recalculations of NMVOC emissions in **3B1a and 3B1b** was done **according to the NECD recommendation A2/SK-3B1-2023-0001 of the SVK NECD Final Review Report2023** correction of the identified issues (missing the $Frac_{silage}$, store parameter). Recalculation of NMVOC leads to an increase in emissions by 0.29% compared to the previous submission (2022). For 3B4h Manure management - Other animals Rabbits for all years, was implemented based on a Tier 1 method available in the 2023 EMEP/EEA Guidebook. Additionally, in the period from 1990 to 2021, revisions in swine categories were made due to changes in the distribution of swine. There was an increase in the number of market swine compared to breeding swine, resulting in a decrease in the overall numbers. Effect of recalculations is shown in ***Table 5.27,*** emission decrease from -2.5% to -13% depending on the year.

Table 5.27: *The impact of recalculations of NMVOC emissions in manure management in 1990–2021*

Category	3B - Manure management - NMVOC [kt]		Interannual difference
Year of submission	2024	2023	
1990	22.17	22.91	-3.2%
1991	16.73	19.23	-13.0%
1992	14.74	16.90	-12.8%
1993	13.04	14.98	-13.0%
1994	12.79	14.65	-12.7%
1995	12.52	14.22	-11.9%
1996	12.16	13.75	-11.6%
1997	12.43	13.79	-9.8%
1998	11.19	12.44	-10.1%
1999	10.57	11.74	-10.0%
2000	10.55	11.72	-10.0%
2001	10.81	11.94	-9.4%
2002	10.40	11.58	-10.1%
2003	9.99	11.10	-10.0%
2004	9.29	10.28	-9.6%
2005	9.30	10.35	-10.2%
2006	8.53	9.40	-9.3%
2007	8.49	9.33	-9.0%
2008	7.99	8.78	-8.9%
2009	8.13	8.82	-7.8%
2010	7.68	8.44	-9.0%
2011	7.56	8.31	-9.1%
2012	7.50	8.26	-9.2%
2013	7.33	8.07	-9.2%
2014	7.21	7.97	-9.5%
2015	7.41	8.22	-9.9%
2016	7.08	7.86	-9.9%

Category	3B - Manure management - NMVOC [kt]		Interannual difference
Year of submission	2024	2023	
2017	7.19	8.00	-10.2%
2018	6.79	7.51	-9.7%
2019	6.57	7.32	-10.3%
2020	6.13	6.86	-10.6%
2021	5.97	6.12	-2.5%

5.9 AGRICULTURAL SOILS (NFR 3D)

Emitted gas: *NH_3, NMVOC, NOx, TSP, PM_{10}, $PM_{2.5}$*
Methods: *Tier 1, Tier 2*
Emission factors: *D*
Key sources: *Yes*
Particular significant subcategories: *Inorganic N-fertilizers, Animal manure applied to the soils*

The NFR sector **3D** contains NH_3 and NOx emissions from Inorganic N-fertilizer (**3Da1**), Animal manure applied to soils (**3Da2a**), Sewage sludge applied to soils (**3Da2b**), Other organic fertilizers applied to soils (**3Da2c**), Urine and dung deposited during grazing (**3Da3**) as well as PM and NMVOC emissions from crop production (**3De**). The emission sources are calculated according to the revised EMEP/EEA GB_{2023} accept 3Da1 Inorganic N-fertilizers. The major reason for the overall decreasing trend is a sharp decrease in the use of synthetic fertilizers in the early 90-ties and the continual decrease in the use of animal manure with the decrease in the number of animals. Since 1999, the trend is stable with small fluctuations caused by changes in animal population and inter-annual changes in categories, **3D1** - Inorganic Nitrogen Fertilizers.

Table 5.28: *NH_3 emissions (kt) in agricultural soils according to the subcategories in particular years*

YEAR	3D NH_3 EMISSIONS FROM MANAGED SOILS [kt]					
	3Da1 INORGANIC-N FERTILIZERS	3Da2a ANIMAL MANURE APPLIED TO SOILS	3Da2b SEWAGE SLUDGE APPLIED TO SOILS	3Da2c OTHER ORGANIC FERTILIZERS APPLIED TO SOILS	3Da3 URINE AND DUNG DEPOSITED BY GRAZING ANIMAL	TOTAL EMISSIONS
1990	7.71	28.54	0.043	0.05	1.99	1.62
1995	2.91	19.27	0.027	0.05	1.37	1.42
2000	3.22	16.06	0.011	0.11	1.15	0.91
2005	4.64	14.46	0.035	0.01	1.06	1.28
2010	4.81	11.86	0.009	0.28	0.98	1.00
2011	5.39	11.52	0.004	0.49	0.97	1.31
2012	5.95	11.60	0.007	0.26	1.01	1.09
2013	6.94	10.99	0.005	0.47	1.00	1.27
2014	7.14	11.39	0.003	0.60	1.02	1.63
2015	6.17	11.50	0.003	0.63	1.01	1.36
2016	8.04	11.07	0.005	0.07	1.00	1.70
2017	9.59	11.08	0.002	0.04	0.98	1.32
2018	9.20	11.68	0.001	0.04	1.02	1.46
2019	9.19	11.22	0.000211	0.27	1.00	1.48
2020	7.50	9.63	0.000004	0.26	0.99	1.58
2021	7.85	7.95	0.000004	0.30	0.99	1.52
2022	6.96	7.83	0.000004	0.31	1.00	1.52

Table 5.29: *NO_x emissions (kt) in agricultural soils according to the subcategories in particular years*

YEAR	3D NOx EMISSIONS FROM MANAGED SOILS [kt]					
	3Da1 INORGANIC-N FERTILIZERS	3Da2a ANIMAL MANURE APPLIED TO SOILS	3Da2b SEWAGE SLUDGE APPLIED TO SOILS	3Da2c OTHER ORGANIC FERTILIZERS APPLIED TO SOILS	3Da3 URINE AND DUNG DEPOSITED BY GRAZING ANIMAL	TOTAL EMISSIONS
1990	8.89	2.93	0.0132	0.03	1.33	13.19
1995	2.78	2.05	0.0083	0.02	0.92	5.79
2000	3.38	1.71	0.0034	0.05	0.77	5.92
2005	3.99	1.53	0.0107	0.01	0.72	6.26
2010	4.26	1.35	0.0027	0.14	0.67	6.42
2011	4.82	1.26	0.0014	0.25	0.67	6.99
2012	4.04	1.31	0.0023	0.13	0.69	6.17
2013	4.54	1.24	0.0015	0.23	0.68	6.70
2014	4.76	1.29	0.0009	0.30	0.70	7.05
2015	4.59	1.30	0.0011	0.31	0.69	6.90
2016	5.05	1.24	0.0015	0.04	0.68	7.01
2017	4.90	1.26	0.0005	0.02	0.67	6.85
2018	5.16	1.32	0.0004	0.02	0.69	7.19
2019	5.14	1.26	0.0001	0.13	0.68	7.21
2020	5.11	1.06	0.000001	0.13	0.67	6.97
2021	5.10	1.02	0.000001	0.15	0.67	6.94
2022	4.61	1.00	0.000001	0.15	0.67	6.43

Figure 5.13: *The share of NH_3 emissions by categories within agricultural soils in 2022*

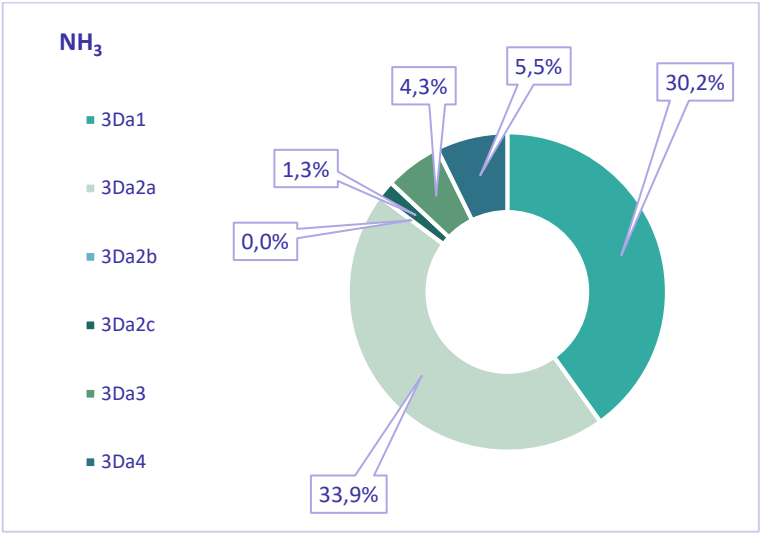
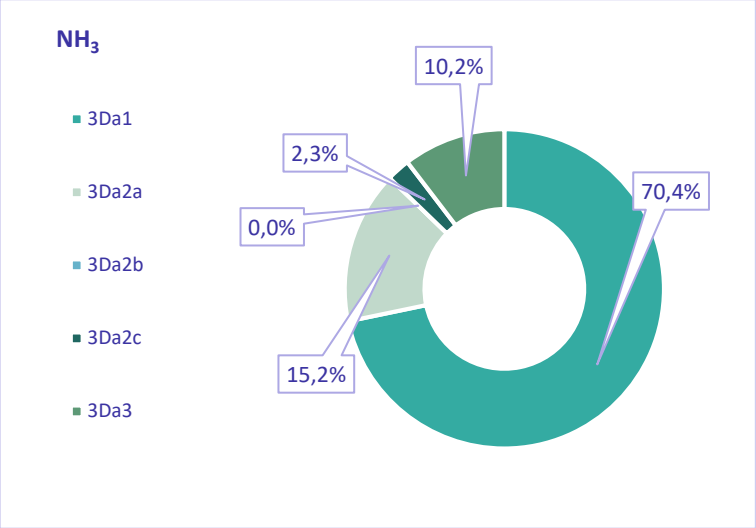


Figure 5.14: *The share of NOx emissions by categories within agricultural soils in 2022*



5.9.1 Activity data

Data of sown areas were taken from the ŠÚ SR. Data is available on 20th May every year (***Table 5.30***).

Table 5.30: *A Sown area in thousand hectares for the years 1990-2022*

YEAR	WHEAT	RYE	OIL PLANTS	GRASS	BARLEY	OAT
	[ha]					
1990	412 423	40 474	67 087	813 000	199 849	14 361
1995	442 874	31 162	87 883	839 025	239 559	13 572
2000	406 400	29 800	178 300	865 222	245 900	22 800
2005	375 801	32 500	215 547	881 283	222 000	24 500
2010	349 700	29 370	280 000	876 484	138 930	17 240
2011	364 000	13 358	261 600	874 224	136 325	16 158
2012	388 700	28 568	225 100	871 338	147 994	15 773
2013	368 200	35 408	254 800	868 171	121 304	13 901
2014	380 200	29 369	243 400	864 681	138 826	15 367
2015	379 400	15 175	247 400	858 601	138 920	16 422
2016	417 700	12 843	254 000	855 882	115 364	14 834
2017	374 781	10 380	292 854	853 757	121 026	15 932
2018	404 014	13 008	282 076	851 685	124 574	14 122
2019	408 168	14 292	259 801	850 600	126 887	12 817
2020	390 872	13 045	269 463	850 027	132 885	13 408
2021	356 969	10 181	289 801	506 922	117 205	16 342
2022	410 247	9 452	295 793	508 950	108 782	10 701
1990/2022	**-1%**	**-77%**	**341%**	**-37%**	**-46%**	**-25%**
2020/2022	**15%**	**-7%**	**2%**	**0%**	**-7%**	**-35%**

5.9.3 Inorganic N Fertilizers (NFR 3Da1)

The applied amounts of synthetic fertilizers into cultivated soils were very low in the last 15 years. At present, the consumption of synthetic fertilizers applied to agricultural soils increased again. This fact is the main driver in increasing emissions in the sector. The potential for the volatilization of ammonia emissions can vary in a very large range. The best information on NH_3 emissions from cultivated soils in the Slovak Republic is based on applied nitrogen fertilizers. Emissions also depend on the type of fertilizers, soil parameters (pH), meteorological conditions and time of fertilizers' application concerning crop development. Applied nitrogen fertilizers were provided by the ŠÚ SR.

5.9.3.1 Activity data

Activity data on synthetic fertilizers consumption is based on the combination of two databases. IFASTAT and database by the Central Control Testing and Testing Institute (UKSÚP). The national total of nitrogen from fertilizers was used from the UKSÚP and the distribution of type of fertilizers was taken from the IFASTAT (1990-2017). The data was disseminated according to Act No 202/2008 Coll. on fertilizers. The farmers have obligatory to report the amount of applied fertilizers to the UKSÚP each year. The UKSÚP as admin of databases made validation each year.

The consumption of synthetic fertilizers decreased during the last decade of the 20th century, from 222 kt in 1990 to 115.4 kt in 2022 (-48%). Consumption of synthetic fertilizers increased by +16% in 2022 compared with 2005 and then decreased by almost -10 % in comparison with the year 2021. Decreasing numbers of domestic livestock caused the demand for inorganic nitrogen to be bigger. Missing organic nitrogen compensates for a higher consumption of synthetic fertilizers.

Table 5.31: *Input parameters in 3Da1 Inorganic N fertilizers*

YEAR	TYPE OF FERTILIZERS [*t*]									
	AMMONIUM NITRATE	AMMONIUM SULPHATE	CALC. AMM. NITRATE	NITROGEN SOLUTIONS	OTHER N STRAIGHT	UREA	AMMONIUM PHOSPHATE	NK COMPOUND	NPK COMPOUND	OTHER NP
1990	8	22 156	55 114	1 731	NO	8 239	1 939	NO	49 220	500
1995	16 000	6 100	24 200	7 600	NO	3 787	NO	NO	11 400	500
2000	2 200	4 900	29 000	10 000	8 700	3 553	900	11 956	12 600	800
2005	3 000	10 000	31 000	9 000	NO	8 317	5 000	18 443	15 000	NO
2010	4 000	9 000	33 000	2 000	NO	11 873	1 000	19 640	26 000	NO
2011	2 000	1 000	40 000	17 000	6 000	13 969	1 000	27 586	12 000	NO
2012	NO	1 000	41 000	18 000	7 000	19 004	1 000	NO	12 000	2 000
2013	NO	2 000	45 000	18 000	12 000	25 581	1 000	NO	10 000	NO
2014	2 000	2 000	45 000	15 000	15 000	28 036	1 000	NO	10 000	1 000
2015	2 000	1 300	44 000	17 000	14 000	19 473	1 000	NO	14 000	2 000
2016	2 000	1 600	42 800	18 100	13 600	30 536	3 300	NO	12 300	2 000
2017	NO	2 000	40 000	23 600	NO	37 741	1 600	900	12 000	4 700
2018	1 100	1 103	31 983	16 463	25 966	41 299	1 125	NO	9 939	NO
2019	880	1 365	34	16 814	53 258	39 779	1 717	3 348	10 982	355
2020	1 413	1 346	85	NO	75 610	39 434	NO	NO	9 461	328
2021	1 394	1 744	34 465	40	34 138	40 615	0	18	11 193	3 888
2022	714	1 393	32 489	0	31 181	35 930	0	32	10 090	3 517

5.9.3.2 Methodological issues

NH_3 emissions from Inorganic-N fertilizers were calculated using the Tier 2 methodology according to the EMEP/EEA GB_{2019}. To reflect average Slovak conditions, the emission factors for a cool climate and a pH value lower than 7 were chosen. NOx was calculated using the simpler Tier 1 methodology. Slovakia still use emission factors from previous version of EMEP/EEA guideline.

In previous version of guideline the seasonal distribution of fertilisers of different types, and obtaining the weather data for the different seasons were implemented. In new version of guidebook, the weather variables from the Tier 2 methodology were omitted, therefore it was decided to estimated emission with previous version of emission factors.

Table 5.32: *Emission factors per fertilizers type*

TYPE OF FERTILIZERS	EMISSION FACTOR FOR NORMAL PH [g NH_3 (kg N applied)$^{-1}$)]
Ammonium nitrate (AN)	15

TYPE OF FERTILIZERS	EMISSION FACTOR FOR NORMAL PH [g NH_3 (kg N applied)$^{-1}$)]
Ammonium sulphate (AS)	90
Calcium ammonium nitrate (CAN)	8
N solutions	98
Other straight N compounds	10
Urea	155
Ammonium phosphates (AP)	50
NK Mixtures	15
NPK Mixtures	50
NP Mixtures	50

Table 5.33: *Input parameters and EFs in 3Da1 Inorganic N fertilizers in particular years*

YEAR	NITROGEN INPUT INTO SOILS	EMISSION FACTOR NH_3	EMISSION FACTOR NO_x	EMISSIONS NH_3	EMISSIONS NO_x
	[kg/year]	[kg NH_3/kg N]	[kg NOx/kg N]	[kt]	[kt]
1990	222 255 000	0.03	0.04	7.71	8.89
1995	69 587 000	0.04	0.04	2.91	2.78
2000	84 609 000	0.04	0.04	3.22	3.38
2005	99 760 000	0.05	0.04	4.64	3.99
2010	106 513 000	0.05	0.04	4.81	4.26
2011	120 555 000	0.04	0.04	5.39	4.82
2012	101 004 000	0.06	0.04	5.95	4.04
2013	113 581 390	0.06	0.04	6.94	4.54
2014	119 036 050	0.06	0.04	7.14	4.76
2015	114 773 000	0.05	0.04	6.17	4.59
2016	126 235 769	0.06	0.04	8.04	5.05
2017	122 541 152	0.08	0.04	9.59	4.90
2018	128 976 885	0.07	0.04	9.20	5.16
2019	128 532 971	0.07	0.04	9.19	5.14
2020	127 676 520	0.06	0.04	7.50	5.11
2021	127 494 597	0.06	0.04	7.85	5.10
2022	115 346 776	0,06	0,04	6.96	4.61
1990/2022	**-48%**			**-10%**	**-48%**
2020/2022	**-9,5%**			**-11,3%**	**-9,5%**

5.9.4 Animal Manure applied to the soils (NFR 3Da2a) NH_3, NO_x, NMVOC

Livestock numbers and information on animal waste management systems are described in **Chapters 5.8.1** and **5.8.3**. This application is connected with the utilization of NH_3, PMs, NMVOC, N_2O and NOx losses. A detailed description of the methods applied for the calculation of N_2O emissions is given in the report "Slovak Republic National Inventory Report 2022" – Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol". For this calculation was applied country-specific methodology.

At application evaporate around 50% of ammonia. During this operation are the highest emissions of ammonia. It is a key source of emissions. During application (spreading) is formed on the field's huge evaporating surface. Emissions are highest in the windy, hot weather and high humidity and permeability of the soil.

Each farmer should directly apply manure to the soil as quickly as possible. After the direct incorporation of manure into soils, the ammonia losses are reduced. The crops have sufficient nitrogen for growth. The Ministry of Agriculture and Rural Development issued Regulation Decree No 410/2012 Coll. ordering the solid into the soil organic fertilizers in 48 hours, and the liquid from arable land to 24 hours after application. This regulation is rather to prevent rafting fertilizers into surface waters to prevent the escape of ammonia because ammonia

emissions are substantial immediately after application. The first 6 hours after application evaporate 50% ammonia, and then emissions decreased.

5.9.4.1 Activity data

See **Chapter 5.8.3**.

5.9.4.2 Methodological issues-Method-NH3, NO_x

Default NH_3 emission factors of the EMEP/EEA GB_{2023} for spreading of slurry and solid manure were applied in the proportion of total ammoniacal nitrogen (TAN) according to ***Table 3.9*** p 29 of EMEP/EEA GB_{2023} in 1990-2005. In 2006, the abatement technology was applied mainly through deep injection, incorporation within 12 hours and 24 hours and furrow injections. The default emission factors were modified with the implementation of penetration parameters as a share of farms where abatement technology was used and abatement efficiency. The result is the country-specific emission factors, which are lower than default approximately about -10%.

Table 5.34: *EFs of ammonia in 3Da2a Animal applied to the soils per animal species in particular years*

SPECIFIC EFS	DAIRY CATTLE	NON-DAIRY CATTLE	POULTRY	HORSES	BREEDING SWINE	FATTENING SWINE
YEARS	LIQUID [kg NH_3/kg N]					
2006	0.4897	0.4903	NO	NO	0.2585	0.3569
2007	0.4889	0.4902	NO	NO	0.2582	0.3577
2008	0.4868	0.4877	NO	NO	0.2557	0.3547
2009	0.4857	0.4865	NO	NO	0.2559	0.3537
2010	0.4853	0.4873	NO	NO	0.2536	0.3527
2011	0.4851	0.4871	NO	NO	0.2534	0.3536
2012	0.4850	0.4873	NO	NO	0.2533	0.3541
2013	0.4851	0.4879	NO	NO	0.2548	0.3544
2014	0.4854	0.4884	NO	NO	0.2557	0.3565
2015	0.4862	0.4891	NO	NO	0.2564	0.3562
2016	0.4864	0.4889	NO	NO	0.2563	0.3568
2017	0.4873	0.4903	NO	NO	0.2565	0.3582
2018	0.4886	0.4909	NO	NO	0.2571	0.3576
2019	0.4889	0.4919	NO	NO	0.2570	0.3564
2020	0.4889	0.4918	NO	NO	0.2580	0.3569
2021	0.3806	0.3902	NO	NO	0.2013	0.2742
2022	0.3625	0.3853	NO	NO	0.1843	0.3226

Table 5.35: *EFs of ammonia in 3Da2a Animal applied to the soils per animal species in particular years*

SPECIFIC EFS	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
YEARS	SOLID [kg NH_3/kg N]										
2006	0.6055	0.6062	0.3591	0.4377	0.4179	0.5014	0.5014	NO	NO	0.4012	0.4016
2007	0.6045	0.6060	0.3636	0.4397	0.4250	0.5100	0.5100	0.7650	0.4006	0.4024	0.7996
2008	0.6016	0.6026	0.3663	0.4402	0.4200	0.5040	0.5040	0.7650	0.3974	0.3989	0.8005
2009	0.6006	0.6013	0.3669	0.4395	0.4313	0.5175	0.5175	0.7650	0.3977	0.3978	0.8055
2010	0.6004	0.6024	0.3660	0.4403	0.4260	0.5112	0.5112	0.7560	0.3947	0.3960	0.7906
2011	0.6006	0.6025	0.3668	0.4366	0.4275	0.5130	0.5130	0.7550	0.3935	0.3968	0.7872
2012	0.6008	0.6027	0.3661	0.4369	0.4318	0.5181	0.5181	0.7605	0.3935	0.3978	0.7771
2013	0.6010	0.6036	0.3653	0.4297	0.4262	0.5114	0.5114	0.7581	0.3959	0.3984	0.7811
2014	0.6014	0.6040	0.3667	0.4327	0.4331	0.5198	0.5198	0.7463	0.3975	0.4008	0.7768
2015	0.6026	0.6049	0.3684	0.4381	0.4395	0.5274	0.5274	0.7479	0.3983	0.4005	0.7847

SPECIFIC EFS	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
YEARS	SOLID [kg NH_3/kg N]										
2016	0.6029	0.6047	0.3683	0.4398	0.4420	0.5304	0.5304	0.7577	0.3977	0.4009	0.7872
2017	0.6029	0.6047	0.3683	0.4398	0.4420	0.5304	0.5304	0.7577	0.3977	0.4009	0.7872
2018	0.6062	0.6074	0.3687	0.4408	0.4410	0.5292	0.5292	0.7926	0.3995	0.4036	0.7976
2019	0.6065	0.6088	0.3687	0.4412	0.4373	0.5247	0.5247	0.8013	0.3994	0.4023	0.8010
2020	0.6066	0.6087	0.3678	0.4418	0.4347	0.5217	0.5217	0.8071	0.4003	0.4028	0.8038
2021	0.4765	0.4844	0.3438	0.4268	0.4026	0.4832	0.4832	0.6955	0.3143	0.3126	0.6731
2022	0.4604	0.4786	0.3718	0.4252	0.3649	0.3506	0.5399	0.6775	0.3284	0.3629	0.8438

The default NOx emission factor of the EMEP/EEA GB_{2023} for spreading was used. NH_3 emissions were calculated using the nitrogen flow approach similarly, to the calculation of EFs for emissions from housing and storage.

5.9.4.3 Methodological issues-Method- NMVOC

Cattle

All references for calculation are in **Chapter 5.8.6.2**. Used notation key IE.

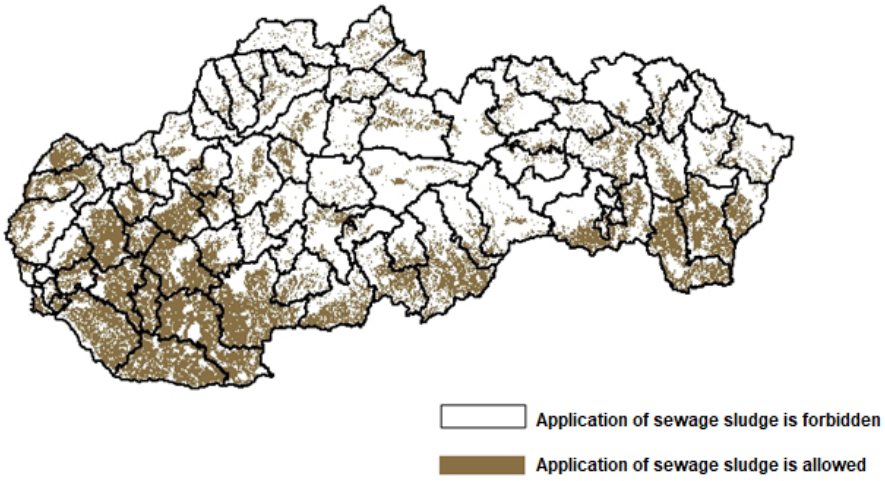
5.9.5 Sewage sludge applied to Soils (NFR 3Da2b)

The reduction of organic matter in the soil is dependent on the continuous decline of livestock production. The decrease in the number of organic fertilizers causes pressure to find alternative sources of organic fertilizers. Sewage sludge is one of the ways to resolve this issue. Sludge is a potential source of nutrients and organic matter. Sewage sludge must be stabilized and afterwards applied to the soils. Sludge must be treated biologically, chemically or by heat, long-term storage or any other appropriate process. These processes cause a significant reduction in health risks and save the environment. Act No 188/2003 Coll. regulates the application of sludge to agricultural soils. Sludge from domestic or urban treatment plants can be applied to agricultural soils. Application of other sludge is prohibited by Slovak law.

5.9.5.1 Activity data

Activity data on sewage sludge consumption in agriculture (***Table 5.36***) is based on the data provided by the Water Research Institute (WRP) (applied sludge from municipal wastewater treatment plants) and the Ministry of Environment of the Slovak Republic (Industrial sludge). The WRP collects data on nitrogen inputs (bottom-up approach) into the soils. The Water Research Institute informed, that municipal sewage sludge was not applied to agricultural soils in the years 2015 – 2022, therefore notation key NO was used. The data are consistent between the **Waste sector**. Missing data were extrapolated to enhance completeness before the year 2003 (municipal sewage sludge) and 2002 (Industrial sewage sludge), due to unavailable statistics. The percentage of pure nitrogen from sewage sludge was provided by the Guidelines for the Sewage Sludge Application by the Soil Science and Conservation Research Institute. Based on the presented publication, the sludge contains 3.31% nitrogen.

Figure 5.15: *The map of sensitive parts of Slovakia where sludge cannot be applied*



5.9.5.2 Methodological issues - Method-NH_3, NOx

Default methodology Tier 1 and default emission factors were used for the estimation of direct NH_3 and NOx emissions from sewage sludge applied to soils. The methodology was following the EMEP/EEA GB_{2023}. The Percentage of pure nitrogen in sewage sludge was provided by the Soil Science and Conservation Research Institute.[3] Emissions were estimated using these equations:

$$A_{\text{sewage sludge}} = N_{\text{sewage sludge}} * P_N$$
$$NO_{\text{sewage sludge}} = A_{\text{sewage sludge}} * EF_{NO}$$
$$NH_{3\,\text{sewage sludge}} = A_{\text{sewage sludge}} * EF_{NH3}$$

Where: $NH_{3\ \text{sewage sludge}}$, $NO_{\text{sewage sludge}}$: Emissions from sewage sludge applied into the soil in kg. $N_{\text{Sewage sludge}}$: the amount of sludge from wastewater treatment in kg. P_N: Weight percentage of nitrogen from sewage sludge (3.31%)., EF_{NO}, NH3: Emissions factors for NH_3 and NO kg NO respectively NH_3.

Table 5.36: *Input parameters and EFs in 3Da2b - Sewage Sludge in particular years*

YEAR	MUNICIPAL SLUDGE	INDUSTRIAL SLUDGE	INPUT INTO SOIL	N-INPUT FROM SEWAGE SLUDGE	EMISSIONS NH_3	EMISSIONS NO_X
	[t]	[t]	*t*	*kg*	[kt]	[kt]
1990	6 832	3 160	9 992	330 732	0.0430	0.0132
1995	4 043	2 251	6 294	208 345	0.0271	0.0083
2000	1 254	1 342	2 597	85 957	0.0112	0.0034
2005	5 870	2 231	8 101	268 144	0.0349	0.0107
2010	923	1 102	2 025	67 023	0.0087	0.0027
2011	358	685	1 043	34 536	0.0045	0.0014
2012	1 254	478	1 732	57 340	0.0075	0.0023
2013	518	627	1 145	37 900	0.0049	0.0015
2014	8	688	696	23 021	0.0030	0.0009
2015	0	813	813	26 899	0.0035	0.0011
2016	0	1 134	1 134	37 523	0.0049	0.0015
2017	0	362	362	11 987	0.0016	0.0005
2018	0	287	287	9 513	0.0012	0.0004
2019	0	49	49	1 620	0.0002	0.0001
2020	NO	1	1	32	0.000004	0.000001
2021	NO	1	1	33	0.000004	0.000001

[3] *Guideline for sewage sludge application (In Slovak):*http://www.vupop.sk/dokumenty/prv/prirucka_pre_aplikaciu_kalu.pdf

YEAR	MUNICIPAL SLUDGE	INDUSTRIAL SLUDGE	INPUT INTO SOIL	N-INPUT FROM SEWAGE SLUDGE	EMISSIONS NH_3	EMISSIONS NO_X
	[t]	[t]	*t*	*kg*	[kt]	[kt]
2022	NO	1	1	33	0.000004	0.000001

5.9.6 Other Organic Fertilizers Applied to Soils (NFR 3Da2c)

Emissions of NH_3 and NOx from compost applied to soils contributed less than 1% to the emissions from agricultural soils in 2021.

5.9.6.1 Activity data

Other organic fertilizers applied to soils include composted waste, digested slurry from digesters, compost and vitahlum, natural harmony and green fertilizers. The Consumption is provided with the total amount of organic waste in soils (**OW**) and the data (***Table 5.38***) is provided by the UKSÚP. The Data are converted into nitrogen content (**NC**). Conversion factors are presented in ***Table 5.37***.
Data is available from 2000 to 2022. Other organic nitrogen fertilizers were applied to the soil even before the year 2000, but there are no available statistics. Missing data was extrapolated by linear extrapolation in Excel spreadsheets.

Table 5.37: *Share pure nitrogen from other nitrogen fertilizers in %*

TYPE OF FERTILIZERS	P_N	SOURCES
	%	
Fugate	0.92	*https://nasepole.sk/digestat-vo-vyzive-a-hnojeni-repky/*
Compost	0.7	*ÚKSÚP*
Natural harmony (organic waste from pharmaceutical production[4]	1	*ÚKSÚP*
Hay	8.2	*https://nasepole.sk/dusikate-hnojenie-po-zbere-obilnin/*
Vitahum (organic - humus fertilizer made from natural substances)[5]	1	*ÚKSÚP*
Green fertilizers	1	*ÚKSÚP*

Table 5.38: *Input parameters in the category 3D12c - Other Organic Fertilizers applied to soils*

YEAR	FUGATE		COMPOST		NATURAL HARMONY		HAY		VITAHLUM		GREEN FERTILIZERS	
	OW	NC	OW	NC	OW	NC	OW	NC	OW	NC	OW	NC
	[t]											
1990	0	0	33 430	234	0	0	0	0	28 290	283	12 013	120
1991	0	0	34 303	336	0	0	0	0	26 501	265	11 752	118
1992	0	0	35 177	246	0	0	0	0	24 713	247	11 492	115
1993	0	0	36 050	252	0	0	0	0	22 924	229	11 231	112
1994	0	0	36 924	362	0	0	0	0	21 136	211	10 970	110
1995	0	0	37 797	265	0	0	0	0	19 348	193	10 709	107
1996	0	0	38 671	271	0	0	0	0	17 559	176	10 449	104
1997	0	0	39 544	388	0	0	0	0	15 771	158	10 188	102
1998	0	0	40 418	283	0	0	0	0	13 982	140	9 927	99
1999	0	0	41 291	289	0	0	0	0	12 194	122	9 666	97
2000	0	0	74 923	734	0	0	0	0	50 641	506	10 245	102
2001	0	0	40 885	286	0	0	0	0	54 338	543	18 285	183

[4] https://www.biotika.sk/

[5] http://www.eba.sk/substraty-a-vyrobky/volne-lozene-vyrobky/

YEAR	FUGATE		COMPOST		NATURAL HARMONY		HAY		VITAHLUM		GREEN FERTILIZERS	
	OW	NC	OW	NC	OW	NC	OW	NC	OW	NC	OW	NC
	[t]											
2002	0	0	36 422	255	0	0	0	0	42 810	428	10 920	109
2003	0	0	34 225	240	0	0	0	0	9 321	93	6 206	62
2004	0	0	42 904	300	0	0	0	0	2 845	28	18 990	190
2005	0	0	7 006	49	0	0	0	0	3 552	36	5 905	59
2006	0	0	13 878	97	0	0	0	0	10 828	108	7 006	70
2007	0	0	21 762	152	0	0	8 868	727	8 758	88	3 540	35
2008	0	0	21 317	149	0	0	90 977	7 460	7 185	72	13 534	135
2009	0	0	25 364	178	0	0	68 637	5 628	195	2	16 642	166
2010	0	0	40 097	281	0	0	36 774	3 015	4 999	50	11 956	120
2011	0	0	50 583	354	5 367	54	66 704	5 470	2 261	23	25 837	258
2012	108 181	995	18 291	128	7 132	71	25 020	2 052	0	0	1 401	14
2013	301 580	2 775	63 145	442	5 896	59	30 698	2 517	500	5	2 547	25
2014	382 111	3 515	85 907	601	1 693	17	40 912	3 355	0	0	6 375	64
2015	543 489	5 000	90 967	637	555	6	26 554	2 177	1 015	10	4 036	40
2016	388 174	577	46 701	318	0	0	0	0	0	0	0	0
2017	32 517	163	46 649	327	0	0	0	0	17 928	36	0	0
2018	28 406	102	43 257	411	0	0	0	0	1 345	23	0	0
2019	776 427	3 057	37 618	300	0	0	0	0	0	0	0	0
2020	800 393	2 936	43 557	250	0	0	0	0	0	0	34 089	83
2021	796 945	3 347	60 047	401	0	0	0	0	0	0	0	0
2022	36 992	3 403	5 978	418	0	0	0	0	0	0	0	0

5.9.6.2 Methodological issues – Methods – NO_x, NH_3

Default methodology Tier 1 according to EMEP/EEA GB_{2023} and default emission factor (0.08 kg NH_3 kg^{-1} waste N applied and 0.04 kg.NO) were used for the estimation of NOx, and NH_3 emissions from compost applied to soils. The percentage of nitrogen in used compost was provided by the Soil Science and Conservation Research Institute.[6] Amount of compost applied to soils provided by the UKSÚP. Emissions were estimated using these equations:

$$A_{compost} = N_{compost} * P_N$$

$$NO_{compost} = A_{compost} * EF_{NO}$$

$$NH_{3\ compost} = A_{compost} * EF_{NH_3}$$

Where: $N_{compost}$ is the input of pure nitrogen in compost applied to the soil in kg, $N_{compost}$ is the amount of compost from the composting plant, P_N is 1 tonne of compost = 7 kg N

Table 5.39: *Emission factors and emissions in 3Da2c - Other organic fertilizers applied to soils*

YEARS	EMISSION FACTORS NH_3	EMISSION FACTORS NOx	EMISSIONS NH_3	EMISSIONS NOx
	[kg NH_3/kg N]	[kg NOx/kg N]	[kt]	[kt]
1990	0.08	0.04	0.0510	0.0255
1995	0.08	0.04	0.0452	0.0226
2000	0.08	0.04	0.1074	0.0537
2005	0.08	0.04	0.0115	0.0057
2010	0.08	0.04	0.2773	0.1386
2011	0.08	0.04	0.4927	0.2463
2012	0.08	0.04	0.2608	0.1304

[6] *Guideline for sewage sludge application (In Slovak):*http://www.vupop.sk/dokumenty/prv/prirucka_pre_aplikaciu_kalu.pdf

YEARS	EMISSION FACTORS NH_3	EMISSION FACTORS NOx	EMISSIONS NH_3	EMISSIONS NOx
	[kg NH_3/kg N]	[kg NOx/kg N]	[kt]	[kt]
2013	0.08	0.04	0.4659	0.2329
2014	0.08	0.04	0.6042	0.3021
2015	0.08	0.04	0.6296	0.3148
2016	0.08	0.04	0.0716	0.0358
2017	0.08	0.04	0.0420	0.0210
2018	0.08	0.04	0.0428	0.0214
2019	0.08	0.04	0.2685	0.1343
2020	0.08	0.04	0.2615	0.1308
2021	0.08	0.04	0.2999	0.1499
2022	0.08	0.04	0.3057	0.1529
1990/2022	-	-	**500%**	**500%**
2020/2022	-	-	**2%**	**2%**

5.9.7 Urine and dung deposited by grazing animals (NFR 3Da3)

Pasture is typical for some livestock categories. Animals such as sheep, goats, horses and some subcategories of cattle are mainly grazed during spring, summer, and autumn in the small farms. Animals are in their winter grounds during the winter.

It is supposed that sheep, goats, and horses can stay on pasture for 200 days, but 41% of non-dairy cattle stay only for 150 days. Results of the analysis of AWMS were used for the calculation of nitrogen input from animal husbandry into N-cycle. Emissions from pasture were based on the proportion of the pasture for housing that was made by the NPPC - VÚŽV. The proportion of the pasture for the category of animals is demonstrated in ***Table 5.18***.

5.9.7.1 Activity data

This analysis was based on the questionnaires from 222 agricultural subjects (21.3% of total subjects in Slovakia). These subjects cultivated 14.7% of total agricultural land and 15.2% of arable land. The duration of the grazing period can vary significantly depending on weather conditions in different parts of the Slovak Republic. Reliable data for statistical evaluation is not available, but significant differences can be found in this regard. NH_3 and NOx emissions from pasture were based on the proportion of the pasture for housing that was made by the NPPC - VÚŽV. Activity data is summarized in ***Table 5.11-5.14***. Activity data in this category are consistent with the activity data used for estimation in category **3B** - Manure Management.

5.9.7.2 Methodological issues – Methods –NH_3, NO_x

The estimation of NH_3 and NOx from pasture is based on the Tier 2 method according to the EMEP/EEA GB_{2023}. The emission of urine and dung deposited by grazing animals is based on nitrogen excreted from farm animals, the number of days the animals are on the pasture and the emission factors.

Table 5.40: *Input parameters, EFs and emissions in 3Da3- Urine and dung deposited by grazing animals*

YEARS	NITROGEN EXCRETED DURING PASTURE	IMPLIED EMISSION FACTORS NH_3	IMPLIED EMISSION FACTORS NOx	EMISSIONS NH_3	EMISSIONS NOx
	[kg/year]	[kg NH_3/kg N]	[kg NOx/kg N]	[kt]	[kt]
1990	16 741 674	0.119	0.080	1.987	1.335
1995	13 667 241	0.100	0.068	1.370	0.925
2000	11 001 614	0.105	0.070	1.150	0.772
2005	10 856 112	0.098	0.066	1.063	0.716
2010	11 654 140	0.084	0.058	0.977	0.671

YEARS	NITROGEN EXCRETED DURING PASTURE	IMPLIED EMISSION FACTORS NH_3	IMPLIED EMISSION FACTORS NOx	EMISSIONS NH_3	EMISSIONS NOx
	[kg/year]	[kg NH_3/kg N]	[kg NOx/kg N]	[kt]	[kt]
2011	11 583 930	0.084	0.058	0.972	0.667
2012	12 025 110	0.084	0.057	1.006	0.691
2013	12 107 574	0.082	0.056	0.995	0.683
2014	12 407 007	0.082	0.056	1.019	0.697
2015	12 435 605	0.081	0.055	1.009	0.690
2016	12 340 398	0.081	0.055	1.001	0.684
2017	12 142 924	0.080	0.055	0.976	0.668
2018	12 690 648	0.081	0.055	1.022	0.694
2019	12 551 244	0.080	0.054	1.005	0.680
2020	12 368 986	0.080	0.054	0.993	0.667
2021	12 660 424	0.079	0.053	0.994	0.666
2022	12 747 643	0.078	0.052	0.997	0.668

5.9.7.3 Methodological issues –Methods - NMVOC

Cattle

All references for calculation are in **Chapter 5.8.6.2**. The used notation key is IE.

5.9.8 Crop Residue (NFR 3Da4)

Directly after incorporation of the crop residues into the soil, the multilateral interactions between organic compounds and nutrients present in the residues with the mineral and organic components of soil take place. The knowledge of nutrient potential in crop residues by crop rotation are mostly actual in the present requirements of sustainable land use - greening in plant production. Incorporation of the crop residues into the soil is used as sustainable agricultural practice, due to high nutrition potential.

Table 5.41: *Input parameters and EFs in the category 3.D.1.4 - Crop Residue in particular years*

YEAR	HARVESTED AREA	CROP (T)	CROP RESIDUES	NH_3 EMISSIONS
	ha	*kg d.m/ha*	*kg N/year*	*Gg*
1990	2 147 737	67 462	78 466 264	0.617
1995	2 152 852	63 386	65 755 818	0.517
2000	2 080 004	45 812	40 680 816	0.320
2005	1 721 125	68 071	58 191 208	0.457
2010	1 617 786	54 870	44 086 328	0.346
2011	1 680 333	71 666	58 053 855	0.456
2012	1 703 613	63 316	49 566 275	0.389
2013	1 716 326	63 796	56 186 635	0.441
2014	1 745 299	79 312	72 472 343	0.569
2015	1 728 043	66 540	60 237 610	0.473
2016	1 717 480	85 743	75 505 655	0.593
2017	1 722 049	67 595	58 749 087	0.462
2018	1 725 424	76 863	64 962 867	0.510
2019	1 750 468	76 280	65 934 371	0.518
2020	1 736 499	81 026	70 272 930	0.552
2021	1 741 541	74 003	66 749 560	0.524
2022	2 444 976	62 543	70 397 463	0.553

Total NH_3 emissions from crop residues represented 1.24 Gg of NH_3 from 30 517 283 kg of nitrogen in crop residues returned to soils in 2022. Total harvested area (wheat, ray, barley, oat, maize, potato, sugar beet, oil plants, tobacco, maize for silage, leguminous, fodder leguminous, soya, meadows) decreased in comparison with the previous year (-0.5%). In 2022, harvested area was 1 733 kha.

Methodological issues – method

According to the 2023 EMEP/EEA GB, nitrogen input from crop residues was estimated used by equation p.18.

There is no comprehensive survey on the amount of crop residues burned as fuel in the Slovak Republic. Therefore, no removal from the burning of fuel was assumed. Also, data on fraction of above-ground residues of crop removed annually for a purpose such as feed bedding and construction is not available. The seams and leaves are usually utilized as a fodder of domestic livestock. Data on straw exported abroad are missing.

Country specific nutrition potential: The country specific value for sugar beet regarding potential nitrogen nutrition was considered instead of the IPCC default method which is not accurate for the Slovak conditions. According to the national publication Postharvest residues of sugar beet and their role in the nutrient cycle by Stanislav Torma, 20 kg N/ha for sugar beet was taken as country specific value. The default values were considered for other crops. The values are presented in ***Table 5.42***.

Table 5.42: *Parameters used to estimate emissions from crop residues*

CROP TYPE	$N_{(AG)}$	SLOPE	INTERCEPT	$RAG_{(T)a}$	DRY MATTER FRACTION OF HARVESTED PRODUCTS (DRY)	NUTRITION POTENTIAL IN CROP RESIDUES
	kg N (kg d.m.)$^{-1}$			kg d.m. (kg d.m.)$^{-1}$		*kg N/ha*
Wheat	0.006	1.510	0.520	1.300	0.890	-
Rye	0.005	1.090	0.880	1.600	0.880	-
Barley	0.007	0.980	0.590	1.200	0.890	-
Oat	0.007	0.910	0.890	1.300	0.890	-
Maize	0.006	1.030	0.610	1.000	0.870	-
Potato	0.019	0.100	1.060	0.400	0.220	-
Sugar beet	-	-	-	0.000	-	20
Oil plants	0.008	1.130	0.850	1.000	0.850	-
Tobacco	0.008	0.300	0.000	1.000	0.850	-
Maize for silage	0.006	0.000	0.000	1.000	0.870	-
Meadows	0.015	0.300	0.000	0.300	0.900	-
Peas	0.008	1.130	0.850	2.100	0.910	-
Lens	0.008	1.130	0.850	2.100	0.910	-
Beans	0.008	1.130	0.850	2.100	0.910	-
Other leguminous plants	0.027	0.300	0.000	2.100	0.900	-
Soya	0.008	0.930	1.350	0.300	0.910	-
Clover	0.025	0.300	0.000	0.300	0.900	-
Alfaalfa	0.027	0.290	0.000	0.300	0.900	-

Country specific $FRAC_{Remove}$: Slovak inventory uses a N-flow approach to calculate the emissions from 3.B and 3.D, which is in line with the IPCC Guidelines, the N_2O emissions from straw used for bedding is reported in CRF 3.D.a.2 Animal manure applied to soils, and this amount of N was taken into account in the value of $Frac_{Remove}$. The value of $Frac_{Remove}$ was calculated for all year from the N content of straw used for bedding divided by the sum of the N content of the above-ground biomass of grain crops of which straw is used for bedding (wheat, barley, rye and oats). The amount of straw used as bedding material was taken from Articles: Livestock breeding by Vojtech Brestenský and Storage of agricultural fertilizers by Vojtech Brestenský (in Slovak) and Removal and

storage of fertilizers by Vojtech Brestenský (in Slovak). Publications were provided litter requirements per species and categories per day in kilograms. Nitrogen input from straw was not available in presented publications. Nitrogen input from straw was taken from article Nitrogen fertilization after harvesting cereals by Štefan Gáborík (in Slovak). In aforementioned article, average nitrogen inputs from straw in selected cereals (wheat, barley) were estimated as 0.82%. $Frac_{Remove}$ parameter for silage maize was implemented while only below-ground biomass was considered. It is assumed, that maize for silage is used for fodder purpose in Slovakia.

The amount of forage consumed by livestock was removed from below-ground biomass in meadows. Maize for silage is using for biogas production in biogas stations. Based on expert judgement of ERT and country expert judgement $Frac_{Remove}$ for maize is 1. According to the publication Guidelines for the support for selected non-projects measures, the farmer is obliged to maintain agricultural areas in a condition suitable for grazing or cultivation in accordance with § 5 of the SR Government Regulation no 342/2014 Coll. Areas of permanent grassland or meadows must be managed in accordance with agro-technical practice. For areas of meadows, this means maintaining all areas by mowing, grazing and additionally by mulching according to altitude and in following terms: Mowing 4 times per year from 0-800 meters above sea level, grazing 4 times per year from 0-800 meters above sea level and mulching as well. Based on presented information, it was impossible to derivate share for $Frac_{Remove}$. The review analysis of inventories was done and only in Polish inventory $Frac_{Remove}$ parameter was derivated. Poland is neighbouring country with similar agricultural conditions and value was taken into Slovak inventory. Used $Frac_{Remove}$ and $Frac_{Incorp}$ values are presented in *Tables 5.43* and *5.44*.

Table 5.43: *Parameters used to estimate emissions from crop residues*

TYPE OF CROP	$FRAC_{Incorp}$	$FRAC_{Remove}$
WHEAT	0	0.163
RYE	0	0.163
BARLEY	0	0.163
OAT	0	0.163
MAIZE	0	0
POTATO	0	0
SUGAR BEET	0	0
OIL PLANTS	0	0
TOBACCO	0	0
MAIZE FOR SILAGE	0	1
MEADOWS	0	0.95
PEAS	0	0
LENS	0	0
BEANS	0	0
OTHER LEGUMINOUS PLANTS	0	0
SOYA	0	0
CLOVER	0	0
ALFALFA	0	0

Table 5.44: *Nitrogen in bedding materials and $Frac_{Remove}$ in particular years*

YEAR	N INPUT FROM BEDDING MATERIALS	N CONTENT OF ABOVE-GROUND BIOMASS OF GRAIN CROPS USED AS BEDDING MATERIAL	$Frac_{Remove}$ (WHEAT, BARLEY, RYE, OAT)
	kg		*%*
1990	415 531	6 167 765	6.74
1995	319 525	5 038 292	6.34
2000	309 934	3 677 159	8.43
2005	299 021	2 921 960	10.23

YEAR	N INPUT FROM BEDDING MATERIALS	N CONTENT OF ABOVE-GROUND BIOMASS OF GRAIN CROPS USED AS BEDDING MATERIAL	$Frac_{Remove}$ (WHEAT, BARLEY, RYE, OAT)
	kg		*%*
2010	233 091	1 961 914	11.88
2011	190 096	1 657 890	11.47
2012	202 753	1 789 406	11.33
2013	192 604	1 779 498	10.82
2014	226 830	1 780 288	12.74
2015	228 504	1 818 204	12.57
2016	207 206	1 655 661	12.51
2017	239 565	1 742 469	13.75
2018	253 338	1 828 406	13.86
2019	240 214	1 704 719	14.09
2020	221 479	1 487 173	14.89
2021	212 643	1 316 377	16.15
2022	181 063	1 112 213	16.28

Activity data

Activity data on crop yields and annual area of harvested crops were taken from the ŠÚ SR. To estimate the N added to soils from crop residues and forage/pasture renewal, mainly default parameters from Table 11.2, 11.1A (IPCC 2019 RF) were used. Since yield statistics are reported as field-dry weight, a correction factor was applied to estimate dry matter yields in accordance with the Equation 11.7 IPCC 2019 RF):

Table 5.45: *Growing areas and total nitrogen in crops and legumes in 2022*

CROP		HARVESTED AREA	HARVESTED ANNUAL CROP YIELD CROP (T)	ANNUAL AMOUNT OF N IN CROP RESIDUES
		ha	*kg d.m. ha^{-1}*	*kg N yr^{-1}*
CEREALS	Wheat	411 694	4 428	13 827 583
	Ray	8 964	3 124	127 790
	Barley	109 125	4 539	2 844 812
	Oat	10 179	2 115	114 881
OTHER	Maize	158 690	3 748	3 676 535
	Potato	5 734	5 012	54 720
	Sugar beet	19 484	0	0
	Oil plants	293 127	2 226	5 510 517
	Tobacco	8	353	6
	Maize for silage	70 800	20 099	1 415 999
	Meadows	503 811	1 850	209 749
NITROGEN FIXING CROPS	Peas	5 829	2 720	143 354
	Lens	113	1 469	1 496
	Beans	118	1 184	1 265
	Other leguminous plants	8 802	1 073	76 488
	Soya	66 651	1 318	654 198
	Clover	11 977	3 117	279 978
	Alfalfa	48 335	4 169	1 577 913
2022 TOTAL		**1 733 440**	**62 543**	**30 517 283**

5.9.4 Category-specific recalculations

The recalculations extended to activities beyond livestock management, such as the application of crop residues to soils. New emission categories, such as crop residue emissions (NH_3), were introduced based on updated 2023 EMEP/EEA Guidebook. The recalculation of NO_x and NH_3 emissions from animal manure applied to the soils were processed due to the recalculation in the 3B1 Cattle, 3B2 Sheep, 3B3 Swine, 3B4 Other animals. Recalculations led to an increase in NH_3 emissions and NOx emissions compared to the previous submission.

The recalculation of NH_3 and NO_x emissions from 3.D.1.3 Urine and Dung Deposited by Grazing Animals in 1990-2021 were done due to the recalculation in the 3B1 Cattle, 3B2 Sheep, 3B4 Other animals categories. Recalculations led to a decrease (1990-2021) in emissions compared to the previous submission. Effect of recalculations are visible in ***Table 5.46*** and ***Table 5.47***.

Table 5.46: *The impact of recalculations of NH_3 emissions in Animal manure applied to soils and Urine and dung deposited by grazing animals in 1990–2021*

Category	3Da2a - Animal manure applied to soils - NH_3 [kt]		Interannual difference	3D3 - Urine and dung deposited by grazing animals - NH_3 [kt]		Interannual difference
Year of submission	2024	2023		2024	2023	
1990	28.54	27.79	3%	1.99	2.17	-9%
1991	25.62	24.96	3%	1.84	2.01	-8%
1992	22.45	22.04	2%	1.64	1.81	-10%
1993	20.13	19.46	3%	1.45	1.59	-9%
1994	19.96	18.97	5%	1.37	1.50	-9%
1995	19.27	18.41	5%	1.37	1.51	-9%
1996	18.88	17.98	5%	1.32	1.46	-10%
1997	18.37	17.74	4%	1.25	1.39	-10%
1998	16.39	15.80	4%	1.17	1.28	-9%
1999	15.66	15.26	3%	1.14	1.26	-9%
2000	16.06	15.56	3%	1.15	1.27	-9%
2001	17.05	15.88	7%	1.12	1.23	-9%
2002	15.97	15.28	5%	1.14	1.25	-9%
2003	15.48	14.77	5%	1.11	1.22	-9%
2004	14.13	13.53	4%	1.05	1.16	-10%
2005	14.46	13.86	4%	1.06	1.17	-9%
2006	13.17	12.46	6%	1.04	1.15	-10%
2007	12.86	12.07	7%	1.04	1.16	-10%
2008	11.87	11.23	6%	1.03	1.15	-11%
2009	12.11	11.15	9%	0.97	1.10	-11%
2010	11.86	10.98	8%	0.98	1.11	-12%
2011	11.52	10.68	8%	0.97	1.10	-12%
2012	11.60	10.75	8%	1.01	1.14	-12%
2013	10.99	10.33	6%	1.00	1.13	-12%
2014	11.39	10.68	7%	1.02	1.15	-11%
2015	11.50	10.67	8%	1.01	1.14	-11%
2016	11.07	10.22	8%	1.00	1.12	-11%
2017	11.08	10.20	9%	0.98	1.10	-11%
2018	11.68	10.68	9%	1.02	1.14	-10%
2019	11.22	10.37	8%	1.00	1.11	-10%
2020	9.63	9.30	4%	0.99	1.08	-8%
2021	7.95	7.55	5%	0.99	1.08	-8%

Table 5.47: *The impact of recalculations of NO_x emissions in Animal manure applied to soils and Urine and dung deposited by grazing animals in 1990–2021*

Category	3Da2a - Animal manure applied to soils - NOx [kt]		Interannual difference	3D3 - Urine and dung deposited by grazing animals - NOx [kt]		Interannual difference
Year of submission	2024	2023		2024	2023	
1990	2.93	2.73	7%	1.33	1.56	-14%
1991	2.65	2.46	8%	1.24	1.44	-14%
1992	2.34	2.18	7%	1.11	1.32	-16%
1993	2.11	1.94	9%	0.97	1.14	-14%
1994	2.11	1.91	11%	0.92	1.08	-15%
1995	2.05	1.86	10%	0.92	1.10	-16%
1996	2.02	1.83	11%	0.89	1.06	-16%
1997	1.97	1.80	9%	0.85	1.01	-16%
1998	1.76	1.60	10%	0.78	0.92	-15%
1999	1.67	1.54	9%	0.76	0.90	-15%
2000	1.71	1.57	9%	0.77	0.91	-15%
2001	1.84	1.62	13%	0.75	0.88	-15%
2002	1.72	1.56	11%	0.77	0.90	-15%
2003	1.67	1.50	11%	0.75	0.88	-15%
2004	1.51	1.36	11%	0.71	0.84	-16%
2005	1.53	1.38	11%	0.72	0.85	-16%
2006	1.51	1.34	12%	0.70	0.84	-16%
2007	1.46	1.30	13%	0.71	0.85	-17%
2008	1.33	1.18	12%	0.70	0.84	-17%
2009	1.38	1.21	14%	0.67	0.82	-18%
2010	1.35	1.17	15%	0.67	0.83	-19%
2011	1.26	1.10	15%	0.67	0.82	-19%
2012	1.31	1.14	15%	0.69	0.85	-19%
2013	1.24	1.09	13%	0.68	0.84	-19%
2014	1.29	1.14	13%	0.70	0.85	-18%
2015	1.30	1.14	14%	0.69	0.84	-18%
2016	1.24	1.08	15%	0.68	0.83	-18%
2017	1.26	1.09	15%	0.67	0.81	-18%
2018	1.32	1.14	16%	0.69	0.83	-17%
2019	1.26	1.10	15%	0.68	0.81	-16%
2020	1.06	0.97	10%	0.67	0.77	-14%
2021	1.02	0.95	8%	0.67	0.77	-14%

5.10 NMVOC EMISSIONS FROM CULTIVATED CROPS (NFR 3DE)

Emissions of NMVOC from crops may arise to attract pollinating insects, eliminate waste products or as a means of losing surplus energy. It is difficult to quantify NMVOCs in atmospheric samples. Temperature and light intensity, plant growth stage, water stress, air pollution, and senescence can influence NMVOCs. NMVOC emissions from crop production are reported under the NFR **3De** category.

5.10.1 Activity data

Data of sown areas were taken from the ŠÚ SR. Data is available on 20th May every year. (**according to the NECD recommendation No A7/SK-3D-2023-0001 of the SVK NECD Final Review Report 2023**)

Table 5.48: Sowing areas in time series

YEAR	CROPS - SOWING AREAS [ha]			
	WHEAT	RAY	OIL PLANTS/RAPESEED	MEADOWS
1990	412 423	40 474	67 087	813 000
1995	442 874	31 162	87 883	839 025
2000	406 400	29 800	178 300	865 222
2005	375 801	32 500	215 547	881 283
2010	349 700	29 370	280 000	876 484
2011	364 000	13 358	261 600	874 224
2012	388 700	28 568	225 100	871 338
2013	368 200	35 408	254 800	868 171
2014	380 200	29 369	243 400	864 681
2015	379 400	15 175	247 400	858 601
2016	417 700	12 843	254 000	855 882
2017	374 781	10 380	292 854	853 757
2018	404 014	13 008	282 076	851 685
2019	408 168	14 292	259 801	850 600
2020	390 872	13 045	269 463	850 027
2021	356 969	10 181	289 801	506 922
2022	410 247	9 452	295 793	508 950

5.10.2 Methodological issues - Methods

Emissions were estimated according to the EMEP/EEA GB_{2023} Tier 2 methodology. Used emission factors are presented in ***Table 5.49***.

Table 5.49: Used emission factors in kg/ha

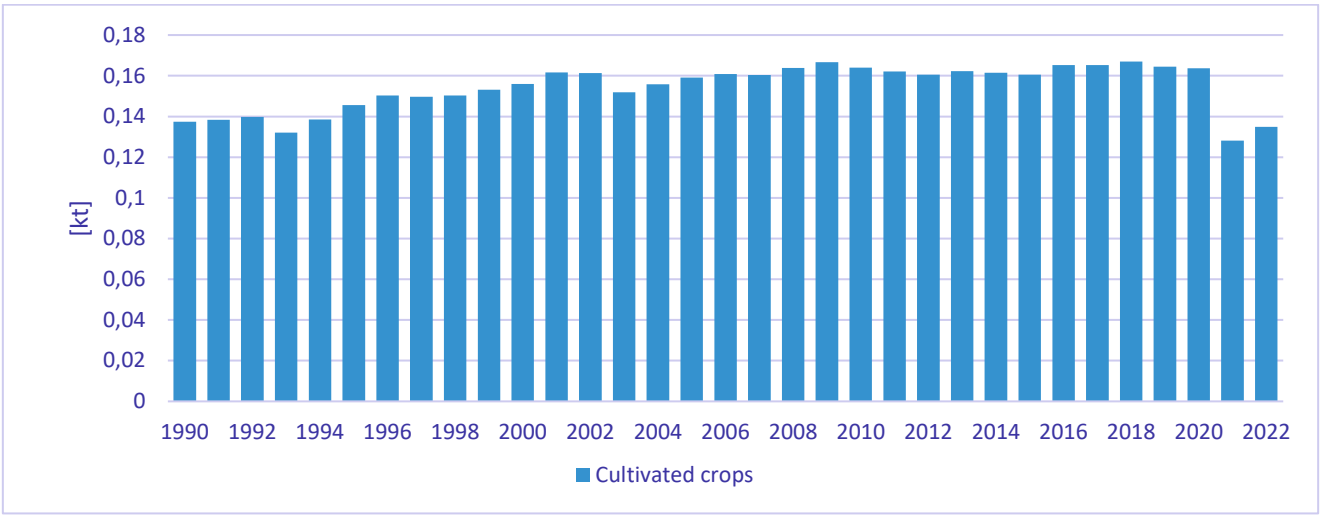
TYPE OF CROPS	EMISSION FACTORS [kg/ha]
Wheat	0.11
Rye	0.05
Rapeseed	0.13
Grass	0.1

Calculations were prepared following the following equation:

$$E_{NMVOC} = S_{Area} * EF_{NMVOC}$$

Where: E_{NMVOC}: Amount of the emitted pollutant (kg), S_{Area}: Annual sown area (ha), EF_{NMVOC}: Annual default emission factor (**kg.ha^{-1}**)

Figure 5.16: Trend of NMVOC emissions from NFR 3De cultivated crops



5.10.3 Category-Specific Recalculations

No recalculations was implemented

5.11 PM AND TSP EMISSIONS FROM FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS (NFR 3DC)

5.11.1 Methodological issues - Methods

Pollution TSP was calculated using the Tier 1 methodology from EMEP/EEA GB$_{2023}$. PM$_{2.5}$ and PM$_{10}$ were calculated using Tier 2 EMEP/EEA GB$_{2023}$ methodology. Emission factors for wet climate were used. In emission estimation, all operations with crops were considered only one time. Implementation of the Tier 2 approach in PMs emissions caused that, TSP emissions are lower ten PM$_{10}$ emissions, which indicates an overestimation of PM$_{10}$ emissions. TSP emissions incorporated PM$_{10}$ and PM$_{2.5}$ and other fractions of a particular matter. Tier 2 approach had to be implemented due to NFR **3Dc** category is the key category of PM$_{10}$ emissions.

Table 5.50: *Used emission factors in kg/ha (according to the NECD recommendation A9/SK-3Dc-2023-0001of the SVK NECD Final Review Report 2023)*

EF TSP		1.56		
Crop (PM$_{10}$) [kg/h]	**SOIL CULTIVATION**	**HARVESTING**	**CLEANING**	**DRYING**
Wheat	0.25	2.70	0.19	0.56
Rye	0.25	2.00	0.16	0.37
Barley	0.25	2.30	0.16	0
Oat	0.25	3.40	0.25	1
Other arable	0.25	NC	NC	NC
Grass	0.25	0.25	0	0
Crop (PM$_{2.5}$) [kg/ha]	**SOIL CULTIVATION**	**HARVESTING**	**CLEANING**	**DRYING**
Wheat	0.015	0.0200	0.0090	0.168
Rye	0.015	0.0150	0.0080	0.111
Barley	0.015	0.0160	0.0080	0.129
Oat	0.015	0.0250	0.0125	0.198
Other arable	0.015	NC	NC	NC
Grass	0.015	0.0100	0	0

Emissions of TSP were calculated with the following equation (Tier 1 approach):

$$\mathrm{E_{TSP}} = \mathrm{AR_{area}} \times EF_{pollutant}$$

Where: $\mathrm{E_{TSP}}$ Emissions PM$_{10}$ and PM$_{2.5}$ (kg.a^{-1}), $\mathrm{EF_{pollutant}}$ Annual default emission factor in (kg ha^{-1}), $\mathrm{AR_{area}}$ The annual sown area of the crop in ha

Emissions of PM$_{10}$ and PM$_{2.5}$ were calculated with the following equation (Tier 2 approach):

$$\mathrm{E_{PM}} = \sum_{t=1}^{l} \sum_{n=0}^{N_{t,k}} \mathrm{EF_{PM\,t,k}} * \mathrm{A_t} \times n$$

Where: $\mathrm{E_{PM}}$ Emissions PM$_{10}$ and PM$_{2.5}$ (kg.a^{-1}), $\mathrm{EF_{PM}}$ Annual default emission factor in (kg ha^{-1}), $\mathrm{A_t}$ The annual sown area of the crop in ha, n_l is the number of times the $k_{t,h}$ operation is performed on the crop in a^{-1}

Table 5.51: *Frequency of operations in 1990-2022*

CROP	**SOIL CULTIVATION**	**HARVESTING**	**CLEANING**	**DRYING**
Wheat	4	1	1	1
Rye	4	1	1	1

CROP	SOIL CULTIVATION	HARVESTING	CLEANING	DRYING
Barley	4	1	1	1
Oat	4	1	1	1
Other arable	4	0	0	0
Grass	1	2	0	0

5.11.2 Activity data

Data of sown areas were taken from the ŠÚ SR. Data is available on 20th May every year.(according to the NECD recommendation No A7/SK-3D-2023-0001of the SVK NECD Final Review Report 2023)

Table 5.52: *Sowing areas in time series*

YEAR	CROPS - SOWING AREAS [ha]					
	WHEAT	RAY	OIL PLANTS/RAPESEED	MEADOWS	BARLEY	OAT
1990	412 423	40 474	67 087	813 000	199 849	14 361
1995	442 874	31 162	87 883	839 025	239 559	13 572
2000	406 400	29 800	178 300	865 222	245 900	22 800
2005	375 801	32 500	215 547	881 283	222 000	24 500
2010	349 700	29 370	280 000	876 484	138 930	17 240
2011	364 000	13 358	261 600	874 224	136 325	16 158
2012	388 700	28 568	225 100	871 338	147 994	15 773
2013	368 200	35 408	254 800	868 171	121 304	13 901
2014	380 200	29 369	243 400	864 681	138 826	15 367
2015	379 400	15 175	247 400	858 601	138 920	16 422
2016	417 700	12 843	254 000	855 882	115 364	14 834
2017	374 781	10 380	292 854	853 757	121 026	15 932
2018	404 014	13 008	282 076	851 685	124 574	14 122
2019	408 168	14 292	259 801	850 600	126 887	12 817
2020	390 872	13 045	269 463	850 027	132 885	13 408
2021	356 969	10 181	289 801	506 922	117 205	16 342
2022	410 247	9 452	295 793	508 950	108 782	10 701

5.11.3 Category-specific recalculations

No recalculations were made.

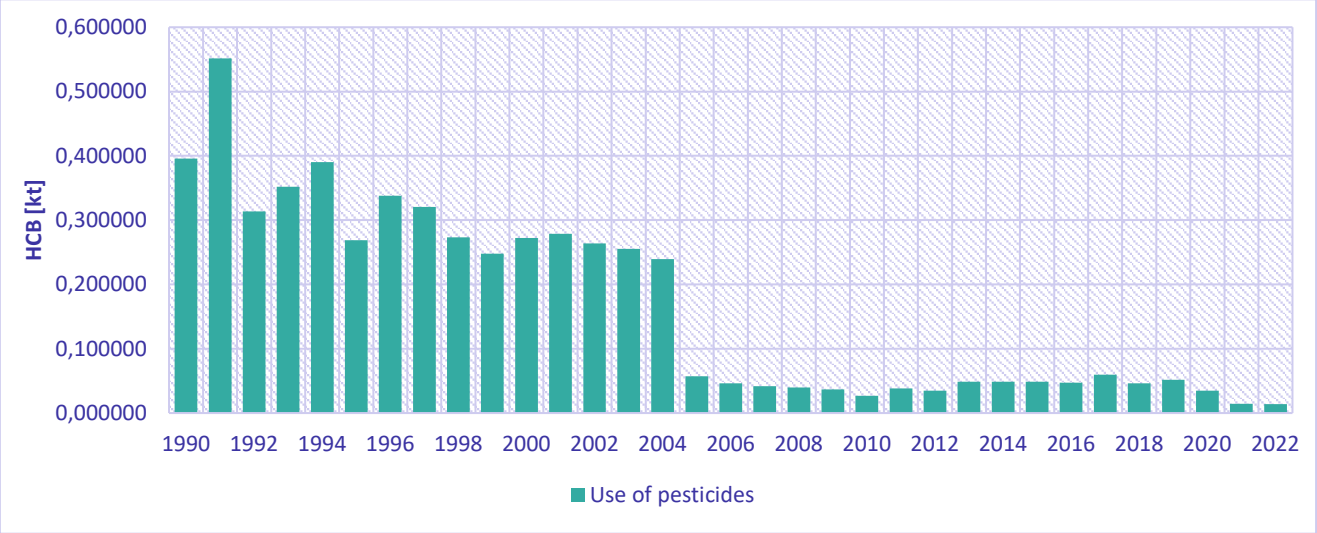
5.12 AGRICULTURE OTHER INCLUDING USE OF PESTICIDES (NFR 3DF)

A scope of pesticides is used in the Slovak agricultural sector, and a very small amount of them contain Hexachlorobenzene (HCB) as an impurity. HCB as the active substance is carried out in the Slovak Republic and is forbidden in consonance with the Stockholm Convention on Persistent Organic Pollutants and these substances.

5.12.1 Methodological issues - Methods

The emissions of HCB from the use of pesticides are based on the amount of effectual substance used and emission factors for each type of pesticide. Impurity factors of used pesticides were taken from Table 7-3 p.15 of EMEP/EEA GB_{2023}.

Figure 5.17: HCB from pesticides used



5.12.2 Activity data

Data on pesticide consumption was provided by the Central Control and Testing Institute in Agriculture. Consumptions are collected annually direct from the Farmers base of Government Regulation of the Slovak Republic no 186/2012 Coll. on the review of authorized plant protection products. The situation of using pesticides in the Slovak Republic Propazine, Atrazine, Endosulfan, Lindane, Simazine and Pentachlorophenol fenol were not obligated. Atrazine was not used since 2006 and also was not obliged. Only Clopiralid Chlorothalonil and Picloram are used. The total consumption f pesticides by active substances are available in ***Table 5.54***.

Table 5.54: *Consumption of pesticides in kilograms*

YEAR	NAME OF PESTICIDE [kg]					
	ATRAZIN	CLOPIRALID	CHLOROTHALONIL	ENDOSULFAN	PICLORAM	SIMAZIN
1990	148 842	5 506	25	19	NO	3 897
1991	208 958	3 755	50	NO	NO	7 848
1992	120 966	509	1 692	NO	NO	2 314
1993	134 141	1 975	1 377	NO	NO	3 207
1994	149 153	3 531	651	30	NO	2 834
1995	90 263	4 583	3 511	111	NO	9 096
1996	122 760	6 810	3 438	32	NO	2 198
1997	115 959	8 255	1 703	5	NO	2 384
1998	100 017	6 181	1 434	2	NO	1 748
1999	89 351	7 424	1 034	NO	NO	1 276
2000	96 329	6 808	4 716	NO	NO	1 036
2001	95 050	8 536	7 151	1	NO	734
2002	84 964	10 208	10 093	NO	NO	213
2003	87 533	5 752	8 074	NO	NO	699
2004	79 208	8 124	7 331	NO	636	481
2005	6 715	9 175	5 437	NO	1 219	250
2006	NO	9 512	7 690	NO	1 261	NO
2007	NO	10 315	4 773	NO	1 591	NO
2008	NO	9 160	5 292	NO	1 522	NO
2009	NO	9 817	2 958	NO	1 965	NO
2010	NO	6 324	3 418	NO	1 094	NO
2011	NO	6 517	7 594	NO	1 199	NO

YEAR	NAME OF PESTICIDE [kg]					
	ATRAZIN	CLOPIRALID	CHLOROTHALONIL	ENDOSULFAN	PICLORAM	SIMAZIN
2012	NO	5 554	7 305	NO	1 071	NO
2013	NO	7 432	10 498	NO	1 542	NO
2014	NO	5 842	12 507	NO	1 165	NO
2015	NO	4 537	13 946	NO	960	NO
2016	NO	4 324	13 728	NO	906	NO
2017	NO	5 320	17 252	NO	1 209	NO
2018	NO	5 146	12 189	NO	1 212	NO
2019	NO	4 901	14 773	NO	1 119	NO
2020	NO	4 238	8 398	NO	1 276	NO
2021	NO	4 509	24	NO	1 209	NO
2022	NO	4 238	122	NO	1 213	NO

5.12.3 Category-specific recalculations

Recalculation of HCB estimation due to correction of the units that were used when reporting in the template Effect on emissions are higher than 100%. Emissions was overestimated. Revision is visible in ***Table 5.55***.

Table 5.55: *Consumption of pesticides in kilograms*

Category	3B - Manure management - NMVOC [kt]		Interannual
Year of submission	2024	2023	difference
1990	0.40	0.0000004	more than 100%
1991	0.55	0.0000006	more than 100%
1992	0.31	0.0000008	more than 100%
1993	0.35	0.0000008	more than 100%
1994	0.39	0.0000006	more than 100%
1995	0.27	0.0000012	more than 100%
1996	0.34	0.0000012	more than 100%
1997	0.32	0.0000006	more than 100%
1998	0.27	0.0000005	more than 100%
1999	0.25	0.0000004	more than 100%
2000	0.27	0.0000020	more than 100%
2001	0.28	0.0000030	more than 100%
2002	0.26	0.0000041	more than 100%
2003	0.26	0.0000033	more than 100%
2004	0.24	0.0000031	more than 100%
2005	0.06	0.0000001	more than 100%
2006	0.05	0.0000002	more than 100%
2007	0.04	0.0000002	more than 100%
2008	0.04	0.0000002	more than 100%
2009	0.04	0.0000002	more than 100%
2010	0.03	0.0000014	more than 100%
2011	0.04	0.0000031	more than 100%
2012	0.03	0.0000030	more than 100%
2013	0.05	0.0000043	more than 100%
2014	0.05	0.0000051	more than 100%
2015	0.05	0.0000056	more than 100%

Category	3B - Manure management - NMVOC [kt]		Interannual
Year of submission	2024	2023	difference
2016	0.05	0.0000055	more than 100%
2017	0.06	0.0000070	more than 100%
2018	0.05	0.0000049	more than 100%
2019	0.05	0.0000060	more than 100%
2020	0.03	0.0000034	more than 100%
2021	0.01	0.0000001	more than 100%

5.13 FIELD BURNING OF AGRICULTURAL RESIDUES (NFR 3F)

The Field burning of agricultural residues is strictly prohibited by law in the Slovak Republic. Therefore, no emissions from this category were estimated, and the notation key NO was used. The prohibition of activity results from the law mentioned below:

- Act No 223/2001 Coll. on wastes and amendment and implementation of some acts in the wording of Act No 553/2001 Coll. the Act No 96/2002 Coll., Act No 261/2002, the Act No 393/2002, the Act No 529/2002 Coll., the Act No 188/2003 Coll., the Act No 245/2003 Coll., the Act No 525/2003 Coll., the Act No 24/2004 Coll. and the Act No 443/2004 Coll., Act No 314/2001 Coll. on protection against fire and the amendment and implement of some acts

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Last update: 15.3.2024

6.1 OVERVIEW OF THE SECTOR

This chapter represents emissions from the activities involved in the NFR categories listed in ***Table 6.1***. The waste sector emits all reported pollutants (ammonia, sulphur oxides, heavy metals, particulate matter, black carbon, carbon oxides, persistent organic pollutants, non-methane organic pollutants, and nitrogen oxides) due to the variety of activities and diverse waste treatment manners. Emissions from waste incineration with energy use were allocated to the energy sector (**NFR 1A**).

Table 6.1: *Categories included in the Waste sector and method used for calculations (NFR 5)*

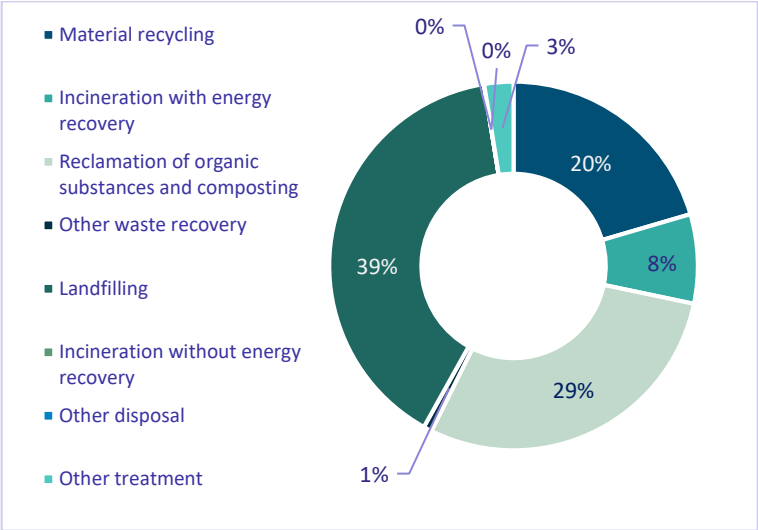
NFR Code	Longname	Method
5A	Biological treatment of waste - Solid waste disposal on land	T2/T3
5B1	Biological treatment of waste - Composting	T2
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	T1
5C1a	Municipal waste incineration	T3/T2
5C1bi	Industrial waste incineration	T1
5C1bii	Hazardous waste incineration	T1
5C1biii	Clinical waste incineration	T2
5C1biv	Sewage sludge incineration	T2
5C1bv	Cremation	T1
5C1bvi	Other waste incineration	-
5C2	Open burning of waste	T2
5D1	Domestic wastewater handling	T1/T2/T3
5D2	Industrial wastewater handling	T1/T3
5D3	Other wastewater handling	-
5E	Other waste	T2

The main source of activity data is national statistics represented by data from the ŠÚ SR. In line with statistics, total waste is classified by three ways of treatment:

a) **Recovery** (material recycling – not involved in the inventory, incineration with energy recovery – relevant emissions allocated in energy chapter, backfilling – not included, reclamation of organic substances and composting – included in **Chapter 6.6.1**, other recovery – not involved);
b) **Disposal** (landfilling (**Chapter 6.4**) and incineration without energy recovery (**Chapter 6.6**) – included in the inventory, other disposal – not involved)
c) Waste temporarily stored in place of origin – not included in the inventory.

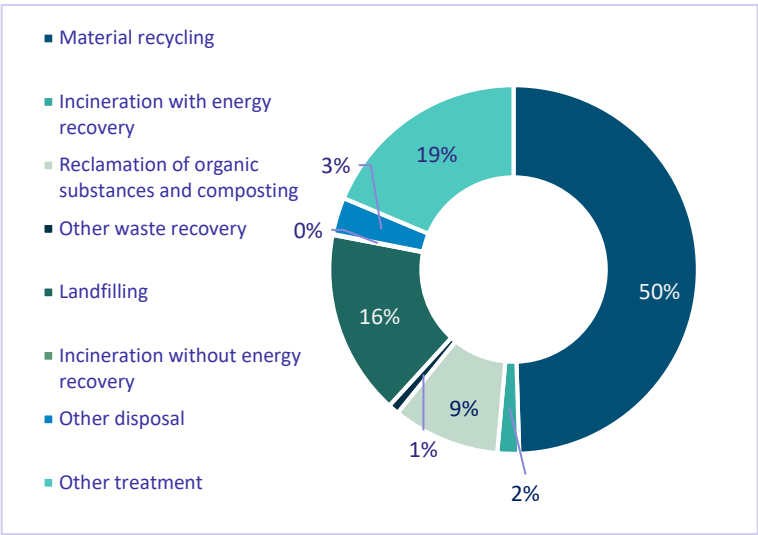
According to the annual statistics of the Statistical Office of the Slovak Republic, the total municipal waste produced in the Slovak Republic in 2022 was 2 597.46 kt. The amount of municipal waste produced decreased compared to the previous year (4%). The generation of municipal waste per capita (478.26) in the Slovak Republic is still below the European average. However, the predominant waste treatment is still landfilling (39%). The amount of waste recovered stayed stable in 2022 to 58%. In 2021, prevailed waste recovery treatment was material recycling (37% of recovered waste, 22% of all waste); in 2022, it was also material recycling (35% of recovered waste, 20% of all waste). The share of composting increased slightly (2%) and energy utilization decreased by 7%. ***Figure 6.1*** shows a detailed share of municipal waste treatment.

Figure 6.1: *Municipal waste treatment in the Slovak Republic in 2022*



In the year 2022, total industrial and other waste was produced in the amount of 10 593,12 kt. The amount increased by 7% compared to the year 2021. The largest share represents waste from construction and demolition (43%) which has increased by 6% annually due to the post-Covid revitalisation of the construction business.

Figure 6.2: *Industrial waste treatment in the Slovak Republic in 2022*



In general, in most waste categories, the **condensable component of PMs** is not included in emission factors. Emissions of air pollutants (excluding NMVOC and NH_3) in this sector are emitted into the air by waste incineration plants. The trend in the incineration categories is decreasing until 2008. Since 2009 emissions of all main pollutants have increased. Emissions of heavy metals and POPs have generally decreasing character.
Wastewater handling and composting are the main contributors to ammonia emissions in this sector. The ratio of the population using the connection to no sewage systems or using no septic tanks etc. decreased since 1990 significantly.
Non-methane volatile compounds are formed mainly at waste disposal sites. These emissions are increasing in the long term. Summary values for waste categories are given in ***Table 6.2***. The overall trend has dramatically declined since 1990 due to the continual development of the legislation.
A share of waste sector categories on the emissions of the main pollutants is available in ***Figure 6.3***. For main pollutants, emissions of NOx, SOx and CO are emitted by the sources of waste incineration (**5C**). NMVOC is mostly emitted from landfilled waste (**5A**). Ammonia is emitted mostly by biological treatment (**5B**) of waste and PMs are emitted by accidental fires (**5E**).

Figure 6.3: *Share of subsectors of the waste sector on emissions of the main pollutants in 2022*

Figure 6.4 presents emissions of HMs and POPs are all emitted mostly from sources in the category of waste incineration (**5C**).

Figure 6.4: *Share of subsectors of the waste sector on emissions of the HMs and POPs in 2022*

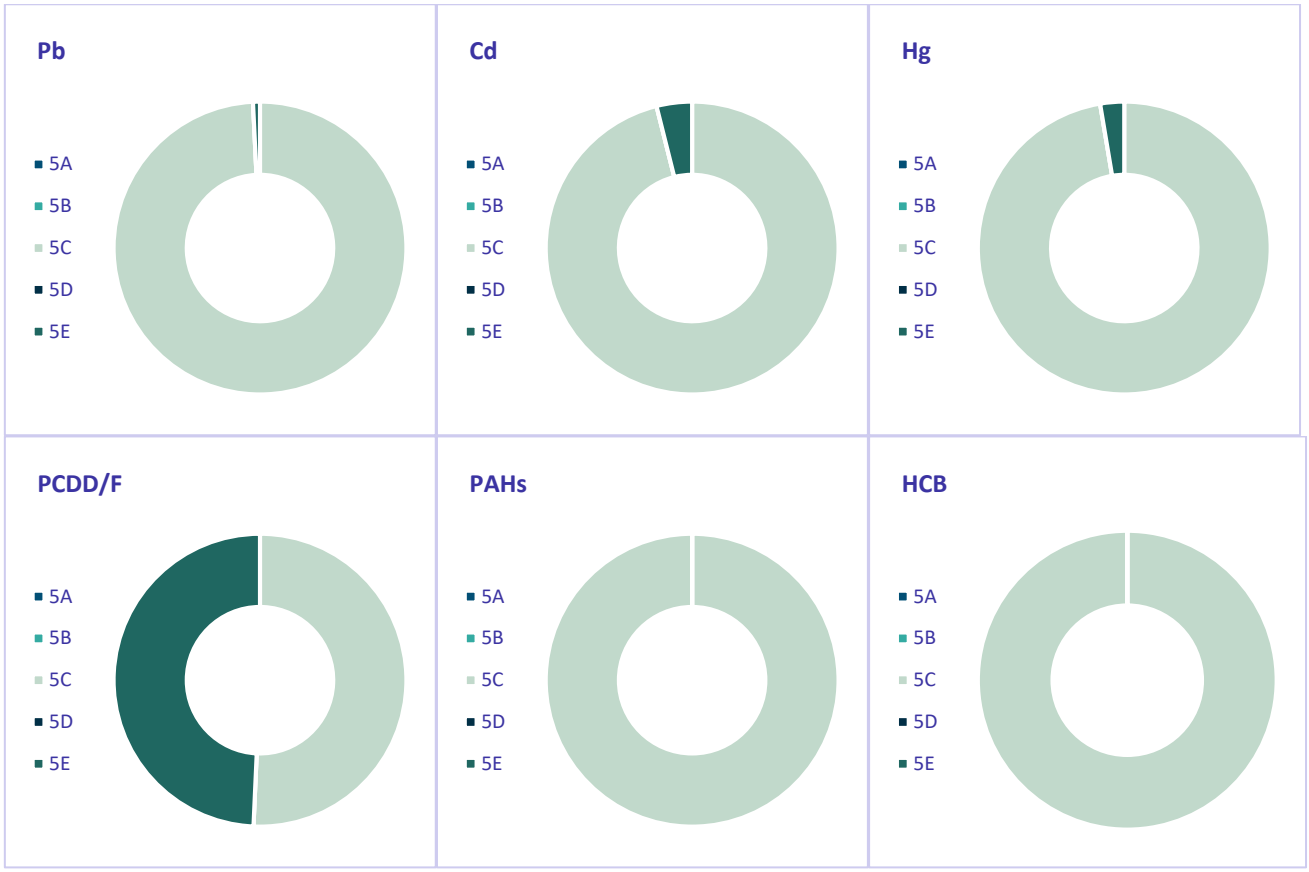


Table 6.2: *The overview of the pollutants in the Waste sector and their trends*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [k]
1990	0.2185	1.2689	0.0115	1.2872	0.5423	0.5832	0.6051	0.1115	6.9432
1995	0.1923	1.3260	0.0115	1.1947	0.4933	0.5284	0.5475	0.0955	5.9718
2000	0.2668	1.9772	0.0087	1.0005	0.6469	0.6981	0.7250	0.1413	8.7856
2005	0.4268	1.3785	0.0118	1.0072	0.9620	1.0425	1.0827	0.2281	14.2506
2010	0.4342	0.8234	0.0115	0.9250	1.0020	1.0833	1.1233	0.2319	14.5097
2011	0.4192	0.7405	0.0117	0.8968	0.9923	1.0707	1.1092	0.2238	13.9992
2012	0.2586	0.6002	0.0084	1.0986	0.6718	0.7192	0.7425	0.1348	8.4016
2013	0.2626	0.6760	0.0088	1.3826	0.6654	0.7130	0.7365	0.1354	8.4714
2014	0.4944	0.7805	0.0126	2.0269	1.1123	1.2061	1.2522	0.2679	16.7622
2015	0.4773	0.7977	0.0137	2.5476	1.0987	1.1885	1.2326	0.2564	16.0447
2016	0.4600	0.7882	0.0116	2.4255	1.0781	1.1653	1.2080	0.2491	15.5857
2017	0.4478	0.7914	0.0115	2.4101	1.0661	1.1512	1.1929	0.2432	15.2122
2018	0.4728	0.8277	0.0125	2.4794	1.0873	1.1764	1.2200	0.2546	15.9271
2019	0.4533	0.8146	0.0132	2.3039	1.0248	1.1097	1.1515	0.2421	15.1395
2020	0.3828	0.7497	0.0115	2.2264	0.8909	0.9616	0.9966	0.2010	12.5671
2021	0.3963	0.7442	0.0131	2.1089	0.9142	0.9863	1.0220	0.2051	12.8377
2022	0.3853	0.7176	0.0118	2.1747	0.8978	0.9691	1.0043	0.2030	12.6735
1990/2022	**76%**	**-43%**	**2%**	**69%**	**66%**	**66%**	**66%**	**82%**	**83%**
2021/2022	**-3%**	**-4%**	**-10%**	**3%**	**-2%**	**-2%**	**-2%**	**-1%**	**-1%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.1435	0.0236	0.1616	0.0847	0.0024	0.0474	0.0021	0.0106	1.7869
1995	0.1375	0.0216	0.1611	0.0729	0.0025	0.0436	0.0021	0.0091	1.5302
2000	0.1607	0.0280	0.1753	0.1070	0.0025	0.0559	0.0023	0.0135	2.2642
2005	0.1256	0.0337	0.0827	0.1718	0.0020	0.0678	0.0025	0.0217	3.6584
2010	0.0803	0.0305	0.0238	0.1747	0.0018	0.0626	0.0017	0.0221	3.7197
2011	0.0753	0.0294	0.0235	0.1688	0.0020	0.0620	0.0016	0.0214	3.5899
2012	0.0490	0.0184	0.0222	0.1025	0.0019	0.0386	0.0013	0.0130	2.1640
2013	0.0505	0.0185	0.0263	0.1029	0.0019	0.0385	0.0015	0.0131	2.1731
2014	0.0895	0.0346	0.0257	0.2014	0.0016	0.0693	0.0014	0.0256	4.2969
2015	0.0883	0.0335	0.0280	0.1931	0.0019	0.0667	0.0016	0.0245	4.1141
2016	0.0799	0.0321	0.0273	0.1877	0.0020	0.0642	0.0008	0.0238	3.9966
2017	0.0786	0.0314	0.0236	0.1833	0.0020	0.0624	0.0008	0.0232	3.9014
2018	0.0847	0.0330	0.0294	0.1917	0.0019	0.0652	0.0012	0.0244	4.0846
2019	0.0811	0.0313	0.0327	0.1823	0.0017	0.0614	0.0012	0.0232	3.8845
2020	0.0677	0.0263	0.0376	0.1518	0.0019	0.0521	0.0011	0.0194	3.2258
2021	0.0671	0.0267	0.0498	0.1550	0.0021	0.0534	0.0011	0.0200	3.2941
2022	0.0669	0.0264	0.0392	0.1532	0.0019	0.0529	0.0010	0.0196	3.2579
1990/2022	**-53%**	**12%**	**-76%**	**81%**	**-21%**	**12%**	**-50%**	**85%**	**82%**
2021/2022	**0%**	**-1%**	**-21%**	**-1%**	**-8%**	**-1%**	**-1%**	**-2%**	**-1%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [t]	PCB [t]
1990	115.3886	0.3309	0.5410	0.6776	0.0000	1.5497	0.3558	0.0707
1995	114.2834	0.2833	0.4632	0.5802	0.0000	1.3269	0.3523	0.0703
2000	124.0130	0.4193	0.6856	0.8586	0.0000	1.9637	0.3829	0.0765
2005	54.5594	0.6776	1.1078	1.3874	0.0000	3.1730	0.2912	0.0579
2010	8.5327	0.6888	1.1262	1.4105	0.0000	3.2257	0.1826	0.0386

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [t]	PCB [t]
2011	10.2776	0.6648	1.0869	1.3613	0.0000	3.1131	0.2181	0.0463
2012	6.4580	0.4006	0.6549	0.8203	0.0000	1.8759	0.1244	0.0274
2013	6.1417	0.4022	0.6576	0.8236	0.0000	1.8835	0.1208	0.0274
2014	6.0544	0.7957	1.3010	1.6294	0.0000	3.7262	0.1231	0.0280
2015	5.4435	0.7618	1.2455	1.5599	0.0000	3.5674	0.1044	0.0242
2016	4.1280	0.7400	1.2099	1.5153	0.0000	3.4653	0.0616	0.0176
2017	3.2752	0.7225	1.1812	1.4794	0.0000	3.3831	0.0383	0.0119
2018	3.8306	0.7563	1.2365	1.5486	0.0000	3.5416	0.0611	0.0171
2019	2.8601	0.7192	1.1758	1.4726	0.0000	3.3676	0.0421	0.0142
2020	3.1027	0.5970	0.9761	1.2224	0.0000	2.7956	0.0442	0.0162
2021	3.2485	0.6094	0.9963	1.2478	0.0000	2.8537	0.0442	0.0200
2022	3.6238	0.6029	0.9858	1.2346	0.0000	2.8233	0.0556	0.0193
1990/2022	**-97%**	**82%**	**82%**	**82%**	**316%**	**82%**	**-84%**	**-73%**
2021/2022	**12%**	**-1%**	**-1%**	**-1%**	**-22%**	**-1%**	**26%**	**-4%**

Several categories were recalculated throughout the whole time series. Activity data from the national statistics for incineration of industrial waste were reconsidered since the submission in 2020, as there was a different definition of waste in national legislation and also the methodology for data collection and processing was not transparent and comparable with another national database. National statistics are based on information on waste production and the final treatment of waste is not recorded. The same waste can be recorded in the national statistics database several times as it can change its categorisation (according to the waste catalogue) after its processing or sterilisation, which can lead to significant overestimations. Therefore, activity data from the NEIS database were used as these data are reported to the database by each of the operators. Activity data for emissions estimation of waste incineration were disaggregated into waste incineration with and without energy recovery. Emissions from waste incineration with energy recovery are reported under the energy sector (subcategory **1A**) and without energy utilisation are reported under **5C**. The methodology used for each category is summarised in the following table (***Table 6.3***).

Table 6.3: *The overview of the activity data source and methodology used for the Waste categories*

NFR	TIER	AD SOURCE	NEIS CATEGORIES (DECREE NO 410/2012)	METHOD FOR 2021 REPORTING	ALLOC./ NK
5A	T1	ŠÚ SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
5B1	T2	ŠÚ SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
5B2	T2	ŠÚ SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
5C1a	T3*	NEIS*	-	$E_{TOTAL} = AD * EF_{GB2023} - 1 - ATE$	1A1a
	T3	NEIS**	NEIS	E_{TOTAL} = 100% NEIS	1A1a
5C1bi	T1	NEIS	-	$E_{TOTAL} = AD * EF_{GB2023}$	
	T1	NEIS**	NEIS	$E_{TOTAL} = 100\% NEIS$	1A1b,1A2c; 1A2f
5C1bii	T2	NEIS	-	$E_{TOTAL} = AD * EF_{GB2023}$	
5C1biii	T2	NEIS	-	$E_{TOTAL} = AD * EF_{GB2023} - 1 - ATE$	
5C1biv	T2	VÚVH-SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
5C1bv	T1	Operators	-	$E_{TOTAL} = AD * EF_{GB2023}$	
5C1bvi	-	-	-	-	NO
5C2	T2	-	-	-	NO
5D1	T1/T2/T3	ŠÚ SR VÚVH SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
	T3	NEIS*1	NEIS	$E_{TOTAL} = 100\% NEIS$	
5D2	T1	ŠÚ SR		$E_{TOTAL} = AD * EF_{GB2023}$	
	T3	NEIS*1	NEIS	$E_{TOTAL} = 100\% NEIS$	

NFR	TIER	AD SOURCE	NEIS CATEGORIES (DECREE NO 410/2012)	METHOD FOR 2021 REPORTING	ALLOC./ NK
5D3					NO
5E	T2	PTaEÚ MV SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
6A	-	-	-	-	NO
* for POPs and heavy metals, ** with Energy Recovery, *[1] emissions from biogas flaring in WWT plants,					
ATE –abatement technology efficiency					

6.2 SECTOR-SPECIFIC QA/QC AND VERIFICATION

QA/QC procedures in the waste sector are linked with the QA/QC plans and follow basic rules and activities of QA/QC as defined in EMEP/EEA GB_{2023}.

The QC checks (e.g. consistency check between NFR data and national statistics) were done during the NFR and IIR compilation, the General QC questionnaire was filled out and archived by the QA/QC manager.

Verification of activity data used for estimation of emissions from solid waste disposal to SWDS was performed by comparing reported year data to the previous year's data and data from the GHG inventory. Data on MSW composition were verified by comparing with the National Waste Management Plan and the National Strategy on Biodegradable Waste Management.

Verification of data on biological treatment was done by comparing data from the Statistical Office of the Slovak Republic (ŠÚ SR) with the National Strategy of Biodegradable Waste Management provided by the Ministry of Environment of the Slovak Republic (MŽP SR). Activity data were also compared with the data from the previous submission.

Verification of activity data and estimated emissions from municipal (MWI), industrial (IWI), hazardous (HWI) and clinical waste incinerators (CWI) was ensured by comparing data from the NEIS database with the data published by operators in their annual reports of operation. NEIS database has its QAQC procedures which ensure verification of the reported data.

Sewage sludge incineration data are verified by the Water Research Institute (VÚVH SR).

Verification of activity data and estimated emissions from Cremation was ensured by comparing data by comparing reported year data from the last submission.

Verification of activity data from Domestic and Industrial wastewater handling was ensured by comparing data with data published by the ŠÚ SR on the website, data used in the GHG inventory and data reported in the previous submission.

Data on population were obtained from the demographic information updated by the ŠÚ SR, from the Report on Water Management prepared by the Water Research Institute of the Slovak Republic (VÚVH SR) and from the national censuses.

Data on the use of retention tanks were based on population censuses done in the years 1991, 2001 and 2011, these censuses were also used to verify population distribution to individual wastewater pathways. Additional information was collected from the SHMÚ and the Association of Wastewater Treatment Experts. The data available in the statistical reports were verified by a comparison of the same category and previous years.

Verification of activity data from Other waste was ensured by comparing data with the previous year's submission.

6.3 IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

The reviews of the Waste Chapter by TERT resulted in two recommendations. This is described below and referenced in relevant paragraphs of this chapter. Improvements are implemented in line with the Improvement Plan for the year 2023.

Recommendation No. SK-5A-2023-0001 asks to use the total amount of waste handled and not only waste disposed in managed landfills. This is described in **Chapter 6.4.4**.
Recommendation No. SK-5C2-2023-0001 concerns the allocation of emissions from forest residues burning under **5C2** Open burning of waste. This issue is described in **Chapter 6.6.5**.

6.4 SOLID WASTE DISPOSAL ON LAND (NFR 5A)

6.4.1 Overview of the Category

The first legislation act, governing the disposal of waste in the Slovak Republic was adopted in 1992. Act No. 238/1991 Coll.[1] stipulated basic requirements for the operation of waste disposal sites and Governmental Regulation No. 606/1992[2] in Annex 5 defined three classes of waste disposal sites and technical requirements for their construction. The next legislative regulation on solid waste management and disposal entered into force on 1st July 2001. Act No 223/2001 Coll.[3] and Decree of the Ministry of Environment No. 283/2001 Coll.[4] contain new instruments for waste disposal minimization, monitoring of waste sites and landfill gas generation. Demand to increase the share of recycled waste resulted in the adoption of Act No. 79/2015 Coll.[5] on waste, which introduces extended responsibility of producers and transfers organisation and financing waste recycling schemes from the state to organisations of waste producers. Regulation No. 372/2015 Coll.[6] describes the technical parameters of landfills. New landfills must be provided with the building of the isolation by bio-membrane or geotextile, a drainage system and a degassing system.
These measurements decrease the release of emissions into the atmosphere. In 2016, new legislation restricting the landfill of bio-waste entered into force[7]. ***Table 6.4*** shows the activity data and emissions from this category.

Table 6.4: *Activity data and emissions in the category 5A*

YEAR	CH_4 [kt]	MINERAL WASTE HANDLED [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	27.92	2933.27	0.1005	0.0001	0.0006	0.0014
1995	29.19	2394.27	0.0967	0.0001	0.0005	0.0011
2000	29.04	1886.08	0.1113	0.0001	0.0004	0.0009
2005	33.78	1794.18	0.1313	0.0001	0.0004	0.0008
2010	38.84	2030.78	0.1507	0.0001	0.0004	0.0009
2011	40.47	1759.22	0.1566	0.0001	0.0004	0.0008
2012	41.86	1487.65	0.1605	0.0000	0.0003	0.0007
2013	43.51	1701.31	0.1634	0.0001	0.0004	0.0008
2014	44.59	1914.97	0.1623	0.0001	0.0004	0.0009
2015	45.38	1644.90	0.1648	0.0001	0.0004	0.0008

[1] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1991/238/
[2] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1992/606/vyhlasene_znenie.html
[3] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/223/20160101
[4] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/283/20011201.html
[5] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20170101
[6] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/372/20160101.html
[7] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20170101

YEAR	CH_4 [kt]	MINERAL WASTE HANDLED [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
2016	45.08	1374.82	0.1650	0.0000	0.0003	0.0006
2017	45.79	1267.71	0.1658	0.0000	0.0003	0.0006
2018	45.82	1160.60	0.1664	0.0000	0.0003	0.0005
2019	46.05	2147.29	0.1656	0.0001	0.0005	0.0010
2020	46.23	3133.99	0.1641	0.0001	0.0007	0.0015
2021	46.00	2896.94	0.1643	0.0001	0.0006	0.0013
2022	45.59	2692.17	0.1552	0.0001	0.0006	0.0012
1990/2022	**65%**	**-1%**	**63%**	**-1%**	**-1%**	**-1%**
2021/2022	**0%**	**-8%**	**0%**	**-8%**	**-8%**	**-8%**

In comparison with the base year, emissions of NMVOC in this category show increasing character due to the continual disposal of waste on the landfill sites. Emissions of PMs decreased slightly in the long term, although in the last four years, the emissions increased.

To ensure the consistency and transparency of activity data for both GHG and AP inventory, the same amounts of sludge (sewage and industrial) landfilled are shown in ***Table 6.5*****.**

Table 6.5: *Amounts of sludge landfilled*

YEAR	SEWAGE SLUDGE LANDFILLED [kt]	INDUSTRIAL SLUDGE LANDFILLED [kt]
2000	13.80	NO
2005	8.53	0.79
2010	0.02	11.06
2011	2.31	7.62
2012	1.62	6.35
2013	1.67	1.46
2014	1.07	1.24
2015	1.71	0.90
2016	2.36	5.64
2017	2.64	1.06
2018	2.45	1.01
2019	2.30	1.33
2020	2.30	6.45
2021	0.46	6.03
2022	1.54	5.60
2005/2022	**-95%**	**669%**
2021/2022	**-80%**	**-6%**

6.4.2 Methodological Issues

Activity data for this category was obtained from publications Waste in the Slovak Republic[8]. The amount of total mineral waste was calculated using waste categories (Mineral waste from construction and demolition, Other mineral waste, Mineral waste from waste treatment and stabilised wastes and Dredging spoils) handled from the Eurostat database for the period 2010-2022. Activity data in the period 1990-2010 were not available; therefore, extrapolated data were used (the amount of mineral waste landfilled was used as surrogate data). Tier 1 emission factors from EMEP/EEA GB_{2023} were used (***Table 6.6***). Emission factors used for calculation are shown in ***Table 6.6***.

Table 6.6: *Emission factors in the category of Solid waste disposal on land*

POLLUTANT	NMVOC	$PM_{2.5}$	PM_{10}	TSP
Unit	[kg/t CH_4]	[g/t]	[g/t]	[g/t]

[8] Waste in the Slovak Republic – Yearbook – available since 2008 https://slovak.statistics.sk/

POLLUTANT	NMVOC	$PM_{2.5}$	PM_{10}	TSP
Value	3.6	0.033	0.219	0.463

The **condensable component of PMs** is not included in EF.

6.4.3 Completeness

The ammonia and carbon monoxide emissions were reported as not estimated due to no emission factor being available. The notation key for these pollutants is NE.

6.4.4 Source-specific Recalculations

NMVOC emissions were recalculated following the new EMEP/EEA GB_{2023}. Emissions of PM were recalculated due to a change of activity data from total waste landfilled to total mineral waste handled as instructed in the EMEP/EEA GB_{2023}. ***Recommendation No. SK-5A-2023-0001*** was not fully implemented as it required to use of the total amount of waste handled, which is not in compliance with the EMEP/EEA GB_{2023}. ***Table 6.7*** shows the difference between the 2023 and 2024 submissions and the percentage change.

Table 6.7: *Previous and revised emissions from landfilling*

YEAR	NMVOC			$PM_{2.5}$		
	PREVIOUS [kt]	REVISED [kt]	CHANGE	PREVIOUS [kt]	REVISED [kt]	CHANGE
1990	0.4419	0.1005	-77%	0.0347	0.0001	-100%
1991	0.4556	0.1036	-77%	0.0291	0.0001	-100%
1992	0.4571	0.1040	-77%	0.0286	0.0001	-100%
1993	0.4621	0.1051	-77%	0.0243	0.0001	-100%
1994	0.4187	0.0952	-77%	0.0255	0.0001	-100%
1995	0.4250	0.0967	-77%	0.0238	0.0001	-100%
1996	0.4309	0.0980	-77%	0.0252	0.0001	-100%
1997	0.4448	0.1012	-77%	0.0245	0.0001	-100%
1998	0.4596	0.1045	-77%	0.0225	0.0001	-100%
1999	0.4731	0.1076	-77%	0.0223	0.0001	-100%
2000	0.4891	0.1113	-77%	0.0229	0.0001	-100%
2001	0.5019	0.1142	-77%	0.0227	0.0001	-100%
2002	0.5146	0.1171	-77%	0.0241	0.0001	-100%
2003	0.5347	0.1216	-77%	0.0251	0.0001	-100%
2004	0.5576	0.1268	-77%	0.0276	0.0001	-100%
2005	0.5772	0.1313	-77%	0.0208	0.0001	-100%
2006	0.5899	0.1342	-77%	0.0356	0.0000	-100%
2007	0.6056	0.1377	-77%	0.0282	0.0000	-100%
2008	0.6148	0.1398	-77%	0.0232	0.0000	-100%
2009	0.6404	0.1457	-77%	0.0207	0.0000	-100%
2010	0.6626	0.1507	-77%	0.0193	0.0001	-100%
2011	0.6864	0.1566	-77%	0.0208	0.0001	-100%
2012	0.6988	0.1605	-77%	0.0203	0.0000	-100%
2013	0.7068	0.1634	-77%	0.0250	0.0001	-100%
2014	0.6998	0.1623	-77%	0.0191	0.0001	-100%
2015	0.7087	0.1648	-77%	0.0199	0.0001	-100%
2016	0.7065	0.1650	-77%	0.0192	0.0000	-100%
2017	0.7124	0.1658	-77%	0.0194	0.0000	-100%

YEAR	NMVOC			$PM_{2.5}$		
	PREVIOUS [kt]	REVISED [kt]	CHANGE	PREVIOUS [kt]	REVISED [kt]	CHANGE
2018	0.7171	0.1664	-77%	0.0169	0.0000	-100%
2019	0.7150	0.1656	-77%	0.0145	0.0001	-100%
2020	0.7099	0.1641	-77%	0.0153	0.0001	-99%
2021	0.7111	0.1643	-77%	0.0130	0.0001	-99%

YEAR	PM_{10}			TSP		
	PREVIOUS [kt]	REVISED [kt]	CHANGE	PREVIOUS [kt]	REVISED [kt]	CHANGE
1990	0.2293	0.0006	-100%	0.4849	0.0014	-100%
1991	0.1918	0.0005	-100%	0.4056	0.0010	-100%
1992	0.1886	0.0005	-100%	0.3988	0.0011	-100%
1993	0.1606	0.0005	-100%	0.3395	0.0010	-100%
1994	0.1687	0.0005	-100%	0.3567	0.0010	-100%
1995	0.1569	0.0005	-100%	0.3318	0.0011	-100%
1996	0.1663	0.0006	-100%	0.3517	0.0012	-100%
1997	0.1621	0.0005	-100%	0.3427	0.0011	-100%
1998	0.1489	0.0005	-100%	0.3147	0.0010	-100%
1999	0.1470	0.0004	-100%	0.3109	0.0009	-100%
2000	0.1510	0.0004	-100%	0.3192	0.0009	-100%
2001	0.1496	0.0004	-100%	0.3163	0.0009	-100%
2002	0.1594	0.0005	-100%	0.3370	0.0010	-100%
2003	0.1657	0.0005	-100%	0.3503	0.0010	-100%
2004	0.1826	0.0005	-100%	0.3860	0.0010	-100%
2005	0.1377	0.0004	-100%	0.2911	0.0008	-100%
2006	0.2353	0.0003	-100%	0.4974	0.0007	-100%
2007	0.1862	0.0003	-100%	0.3936	0.0007	-100%
2008	0.1533	0.0003	-100%	0.3241	0.0007	-100%
2009	0.1366	0.0003	-100%	0.2887	0.0006	-100%
2010	0.1274	0.0004	-100%	0.2694	0.0009	-100%
2011	0.1377	0.0004	-100%	0.2911	0.0008	-100%
2012	0.1343	0.0003	-100%	0.2840	0.0007	-100%
2013	0.1652	0.0004	-100%	0.3493	0.0008	-100%
2014	0.1260	0.0004	-100%	0.2664	0.0009	-100%
2015	0.1316	0.0004	-100%	0.2783	0.0008	-100%
2016	0.1268	0.0003	-100%	0.2681	0.0006	-100%
2017	0.1282	0.0003	-100%	0.2710	0.0006	-100%
2018	0.1119	0.0003	-100%	0.2366	0.0005	-100%
2019	0.0959	0.0005	-100%	0.2027	0.0010	-100%
2020	0.1007	0.0007	-99%	0.2130	0.0015	-99%
2021	0.0857	0.0006	-99%	0.1813	0.0013	-99%

6.5 BIOLOGICAL TREATMENT OF WASTE (NFR 5B)

6.5.1 Overview

Waste Framework Directive 2008/98/EC requires the Member States to reduce the disposal of biodegradable waste in landfills. The EU directive was transposed into the Slovak legislation in Act No 223/2001, Art. 18 (4)m), which stipulates that disposal of biologically degradable waste from parks and gardens together with the MSW is banned in the Slovak Republic from January 2006. There is a range of private and municipal companies, which provide composting of municipal and agricultural waste. With the support of the EU and Governmental grants, the number of municipalities composting waste is growing fast. Decree 348/2020[9] imposes on municipalities the obligation to collect kitchen waste and its subsequent recovery from 1.1.2021.

From this category, only emissions of NH_3 are emitted. An overview of the emission trend is shown in ***Table. 6.8***.

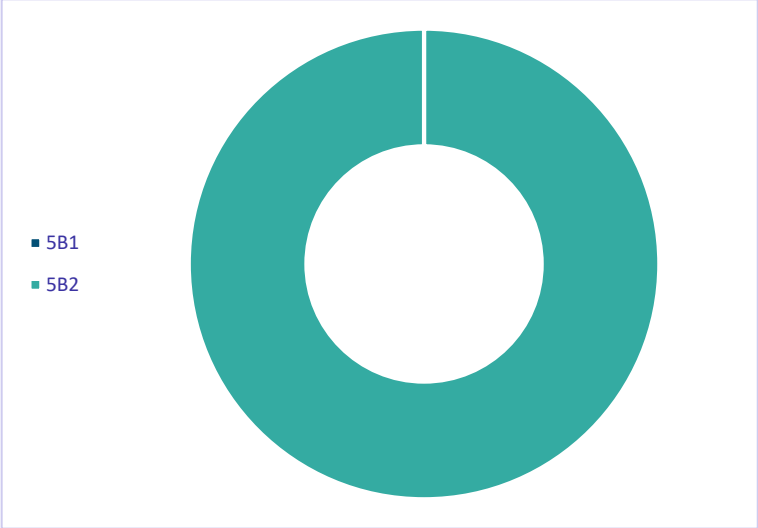
Table 6.8: *Overview of emissions in category 5B*

YEAR	NH_3 [kt]
1990	0.1558
1995	0.1595
2000	0.1597
2005	0.2435
2010	0.3154
2011	0.4206
2012	0.6400
2013	0.9997
2014	1.7090
2015	2.2362
2016	2.1846
2017	2.2600
2018	2.3569
2019	2.2024
2020	2.1287
2021	2.0113
2022	2.0851
1990/2022	**1239%**
2021/2022	**4%**

Shares of emissions of NH_3 in the individual categories are shown in ***Figure 6.5***.

[9] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2020/348/vyhlasene_znenie.html

Figure 6.5: *Share of NH_3 emissions of individual categories in 5B in 2022*



6.5.2 Composting (NFR 5B1)

6.5.2.1 Overview of the Category

In 2006 Act No. 223/2001 Coll. [10] came into force, which prohibits the landfilling of biodegradable waste from gardens and parks, including cemeteries and other green waste. The change in legislation also brought the obligation of municipalities to introduce and ensure the implementation of separate collection of biodegradable municipal waste except for that originating from the operator of the cantinas.

In the year 2004, there were four large or medium composting plants and their number increased from the year 2020 to 18. There is a range of private and municipal companies, which provide composting of municipal and agricultural waste. With the support of the EU and Governmental grants, the number of municipalities composting waste is growing fast.

Since the year 2007, the amount of composted biodegradable waste, as well as the NH_3 emissions from this category, is continually increasing. This increase was caused by improving composting plants capacity and political force on municipalities to create conditions for kitchen and garden waste from households to be composted which was strengthened by Decree 378/2020.

The emission of NH_3 and activity data from this source are displayed in ***Table 6.9***.

Table 6.9: *Overview of the activity data, emissions and trends in the category of Composting of waste*

YEAR	COMPOSTED MUNICIPAL WASTE [kt]	COMPOSTRED INDUSTRIAL WASTE [kt]	COMPOSTED SEWAGE SLUDGE [kt]	COMPOSTED INDUSTRIAL SLUDGE [kt]	NH_3 [kt]
1990	20.00	629.00	NO	NO	0.1558
1995	35.46	629.00	NO	NO	0.1595
2000	36.35	629.00	NO	NO	0.1597
2005	45.00	579.15	NO	1 037.00	0.1498
2010	90.72	578.54	47 140.00	6 369.00	0.1606
2011	99.84	652.55	50 111.00	9 977.00	0.1806
2012	122.76	726.56	46 446.00	7 099.00	0.2038
2013	130.67	619.85	45 261.00	7 727.00	0.1801
2014	145.11	728.11	36 524.00	4 632.00	0.2096
2015	200.49	934.99	34 689.00	3 248.00	0.2725
2016	212.48	713.26	34 695.00	3 353.00	0.2222
2017	317.37	767.38	34 416.00	3 460.00	0.2603

[10] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/223/20160101

YEAR	COMPOSTED MUNICIPAL WASTE [kt]	COMPOSTRED INDUSTRIAL WASTE [kt]	COMPOSTED SEWAGE SLUDGE [kt]	COMPOSTED INDUSTRIAL SLUDGE [kt]	NH_3 [kt]
2018	378.56	783.56	32 982.00	3 520.00	0.2789
2019	441.87	655.10	32 217.00	3 361.00	0.2633
2020	662.87	789.44	36 562.00	3 893.00	0.3486
2021	736.98	680.71	37 289.00	3 191.00	0.3402
2022	754.80	996.19	33 509.00	1 905.00	0.4202
1990/2022	**3674%**	**58%**	**-**	**-**	**170%**
2021/2022	**2%**	**46%**	**-10%**	**-40%**	**24%**

6.5.2.2 Methodological Issues

Activity data provided by the Statistical Office of the Slovak Republic in the yearbook "*Waste in the Slovak Republic*" [11] was used. The amount of composted municipal solid waste has been published since 1992. The missing data for 1990 and 1991 were extrapolated. Data on industrial waste composting has been collected and published since 1997. Methodology and emission factors of Tier 2 – Compost production from GB_{2019} were applied (***Table 6.10***).

Table 6.10: *Emission factors in the category of Composting of waste*

POLLUTANT	NH_3
Unit	[kg/t]
Value	0.24

6.5.2.3 Completeness

Notation keys used were following EMEP/EEA GB_{2023}.

6.5.2.4 Source-specific Recalculations

No recalculations in this submission.

6.5.3 Anaerobic Digestion at Biogas Facilities (NFR 5B2)

6.5.3.1 Overview of the Category

No biogas facilities operated in the Slovak Republic until the year 2001. In 2009, only seven biogas facilities were recorded. After Act No. 309/2009 Coll.[12] on Support of Renewable Energy Sources and High-Efficiency Combined Heat and Power (CHP) Generation entered into force, the development of biogas facilities was significant.

After Decree No. 221/2013 Coll.[13], which provides price regulation in the electricity sector, entered into force, emissions started to increase in 2014. ***Table 6.11*** shows the NH_3 emission trend in this category.

Table 6.11: *Overview of the activity data, emissions and trends in the category Anaerobic digestion at biogas facilities*

YEAR	NITROGEN INTO BIOGAS FACILITY [kt]	NH_3 [kt]
2005	85.75	0.0937
2010	141.66	0.1548
2011	219.67	0.2401
2012	399.09	0.4361
2013	749.98	0.8196
2014	1 372.03	1.4994

[11] Waste in the Slovak Republic – Yearbook – available since 2008, https://slovak.statistics.sk/

[12] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2009/309/20150801

[13] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2013/221/vyhlasene_znenie.html

YEAR	NITROGEN INTO BIOGAS FACILITY [kt]	NH_3 [kt]
2015	1 796.88	1.9637
2016	1 795.72	1.9625
2017	1 829.76	1.9997
2018	1 901.41	2.0780
2019	1 774.35	1.9391
2020	1 628.87	1.7801
2021	1 529.10	1.6711
2022	1 523.38	1.6648
2005/2022	**1677%**	**1677%**
2021/2022	**0%**	**0%**

6.5.3.2 Methodological Issues

The biggest part of biogas facilities is energy producers, so emissions from the incineration of biogas are allocated into **1A5a**. This category includes only the production of biogas. The amount of nitrogen entering the biogas facility was used as activity data. This amount was balanced by the nitrogen cycle used in the agricultural sector. In this submission, also amount of waste, energy crops and others were added to the calculation of the amount of nitrogen entering the biogas facility. Tier 2 emission factor for pre-storage from EMEP/EEA GB_{2023} was used.

6.5.3.3 Completeness

Notation keys used in the inventory follow the EMEP/EEA GB_{2023}.

6.5.3.4 Source-specific Recalculations

Data were recalculated due to the addition of new types of activity data (***Table 6.12***).

Table 6.12: *Previous and revised emissions of NMVOC from anaerobic digestion*

YEAR	PREVIOUS [kt]	REVISED [kt]	CHANGE
2001	0.0001	0.0614	49590%
2002	0.0001	0.0807	66870%
2003	0.0001	0.0804	59729%
2004	0.0002	0.0851	55420%
2005	0.0002	0.0937	46720%
2006	0.0002	0.0998	45128%
2007	0.0002	0.1091	47329%
2008	0.0003	0.1280	50136%
2009	0.0004	0.1453	39322%
2010	0.0003	0.1548	54526%
2011	0.0003	0.2401	85172%
2012	0.0004	0.4361	122248%
2013	0.0004	0.8196	215663%
2014	0.0006	1.4994	238049%
2015	0.0008	1.9637	230960%
2016	0.0009	1.9625	224643%
2017	0.0009	1.9997	215867%
2018	0.0008	2.0780	247493%
2019	0.0008	1.9391	229112%
2020	0.0008	1.7801	212440%
2021	0.0010	1.6711	161669%

6.6 WASTE INCINERATION AND OPEN BURNING OF WASTE (5C)

6.6.1 Overview

Incineration of waste is an accepted practice in the Slovak Republic. It is regulated following EU waste legislation. After a period of modernisation of the waste incineration sector, smaller and non-compliant facilities were replaced by more modern ones.

The following facilities for waste incineration were in operation in 2022:

- Two large MSW incinerators with energy utilisation;
- Five ISW incinerators (three of them with energy utilisation, one of them is co-incinerating wastewater sludge);
- One clinical waste incinerator without energy utilisation;
- One incinerator for rendering plant residues;
- Five facilities co-incinerating ISW (cement and lime kilns).[14]

Not all emissions from waste incineration do have the same trend. Main pollutants (except NMVOC) have an increasing trend, as the amount of incinerated waste is growing slowly. The emissions of heavy metals and POPs have in general decreased as many abatement technologies to reduce them were installed (***Table 6.13***). In this submission, emissions from open forest residue burning were excluded from category 11B and allocated to category **5C2** following ***Recommendation No. SK-5C2-2023-0001***. Emissions in categories **5C1bi**, **5C1bii** and **5C1biii** were recalculated using the new EMEP/EEA GB_{2023}. In category **5C1biii**, activity data was reconsidered as there were waste types which were not included in the calculation as they were not defined as clinical waste although they originate in hospitals and other medical facilities.

Table 6.13: *Overview of emission trends reported in category 5C*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.2114	0.2080	0.0074	0.3980	0.4383	0.4595	0.1115	6.9372
1995	0.1847	0.1853	0.0070	0.3412	0.3759	0.3944	0.0955	5.9653
2000	0.2653	0.2534	0.0087	0.5038	0.5546	0.5810	0.1413	8.7808
2005	0.4220	0.3971	0.0098	0.8104	0.8906	0.9303	0.2281	14.2487
2010	0.4268	0.3763	0.0088	0.8227	0.9037	0.9432	0.2319	14.5073
2011	0.4110	0.3509	0.0085	0.7940	0.8722	0.9102	0.2238	13.9967
2012	0.2528	0.2298	0.0058	0.4787	0.5257	0.5487	0.1348	8.3996
2013	0.2578	0.2376	0.0062	0.4807	0.5279	0.5510	0.1354	8.4680
2014	0.4894	0.4161	0.0099	0.9504	1.0439	1.0895	0.2679	16.7577
2015	0.4716	0.4126	0.0097	0.9100	0.9995	1.0431	0.2564	16.0383
2016	0.4542	0.3666	0.0092	0.8840	0.9709	1.0133	0.2491	15.5838
2017	0.4417	0.3612	0.0088	0.8629	0.9478	0.9891	0.2432	15.2101
2018	0.4669	0.3921	0.0096	0.9034	0.9923	1.0356	0.2546	15.9251
2019	0.4466	0.3753	0.0095	0.8592	0.9437	0.9849	0.2421	15.1372
2020	0.3765	0.3123	0.0087	0.7135	0.7836	0.8178	0.2010	12.5650
2021	0.3894	0.3060	0.0097	0.7286	0.8002	0.8351	0.2051	12.8356
2022	0.3795	0.3072	0.0088	0.7206	0.7914	0.8260	0.2030	12.6716
1990/2022	**80%**	**48%**	**20%**	**81%**	**81%**	**80%**	**82%**	**83%**
2021/2022	**-3%**	**0%**	**-8%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.1431	0.0228	0.1608	0.0835	0.0012	0.0446	0.0021	0.0106	1.7869
1995	0.1371	0.0208	0.1603	0.0715	0.0012	0.0406	0.0021	0.0091	1.5302

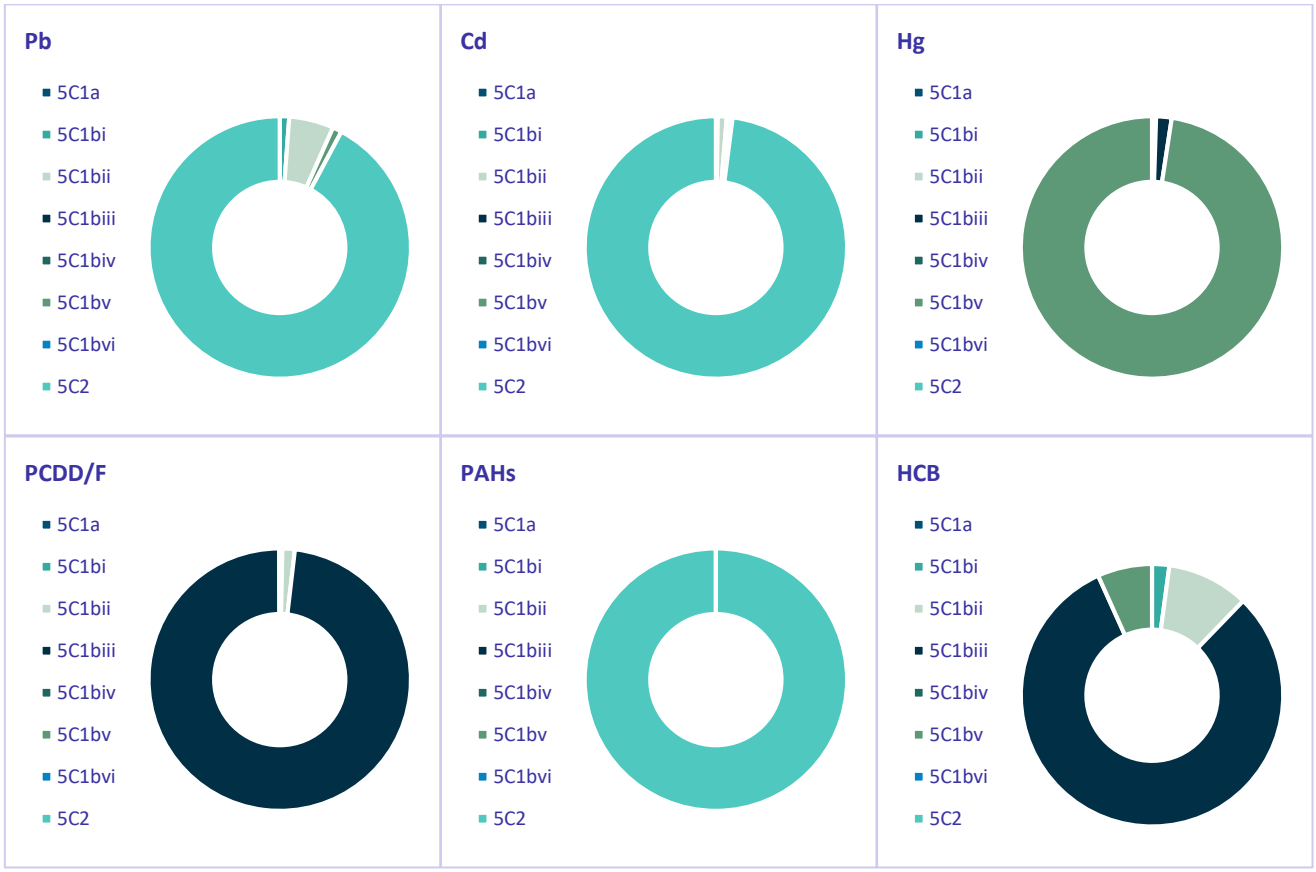
[14] https://www.enviroportal.sk/ovzdusie/zoznam-spalovni-a-zariadeni-na-spoluspalovanie-odpadov-r-2019 (only in Slovak language)

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2000	0.1603	0.0272	0.1745	0.1057	0.0013	0.0530	0.0023	0.0135	2.2642
2005	0.1252	0.0328	0.0819	0.1704	0.0006	0.0647	0.0025	0.0217	3.6584
2010	0.0798	0.0294	0.0227	0.1731	0.0002	0.0589	0.0017	0.0221	3.7197
2011	0.0748	0.0283	0.0224	0.1670	0.0002	0.0580	0.0016	0.0214	3.5899
2012	0.0484	0.0173	0.0210	0.1007	0.0002	0.0347	0.0013	0.0130	2.1640
2013	0.0499	0.0175	0.0253	0.1012	0.0002	0.0347	0.0015	0.0131	2.1731
2014	0.0890	0.0336	0.0248	0.1999	0.0002	0.0660	0.0014	0.0256	4.2969
2015	0.0878	0.0324	0.0269	0.1914	0.0002	0.0628	0.0016	0.0245	4.1141
2016	0.0793	0.0310	0.0262	0.1859	0.0002	0.0603	0.0008	0.0238	3.9966
2017	0.0780	0.0302	0.0224	0.1814	0.0002	0.0583	0.0008	0.0232	3.9014
2018	0.0842	0.0319	0.0283	0.1900	0.0003	0.0614	0.0012	0.0244	4.0846
2019	0.0806	0.0303	0.0317	0.1807	0.0003	0.0580	0.0012	0.0232	3.8845
2020	0.0672	0.0252	0.0366	0.1501	0.0003	0.0485	0.0011	0.0194	3.2258
2021	0.0665	0.0256	0.0487	0.1533	0.0004	0.0496	0.0011	0.0200	3.2941
2022	0.0664	0.0254	0.0381	0.1516	0.0003	0.0493	0.0010	0.0196	3.2579
1990/2022	**-54%**	**11%**	**-76%**	**82%**	**-71%**	**10%**	**-50%**	**85%**	**82%**
2021/2022	**0%**	**-1%**	**-22%**	**-1%**	**-22%**	**-1%**	**-1%**	**-2%**	**-1%**

YEAR	PCDD/F [g I-TEQ]	PAHs[t]	HCB [kg]	PCBs [kg]
1990	113.9853	0.3309	0.5410	0.6776
1995	112.8062	0.2833	0.4632	0.5802
2000	122.6078	0.4193	0.6856	0.8586
2005	53.0274	0.6776	1.1078	1.3874
2010	6.7209	0.6888	1.1262	1.4105
2011	8.2782	0.6648	1.0869	1.3613
2012	4.5051	0.4006	0.6549	0.8203
2013	4.2751	0.4022	0.6576	0.8236
2014	4.4192	0.7957	1.3010	1.6294
2015	3.5412	0.7618	1.2455	1.5599
2016	2.1659	0.7400	1.2099	1.5153
2017	1.2218	0.7225	1.1812	1.4794
2018	1.9706	0.7563	1.2365	1.5486
2019	1.1874	0.7192	1.1758	1.4726
2020	1.3111	0.5970	0.9761	1.2224
2021	1.3799	0.6094	0.9963	1.2478
2022	1.8376	0.6029	0.9858	1.2346
1990/2022	**-98%**	**82%**	**82%**	**82%**
2021/2022	**33%**	**-1%**	**-1%**	**-1%**

Waste incineration contributes mostly to emissions of heavy metals and POPs. The figure below represents shares of emissions through the categories of **5C**.

Figure 6.6: Share of emissions of individual categories in 5C in 2022



6.6.2 Municipal Solid Waste Incineration (NFR 5C1a)

6.6.2.1 Overview of the Category

There are two large municipal waste incinerators in the country, in Bratislava and Košice. The MSW incinerator in Bratislava was put into operation in 1978 and significantly modernised in 2002. Currently installed capacity is 135 Gg/y, and the incinerator can be characterised as a continuously operated stoker. The MSW incinerator in Košice with a capacity of 80 Gg/yr was put in full operation in 1992, modernised to achieve compliance with emission standards in 2005 and reconstructed (boiler replacement and electricity generation) in 2014. Both incineration plants generate heat (steam) and electricity. For this reason, emissions from MSW incineration are included completely in the energy sector, category **1A1a**.

The trend of the amount of incinerated municipal waste is displayed in ***Table 6.14***. As shown, the amount of incinerated municipal waste shows a slightly increasing trend since 1990, due to the gradual prioritization of MSW incineration before landfilling.

Municipal waste incineration with energy recovery is a key category for the main heavy metals (Pb, Cd, Hg), several additional heavy metals (As, Ni, Se), PCDD/F and HCB. Emissions of these pollutants decreased significantly in the year 2003 for the OLO in Bratislava due to extensive reconstruction of the incineration plant and the installation of a modern air pollution control system. Incineration plant KOSIT was reconstructed in the year 2005, also part of it was the installation of the new air pollution control system, therefore emissions for this plant decreased significantly since the year 2006 (***Table 6.14***).

Table 6.14: *Overview of the activity data, emissions and trends in the category of Municipal waste incineration*

YEAR	MSW [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	179.61	0.3233	0.0036	0.3053	0.0005	1.6524	2.4606	3.2868	0.0578	0.1257
1995	159.34	0.2868	0.0032	0.2709	0.0005	1.4660	2.1830	2.9160	0.0513	0.1115
2000	220.21	0.3964	0.0044	0.3744	0.0007	1.2825	1.9098	2.5510	0.0449	0.1541

YEAR	MSW [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2005	193.18	0.2224	0.0016	0.0385	0.0006	0.0055	0.0082	0.0110	0.0002	0.0479
2010	191.93	0.1381	0.0018	0.0066	0.0006	0.0007	0.0010	0.0013	0.0000	0.0096
2011	204.13	0.1628	0.0018	0.0069	0.0006	0.0005	0.0007	0.0009	0.0000	0.0084
2012	180.55	0.1578	0.0020	0.0063	0.0005	0.0009	0.0013	0.0017	0.0000	0.0076
2013	181.52	0.1398	0.0026	0.0075	0.0005	0.0008	0.0012	0.0016	0.0000	0.0082
2014	211.89	0.1504	0.0023	0.0109	0.0006	0.0012	0.0018	0.0023	0.0000	0.0173
2015	200.76	0.1239	0.0021	0.0067	0.0006	0.0008	0.0012	0.0016	0.0000	0.0083
2016	216.54	0.1426	0.0016	0.0087	0.0006	0.0008	0.0012	0.0016	0.0000	0.0088
2017	231.89	0.1450	0.0016	0.0096	0.0007	0.0011	0.0016	0.0021	0.0000	0.0133
2018	245.61	0.1541	0.0018	0.0094	0.0007	0.0009	0.0013	0.0017	0.0000	0.0114
2019	243.04	0.1619	0.0007	0.0055	0.0007	0.0013	0.0019	0.0026	0.0000	0.0074
2020	234.51	0.1515	0.0008	0.0051	0.0007	0.0008	0.0013	0.0017	0.0000	0.0068
2021	230.71	0.1564	0.0008	0.0047	0.0007	0.0008	0.0012	0.0015	0.0000	0.0096
2022	239.15	0.1757	0.0007	0.0039	0.0007	0.0009	0.0013	0.0018	0.0000	0.0085
1990/2022	**33%**	**-46%**	**-81%**	**-99%**	**33%**	**-100%**	**-100%**	**-100%**	**-100%**	**-93%**
2021/2022	**4%**	**12%**	**-9%**	**-16%**	**4%**	**14%**	**14%**	**14%**	**14%**	**-11%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	18.6791	0.6107	0.5029	0.3844	0.0332	0.0167	0.0216	0.0021	0.1616
1995	16.5718	0.5418	0.4462	0.3410	0.0295	0.0148	0.0191	0.0019	0.1434
2000	22.9021	0.7487	0.6166	0.4713	0.0407	0.0205	0.0264	0.0026	0.1982
2005	7.6674	0.2525	0.2096	0.1592	0.0158	0.0091	0.0124	0.0023	0.0986
2010	0.0086	0.0033	0.0054	0.0019	0.0036	0.0048	0.0078	0.0022	0.0518
2011	0.0092	0.0035	0.0057	0.0020	0.0038	0.0051	0.0082	0.0024	0.0551
2012	0.0081	0.0031	0.0051	0.0018	0.0033	0.0045	0.0072	0.0021	0.0487
2013	0.0081	0.0031	0.0051	0.0018	0.0034	0.0045	0.0073	0.0021	0.0490
2014	0.0093	0.0036	0.0059	0.0020	0.0039	0.0054	0.0088	0.0025	0.0572
2015	0.0090	0.0034	0.0056	0.0020	0.0037	0.0050	0.0081	0.0023	0.0542
2016	0.0095	0.0037	0.0061	0.0021	0.0040	0.0056	0.0090	0.0025	0.0585
2017	0.0100	0.0039	0.0065	0.0021	0.0043	0.0061	0.0099	0.0027	0.0626
2018	0.0104	0.0042	0.0069	0.0022	0.0045	0.0067	0.0108	0.0029	0.0663
2019	0.0104	0.0041	0.0068	0.0022	0.0045	0.0066	0.0106	0.0028	0.0656
2020	0.0099	0.0040	0.0066	0.0021	0.0043	0.0064	0.0103	0.0027	0.0633
2021	0.0097	0.0039	0.0065	0.0020	0.0043	0.0063	0.0102	0.0027	0.0623
2022	0.0100	0.0041	0.0067	0.0021	0.0044	0.0066	0.0107	0.0028	0.0646
1990/2022	**-100%**	**-99%**	**-99%**	**-99%**	**-87%**	**-60%**	**-50%**	**33%**	**-60%**
2021/2022	**3%**	**4%**	**4%**	**2%**	**4%**	**5%**	**5%**	**4%**	**4%**

YEAR	PCDD/F [g I-TEQ]	PAHs[t]	HCB [kg]	PCBs [kg]
OPRAVENE1990	628.6224	0.0019	0.3592	0.9519
1995	557.7038	0.0017	0.3187	0.8445
2000	770.7454	0.0023	0.4404	1.1671
2005	258.2458	0.0020	0.3864	1.0239
2010	0.6718	0.0020	0.3839	1.0173
2011	0.7145	0.0021	0.4083	1.0819
2012	0.6319	0.0019	0.3611	0.9569
2013	0.6353	0.0019	0.3630	0.9620
2014	0.7416	0.0022	0.4238	1.1230
2015	0.7026	0.0021	0.4015	1.0640
2016	0.7579	0.0023	0.4331	1.1477

YEAR	PCDD/F [g I-TEQ]	PAHs[t]	HCB [kg]	PCBs [kg]
2017	0.8116	0.0024	0.4638	1.2290
2018	0.8596	0.0026	0.4912	1.3017
2019	0.8507	0.0026	0.4861	1.2881
2020	0.8208	0.0025	0.4690	1.2429
2021	0.8075	0.0024	0.4614	1.2228
2022	0.8370	0.0025	0.4783	1.2675
1990/2022	**-100%**	**33%**	**33%**	**33%**
2021/2022	**4%**	**4%**	**4%**	**4%**

6.6.2.2 Methodological Issues

Activity data on incinerated MSW are based on the data reported to the NEIS database by individual incinerators. Data on total municipal waste incinerated[15] were used to calculate emissions in this category. There are no MSW incinerators without energy recovery in the Slovak Republic, therefore these emissions are reported in category **1A1a** as these operators use waste to produce energy and heat which is sold to the clients through the central heating system.

Activity data from the NEIS database was verified with other sources of data (see **ANNEX VIII**) and for consistency, the NEIS database data was considered the best for the inventory.

For reporting emissions of NO_X, SO_X, NH_3, CO, TSP, $PM_{2.5}$ and PM_{10} data from the NEIS database for the period 2005-2020 were applied. For the period 1990-2004, extrapolated data based on total MWS incinerated were used. Municipal solid waste incineration (MSWI) sources assigned to category 5.1 (according to Annex No. 6 of Decree No. 410/2012 Coll.[16] as amended) are defined as Waste incineration plants: a/ burning hazardous waste with a projected capacity in t/d; b/ burning non-hazardous waste with a capacity in t/h. Further selection based on the NACE categorisation and SNAP coding in the database is also applied to separate the installation of combusted industrial waste.

Tier 2 emission factors from $EMEP/EEAGB_{2019}$ for heavy metals and POPs were used in calculations of emissions except for Selene and Ideno(1,2,3)Pyrene for which Tier 1 emission factors were used. Abatement technology efficiency for heavy metals was calculated separately for each operator by comparing emissions factors from data from discontinuous measurements of heavy metals on stokes with the value of $EMEP/EEA\ GB_{2019}$ Tier 2 emission factors for uncontrolled incinerators. The average value of abatement technology efficiency excluding extreme values was used for the calculation of heavy metals emissions in this submission. For the period 1990-2002, no data about abatement technology was recorded, therefore only emission factors for uncontrolled plants were used.

Values of emission factors are given in ***Table 6.15*** and values of abatement technology efficiency, separately for each operator in ***Table 6.16***.

Table 6.15: *Emission factors in the category of Municipal waste incineration*

POLLUTANT	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]
Value	104	3.4	2.8	2.14	0.185	0.093	0.12	0.0117	0.9

POLLUTANT	PCDD/F	B(a)P	B(b)F	B(k)F	I()P	PAHs	HCB	PCB
Unit	[mg I-TEQ/t]	[mg/t]	[mg/t]	[mg/t]	[mg/t]	[mg/t]	[g/t]	[mg/t]
Value	3.5	4.2	3.2	3.1	0.0116	10.5116	0.002	5.3

[15] Waste in the Slovak Republic – Yearbook – available since 2008 https://slovak.statistics.sk/
[16] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/410/

Table 6.16: Abatement technology efficiency for heavy metals and PCDD/F in the category of Municipal waste incineration from the year 2003

OLO	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn	PCDD/F
Value	99.95%	99.5%	99%	99.4%	90%	80%	75%	70%	99.9%

KOSIT	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn	PCDD/F
Value	99.97%	99.5%	99%	99.8%	90%	60%	50%	70%	99.9%

6.6.2.3 Completeness

Municipal waste incineration without energy recovery is not occurring in the Slovak Republic, therefore notation key NO was used. Emissions from MSW incineration with energy recovery were reported in the energy sector under **1A1a**.

6.6.2.4 Source-specific Recalculations

Data were recalculated due to error correction in the calculation.

Table 6.17: Previous and revised emissions from municipal waste incineration with energy recovery

YEAR	NOx [kt]		CHANGE	NMVOC [kt]		CHANGE	SOx [kt]		CHANGE
	P	R		P	R		P	R	
2020	0.1515	0.1515	-	0.0002	0.0008	319%	0.0051	0.0051	-
2021	0.0217	0.1564	620%	0.0001	0.0008	1093%	0.0011	0.0047	329%

YEAR	CO [kt]		CHANGE	TSP [kt]		CHANGE
	P	R		P	R	
2003	0.0561	0.0386	-31%	0.0131	0.0131	-
2004	0.0573	0.0289	-49%	0.0097	0.0097	-
2005	0.0647	0.0479	-26%	0.0110	0.0110	-
2006	0.0651	0.0176	-73%	0.0018	0.0018	-
2007	0.0072	0.0087	20%	0.0018	0.0018	-
2008	0.0061	0.0083	35%	0.0008	0.0008	-
2009	0.0069	0.0086	25%	0.0007	0.0007	-
2010	0.0074	0.0096	30%	0.0013	0.0013	-
2011	0.0071	0.0084	19%	0.0009	0.0009	-
2012	0.0070	0.0076	9%	0.0017	0.0017	-
2013	0.0081	0.0082	1%	0.0016	0.0016	-
2014	0.0098	0.0173	76%	0.0023	0.0023	-
2015	0.0081	0.0083	3%	0.0016	0.0016	-
2016	0.0068	0.0088	29%	0.0016	0.0016	-
2017	0.0077	0.0133	72%	0.0021	0.0021	-
2018	0.0069	0.0114	64%	0.0017	0.0017	-
2019	0.0057	0.0074	29%	0.0026	0.0026	-
2020	0.0062	0.0068	10%	0.0017	0.0017	-
2021	0.0038	0.0096	153%	0.0001	0.0015	1079%

6.6.3 Non-municipal Solid Waste Incineration (NFR 5C1b)

6.6.3.1 Overview of the Category

The non-municipal waste incineration sector has undergone significant changes since 1990, but detailed research on their impact has not been done, yet. The key drivers of these changes were stricter legislation, the new standards (EU approximation) and the commercialisation of waste services. This led to replacing small incineration units in factories with regional incinerators. Existing large incinerators were modernised to comply with the new standards or were decommissioned.

From the total of 12 non-MSW incinerators and co-incineration plants operating in 2021, only the Slovnaft and waste co-incineration plants have installed capacity exceeding 2 t/hour. The following companies are using the largest waste incineration facilities:

- Slovnaft Inc., Bratislava (3.7 t/hour) – incinerate industrial sludge with energy recovery;
- Duslo Inc., Šaľa (1.26 t/hour) – with energy recovery;
- Light Stabilizers Ltd., Strážske (0.18 t/hour) – without energy recovery;
- Fecupral Ltd.., Prešov (0.15 t/hour) – without energy recovery;
- Archiv SB Ltd., Liptovský Mikuláš (0.15 t/hour) – without energy recovery;
- FCC Environment Ltd., Kysucké Nové Mesto (0.4 t/hour) – without energy recovery.

Incineration of medical waste occurs in the following plants:

- University H, Martin (0.098 t/hour) - without energy recovery ;

Co-incineration of waste-derived fuels occurs in the following plants:

- CRH Inc., Rohožník (34.5 t/hour) – cement production – with energy recovery;
- CRH Inc., Turňa nad Bodvou (9 t/hour) – cement production – with energy recovery;
- Carmeuse Ltd., Košice-Šaca (7.2 t/hour) - lime production – with energy recovery;
- Cemmac Inc., Horné Sŕnie (65,5 t/year) - cement production – with energy recovery;
- Považská cementáreň Inc., Ladce (.5 t/hour) - cement production – with energy recovery.

Most of the industrial waste is burned in co-incineration plants producing cement and lime. These emissions are allocated in category **1A2f**. The increasing trend of incinerated waste in this category is caused by the increase in the price of traditional fuels and political support for the energy recovery of waste instead of its disposal.

Emissions from ISW burned with energy recovery in the Slovnaft incineration plant were allocated in **1A1b** and the Duslo incineration plant in **1A2c**.

Emissions from ISW burned without energy recovery are allocated in the category **5C1bi** (including industrial sludge). Emissions from the Light Stabilizers incineration plant were allocated in category **2B10a**. Emissions from the plants which incinerate mostly hazardous waste (Fecupral, Archiv SB, FCC Environment) were allocated in category **5C1bii**, emissions from plants incinerating medical waste in category **5C1biii** and emissions from incineration of sewage sludge in category **5C1biv**.

The trend of incinerated waste in this category is relatively stable except for the peak in 2005 when operators used the last year before stricter emission limits, connected with entering the Slovak Republic to the EU, and burned twice as much waste as the year after. Also, many incineration plants were closed after 2005 due to outdated technology.

In this category, emissions from sources without energy recovery are included. ***Table 6.18*** shows activity data of waste incineration with and without energy recovery and its allocation into NFR categories.

Table 6.18: *Overview of activity data and allocation into NFR categories*

YEAR	NON-MSW INCINERATED WITH E RECOVERY [kt]	NON-MSW INCINERATED WITHOUT E RECOVERY [kt]	1A1b [kt]	1A2c [kt]	1A2f [kt]	2B10a [kt]	5C1bi [kt]	5C1bii [kt]	5C1biii [kt]
1990	49.87	10.32	13.00	35.05	1.82	NO	6.13	0.78	3.41
1995	46.69	10.22	13.02	32.20	1.47	NO	6.07	0.77	3.38
2000	41.82	11.10	13.01	27.70	1.11	NO	6.60	0.84	3.67
2005	59.86	13.35	11.98	7.40	40.48	NO	8.45	2.21	2.68
2010	180.75	10.03	1.47	6.73	172.55	1.14	5.56	1.67	1.66
2011	204.78	8.43	5.39	6.75	192.64	1.10	3.69	1.59	2.06
2012	213.32	7.62	3.33	5.48	204.51	0.84	3.42	2.24	1.11
2013	255.89	8.54	12.51	4.80	238.57	0.88	3.84	2.78	1.05
2014	295.81	7.82	3.73	3.81	288.27	0.81	3.33	2.59	1.09
2015	289.03	9.35	3.55	4.51	280.97	0.87	5.21	2.39	0.87

YEAR	NON-MSW INCINERATED WITH E RECOVERY [kt]	NON-MSW INCINERATED WITHOUT E RECOVERY [kt]	1A1b [kt]	1A2c [kt]	1A2f [kt]	2B10a [kt]	5C1bi [kt]	5C1bii [kt]	5C1biii [kt]
2016	302.04	3.33	3.25	4.52	294.28	NO	0.21	2.58	0.53
2017	323.33	4.61	3.84	5.31	314.18	1.13	NO	3.19	0.30
2018	319.12	6.86	2.16	5.10	311.86	1.16	2.16	3.05	0.48
2019	351.73	6.61	2.39	4.07	345.27	1.02	2.39	2.91	0.28
2020	372.41	5.36	1.51	4.04	366.85	0.57	1.53	2.95	0.32
2021	390.70	3.31	1.48	2.70	386.52	0.15	NO	2.82	0.34
2022	314.71	3.85	1.85	3.00	309.86	NO	0.59	2.81	0.45
1990/2022	**531%**	**-63%**	**-86%**	**-91%**	**16927%**	**-**	**-90%**	**260%**	**-87%**
2021/2022	**-19%**	**16%**	**25%**	**11%**	**-20%**	**-**	**-**	**-1%**	**33%**

6.6.3.2 Category-specific Recalculations

In this submission, several activity data corrections were made in categories **5C1bii** and **5C1biii**. Several emission factors and abatement technology efficiency were changed following the new EMEP/EEA GB$_{2023}$.

6.6.3.3 Industrial Waste Incineration (5C1bi)

Industrial waste incineration without energy recovery had a decreasing trend. After 2002, emissions from industrial sludge incineration are included in the calculation. Activity data and resulting emissions are shown in ***Table 6.19***.

Table 6.19: *Overview of activity data and emissions in the category 5C1bi*

YEAR	IW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	6.13	0.0053	0.0454	0.0003	0.0000	0.0000	0.0001	0.0000	0.0004
1995	6.07	0.0053	0.0449	0.0003	0.0000	0.0000	0.0001	0.0000	0.0004
2000	6.60	0.0057	0.0488	0.0003	0.0000	0.0000	0.0001	0.0000	0.0005
2005	8.45	0.0074	0.0625	0.0004	0.0000	0.0001	0.0001	0.0000	0.0006
2010	5.56	0.0048	0.0412	0.0003	0.0000	0.0000	0.0001	0.0000	0.0004
2011	3.69	0.0032	0.0273	0.0002	0.0000	0.0000	0.0000	0.0000	0.0003
2012	3.42	0.0030	0.0253	0.0002	0.0000	0.0000	0.0000	0.0000	0.0002
2013	3.84	0.0033	0.0284	0.0002	0.0000	0.0000	0.0000	0.0000	0.0003
2014	3.33	0.0029	0.0246	0.0002	0.0000	0.0000	0.0000	0.0000	0.0002
2015	5.21	0.0045	0.0386	0.0002	0.0000	0.0000	0.0001	0.0000	0.0004
2016	0.21	0.0002	0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2017	NO	NO	NO	NO	NO	NO	NO	NO	NO
2018	2.16	0.0019	0.0160	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2019	2.39	0.0021	0.0177	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2020	1.53	0.0013	0.0113	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2021	NO	NO	NO	NO	NO	NO	NO	NO	NO
2022	0.59	0.0005	0.0044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1990/2022	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**
2021/2022	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]
1990	0.0080	0.0006	0.0003	0.0001	0.0009	0.0613	0.0001	0.0123
1995	0.0079	0.0006	0.0003	0.0001	0.0008	0.0607	0.0001	0.0121
2000	0.0086	0.0007	0.0004	0.0001	0.0009	0.0660	0.0001	0.0132
2005	0.0110	0.0008	0.0005	0.0001	0.0012	0.0845	0.0002	0.0169

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]
2010	0.0072	0.0006	0.0003	0.0001	0.0008	0.0556	0.0001	0.0111
2011	0.0048	0.0004	0.0002	0.0001	0.0005	0.0369	0.0001	0.0074
2012	0.0044	0.0003	0.0002	0.0001	0.0005	0.0342	0.0001	0.0068
2013	0.0050	0.0004	0.0002	0.0001	0.0005	0.0384	0.0001	0.0077
2014	0.0043	0.0003	0.0002	0.0001	0.0005	0.0333	0.0001	0.0067
2015	0.0068	0.0005	0.0003	0.0001	0.0007	0.0521	0.0001	0.0104
2016	0.0003	0.0000	0.0000	0.0000	0.0000	0.0021	0.0000	0.0004
2017	NO	NO	NO	NO	NO	NO	NO	NO
2018	0.0028	0.0002	0.0001	0.0000	0.0003	0.0216	0.0000	0.0043
2019	0.0031	0.0002	0.0001	0.0000	0.0003	0.0239	0.0000	0.0048
2020	0.0020	0.0002	0.0001	0.0000	0.0002	0.0153	0.0000	0.0031
2021	NO	NO	NO	NO	NO	NO	NO	NO
2022	0.0008	0.0001	0.0000	0.0000	0.0001	0.0059	0.0000	0.0012
1990/2022	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**	**-90%**
2021/2022	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

6.6.3.3.1 Methodological Issues

For industrial waste incineration sources without energy recovery, data from the NEIS database were used. Using statistical data was reconsidered after a detailed analysis and comparing the data with other sources. Statistical data were assumed as highly overestimated. Detailed descriptions can be found in **ANNEX VIII**. In this submission, industrial sludge from wastewater treatment is included in this category.

Tier 1 methodology from the EMEP/EEA GB_{2023} was used to calculate emissions in this category, where the emission factor for PCDD/F was changed. Emission factors are shown in ***Table 6.20***.

The **condensable component of PMs** is not included in EFs.

Table 6.20: *Emission factors in the category Industrial waste incineration without E recovery*

POLLUTANT	NOx	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	BC	CO
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	% of $PM_{2.5}$	[kg/t]
Value	0.87	7.4	0.047	0.004	0.007	0.01	3.5	0.07

POLLUTANT	Pb	Cd	Hg	As	Ni	Se	PCDD/F	PAHs	HCB
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	µg/t I-TEQ	mg/t	mg/t
Value	1.3	0.1	0.056	0.016	0.14	0.06	**10**	38.87	3

6.6.3.3.2 Completeness

Emissions from Industrial waste incineration with energy recovery are reported in the energy sector under **1A1b**, **1A2c** and **1A2f**. Notation keys were used to comply with EMEP/EEA GB_{2023}.

6.6.3.3.3 Source-specific Recalculations

Recalculations in this category are the result of a change to EMEP/EEA GB_{2023} (***Table 6.21***).

Table 6.21: *Previous and revised emissions from industrial waste incineration without energy recovery*

YEAR	PCDD/F [g I-TEQ]		CHANGE
	PREVIOUS	REVISED	
1990	2.1461	0.0613	-97%
1991	2.1428	0.0612	-97%
1992	2.1376	0.0611	-97%
1993	2.1505	0.0614	-97%
1994	2.1509	0.0615	-97%
1995	2.1239	0.0607	-97%

YEAR	PCDD/F [g I-TEQ]		CHANGE
	PREVIOUS	REVISED	
1996	2.1504	0.0614	-97%
1997	2.1890	0.0625	-97%
1998	2.0984	0.0600	-97%
1999	2.1071	0.0602	-97%
2000	2.3084	0.0660	-97%
2001	2.3971	0.0685	-97%
2002	6.5335	0.1867	-97%
2003	3.8308	0.1095	-97%
2004	5.2691	0.1505	-97%
2005	2.9580	0.0845	-97%
2006	5.2383	0.1497	-97%
2007	1.1654	0.0333	-97%
2008	2.6790	0.0765	-97%
2009	1.4575	0.0416	-97%
2010	1.9464	0.0556	-97%
2011	1.2901	0.0369	-97%
2012	1.1965	0.0342	-97%
2013	1.3432	0.0384	-97%
2014	1.1648	0.0333	-97%
2015	1.8247	0.0521	-97%
2016	0.0727	0.0021	-97%
2017	NO	NO	-
2018	0.7577	0.0216	-97%
2019	0.8372	0.0239	-97%
2020	0.5346	0.0153	-97%
2021	NO	NO	-

6.6.3.4 Hazardous Waste Incineration (NFR 5C1bii)

Emissions in this category have an increasing trend due to legislation that sets the preference for the incineration of waste instead of disposal at landfill sites.

Table 6.22: *Overview of activity data and emissions in the category 5C1bii*

YEAR	HW Incinerated [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.78	0.0007	0.0058	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
1995	0.77	0.0007	0.0057	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2000	0.84	0.0007	0.0062	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
2005	2.21	0.0019	0.0164	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2010	1.67	0.0015	0.0124	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2011	1.59	0.0014	0.0118	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2012	2.24	0.0020	0.0166	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2013	2.78	0.0024	0.0206	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2014	2.59	0.0023	0.0192	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2015	2.39	0.0021	0.0177	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2016	2.58	0.0022	0.0191	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2017	3.19	0.0028	0.0236	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2018	3.05	0.0027	0.0226	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2019	2.91	0.0025	0.0215	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2020	2.95	0.0026	0.0218	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002

YEAR	HW Incinerated [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2021	2.82	0.0025	0.0209	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2022	2.81	0.0024	0.0208	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
1990/2022	**262%**	**262%**	**262%**	**262%**	**262%**	**262%**	**262%**	**262%**	**262%**
2021/2022	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]
1990	0.0010	0.0001	0.0000	0.0000	0.0001	0.0078	0.0000	0.0016
1995	0.0010	0.0001	0.0000	0.0000	0.0001	0.0077	0.0000	0.0015
2000	0.0011	0.0001	0.0000	0.0000	0.0001	0.0084	0.0000	0.0017
2005	0.0029	0.0002	0.0001	0.0000	0.0003	0.0221	0.0000	0.0044
2010	0.0022	0.0002	0.0001	0.0000	0.0002	0.0167	0.0000	0.0033
2011	0.0021	0.0002	0.0001	0.0000	0.0002	0.0159	0.0000	0.0032
2012	0.0029	0.0002	0.0001	0.0000	0.0003	0.0224	0.0000	0.0045
2013	0.0036	0.0003	0.0002	0.0000	0.0004	0.0278	0.0001	0.0056
2014	0.0034	0.0003	0.0001	0.0000	0.0004	0.0259	0.0001	0.0052
2015	0.0031	0.0002	0.0001	0.0000	0.0003	0.0239	0.0000	0.0048
2016	0.0034	0.0003	0.0001	0.0000	0.0004	0.0258	0.0001	0.0052
2017	0.0041	0.0003	0.0002	0.0001	0.0004	0.0319	0.0001	0.0064
2018	0.0040	0.0003	0.0002	0.0000	0.0004	0.0305	0.0001	0.0061
2019	0.0038	0.0003	0.0002	0.0000	0.0004	0.0291	0.0001	0.0058
2020	0.0038	0.0003	0.0002	0.0000	0.0004	0.0295	0.0001	0.0059
2021	0.0037	0.0003	0.0002	0.0000	0.0004	0.0282	0.0001	0.0056
2022	0.0037	0.0003	0.0002	0.0000	0.0004	0.0281	0.0001	0.0056
1990/2022	**262%**	**262%**	**262%**	**262%**	**262%**	**262%**	**262%**	**262%**
2021/2022	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**

6.6.3.4.1 Methodological Issues

For hazardous waste incineration sources without energy recovery, data from the NEIS database were used. Using statistical data was reconsidered after a detailed analysis and comparing the data with other sources. Statistical data were assumed as highly overestimated. Detailed descriptions can be found in **ANNEX VIII**. In this submission, hazardous waste was excluded from category **5C1bi** and allocated in this category. Abatement technology installed at the incineration plants is not included in the methodology.

Tier 1 methodology from the EMEP/EEA GB_{2023}, where the emission factor for PCDD/F was changed, was used to calculate emissions in this category. Emission factors are shown in ***Table 6.23***.

The **condensable component of PMs** is not included in EFs.

Table 6.23: *Emission factors in the category Hazardous waste incineration without E recovery*

POLLUTANT	NOx	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	BC	CO
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	% of $PM_{2.5}$	[kg/t]
Value	0.87	7.4	0.047	0.004	0.007	0.01	0.035	0.07

POLLUTANT	Pb	Cd	Hg	As	Ni	Se	PCDD/F	PAHs	HCB
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	µg/t I-TEQ	mg/t	mg/t
Value	1.3	0.1	0.056	0.016	0.14	0.06	**10**	38.87	3

6.6.3.4.2 Completeness

Emissions from Industrial waste incineration with energy recovery are reported in the energy sector under **1A1b**, **1A2c** and **1A2f**. Notation keys were used to comply with EMEP/EEA GB_{2023}.

6.6.3.4.3 Source-specific Recalculations

Recalculations in this category are the result of the improvement of activity data and change of the emission factor for PCDD/F in the new EMEP/EEA GB_{2023}(***Table 6.24***).

Table 6.24: *Previous and revised emissions from Hazardous waste without energy recovery*

YEAR	NOx [kt]		NMVOC [kt]		SOx [kt]		CO [kt]		TSP [kt]		CHANGE
	P	R	P	R	P	R	P	R	P	R	
1990	0.0003	0.0007	0.0029	0.0058	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1991	0.0003	0.0007	0.0029	0.0058	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1992	0.0003	0.0007	0.0029	0.0058	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1993	0.0003	0.0007	0.0029	0.0058	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1994	0.0003	0.0007	0.0029	0.0058	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1995	0.0003	0.0007	0.0028	0.0057	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1996	0.0003	0.0007	0.0029	0.0058	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1997	0.0003	0.0007	0.0029	0.0059	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1998	0.0003	0.0007	0.0028	0.0056	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
1999	0.0003	0.0007	0.0028	0.0057	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
2000	0.0004	0.0007	0.0031	0.0062	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	101%
2001	0.0005	0.0006	0.0045	0.0053	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	17%
2002	0.0014	0.0015	0.0118	0.0130	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	11%
2003	0.0015	0.0016	0.0124	0.0136	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	9%
2004	0.0014	0.0015	0.0116	0.0131	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	13%
2005	0.0017	0.0019	0.0144	0.0164	0.0001	0.0001	0.0001	0.0002	0.0000	0.0000	14%
2006	0.0005	0.0006	0.0046	0.0049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	6%
2007	0.0008	0.0009	0.0066	0.0073	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	11%
2008	0.0006	0.0006	0.0051	0.0052	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1%
2009	0.0017	0.0018	0.0142	0.0155	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	9%
2010	0.0014	0.0015	0.0123	0.0124	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0%
2011	0.0014	0.0014	0.0117	0.0118	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	1%
2012	0.0018	0.0020	0.0155	0.0166	0.0001	0.0001	0.0001	0.0002	0.0000	0.0000	7%
2013	0.0023	0.0024	0.0194	0.0206	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	6%
2014	0.0022	0.0023	0.0183	0.0192	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	5%
2015	0.0019	0.0021	0.0164	0.0177	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	8%
2016	0.0021	0.0022	0.0181	0.0191	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	6%
2017	0.0027	0.0028	0.0228	0.0236	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	4%
2018	0.0024	0.0027	0.0205	0.0226	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	10%
2019	0.0023	0.0025	0.0198	0.0215	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	9%
2020	0.0023	0.0026	0.0200	0.0218	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	9%
2021	0.0023	0.0025	0.0192	0.0209	0.0001	0.0001	0.0002	0.0002	0.0000	0.0000	9%

YEAR	Pb [t]		Cd [t]		Hg [t]		As [t]		Ni [t]		CHANGE
	P	R	P	R	P	CHANGE	P	R	P	R	
1990	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1991	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1992	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1993	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1994	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1995	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1996	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1997	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
1998	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%

YEAR	Pb [t]		Cd [t]		Hg [t]		As [t]		Ni [t]		CHANGE
	P	R	P	R	P	CHANGE	P	R	P	R	
1999	0.0005	0.0010	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
2000	0.0005	0.0011	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	101%
2001	0.0008	0.0009	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	17%
2002	0.0021	0.0023	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0002	0.0002	11%
2003	0.0022	0.0024	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0002	0.0003	9%
2004	0.0020	0.0023	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0002	0.0002	13%
2005	0.0025	0.0029	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0003	0.0003	14%
2006	0.0008	0.0009	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	6%
2007	0.0012	0.0013	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0001	0.0001	11%
2008	0.0009	0.0009	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	1%
2009	0.0025	0.0027	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0003	0.0003	9%
2010	0.0022	0.0022	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0002	0.0002	0%
2011	0.0021	0.0021	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0002	0.0002	1%
2012	0.0027	0.0029	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0003	0.0003	7%
2013	0.0034	0.0036	0.0003	0.0003	0.0001	0.0002	0.0000	0.0000	0.0004	0.0004	6%
2014	0.0032	0.0034	0.0002	0.0003	0.0001	0.0001	0.0000	0.0000	0.0003	0.0004	5%
2015	0.0029	0.0031	0.0002	0.0002	0.0001	0.0001	0.0000	0.0000	0.0003	0.0003	8%
2016	0.0032	0.0034	0.0002	0.0003	0.0001	0.0001	0.0000	0.0000	0.0003	0.0004	6%
2017	0.0040	0.0041	0.0003	0.0003	0.0002	0.0002	0.0000	0.0001	0.0004	0.0004	4%
2018	0.0036	0.0040	0.0003	0.0003	0.0002	0.0002	0.0000	0.0000	0.0004	0.0004	10%
2019	0.0035	0.0038	0.0003	0.0003	0.0001	0.0002	0.0000	0.0000	0.0004	0.0004	9%
2020	0.0035	0.0038	0.0003	0.0003	0.0002	0.0002	0.0000	0.0000	0.0004	0.0004	9%
2021	0.0034	0.0037	0.0003	0.0003	0.0001	0.0002	0.0000	0.0000	0.0004	0.0004	9%

YEAR	PCDD/F [g I-TEQ]		CHANGE	PAHs [t]		HCB [kg]		CHANGE
	P	R		P	R	P	R	
1990	0.1358	0.0078	-94%	0.0000	0.0000	0.0008	0.0016	101%
1991	0.1355	0.0078	-94%	0.0000	0.0000	0.0008	0.0016	101%
1992	0.1352	0.0078	-94%	0.0000	0.0000	0.0008	0.0016	101%
1993	0.1360	0.0078	-94%	0.0000	0.0000	0.0008	0.0016	101%
1994	0.1361	0.0078	-94%	0.0000	0.0000	0.0008	0.0016	101%
1995	0.1343	0.0077	-94%	0.0000	0.0000	0.0008	0.0015	101%
1996	0.1360	0.0078	-94%	0.0000	0.0000	0.0008	0.0016	101%
1997	0.1385	0.0080	-94%	0.0000	0.0000	0.0008	0.0016	101%
1998	0.1327	0.0076	-94%	0.0000	0.0000	0.0008	0.0015	101%
1999	0.1333	0.0077	-94%	0.0000	0.0000	0.0008	0.0015	101%
2000	0.1460	0.0084	-94%	0.0000	0.0000	0.0008	0.0017	101%
2001	0.2140	0.0072	-97%	0.0000	0.0000	0.0012	0.0014	17%
2002	0.5566	0.0176	-97%	0.0000	0.0000	0.0032	0.0035	11%
2003	0.5858	0.0183	-97%	0.0000	0.0000	0.0033	0.0037	9%
2004	0.5478	0.0177	-97%	0.0000	0.0000	0.0031	0.0035	13%
2005	0.6794	0.0221	-97%	0.0000	0.0000	0.0039	0.0044	14%
2006	0.2179	0.0066	-97%	0.0000	0.0000	0.0012	0.0013	6%
2007	0.3134	0.0099	-97%	0.0000	0.0000	0.0018	0.0020	11%
2008	0.2414	0.0070	-97%	0.0000	0.0000	0.0014	0.0014	1%
2009	0.6710	0.0210	-97%	0.0000	0.0000	0.0038	0.0042	9%
2010	0.5823	0.0167	-97%	0.0000	0.0000	0.0033	0.0033	0%
2011	0.5534	0.0159	-97%	0.0000	0.0000	0.0032	0.0032	1%
2012	0.7314	0.0224	-97%	0.0000	0.0000	0.0042	0.0045	7%

YEAR	PCDD/F [g I-TEQ]		CHANGE	PAHs [t]		HCB [kg]		CHANGE
	P	R		P	R	P	R	
2013	0.9185	0.0278	-97%	0.0001	0.0001	0.0052	0.0056	6%
2014	0.8668	0.0259	-97%	0.0000	0.0001	0.0050	0.0052	5%
2015	0.7765	0.0239	-97%	0.0000	0.0000	0.0044	0.0048	8%
2016	0.8570	0.0258	-97%	0.0000	0.0001	0.0049	0.0052	6%
2017	1.0775	0.0319	-97%	0.0001	0.0001	0.0062	0.0064	4%
2018	0.9712	0.0305	-97%	0.0001	0.0001	0.0055	0.0061	10%
2019	0.9366	0.0291	-97%	0.0001	0.0001	0.0054	0.0058	9%
2020	0.9436	0.0295	-97%	0.0001	0.0001	0.0054	0.0059	9%
2021	0.9064	0.0282	-97%	0.0001	0.0001	0.0052	0.0056	9%

P-Previous, R-Revised

6.6.3.5 Clinical Waste Incineration (NFR 5C1biii)

The number of clinical waste incineration plants in the Slovak Republic decreased significantly between the years 2005/2006 due to stricter legislation[17] and emission limits connected to the accession of the Slovak Republic to the European Union in the year 2005. Older plants without any (or minimal) abatement technology, non-compliant with emission limits stopped operation. From 2006 to 2010 only reconstructed plants or new plants with air pollution control technologies operated. In the year 2005, there were twenty-four plants incinerated clinical waste, mostly small ones within the hospital facility area, in 2022 there was only one. Over the past five years, mostly large plants focused on the incineration of different types of toxic and hazardous waste have been used to dispose of clinical waste.

The most significant pollutants from clinical waste incineration are heavy metals or dioxins and furans and polycyclic aromatic hydrocarbons, which can be present in hospital waste or can be formed during the combustion and post-combination processes. Organics in the flue gas can exist in the vapour phase or can be condensed or absorbed by fine particulates.

Other pollutants released are sulphur oxides, nitrogen oxides, volatile organic compounds, carbon monoxide, carbon dioxide and nitrous oxide. Carbon monoxide emissions result when carbon in the waste is not completely oxidised to carbon dioxide (CO_2). Nitrogen oxides are products of combustion processes. Nitrogen oxides are formed during combustion through the oxidation of nitrogen in the waste, and the oxidation of atmospheric nitrogen. ***Table 6.25*** shows emissions released into the air from this activity using the methodology described below.

Table 6.25: *Overview of the activity data, emissions and emission trends in the category Clinical waste incineration without E recovery*

YEAR	CW Incinerated [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.41	0.0061	0.0024	0.0032	0.0064	0.0001	0.0051
1995	3.38	0.0061	0.0024	0.0032	0.0064	0.0001	0.0051
2000	3.67	0.0066	0.0026	0.0035	0.0069	0.0002	0.0055
2005	2.68	0.0048	0.0019	0.0017	0.0028	0.0001	0.0040
2010	1.66	0.0030	0.0012	0.0004	0.0001	0.0000	0.0025
2011	2.06	0.0037	0.0014	0.0005	0.0001	0.0000	0.0031

[17] Act 245/2003 Coll. on Integrated Prevention and Control of Environmental Pollution
Act 532/2005 Coll. on integrated pollution prevention and control
Act 571/2005 Coll. on the protection of the air
DECREE of the Ministry of the Environment of the Slovak Republic 575/2005 Z. on air pollution sources, on emission limits, on technical requirements and general conditions of operation, on the list of pollutants, on the categorization of sources of air pollution and on the requirements for ensuring the dispersion of pollutant emissions as amended (only in Slovak)
https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2005/575/20051227

YEAR	CW Incinerated [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	TSP [kt]	BC [kt]	CO [kt]
2012	1.11	0.0020	0.0008	0.0003	0.0000	0.0000	0.0017
2013	1.05	0.0019	0.0007	0.0003	0.0000	0.0000	0.0016
2014	1.09	0.0020	0.0008	0.0003	0.0000	0.0000	0.0016
2015	0.87	0.0016	0.0006	0.0002	0.0000	0.0000	0.0013
2016	0.53	0.0010	0.0004	0.0001	0.0000	0.0000	0.0008
2017	0.30	0.0005	0.0002	0.0001	0.0000	0.0000	0.0004
2018	0.48	0.0009	0.0003	0.0001	0.0000	0.0000	0.0007
2019	0.28	0.0005	0.0002	0.0001	0.0000	0.0000	0.0004
2020	0.32	0.0006	0.0002	0.0001	0.0000	0.0000	0.0005
2021	0.34	0.0006	0.0002	0.0001	0.0000	0.0000	0.0005
2022	0.45	0.0008	0.0003	0.0001	0.0000	0.0000	0.0007
1990/2022	**-87%**	**-87%**	**-87%**	**-96%**	**-100%**	**-100%**	**-87%**
2021/2022	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	0.1003	0.0084	0.1514	0.0003	0.0011	0.0183	0.0010	113.9160	0.0000	0.3411	0.0682
1995	0.0992	0.0083	0.1499	0.0003	0.0011	0.0181	0.0010	112.7376	0.0000	0.3376	0.0675
2000	0.1079	0.0091	0.1629	0.0003	0.0012	0.0196	0.0011	122.5333	0.0000	0.3669	0.0734
2005	0.0422	0.0037	0.0657	0.0001	0.0005	0.0107	0.0008	52.9205	0.0000	0.2683	0.0537
2010	NO	0.0002	0.0027	0.0000	0.0000	0.0041	0.0005	6.6482	0.0000	0.1662	0.0332
2011	NO	0.0002	0.0033	0.0000	0.0000	0.0051	0.0006	8.2251	0.0000	0.2056	0.0411
2012	NO	0.0001	0.0018	0.0000	0.0000	0.0027	0.0003	4.4481	0.0000	0.1112	0.0222
2013	NO	0.0001	0.0017	0.0000	0.0000	0.0026	0.0003	4.2085	0.0000	0.1052	0.0210
2014	NO	0.0001	0.0018	0.0000	0.0000	0.0027	0.0003	4.3596	0.0000	0.1090	0.0218
2015	NO	0.0001	0.0014	0.0000	0.0000	0.0021	0.0003	3.4647	0.0000	0.0866	0.0173
2016	NO	0.0001	0.0009	0.0000	0.0000	0.0013	0.0002	2.1375	0.0000	0.0534	0.0107
2017	NO	0.0000	0.0005	0.0000	0.0000	0.0007	0.0001	1.1896	0.0000	0.0297	0.0059
2018	NO	0.0001	0.0008	0.0000	0.0000	0.0012	0.0001	1.9180	0.0000	0.0479	0.0096
2019	NO	0.0000	0.0005	0.0000	0.0000	0.0007	0.0001	1.1338	0.0000	0.0283	0.0057
2020	NO	0.0000	0.0005	0.0000	0.0000	0.0008	0.0001	1.2657	0.0000	0.0316	0.0063
2021	NO	0.0000	0.0005	0.0000	0.0000	0.0008	0.0001	1.3508	0.0000	0.0338	0.0068
2022	NO	0.0001	0.0007	0.0000	0.0000	0.0011	0.0001	1.8029	0.0000	0.0451	0.0090
1990/2022	**-**	**-99%**	**-100%**	**-100%**	**-99%**	**-94%**	**-87%**	**-98%**	**-87%**	**-87%**	**-87%**
2021/2022	**-**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**

An increase in 2005 and subsequently a rapid decrease in 2006 for both pollutants were caused by the adoption of strict legislation and emission limits for this activity related to entering the Slovak Republic into the European Union. From 2009 emissions are slightly increasing, but after the year 2011 emissions are decreasing due to strict emissions limits for the clinical waste incineration plants. Most of the hospitals closed their plants because the operation of such a plant is very expensive and its capacity is mostly not covered. Also, other treatments, such as sterilisation of waste became more available in the Slovak Republic.

6.6.3.5.1 Methodological Issues

Activity data for this source of pollution is the NEIS database, which contains detailed information about amounts and types of waste incinerated in each plant for the years 2000-2021. These data were reconsidered as there were waste types which were not included in the calculation as they were not defined as clinical waste although they originate in hospitals and other medical facilities. Historical data were extrapolated using the trend of the category hospital and veterinary wastes. Activity data from the NEIS database were used as in the national statistics, separation of clinical and veterinary waste is not possible. Data from national statistics were

considered as overestimated for the incineration of waste with or without energy recovery. Detailed information can be found in **ANNEX VIII**.

The **condensable component of PMs** is not included in EFs.

Clinical waste incineration **with energy recovery** was considered in this submission as not occurring. After discussion with the operators, which burn also other hazardous waste and use the heat to produce energy, it was assumed all clinical waste is burned without energy recovery. Several incinerating plants were removed from this category as they burn mostly hazardous waste and only partly clinical waste. Emissions were therefore allocated in the category **5C1bii**.

Data about the technology used to incinerate clinical waste and abatement technologies are available from the year 2000 when were these data published as a part of the Waste Management Program for the period 2001-2005. This program is updated every 5 years.

Emission estimates were calculated using the Tier 2 approach. Emission factors were taken from the EMEP/EEA GB_{2023}. Technology-specific information was collected from operators and Waste Management Programs, and plants using an abatement technology were identified. ***Table 6.26*** shows the analysis of the distribution of clinical waste burned by combustion technologies in the period 1990-2022.

Table 6.26.: *Distribution of the incinerated hospital waste without energy recovery by combustion technologies*

YEAR	% OF WASTE BURNED IN UNCONTROLLED WI	% OF WASTE BURNED IN CONTROLLED WI
1990-2000	80%	20%
2001	77%	23%
2002	63%	37%
2003	66%	34%
2004	60%	40%
2005	43%	57%
2006	-	100%
2007	-	100%
2008	-	100%
2009	-	100%
2010	-	100%
2011	-	100%
2012	-	100%
2013	-	100%
2014	-	100%
2015	-	100%
2016	-	100%
2017	-	100%
2018	-	100%
2019	-	100%
2020	-	100%
2021	-	100%
2022	-	100%

Operators of clinical waste were assigned to combustion technology based on data from Waste Management Programs and the NEIS database. Information about the type of air pollution control technology is available in Waste Management Programs (historical years) and the NEIS database (after 2005).

Emission factors and efficiencies of abatement technologies, which were used in calculations for incineration with/without energy recovery, are shown in ***Table 6.27.***

Table 6.27: *Emission factors and abatement technology efficiencies in the category of Clinical waste incineration*

POLLUTANT	NOx	CO	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	BC*	Pb	Cd	Hg	As	Cr	Cu	Ni
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[% of TSP]	[% of TSP]	[kg/t]	[% of TSP]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]
Value	1.8	1.5	0.7	1.1	43	65	2.3	2.3	36	3	54	0.1	0.4	6	0.3
% Efficiency controlled air	-	-	-	76			98.4	-	100[1]	96[1]	97[1]	99[1]	96[1]	59[1]	-

* Tier 1

[1] EMEP/EEA GB_{2019}

POLLUTANT	PCDD/F	Total 4 PAHs	HCB	PCB
Unit	[mg I-TEQ/t]	[mg/t]	[g/t]	[g/t]
Value	40	0.04	0.1	0.02
% Efficiency	90	-	-	-

6.6.3.5.2 Completeness

All rising pollutants are recorded and reported.

6.6.3.5.3 Source-specific Recalculations

Recalculations were made due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB_{2023} (see ***Table 6.28***).

Table 6.28: *Previous and revised emissions from clinical waste incineration without energy recovery*

YEAR	NOx [kt]		NMVOC [kt]		CO [kt]		C	SOx [kt]		C	TSP [kt]		C
	P	R	P	R	P	R		P	R		P	R	
1990	0.0039	0.0061	0.0015	0.0024	0.0033	0.0051	56%	0.0020	0.0032	65%	0.0041	0.0064	56%
1991	0.0039	0.0061	0.0015	0.0024	0.0033	0.0051	56%	0.0020	0.0032	65%	0.0041	0.0064	56%
1992	0.0039	0.0061	0.0015	0.0024	0.0033	0.0051	56%	0.0020	0.0032	65%	0.0041	0.0064	56%
1993	0.0039	0.0062	0.0015	0.0024	0.0033	0.0051	56%	0.0020	0.0032	65%	0.0041	0.0064	56%
1994	0.0039	0.0062	0.0015	0.0024	0.0033	0.0051	56%	0.0020	0.0032	65%	0.0041	0.0064	56%
1995	0.0039	0.0061	0.0015	0.0024	0.0032	0.0051	56%	0.0019	0.0032	65%	0.0041	0.0064	56%
1996	0.0039	0.0062	0.0015	0.0024	0.0033	0.0051	56%	0.0020	0.0032	65%	0.0041	0.0064	56%
1997	0.0040	0.0063	0.0016	0.0024	0.0033	0.0052	56%	0.0020	0.0033	65%	0.0042	0.0066	56%
1998	0.0038	0.0060	0.0015	0.0023	0.0032	0.0050	56%	0.0019	0.0032	65%	0.0040	0.0063	56%
1999	0.0039	0.0060	0.0015	0.0023	0.0032	0.0050	56%	0.0019	0.0032	65%	0.0040	0.0063	56%
2000	0.0042	0.0066	0.0016	0.0026	0.0035	0.0055	56%	0.0021	0.0035	65%	0.0044	0.0069	56%
2001	0.0039	0.0059	0.0015	0.0023	0.0032	0.0049	51%	0.0019	0.0030	61%	0.0039	0.0060	51%
2002	0.0038	0.0056	0.0015	0.0022	0.0032	0.0046	46%	0.0015	0.0024	58%	0.0033	0.0045	38%
2003	0.0036	0.0053	0.0014	0.0021	0.0030	0.0044	48%	0.0015	0.0023	54%	0.0032	0.0043	35%
2004	0.0039	0.0066	0.0015	0.0026	0.0032	0.0055	72%	0.0015	0.0024	64%	0.0032	0.0041	30%
2005	0.0034	0.0048	0.0013	0.0019	0.0029	0.0040	40%	0.0010	0.0017	68%	0.0022	0.0028	28%
2006	0.0017	0.0025	0.0007	0.0010	0.0014	0.0020	43%	0.0001	0.0004	329%	0.0002	0.0001	-77%
2007	0.0021	0.0030	0.0008	0.0012	0.0018	0.0025	42%	0.0001	0.0004	325%	0.0003	0.0001	-77%
2008	0.0018	0.0029	0.0007	0.0011	0.0015	0.0024	60%	0.0001	0.0004	380%	0.0002	0.0001	-74%
2009	0.0016	0.0027	0.0006	0.0010	0.0013	0.0022	68%	0.0001	0.0004	403%	0.0002	0.0001	-73%
2010	0.0020	0.0030	0.0008	0.0012	0.0017	0.0025	47%	0.0001	0.0004	340%	0.0003	0.0001	-77%
2011	0.0028	0.0037	0.0011	0.0014	0.0024	0.0031	30%	0.0001	0.0005	291%	0.0004	0.0001	-79%
2012	0.0012	0.0020	0.0005	0.0008	0.0010	0.0017	66%	0.0001	0.0003	398%	0.0002	0.0000	-73%
2013	0.0012	0.0019	0.0005	0.0007	0.0010	0.0016	60%	0.0001	0.0003	379%	0.0002	0.0000	-74%
2014	0.0012	0.0020	0.0005	0.0008	0.0010	0.0016	67%	0.0001	0.0003	402%	0.0001	0.0000	-73%
2015	0.0009	0.0016	0.0004	0.0006	0.0008	0.0013	64%	0.0000	0.0002	393%	0.0001	0.0000	-74%
2016	0.0005	0.0010	0.0002	0.0004	0.0004	0.0008	102%	0.0000	0.0001	507%	0.0001	0.0000	-68%

YEAR	NOx [kt]		NMVOC [kt]		CO [kt]		C	SOx [kt]		C	TSP [kt]		C
	P	R	P	R	P	R		P	R		P	R	
2017	0.0002	0.0005	0.0001	0.0002	0.0002	0.0004	163%	0.0000	0.0001	690%	0.0000	0.0000	-58%
2018	0.0005	0.0009	0.0002	0.0003	0.0004	0.0007	80%	0.0000	0.0001	440%	0.0001	0.0000	-71%
2019	0.0003	0.0005	0.0001	0.0002	0.0002	0.0004	78%	0.0000	0.0001	434%	0.0000	0.0000	-72%
2020	0.0003	0.0006	0.0001	0.0002	0.0003	0.0005	85%	0.0000	0.0001	456%	0.0000	0.0000	-70%
2021	0.0004	0.0006	0.0002	0.0002	0.0003	0.0005	52%	0.0000	0.0001	356%	0.0001	0.0000	-76%

YEAR	Pb [t]		CHANGE	Cd [t]		Hg [t]		As [t]		Ni [t]		CHANGE
	P	R		P	R	P	R	P	R	P	R	
1990	0.0629	0.1003	59%	0.0053	0.0084	0.0950	0.1514	0.0002	0.0003	0.0007	0.0010	56%
1991	0.0628	0.1001	59%	0.0053	0.0084	0.0949	0.1512	0.0002	0.0003	0.0007	0.0010	56%
1992	0.0626	0.0999	59%	0.0053	0.0084	0.0947	0.1508	0.0002	0.0003	0.0007	0.0010	56%
1993	0.0630	0.1005	59%	0.0053	0.0084	0.0952	0.1517	0.0002	0.0003	0.0007	0.0010	56%
1994	0.0630	0.1005	59%	0.0053	0.0084	0.0953	0.1518	0.0002	0.0003	0.0007	0.0010	56%
1995	0.0622	0.0992	59%	0.0052	0.0083	0.0941	0.1499	0.0002	0.0003	0.0006	0.0010	56%
1996	0.0630	0.1005	59%	0.0053	0.0084	0.0952	0.1517	0.0002	0.0003	0.0007	0.0010	56%
1997	0.0642	0.1023	59%	0.0054	0.0086	0.0969	0.1545	0.0002	0.0003	0.0007	0.0010	56%
1998	0.0615	0.0980	59%	0.0052	0.0082	0.0929	0.1481	0.0002	0.0003	0.0006	0.0010	56%
1999	0.0618	0.0985	59%	0.0052	0.0083	0.0933	0.1487	0.0002	0.0003	0.0006	0.0010	56%
2000	0.0676	0.1079	59%	0.0057	0.0091	0.1022	0.1629	0.0002	0.0003	0.0007	0.0011	56%
2001	0.0599	0.0928	55%	0.0050	0.0078	0.0906	0.1403	0.0002	0.0003	0.0006	0.0010	51%
2002	0.0482	0.0698	45%	0.0041	0.0060	0.0735	0.1066	0.0001	0.0002	0.0006	0.0009	46%
2003	0.0473	0.0664	40%	0.0040	0.0057	0.0721	0.1015	0.0001	0.0002	0.0006	0.0009	48%
2004	0.0463	0.0632	36%	0.0040	0.0055	0.0708	0.0979	0.0001	0.0002	0.0006	0.0011	72%
2005	0.0298	0.0422	42%	0.0026	0.0037	0.0465	0.0657	0.0001	0.0001	0.0006	0.0008	40%
2006	NO	NO	-	0.0001	0.0002	0.0015	0.0022	0.0000	0.0000	0.0003	0.0004	43%
2007	NO	NO	-	0.0001	0.0002	0.0019	0.0027	0.0000	0.0000	0.0004	0.0005	42%
2008	NO	NO	-	0.0001	0.0002	0.0016	0.0026	0.0000	0.0000	0.0003	0.0005	60%
2009	NO	NO	-	0.0001	0.0002	0.0014	0.0024	0.0000	0.0000	0.0003	0.0004	68%
2010	NO	NO	-	0.0001	0.0002	0.0018	0.0027	0.0000	0.0000	0.0003	0.0005	47%
2011	NO	NO	-	0.0002	0.0002	0.0026	0.0033	0.0000	0.0000	0.0005	0.0006	30%
2012	NO	NO	-	0.0001	0.0001	0.0011	0.0018	0.0000	0.0000	0.0002	0.0003	66%
2013	NO	NO	-	0.0001	0.0001	0.0011	0.0017	0.0000	0.0000	0.0002	0.0003	60%
2014	NO	NO	-	0.0001	0.0001	0.0011	0.0018	0.0000	0.0000	0.0002	0.0003	67%
2015	NO	NO	-	0.0001	0.0001	0.0009	0.0014	0.0000	0.0000	0.0002	0.0003	64%
2016	NO	NO	-	0.0000	0.0001	0.0004	0.0009	0.0000	0.0000	0.0001	0.0002	102%
2017	NO	NO	-	0.0000	0.0000	0.0002	0.0005	0.0000	0.0000	0.0000	0.0001	163%
2018	NO	NO	-	0.0000	0.0001	0.0004	0.0008	0.0000	0.0000	0.0001	0.0001	80%
2019	NO	NO	-	0.0000	0.0000	0.0003	0.0005	0.0000	0.0000	0.0000	0.0001	78%
2020	NO	NO	-	0.0000	0.0000	0.0003	0.0005	0.0000	0.0000	0.0001	0.0001	85%
2021	NO	NO	-	0.0000	0.0000	0.0004	0.0005	0.0000	0.0000	0.0001	0.0001	52%

YEAR	PCDD/F [g I-TEQ]		CHANGE	PAHs [t]		HCB [kg]		CHANGE
	P	R		P	R	P	R	
1990	71.1008	113.9160	60%	0.0000	0.0000	0.2183	0.3411	56%
1991	70.9939	113.7446	60%	0.0000	0.0000	0.2180	0.3406	56%
1992	70.8204	113.4667	60%	0.0000	0.0000	0.2175	0.3398	56%
1993	71.2469	114.1500	60%	0.0000	0.0000	0.2188	0.3418	56%
1994	71.2599	114.1709	60%	0.0000	0.0000	0.2188	0.3419	56%
1995	70.3653	112.7376	60%	0.0000	0.0000	0.2161	0.3376	56%
1996	71.2456	114.1480	60%	0.0000	0.0000	0.2188	0.3418	56%

YEAR	PCDD/F [g I-TEQ]		CHANGE	PAHs [t]		HCB [kg]		CHANGE
	P	R		P	R	P	R	
1997	72.5238	116.1958	60%	0.0000	0.0000	0.2227	0.3479	56%
1998	69.5215	111.3857	60%	0.0000	0.0000	0.2135	0.3335	56%
1999	69.8113	111.8500	60%	0.0000	0.0000	0.2144	0.3349	56%
2000	76.4793	122.5333	60%	0.0000	0.0000	0.2348	0.3669	56%
2001	67.9133	105.8334	56%	0.0000	0.0000	0.2160	0.3252	51%
2002	55.6879	82.1774	48%	0.0000	0.0000	0.2118	0.3090	46%
2003	54.4788	78.2809	44%	0.0000	0.0000	0.2004	0.2961	48%
2004	53.8515	77.9045	45%	0.0000	0.0000	0.2146	0.3684	72%
2005	36.1499	52.9205	46%	0.0000	0.0000	0.1916	0.2683	40%
2006	2.6749	5.4594	104%	0.0000	0.0000	0.0955	0.1365	43%
2007	3.2958	6.6690	102%	0.0000	0.0000	0.1177	0.1667	42%
2008	2.8375	6.4803	128%	0.0000	0.0000	0.1013	0.1620	60%
2009	2.4982	5.9846	140%	0.0000	0.0000	0.0892	0.1496	68%
2010	3.1711	6.6482	110%	0.0000	0.0000	0.1133	0.1662	47%
2011	4.4230	8.2251	86%	0.0000	0.0000	0.1580	0.2056	30%
2012	1.8750	4.4481	137%	0.0000	0.0000	0.0670	0.1112	66%
2013	1.8439	4.2085	128%	0.0000	0.0000	0.0659	0.1052	60%
2014	1.8229	4.3596	139%	0.0000	0.0000	0.0651	0.1090	67%
2015	1.4744	3.4647	135%	0.0000	0.0000	0.0527	0.0866	64%
2016	0.7398	2.1375	189%	0.0000	0.0000	0.0264	0.0534	102%
2017	0.3163	1.1896	276%	0.0000	0.0000	0.0113	0.0297	163%
2018	0.7453	1.9180	157%	0.0000	0.0000	0.0266	0.0479	80%
2019	0.4463	1.1338	154%	0.0000	0.0000	0.0159	0.0283	78%
2020	0.4780	1.2657	165%	0.0000	0.0000	0.0171	0.0316	85%
2021	0.6217	1.3508	117%	0.0000	0.0000	0.0222	0.0338	52%

P-Previous, R-Revised, C-change

6.6.3.6 Sewage Sludge Incineration (NFR 5C1biv)

This activity is not occurring in the Slovak Republic.

6.6.4 Cremation (NFR 5C1bv)

An annual increase in cremated bodies gives rise to emissions of heavy metals and persistent pollutants. In comparison to the base year, there was an increase in trends of NO_X, SO_X, TSP, CO, $PM_{2.5}$, and PM_{10} emissions driven by the activity data. As shown in ***Table 6.29***, cremation shows an increasing trend in Slovakia, though in 2017 a slight decrease and subsequently increase in 2018 was recorded. Since then the amount of cremated bodies has increased. In 2020 and 2021, it is a result of the covid-19 pandemic. In the year 2022, amount of cremated bodies decreased as the pandemic ended.

Table 6.29: *Overview of activity data, emissions and emission trends in the category of Cremation*

YEAR	HUMAN BODIES CREMATED [body]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	6 010	0.0050	0.0001	0.0007	0.0002	0.0002	0.0002	0.0008
1995	6 744	0.0056	0.0001	0.0008	0.0002	0.0002	0.0003	0.0009
2000	7 528	0.0062	0.0001	0.0009	0.0003	0.0003	0.0003	0.0011
2005	10 418	0.0086	0.0001	0.0012	0.0004	0.0004	0.0004	0.0015
2010	13 167	0.0109	0.0002	0.0015	0.0005	0.0005	0.0005	0.0018
2011	12 583	0.0104	0.0002	0.0014	0.0004	0.0004	0.0005	0.0018
2012	12 701	0.0105	0.0002	0.0014	0.0004	0.0004	0.0005	0.0018
2013	15 561	0.0128	0.0002	0.0018	0.0005	0.0005	0.0006	0.0022

YEAR	HUMAN BODIES CREMATED [body]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2014	15 243	0.0126	0.0002	0.0017	0.0005	0.0005	0.0006	0.0021
2015	16 824	0.0139	0.0002	0.0019	0.0006	0.0006	0.0006	0.0024
2016	16 907	0.0139	0.0002	0.0019	0.0006	0.0006	0.0007	0.0024
2017	14 582	0.0120	0.0002	0.0016	0.0005	0.0005	0.0006	0.0020
2018	18 264	0.0151	0.0002	0.0021	0.0006	0.0006	0.0007	0.0026
2019	20 800	0.0172	0.0003	0.0024	0.0007	0.0007	0.0008	0.0029
2020	24 028	0.0198	0.0003	0.0027	0.0008	0.0008	0.0009	0.0034
2021	32 196	0.0266	0.0004	0.0036	0.0011	0.0011	0.0012	0.0045
2022	24 973	0.0206	0.0003	0.0028	0.0009	0.0009	0.0010	0.0035
1990/2022	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**
2021/2022	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0002	0.0000	0.0090	0.0001	0.0001	0.0001	0.0001	0.0001	0.0010
1995	0.0002	0.0000	0.0100	0.0001	0.0001	0.0001	0.0001	0.0001	0.0011
2000	0.0002	0.0000	0.0112	0.0001	0.0001	0.0001	0.0001	0.0001	0.0012
2005	0.0003	0.0001	0.0155	0.0001	0.0001	0.0001	0.0002	0.0002	0.0017
2010	0.0004	0.0001	0.0196	0.0002	0.0002	0.0002	0.0002	0.0003	0.0021
2011	0.0004	0.0001	0.0187	0.0002	0.0002	0.0002	0.0002	0.0002	0.0020
2012	0.0004	0.0001	0.0189	0.0002	0.0002	0.0002	0.0002	0.0003	0.0020
2013	0.0005	0.0001	0.0232	0.0002	0.0002	0.0002	0.0003	0.0003	0.0025
2014	0.0005	0.0001	0.0227	0.0002	0.0002	0.0002	0.0003	0.0003	0.0024
2015	0.0005	0.0001	0.0251	0.0002	0.0002	0.0002	0.0003	0.0003	0.0027
2016	0.0005	0.0001	0.0252	0.0002	0.0002	0.0002	0.0003	0.0003	0.0027
2017	0.0004	0.0001	0.0217	0.0002	0.0002	0.0002	0.0003	0.0003	0.0023
2018	0.0005	0.0001	0.0272	0.0002	0.0002	0.0002	0.0003	0.0004	0.0029
2019	0.0006	0.0001	0.0310	0.0003	0.0003	0.0003	0.0004	0.0004	0.0033
2020	0.0007	0.0001	0.0358	0.0003	0.0003	0.0003	0.0004	0.0005	0.0038
2021	0.0010	0.0002	0.0480	0.0004	0.0004	0.0004	0.0006	0.0006	0.0052
2022	0.0007	0.0001	0.0372	0.0003	0.0003	0.0003	0.0004	0.0005	0.0040
1990/2022	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**
2021/2022	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0025
1995	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0028
2000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011	0.0031
2005	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016	0.0043
2010	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0054
2011	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0052
2012	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0052
2013	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0064
2014	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0062
2015	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0025	0.0069
2016	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0025	0.0069
2017	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0022	0.0060
2018	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0027	0.0075
2019	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0031	0.0085

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2020	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0036	0.0099
2021	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0048	0.0132
2022	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0037	0.0102
1990/2022	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**	**316%**
2021/2022	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**	**-22%**

6.6.4.1 Methodological Issues

The source of activity data for air pollutants came from operators of Cremation facilities, which report the number of bodies incinerated in their crematories. Historical data (1990-2000) is not available, therefore, extrapolation was used.

For the emissions, calculation the statistical activity data were used with the default EMEP/EEA GB$_{2023}$ emission factors. The values are given in the tables below (***Table 6.30***).

The inclusion/exclusion of the ***condensable component of PMs*** is unknown.

Table 6.30: *Emission factors in the category of Cremation*

POLLUTANT	NOx	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	CO	Pb
Unit	[kg/body]	[kg/body]	[kg/body]	[g/body]	[g/body]	[g/body]	[kg/body]	[mg/body]
Value	0.825	0.013	0.11	34.7	34.7	38.56	0.14	30.03

POLLUTANT	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
Unit	[mg/body]	[g/body]	[mg/body]	[mg/body]	[mg/body]	[mg/body]	[mg/body]	[mg/body]
Value	5.03	1.49	13.61	13.56	12.43	17.33	19.78	160.12

POLLUTANT	PCDD/F	B(a)P	B(b)F	B(k)F	I()P	PAHs	HCB	PCB
Unit	[µg/body]	[µg/body]	[µg/body]	[µg/body]	[µg/body]	[µg/body]	[mg/body]	[mg/body]
Value	0.027	13.2	7.21	6.44	6.99	33.84	0.15	0.41

6.6.4.2 Completeness

All rising pollutants are recorded and reported.

6.6.4.3 Source-specific Recalculations

No recalculations in this submission.

6.6.5 Open Burning of Waste (5C2)

Open burning of waste is against the law of the Slovak Republic (Decree No. 79/2015 Coll. about Waste.[18] as amended), 314/2001 Coll. on fire protection[19] and 40/1964 Coll. (Civil Code)[20]. It is forbidden to perform the open burning of agricultural waste. The only exception is for the open burning of forest residues. Emissions from this activity were removed from category **11B** and allocated to this category following ***Recommendation No. SK-5C2-2023-0001*** . An overview of emissions from this category is shown in ***Table 6.31***.

Table 6.31: *Overview of activity data, emissions and emission trends in the category of Open burning of waste*

YEAR	TOTAL MASS OF BIOMASS BURNED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	105.05	0.1943	0.1544	0.0032	0.3950	0.4339	0.4528
1995	89.95	0.1671	0.1322	0.0027	0.3382	0.3715	0.3877
2000	133.12	0.2460	0.1957	0.0040	0.5005	0.5498	0.5737

[18] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20190101.html

[19] https://www.minv.sk/swift_data/source/hasici_a_zachranari/kinkorova_dokumenty/zakony_vyhlasky_pokyny/314-20001.pdf

[20] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1964/40/

YEAR	TOTAL MASS OF BIOMASS BURNED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
2005	215.10	0.3993	0.3162	0.0065	0.8088	0.8884	0.9271
2010	218.68	0.4066	0.3215	0.0066	0.8222	0.9031	0.9425
2011	211.05	0.3923	0.3102	0.0063	0.7936	0.8716	0.9096
2012	127.17	0.2354	0.1869	0.0038	0.4782	0.5252	0.5481
2013	127.68	0.2373	0.1877	0.0038	0.4801	0.5273	0.5503
2014	252.62	0.4697	0.3713	0.0076	0.9498	1.0433	1.0888
2015	241.85	0.4496	0.3555	0.0073	0.9093	0.9988	1.0424
2016	234.93	0.4368	0.3454	0.0070	0.8833	0.9703	1.0126
2017	229.36	0.4264	0.3372	0.0069	0.8624	0.9472	0.9885
2018	240.10	0.4464	0.3529	0.0072	0.9028	0.9916	1.0348
2019	228.30	0.4243	0.3356	0.0068	0.8584	0.9429	0.9840
2020	189.53	0.3522	0.2786	0.0057	0.7126	0.7827	0.8169
2021	193.47	0.3597	0.2844	0.0058	0.7274	0.7990	0.8338
2022	191.41	0.3552	0.2814	0.0057	0.7197	0.7905	0.8250
1990/2022	**82%**	**83%**	**82%**	**82%**	**82%**	**82%**	**82%**
2021/2022	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**

YEAR	BC [kt]	CO [kt]	Pb [t]	Cd [t]	As [t]	Cu [t]	Se [t]	Zn [t]
1990	0.1114	6.9307	0.0336	0.0137	0.0830	0.0263	0.0105	1.7859
1995	0.0954	5.9588	0.0288	0.0117	0.0711	0.0225	0.0090	1.5291
2000	0.1411	8.7738	0.0426	0.0173	0.1052	0.0333	0.0133	2.2630
2005	0.2281	14.2425	0.0688	0.0280	0.1699	0.0538	0.0215	3.6567
2010	0.2319	14.5025	0.0700	0.0284	0.1728	0.0547	0.0219	3.7176
2011	0.2238	13.9914	0.0675	0.0274	0.1667	0.0528	0.0211	3.5879
2012	0.1348	8.3957	0.0407	0.0165	0.1005	0.0318	0.0127	2.1620
2013	0.1354	8.4638	0.0409	0.0166	0.1009	0.0319	0.0128	2.1706
2014	0.2679	16.7535	0.0808	0.0328	0.1996	0.0632	0.0253	4.2945
2015	0.2564	16.0341	0.0774	0.0314	0.1911	0.0605	0.0242	4.1114
2016	0.2491	15.5804	0.0752	0.0305	0.1856	0.0587	0.0235	3.9939
2017	0.2432	15.2074	0.0734	0.0298	0.1812	0.0573	0.0229	3.8991
2018	0.2546	15.9214	0.0768	0.0312	0.1897	0.0600	0.0240	4.0817
2019	0.2421	15.1335	0.0731	0.0297	0.1804	0.0571	0.0228	3.8812
2020	0.2010	12.5608	0.0606	0.0246	0.1497	0.0474	0.0190	3.2219
2021	0.2051	12.8304	0.0619	0.0252	0.1528	0.0484	0.0193	3.2889
2022	0.2030	12.6672	0.0613	0.0249	0.1512	0.0479	0.0191	3.2539
1990/2022	**82%**	**83%**	**82%**	**82%**	**82%**	**82%**	**82%**	**82%**
2021/2022	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**

YEAR	B(a)P [t]	B(b)F [t]	B(k)F [t]	PAHs [t]
1990	0.3309	0.5410	0.6776	1.5495
1995	0.2833	0.4632	0.5802	1.3267
2000	0.4193	0.6856	0.8586	1.9635
2005	0.6776	1.1078	1.3874	3.1727
2010	0.6888	1.1262	1.4105	3.2255
2011	0.6648	1.0869	1.3613	3.1130
2012	0.4006	0.6549	0.8203	1.8758
2013	0.4022	0.6576	0.8236	1.8833
2014	0.7957	1.3010	1.6294	3.7261

YEAR	B(a)P [t]	B(b)F [t]	B(k)F [t]	PAHs [t]
2015	0.7618	1.2455	1.5599	3.5672
2016	0.7400	1.2099	1.5153	3.4653
2017	0.7225	1.1812	1.4794	3.3830
2018	0.7563	1.2365	1.5486	3.5415
2019	0.7192	1.1758	1.4726	3.3675
2020	0.5970	0.9761	1.2224	2.7955
2021	0.6094	0.9963	1.2478	2.8536
2022	0.6029	0.9858	1.2346	2.8233
1990/2022	**82%**	**82%**	**82%**	**82%**
2021/2022	**-1%**	**-1%**	**-1%**	**-1%**

6.6.5.1 Methodological Issues

The Slovak National Forest Centre provided activity data about wood burned (controlled forest fires in Slovakia) Tier 2 emissions factors for temperate forests from EMEP/EEA GB_{2023} were used to calculate emissions. To maintain consistency with GHG inventory, emissions of NOx and CO were calculated using emission factors and methodology from $IPCC_{2006}$ Guidelines, ***Chapter 2.4: Non-CO_2 Emissions*** (H. Aalde, 2006). The inclusion/exclusion of the ***condensable component of PMs*** is unknown.

Table 6.32: *Emission factors in the category of Open burning of waste*

POLLUTANT	NOx	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	BC
Unit	[g/kg dm]	[kg/t waste]	[kg/t waste]	[kg/t waste]	[kg/t waste]	[kg/t waste]	[% of $PM_{2.5}$]
Value	3	1.47	0.03	3.76	4.13	4.31	28.2

POLLUTANT	CO	Pb	Cd	As	Cu	Se	Zn
Unit	[g/kg dm]	[g/t waste]	[g/t waste]	[g/t waste]	[g/t waste]	[g/t waste]	[g/t waste]
Value	107	0.32	0.13	0.79	0.25	0.10	17.00

POLLUTANT	B(a)P	B(b)F	B(k)F	PAHs
Unit	[g/t waste]	[g/t waste]	[g/t waste]	[g/t waste]
Value	3.15	6.45	5.15	14.75

6.6.4.2 Completeness

All rising pollutants are recorded and reported.

6.6.4.3 Source-specific Recalculations

This category is reported for the first time in this submission, therefore, no recalculations were made.

6.7 WASTEWATER HANDLING (NFR 5D)

6.7.1 Overview

This sector includes emissions of main pollutants from domestic and industrial wastewater treatment. In these categories, also emissions from biogas incineration are included, but these emissions are not the key source of emissions. For wastewater treatment, NMVOC is the most significant pollutant emitted from these sources, but this category is not key for NMVOC emissions.

Total NMVOC emissions from wastewater treatment (including biogas incineration) were 0.26 kt in 2022. Compared to the previous years, these emissions continue to decrease, which is caused mainly by building and connecting the houses to the sewage systems. I

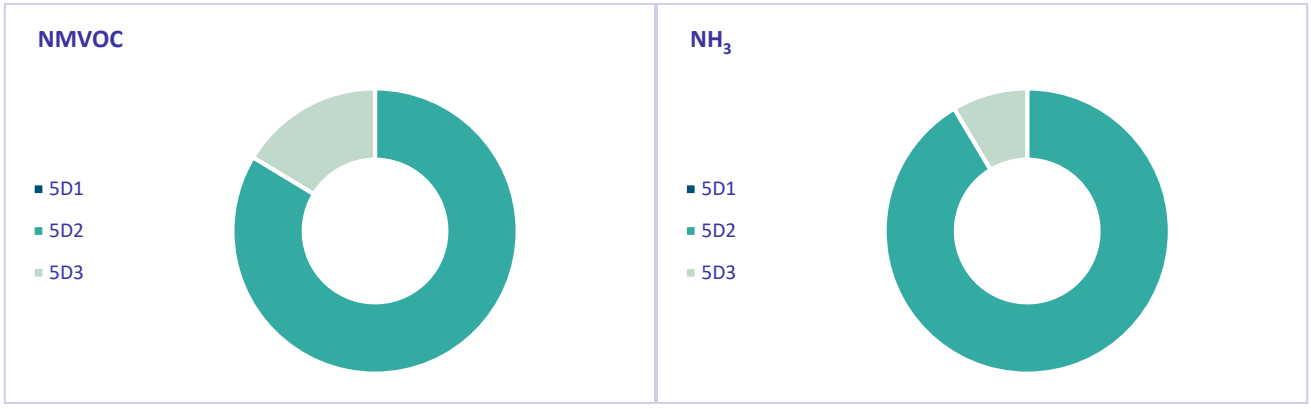
Table 6.33 shows trends of emissions from domestic and industrial wastewater during the last years.

Table 6.33: *Overview of emission trends in the category of Wastewater handling*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO[kt]
1990	0.0070	0.9603	0.0042	1.1315	0.0059	0.0059	0.0059	0.0060
1995	0.0077	1.0440	0.0045	1.0352	0.0064	0.0064	0.0064	0.0065
2000	0.0015	1.6126	0.0000	0.8408	0.0045	0.0045	0.0045	0.0048
2005	0.0048	0.8500	0.0019	0.7637	0.0005	0.0005	0.0005	0.0019
2010	0.0074	0.2964	0.0027	0.6096	0.0007	0.0007	0.0007	0.0023
2011	0.0082	0.2330	0.0031	0.4761	0.0008	0.0008	0.0008	0.0026
2012	0.0058	0.2099	0.0026	0.4586	0.0004	0.0004	0.0004	0.0021
2013	0.0048	0.2750	0.0026	0.3829	0.0007	0.0007	0.0007	0.0034
2014	0.0050	0.2021	0.0027	0.3179	0.0008	0.0008	0.0008	0.0045
2015	0.0057	0.2202	0.0039	0.3113	0.0011	0.0011	0.0011	0.0064
2016	0.0058	0.2566	0.0024	0.2409	0.0005	0.0005	0.0005	0.0019
2017	0.0061	0.2645	0.0028	0.1501	0.0004	0.0004	0.0004	0.0021
2018	0.0059	0.2692	0.0029	0.1225	0.0004	0.0004	0.0004	0.0021
2019	0.0067	0.2737	0.0036	0.1015	0.0005	0.0005	0.0005	0.0023
2020	0.0063	0.2733	0.0028	0.0977	0.0005	0.0005	0.0005	0.0021
2021	0.0069	0.2740	0.0035	0.0976	0.0005	0.0005	0.0005	0.0021
2022	0.0058	0.2552	0.0029	0.0896	0.0004	0.0004	0.0004	0.0019
1990/2022	**-18%**	**-73%**	**-29%**	**-92%**	**-93%**	**-93%**	**-93%**	**-68%**
2021/2022	**-16%**	**-7%**	**-16%**	**-8%**	**-21%**	**-21%**	**-21%**	**-7%**

Shares of NMVOC emission in 2022 NFR categories included in the wastewater treatment are shown in ***Figure 6.7***.

Figure 6.7: *Share in NMVOC and NH_3 emissions of individual categories in 5D in 2022*



The legislation and practice in wastewater treatment in Slovakia require that sewage sludge must be stabilised directly by the wastewater treatment plant (e.g. Act No 188/2003 Coll. requires that only stabilised sewage sludge can be indirectly applied on agricultural land). Thus, according to the Slovak Technical Norm 75 6401 "Sewage Treatment Plants for more than 500 population equivalents", wastewater treatment plants (WWTPs) with a capacity of up to 10,000 population-equivalents (p.e.) shall have aerobic sludge stabilisation and larger WWTPs shall have anaerobic sludge stabilisation with biogas production. ***Tables 6.34*** and ***6.35*** provide information on the data sources regarding the share of the distribution of domestic and industrial sludge treatment.

Table 6.34: WWT distribution of domestic sludge

YEAR	TOTAL GENERATED	TOTAL USE	DIRECT AGR. LAND APPLIC.	COMPOSTED	INCINER.	LANDFILLED	TEMPORARY STORED ON-SITE
	tons						
1990	55 000	45 207	NO	NO	NO	NO	NO
1995	55 000	45 207	NO	NO	NO	NO	NO
2000	56 279	35 358	NO	NO	NO	13 796	7 125
2005	56 360	39 120	NO	NO	NO	8 530	8 710
2010	54 760	48 063	923	47 140	NO	16	6 681
2011	58 718	50 469	358	50 111	NO	2 306	5 946
2012	58 760	50 896	1 254	46 446	3 196	1 615	6 195
2013	57 433	50 787	518	45 261	5 008	1 666	4 980
2014	56 883	52 570	8	36 524	16 038	1 073	3 240
2015	56 242	51 602	NO	34 689	16 913	1 709	2 932
2016	53 054	45 738	NO	34 695	11 043	2 359	4 957
2017	54 517	46 654	NO	34 416	12 238	2 636	5 227
2018	55 929	44 659	NO	32 982	11 677	2 451	8 819
2019	54 832	45 149	NO	32 217	12 932	2 296	7 387
2020	55 519	48 490	NO	36 562	11 928	2 302	4 727
2021	54 764	50 042	NO	37 289	12 753	456	4 266
2022	55 049	43 835	NO	33 509	10 326	1 540	9 674

Table 6.35: WWT distribution of industrial treatment sludge since 2005

YEAR	TOTAL GENERATED	TOTAL USE	DIRECT AGR. LAND APPLIC.	COMPOSTED	INCINER.	LANDFILLED	TEMPORARY STORED ON-SITE
	tons						
2005	10 307	5 577	2 231	1 037	1 501	785	24
2010	25 571	19 769	1 102	6 369	1 228	11 058	13
2011	29 388	19 460	685	9 977	921	7 620	256
2012	22 567	18 483	478	7 099	1 543	6 351	3 012
2013	19 632	17 167	627	7 727	1 720	1 456	5 636
2014	12 377	8 434	688	4 632	1 763	1 237	114
2015	11 485	7 500	813	3 248	2 496	898	45
2016	13 651	12 200	1 134	3 353	2 021	5 641	50
2017	22 211	15 538	362	3 460	1 206	1 063	9 447
2018	49 669	40 461	287	3 520	3 307	1 006	32 341
2019	12 935	9 393	49	3 361	2 663	1 327	1 993
2020	32 599	28 611	1	3 893	1 326	6 445	16 946
2021	20 724	10 992	1	3 191	1 013	6 034	750
2022	14 240	10 046	1	1 905	925	5 598	1 618

6.7.2 Domestic Wastewater Handling (NFR 5D1)

6.7.2.1 Overview of the Category

Council Directive 91/271/EEC[21] concerning urban wastewater treatment as well as obligations arising from the Treaty of Accession of the Slovak Republic to the European Union of 16.4.2003 resulted in the construction of new sewage systems. The construction of new wastewater treatment plants and restoring the hardware of already functioning sewage treatment plants.

[21] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0271&from=EN

Generally, about two-thirds of the population are discharging wastewater through sewers and one-third use retention tanks. Wastewater collection and treatment in Slovakia is developing toward modern, advanced WWT plants with the removal of nitrogen and phosphorus. Sludge from wastewater treatment is anaerobically stabilised on-site in 52 of 734 Domestic WWT plants. On 40 of them, resulting biogas is incinerated to produce energy and on 8 it is flared without energy utilisation.

This category involves also emissions from using latrines in Slovakia. The number of households without connection to the public sewage system decreased significantly in comparison to the base year. ***Tables 6.36*** and ***6.37*** show the emission trend of NH_3.

Table 6.36: *Overview of emission trends from biogas combustion in the category of Domestic wastewater handling*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO[kt]
1990	0.0041	0.0970	0.0041	0.0317	0.0009	0.0009	0.0009	0.0021
1995	0.0045	0.0887	0.0044	0.0344	0.0010	0.0010	0.0010	0.0023
2000	0.0007	0.0010	0.0000	0.0004	0.0001	0.0001	0.0001	0.0001
2005	0.0046	0.1711	0.0019	0.0565	0.0005	0.0005	0.0005	0.0018
2010	0.0073	0.1906	0.0027	0.0653	0.0007	0.0007	0.0007	0.0023
2011	0.0082	0.1991	0.0031	0.0702	0.0008	0.0008	0.0008	0.0026
2012	0.0058	0.1754	0.0026	0.0619	0.0004	0.0004	0.0004	0.0020
2013	0.0048	0.1864	0.0026	0.0660	0.0006	0.0006	0.0006	0.0034
2014	0.0050	0.1822	0.0027	0.0646	0.0008	0.0008	0.0008	0.0045
2015	0.0056	0.2001	0.0039	0.0718	0.0011	0.0011	0.0011	0.0064
2016	0.0058	0.2039	0.0023	0.0733	0.0005	0.0005	0.0005	0.0019
2017	0.0060	0.2123	0.0027	0.0754	0.0004	0.0004	0.0004	0.0021
2018	0.0059	0.2193	0.0028	0.0809	0.0004	0.0004	0.0004	0.0021
2019	0.0067	0.2218	0.0036	0.0812	0.0005	0.0005	0.0005	0.0023
2020	0.0063	0.2207	0.0027	0.0811	0.0005	0.0005	0.0005	0.0021
2021	0.0061	0.2220	0.0029	0.0813	0.0005	0.0005	0.0005	0.0020
2022	0.0055	0.2088	0.0027	0.0773	0.0004	0.0004	0.0004	0.0019
1990/2022	**34%**	**115%**	**-33%**	**144%**	**-54%**	**-54%**	**-54%**	**-9%**
2021/2022	**-9%**	**-6%**	**-4%**	**-5%**	**-17%**	**-17%**	**-17%**	**-5%**

Table 6.37: *Overview of emission trends from water treatment and latrines in the category of Domestic wastewater handling*

YEAR	DOMESTIC WW DISCHARGED [th. m^3]	POPULATION USING DRY TOILETS [inhab]	NMVOC [kt]	NH_3 [kt]
1990	370 257.35	685 274.00	0.0056	1.0964
1995	402 528.74	623 177.40	0.0060	0.9971
2000	447 129.41	522 718.40	0.0067	0.8363
2005	411 842.63	439 789.80	0.0062	0.7037
2010	454 069.00	338 339.80	0.0068	0.5413
2011	364 941.00	252 108.84	0.0055	0.4034
2012	337 545.00	246 164.10	0.0051	0.3939
2013	400 954.00	196 245.18	0.0060	0.3140
2014	377 445.00	156 568.30	0.0057	0.2505
2015	362 142.00	147 745.40	0.0054	0.2364
2016	385 463.00	100 234.50	0.0058	0.1604
2017	382 392.00	42 356.11	0.0057	0.0678
2018	369 599.00	21 807.43	0.0055	0.0349
2019	381 036.00	8 254.66	0.0057	0.0132

YEAR	DOMESTIC WW DISCHARGED [th. m³]	POPULATION USING DRY TOILETS [inhab]	NMVOC [kt]	NH_3 [kt]
2020	404 305.00	6 032.49	0.0061	0.0097
2021	400 700.00	5 441.99	0.0060	0.0087
2022	315 547.00	2 893.85	0.0047	0.0046
1990/2022	**-15%**	**-100%**	**-15%**	**-100%**
2021/2022	**-21%**	**-47%**	**-21%**	**-47%**

As shown in ***Table 6.37***, emissions of NMVOC from water treatment decreased from 1996 to 2003, since 2004 emissions show an increasing trend due to the increase of households connected to a public sewage system and water supply. The emission trend of NH_3 is decreasing due to the decrease in inhabitants using dry toilets. In the combustion of biogas, a significant decrease was identified for ammonia in the year 2000, but the cause is unknown.

6.7.2.2 Methodological Issues

The Source of activity data is national statistical data on the volume of handled wastewater released into watercourses. EMEP/EEA GB_{2023} (Tier 1) were used to calculate emissions of NMVOC emitted into the air during wastewater handling. In the table below, the emission factor used to calculate emissions is shown. Notation keys from EMEP/EEA GB_{2023} were applied for other pollutants. Also, data from the NEIS database for the incineration of residual gases were included in the calculation.

The NEIS database contains data from the year 2000 for pollutants: NOx, NMVOC, SOx, NH_3, TSP and CO. Emissions of $PM_{2.5}$ and PM_{10} are calculated within the database from the year 2005. These data represent emissions from biogas flaring. Emission factors in the NEIS database comply with Decree 363/2010[22] and emission factors are in ANNEX I of the Decree. The share of $PM_{2.5}$ and PM_{10} emissions was determined from the following sources:

- TESO Praha a.s.: Drafting of emission factors for the Ministry of the Environment.
- COMMUNICATION of the Department of Air Protection, which determines the emission factors and ratios of PM10 and PM2.5 particles in TZL for the assessment of the ecological feasibility of the proposal as part of the energy audit and energy assessment according to the procedure specified in Annex no. 6 of Decree No. 480/2012 Coll., on energy audit and energy assessment, as amended
- Notification of the Department of Air Protection, which determines the emission factors according to § 12 para. 1 letter b) decree no. 415/2012 Coll., on the permissible level of pollution and its detection and the implementation of some other provisions of the Air Protection Act
- Jana Smutná: Emission factors in the Czech Republic (overview study)

Emission factors for historical years for NOx, NMVOC, SOx, NH_3, and TSP are calculated using the weighted average of implied emission factors from the period 2000-2004 and for shares of PMs as average shares from the period 2005-2009. Emission factors for historical years are listed in ***Table 6.38***.

Table 6.38: *Historical emission factors for biogas incineration in the category of Domestic wastewater handling*

POLLUTANT	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
Unit	[g/m³]	[g/m³]	[g/m³]	[g/m³]	[of TSP]	[of TSP]	[g/m³]	[g/m³]
Value	0.01	0.24	0.01	0.09	98.4%	98.5%	0.002	0.01

For the usage of dry toilettes, the principle of calculation consisted of determining the percentage of use of dry toilettes in Slovak households (based on information from censuses 2001 and 2011). Activity data were then calculated by multiplying this percentage by the middle-year population in the Slovak Republic. This parameter has been multiplied with Tier 2 emissions factors for dry toilettes from EMEP/EEA GB_{2023} (***Table 6.39***).

[22] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2010/363/20100915.html

Table 6.39: Emission factors for wastewater treatment in the category of Domestic wastewater handling

POLLUTANT	NMVOC	NH_3
Unit	[mg/m³[	[kg/person/year]
Value	15	1.6

6.7.2.3 Completeness

Sources of emissions are well covered.

6.7.2.4 Source-specific Recalculations

Emission factors for $PM_{2.5}$ and PM_{10} were changed to comply with Decree no 248/2023 (*Table 6.40*).

Table 6.40: Previous and revised activity data in the category of Domestic wastewater treatment

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0009	0.0009	2%	0.0009	0.0009	2%
1991	0.0008	0.0008	2%	0.0008	0.0008	2%
1992	0.0009	0.0010	2%	0.0009	0.0010	2%
1993	0.0009	0.0009	2%	0.0009	0.0009	2%
1994	0.0009	0.0010	2%	0.0009	0.0010	2%
1995	0.0010	0.0010	2%	0.0010	0.0010	2%
1996	0.0011	0.0011	2%	0.0011	0.0011	2%
1997	0.0011	0.0011	2%	0.0011	0.0011	2%
1998	0.0011	0.0011	2%	0.0011	0.0011	2%
1999	0.0010	0.0011	2%	0.0010	0.0011	2%
2000	0.0001	0.0001	2%	0.0001	0.0001	2%
2001	0.0006	0.0006	2%	0.0006	0.0006	2%
2002	0.0005	0.0005	2%	0.0005	0.0005	2%
2003	0.0008	0.0008	2%	0.0008	0.0008	2%
2004	0.0029	0.0030	2%	0.0029	0.0030	2%
2005	0.0004	0.0005	2%	0.0004	0.0005	2%
2006	0.0007	0.0007	2%	0.0007	0.0007	2%
2007	0.0004	0.0004	2%	0.0004	0.0004	2%
2008	0.0005	0.0005	2%	0.0005	0.0005	2%
2009	0.0006	0.0006	2%	0.0006	0.0006	2%
2010	0.0006	0.0007	2%	0.0007	0.0007	2%
2011	0.0007	0.0008	2%	0.0007	0.0008	2%
2012	0.0004	0.0004	2%	0.0004	0.0004	2%
2013	0.0006	0.0006	2%	0.0006	0.0006	2%
2014	0.0008	0.0008	2%	0.0008	0.0008	2%
2015	0.0011	0.0011	2%	0.0011	0.0011	2%
2016	0.0004	0.0005	2%	0.0004	0.0005	2%
2017	0.0004	0.0004	2%	0.0004	0.0004	2%
2018	0.0004	0.0004	2%	0.0004	0.0004	2%
2019	0.0005	0.0005	-2%	0.0005	0.0005	-2%
2020	0.0005	0.0005	2%	0.0005	0.0005	2%
2021	0.0009	0.0009	2%	0.0009	0.0009	2%

6.7.3 Industrial Wastewater Handling (NFR 5D2)

6.7.3.1 Overview of the Category

Water consumption for industrial purposes and the resulting discharge of wastewater have significantly decreased in the period 1990–2022. This decrease is caused by the general modernisation of the Slovak industries and stricter standards for the discharge of industrial wastewater to public sewers or watercourses.

Table 6.41: *Overview of emissions and trends in the category of Industrial wastewater handling*

YEAR	INDUSTRIAL WASTEWATER DISCHARGED [th.m³]	NOx [kt]	NMVOC BIOGAS COMB. [kt]	NMVOC WATER TREAT. [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	191 163.24	0.0029	0.8627	0.0029	0.0001	0.0034	0.0050	0.0050	0.0050	0.0039
1995	207 824.90	0.0032	0.9379	0.0031	0.0001	0.0037	0.0054	0.0054	0.0054	0.0042
2000	230 852.15	0.0009	1.6014	0.0035	0.0000	0.0041	0.0044	0.0044	0.0044	0.0047
2005	212 633.64	0.0002	0.6696	0.0032	0.0001	0.0036	0.0000	0.0000	0.0000	0.0001
2010	230 670.00	0.0001	0.0955	0.0035	0.0000	0.0029	0.0000	0.0000	0.0000	0.0000
2011	198 242.00	0.0000	0.0254	0.0030	0.0000	0.0026	0.0000	0.0000	0.0000	0.0000
2012	190 699.00	0.0000	0.0266	0.0029	0.0000	0.0028	0.0000	0.0000	0.0000	0.0000
2013	202 692.00	0.0000	0.0796	0.0030	0.0000	0.0029	0.0001	0.0001	0.0001	0.0000
2014	189 387.00	0.0000	0.0114	0.0028	0.0000	0.0028	0.0000	0.0000	0.0000	0.0000
2015	188 578.00	0.0000	0.0118	0.0028	0.0000	0.0032	0.0000	0.0000	0.0000	0.0000
2016	189 571.00	0.0000	0.0441	0.0028	0.0001	0.0072	0.0000	0.0000	0.0000	0.0000
2017	187 218.00	0.0000	0.0436	0.0028	0.0000	0.0069	0.0000	0.0000	0.0000	0.0000
2018	186 178.00	0.0000	0.0415	0.0028	0.0000	0.0067	0.0000	0.0000	0.0000	0.0000
2019	189 901.00	0.0000	0.0434	0.0028	0.0001	0.0072	0.0000	0.0000	0.0000	0.0000
2020	190 970.00	0.0001	0.0437	0.0029	0.0001	0.0070	0.0000	0.0000	0.0000	0.0000
2021	194 804.00	0.0008	0.0431	0.0029	0.0006	0.0076	0.0000	0.0000	0.0000	0.0000
2022	173 822.00	0.0003	0.0391	0.0026	0.0002	0.0077	0.0000	0.0000	0.0000	0.0000
1990/2022	**-9%**	**-91%**	**-95%**	**-9%**	**179%**	**126%**	**-100%**	**-100%**	**-100%**	**-100%**
2021/2022	**-11%**	**-67%**	**-9%**	**-11%**	**-68%**	**1%**	**-65%**	**-65%**	**-65%**	**-63%**

In ***Table 6.41***, activity data, emissions and their trends are displayed. Emissions of NH_3 have increased since 2016 due to the increase of emissions from residual gases burning,

6.7.3.2 Methodological issues

The amount of industrial wastewater discharged to watercourses was used as the activity data to estimate emissions of NMVOC. Tier 2 emission factor for industrial wastewater handling from EMEP/EEA GB_{2023} was used and its value is **15mg/m³**.

The NEIS database contains data from the year 2000 for pollutants: NOx, NMVOC, SOx, NH_3, TSP and CO. Emissions of $PM_{2.5}$ and PM_{10} are calculated within the database from the year 2005. These data represent emissions from biogas flaring. Emissions of $PM_{2.5}$ and PM_{10} are calculated within the database from the year 2005. These data represent emissions from biogas flaring. Emission factors in the NEIS database comply with Decree 363/2010[23] and emission factors are in ANNEX I of the Decree. The share of $PM_{2.5}$ and PM_{10} emissions was determined from the following sources:

- TESO Praha a.s.: Drafting of emission factors for the Ministry of the Environment.
- COMMUNICATION of the Department of Air Protection, which determines the emission factors and ratios of PM_{10} and $PM_{2.5}$ particles in TZL for the assessment of the ecological feasibility of the proposal

[23] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2010/363/20100915.html

as part of the energy audit and energy assessment according to the procedure specified in Annex no. 6 of Decree No. 480/2012 Coll., on energy audit and energy assessment, as amended

- Notification of the Department of Air Protection, which determines the emission factors according to § 12 para. 1 letter b) decree no. 415/2012 Coll., on the permissible level of pollution and its detection and the implementation of some other provisions of the Air Protection Act
- Jana Smutná: Emission factors in the Czech Republic (overview study)

Emission factors for historical years for NOx, NMVOC, SOx, NH_3, and TSP are calculated using the weighted average of implied emission factors from the period 2000-2004 and for shares of PMs as average shares from the period 2005-2009. Emission factors for historical years are listed in ***Table 6.42***.

Table 6.42: *Historical emission factors for biogas incineration in the category of Industrial wastewater handling*

POLLUTANT	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
Unit	[g/m³]	[g/m³]	[g/m³]	[g/m³]	[of TSP]	[of TSP]	[g/m³]	[g/m³]
Value	0.02	4.51	0.00036	0.02	98.4%	98.5%	0.03	0.02

6.7.3.3 Completeness

Sources of emissions are well covered.

6.7.3.4 Source-specific Recalculations

Emission factors for $PM_{2.5}$ and PM_{10} were changed to comply with Decree no 248/2023. The results of the changes are presented in ***Table 6.43***.

Table 6.43: *Previous and revised NMVOC emissions in the category of Industrial wastewater treatment*

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0049	0.0050	2%	0.0049	0.0050	2%
1991	0.0044	0.0045	2%	0.0044	0.0045	2%
1992	0.0052	0.0053	2%	0.0052	0.0053	2%
1993	0.0049	0.0049	2%	0.0049	0.0049	2%
1994	0.0052	0.0053	2%	0.0052	0.0053	2%
1995	0.0053	0.0054	2%	0.0053	0.0054	2%
1996	0.0062	0.0063	2%	0.0062	0.0063	2%
1997	0.0061	0.0062	2%	0.0061	0.0062	2%
1998	0.0059	0.0060	2%	0.0059	0.0060	2%
1999	0.0058	0.0059	2%	0.0058	0.0059	2%
2000	0.0043	0.0044	2%	0.0043	0.0044	2%
2001	0.0189	0.0192	2%	0.0189	0.0192	2%
2002	0.0023	0.0024	2%	0.0023	0.0024	2%
2003	0.0019	0.0019	2%	0.0019	0.0019	2%
2004	0.0000	0.0000	2%	0.0000	0.0000	2%
2005	0.0000	0.0000	2%	0.0000	0.0000	2%
2006	0.0002	0.0002	2%	0.0002	0.0002	2%
2007	0.0001	0.0001	2%	0.0001	0.0001	2%
2008	0.0001	0.0001	2%	0.0001	0.0001	2%
2009	0.0001	0.0001	2%	0.0001	0.0001	2%
2010	0.0000	0.0000	2%	0.0000	0.0000	2%
2011	0.0000	0.0000	2%	0.0000	0.0000	2%
2012	0.0000	0.0000	2%	0.0000	0.0000	2%
2013	0.0001	0.0001	2%	0.0001	0.0001	2%
2014	0.0000	0.0000	2%	0.0000	0.0000	2%
2015	0.0000	0.0000	2%	0.0000	0.0000	2%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2016	0.0000	0.0000	2%	0.0000	0.0000	2%
2017	0.0000	0.0000	2%	0.0000	0.0000	2%
2018	0.0000	0.0000	2%	0.0000	0.0000	2%
2019	0.0000	0.0000	-16%	0.0000	0.0000	-16%
2020	0.0000	0.0000	2%	0.0000	0.0000	2%
2021	0.0000	0.0000	2%	0.0000	0.0000	2%

6.7.4 Other Wastewater Handling (NFR 5D3)

6.7.4.1 Overview of the Category

This activity is not occurring in the Slovak Republic, therefore notation key NO was used.

6.8 OTHER WASTE (NFR 5E)

6.8.1 Overview of the Category

This chapter covers emissions from:

- Car fires
- Detached house fires
- Industrial building fires
- Apartment building fires

In ***Table 6.44*** and ***Table 6.45*** overview of statistical activity data and emission trends are displayed.

Table 6.44: *Overview of the activity data in the category Other waste*

YEAR	CAR FIRE [No. of fires]	CARS DAMAGED BY FIRE [No. of fires]	DETACHED HOUSES [No. of fires]	APARTMENT BUILDINGS [No. of fires]	INDUSTRIAL BUILDINGS [No. of fires]
1990	611.90	101.51	718.89	594.45	268.09
1995	644.09	106.85	756.71	625.72	282.19
2000	587.00	97.00	592.00	960.00	361.00
2005	660.00	98.00	764.00	706.00	314.00
2010	837.00	139.00	989.00	615.00	260.00
2011	784.00	125.00	1119.00	603.00	293.00
2012	785.00	159.00	1098.00	561.00	295.00
2013	822.00	128.00	1061.00	519.00	240.00
2014	772.00	152.00	915.00	494.00	207.00
2015	822.00	135.00	1094.00	514.00	203.00
2016	812.00	122.00	1139.00	496.00	218.00
2017	814.00	119.00	1197.00	521.00	206.00
2018	811.00	119.00	1059.00	520.00	228.00
2019	679.00	99.00	952.00	460.00	230.00
2020	717.00	108.00	1027.00	480.00	229.00
2021	597.00	47.00	1102.00	432.00	225.00
2022	607.00	79.00	1035.00	463.00	219.00
1990/2022	**-1%**	**-22%**	**44%**	**-22%**	**-18%**
2021/2022	**2%**	**68%**	**-6%**	**7%**	**-3%**

Table 6.45: Overview of emissions in the category Other waste

YEAR	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	Pb [t]	Hg [t]	Cd [t]	As [t]	Cr [t]	Cu [t]	PCDD/F [g I-TEQ]
1990	0.1384	0.1384	0.1384	0.0004	0.0008	0.0008	0.0013	0.0012	0.0028	1.4034
1995	0.1456	0.1456	0.1456	0.0004	0.0009	0.0009	0.0013	0.0013	0.0030	1.4772
2000	0.1386	0.1386	0.1386	0.0004	0.0008	0.0008	0.0013	0.0012	0.0028	1.4052
2005	0.1511	0.1511	0.1511	0.0004	0.0009	0.0009	0.0014	0.0013	0.0031	1.5320
2010	0.1785	0.1785	0.1785	0.0005	0.0010	0.0010	0.0017	0.0016	0.0037	1.8118
2011	0.1974	0.1974	0.1974	0.0006	0.0012	0.0012	0.0018	0.0017	0.0041	1.9994
2012	0.1927	0.1927	0.1927	0.0006	0.0011	0.0011	0.0018	0.0017	0.0040	1.9529
2013	0.1840	0.1840	0.1840	0.0005	0.0011	0.0011	0.0017	0.0016	0.0038	1.8666
2014	0.1610	0.1610	0.1610	0.0005	0.0009	0.0009	0.0015	0.0014	0.0033	1.6352
2015	0.1876	0.1876	0.1876	0.0005	0.0011	0.0011	0.0017	0.0017	0.0039	1.9023
2016	0.1936	0.1936	0.1936	0.0006	0.0011	0.0011	0.0018	0.0017	0.0040	1.9621
2017	0.2027	0.2027	0.2027	0.0006	0.0012	0.0012	0.0019	0.0018	0.0042	2.0533
2018	0.1834	0.1834	0.1834	0.0005	0.0011	0.0011	0.0017	0.0016	0.0038	1.8600
2019	0.1651	0.1651	0.1651	0.0005	0.0010	0.0010	0.0015	0.0015	0.0034	1.6727
2020	0.1769	0.1769	0.1769	0.0005	0.0010	0.0010	0.0016	0.0016	0.0036	1.7915
2021	0.1850	0.1850	0.1850	0.0005	0.0011	0.0011	0.0017	0.0016	0.0038	1.8686
2022	0.1767	0.1767	0.1767	0.0005	0.0010	0.0010	0.0016	0.0016	0.0036	1.7862
1990/2022	**28%**	**28%**	**28%**	**28%**	**28%**	**28%**	**28%**	**28%**	**28%**	**27%**
2021/2022	**-5%**	**-5%**	**-5%**	**-5%**	**-5%**	**-5%**	**-5%**	**-5%**	**-5%**	**-4%**

6.8.2 Methodological Issues

Activity data were obtained from the fire statistics provided by the Fire Appraisal Institute of the Ministry of Interior (***Table 6.44***). Emissions from fires were calculated by multiplying activity data (number of fires) with emission factors from EMEP/EEA GB_{2023} (***Table 6.46***). Historical data (1990-1998) were extrapolated.

Table 6.46: Emission factors for calculation of emissions in the category Other waste

POLLUTANT	TSP, PM	Pb	Cd	Hg	As	Cr	Cu	PCDD/F
Unit	[kg/fire]	[g/fire]	[g/fire]	[g/fire]	[g/fire]	[g/fire]	[g/fire]	[mg/fire]
Car Fires	2.30	-	-	-	-	-	-	-
Detached house fires	143.82	0.42	0.85	0.85	1.35	1.29	2.99	1.44
Apartment building fires	43.78	0.13	0.26	0.26	0.41	0.39	0.91	0.44
Industrial building fires	27.23	0.08	0.16	0.16	0.25	0.24	0.57	0.27

6.8.3 Completeness

All rising pollutants were recorded and reported.

6.8.4 Source-specific Recalculations

No recalculations in this submission.

CHAPTER 7: OTHER AND NATURAL EMISSIONS (NFR 6, NFR 11)

Last update: 15.3.2024

7.1 OTHER SOURCES (NFR 6A)

7.1.1 Overview of the Category

No other activities have occurred in the Slovak Republic. Notation key NO is used.

7.2 VOLCANOES (NFR 11A)

7.2.1 Overview of the Category

There is no active volcano in Slovakia, therefore notation key NO was used.

7.3 FOREST FIRES (NFR 11B)

7.3.1 Overview of the Category

Fire can occur naturally (lightning, smouldering of organic material under sunny weather) or artificially, and often intentionally by human activity. In general, fires that are deliberately set by humans (including pyromania) in the world can be mentioned. Unfortunately, the situation in Slovakia and Central Europe is very similar.
The main reasons for forest fires are negligence and underestimation of risk, pyromania (a disease tendency to armpit) and attempt to benefit financially from a forest fire (e.g. in protected areas, it is easier to promote developers' interests after the removal of vegetation, the field of fire is easier to pre-categorize to a different kind of land, in some countries the intentional burning of tropical forests is practised to obtain easier agricultural land for large-scale cultivation of commercially lucrative crops).
Lightning-induced fires are exceptional in our country, more often occurring in northern Europe [24]
Forest fires are important sources of a large number of particulates and trace gases produced, including the products of incomplete combustion (CO, NMVOCs) and nitrogen and sulphur. In ***Table 7.1***, emissions in this category are shown.

Table 7.1: *Overview of main pollutants emissions in the category Forest fires*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0876	0.0696	0.0046	0.0046	0.2629	0.3213	0.4966	0.0237	3.1254
1995	0.0298	0.0211	0.0014	0.0014	0.0893	0.1091	0.1687	0.0080	1.0616
2000	0.4432	0.2782	0.0185	0.0185	1.3296	1.6251	2.5114	0.1197	15.8074
2005	0.2708	0.1584	0.0106	0.0106	0.8123	0.9929	1.5344	0.0731	9.6578
2010	0.1046	0.0576	0.0038	0.0038	0.3139	0.3836	0.5929	0.0283	3.7318
2011	0.2215	0.1208	0.0081	0.0081	0.6644	0.8121	1.2550	0.0598	7.8992
2012	0.9378	0.5050	0.0337	0.0337	2.8135	3.4387	5.3143	0.2532	33.4491
2013	0.1517	0.0811	0.0054	0.0054	0.4552	0.5563	0.8598	0.0410	5.4117
2014	0.1077	0.0575	0.0038	0.0038	0.3231	0.3949	0.6102	0.0291	3.8410
2015	0.1987	0.1058	0.0071	0.0071	0.5962	0.7287	1.1262	0.0537	7.0887
2016	0.0990	0.0525	0.0035	0.0035	0.2971	0.3631	0.5612	0.0267	3.5321
2017	0.1688	0.0893	0.0060	0.0060	0.5065	0.6190	0.9567	0.0456	6.0215
2018	0.1411	0.0745	0.0050	0.0050	0.4232	0.5172	0.7993	0.0381	5.0310
2019	0.2640	0.1387	0.0092	0.0092	0.7920	0.9680	1.4960	0.0713	9.4157

[24] IPCC 2006 GL

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2020	0.2703	0.1418	0.0095	0.0095	0.8109	0.9910	1.5316	0.0730	9.6402
2021	0.0913	0.0477	0.0032	0.0032	0.2740	0.3349	0.5176	0.0247	3.2578
2022	0.6887	0.3632	0.0242	0.0242	2.0660	2.5251	3.9024	0.1859	24.5624
1990/2022	**686%**	**422%**	**422%**	**422%**	**686%**	**686%**	**686%**	**686%**	**686%**
2021/2022	**654%**	**662%**	**662%**	**662%**	**654%**	**654%**	**654%**	**654%**	**654%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.1460	0.0088	0.0117	0.0050	0.0034	0.0288	0.0026	0.0175
1995	0.0496	0.0030	0.0040	0.0017	0.0011	0.0098	0.0009	0.0060
2000	0.7387	0.0443	0.0591	0.0251	0.0170	0.1455	0.0130	0.0886
2005	0.4513	0.0271	0.0361	0.0153	0.0104	0.0889	0.0079	0.0542
2010	0.1744	0.0105	0.0140	0.0059	0.0040	0.0344	0.0031	0.0209
2011	0.3691	0.0221	0.0295	0.0126	0.0085	0.0727	0.0065	0.0443
2012	1.5630	0.0938	0.1250	0.0531	0.0359	0.3079	0.0275	0.1876
2013	0.2529	0.0152	0.0202	0.0086	0.0058	0.0498	0.0045	0.0303
2014	0.1795	0.0108	0.0144	0.0061	0.0041	0.0354	0.0032	0.0215
2015	0.3312	0.0199	0.0265	0.0113	0.0076	0.0653	0.0058	0.0397
2016	0.1651	0.0099	0.0132	0.0056	0.0038	0.0325	0.0029	0.0198
2017	0.2814	0.0169	0.0225	0.0096	0.0065	0.0554	0.0050	0.0338
2018	0.2351	0.0141	0.0188	0.0080	0.0054	0.0463	0.0041	0.0282
2019	0.4400	0.0264	0.0352	0.0150	0.0101	0.0867	0.0077	0.0528
2020	0.4505	0.0270	0.0360	0.0153	0.0104	0.0887	0.0079	0.0541
2021	0.1522	0.0091	0.0122	0.0052	0.0035	0.0300	0.0027	0.0183
2022	1.1478	0.0689	0.0918	0.0390	0.0264	0.2261	0.0202	0.1377
1990/2022	**686%**	**686%**	**686%**	**686%**	**686%**	**686%**	**686%**	**686%**
2021/2022	**654%**	**654%**	**654%**	**654%**	**654%**	**654%**	**654%**	**654%**

7.3.2 Methodological Issues

The Slovak National Forest Centre provided activity data about wood burned (forest wildfires and controlled forest fires in Slovakia) and the Institute of Fire Engineering and Expertise of the Ministry of the Interior of the Slovak Republic data about area burned by wildfires to air pollutants inventory. Activity data for the period 1990-2001 were changed in comparison with the last submission due to consistency with GHG inventory. Tier 2 emissions factors for temperate forests from EMEP/EEA GB_{2023} were used to calculate emissions of main pollutants and particulate matter from this category. To maintain consistency with GHG inventory, emissions of NOx and CO were calculated using emission factors and methodology from $IPCC_{2006}$ Guidelines, ***Chapter 2.4: Non-CO_2 Emissions*** (H. Aalde, 2006). POPs were calculated using country-specific emission factors (Most, et al, 1992). ***Table 7.3*** shows the emission factors used to estimate emissions in this category.

Table 7.2: *Activity data used in the category of Forest fires*

YEAR	AREA AFFECTED BY WILDFIRES [ha]	BIOMASS BURNED BY WILDFIRES [kt]	BIOMASS BURNED BY CONTROLLED FIRES [kt]	TOTAL BIOMASS BURNED [kt]
1990	232.00	29.21	105.05	134.26
1995	70.42	9.92	89.95	99.87
2000	927.25	147.73	133.12	280.85
2005	527.96	90.26	215.10	305.36
2010	191.96	34.88	218.68	253.56
2011	402.55	73.82	211.05	284.88
2012	1683.46	312.61	127.17	439.78
2013	270.26	50.58	127.68	178.26

YEAR	AREA AFFECTED BY WILDFIRES [ha]	BIOMASS BURNED BY WILDFIRES [kt]	BIOMASS BURNED BY CONTROLLED FIRES [kt]	TOTAL BIOMASS BURNED [kt]
2014	191.73	35.90	252.62	288.51
2015	352.57	66.25	241.85	308.09
2016	174.88	33.01	234.93	267.94
2017	297.66	56.28	229.36	285.63
2018	248.38	47.02	240.10	287.12
2019	462.17	88.00	228.30	316.30
2020	472.68	90.10	189.53	279.62
2021	158.94	30.45	193.47	223.91
2022	1210.55	229.56	191.41	420.96
1990/2022	**422%**	**686%**	**82%**	**214%**
2021/2022	**662%**	**654%**	**-1%**	**88%**

Table 7.3: *Emission factors in the category of Forest fires*

POLLUTANT	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	NOx
Unit	[kg/ha area burned]			[g/kg dm]			[% of $PM_{2.5}$]	[g/kg dm]	
Value	300	20	20	9	11	17	9	107	3

POLLUTANT	PCDD/F	B(a)P	B(b)F	B(k)F	I()P	PAHs	HCB	PCB
Unit	[mg I-TEQ/t]	[mg/tg	[mg/t]	[mg/t]	[mg/t]	[mg/t]	[mg/t]	[mg/t]
Value	0.005	300	400	170	115	985	0.088	0.6

7.3.3 Completeness

All rising pollutants are recorded and reported.

7.3.4 Source-specific QA/QC and Verification

Verification of activity data from Forest fires is ensured by comparing data with data from the last submission.

7.3.5 Source-specific Recalculations

Recalculation in this submission was made due to the change of emission factors in the new EMEP/EEA GB_{2023} and the reallocation of the controlled forest fire to category **5C2** (***Table 7.4***).

Table 7.4: *Previous and revised activity data and emissions in the category of Forest fires*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.2819	0.0876	-69%	0.1160	0.0696	-40%	0.0088	0.0046	-47%
1991	0.2331	0.0796	-66%	0.1040	0.0624	-40%	0.0079	0.0042	-47%
1992	0.3229	0.1847	-43%	0.2370	0.1422	-40%	0.0180	0.0095	-47%
1993	0.6029	0.4611	-24%	0.5770	0.3462	-40%	0.0439	0.0231	-47%
1994	0.1645	0.0155	-91%	0.0190	0.0114	-40%	0.0014	0.0008	-47%
1995	0.1968	0.0298	-85%	0.0352	0.0211	-40%	0.0027	0.0014	-47%
1996	0.2734	0.0926	-66%	0.1075	0.0645	-40%	0.0082	0.0043	-47%
1997	0.2131	0.0153	-93%	0.0175	0.0105	-40%	0.0013	0.0007	-47%
1998	0.2093	0.0143	-93%	0.0160	0.0096	-40%	0.0012	0.0006	-47%
1999	1.3644	1.1424	-16%	1.2483	0.7490	-40%	0.0949	0.0499	-47%
2000	0.6892	0.4432	-36%	0.4636	0.2782	-40%	0.0352	0.0185	-47%
2001	0.3208	0.0770	-76%	0.0796	0.0477	-40%	0.0060	0.0032	-47%
2002	0.5356	0.2938	-45%	0.2977	0.1786	-40%	0.0226	0.0119	-47%
2003	1.0434	0.7807	-25%	0.7839	0.4704	-40%	0.0596	0.0314	-47%
2004	0.3627	0.0702	-81%	0.0694	0.0417	-40%	0.0053	0.0028	-47%
2005	0.6701	0.2708	-60%	0.2640	0.1584	-40%	0.0201	0.0106	-47%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
2006	0.4240	0.0930	-78%	0.0891	0.0535	-40%	0.0068	0.0036	-47%
2007	0.6971	0.3568	-49%	0.3400	0.2040	-40%	0.0258	0.0136	-47%
2008	0.4377	0.0628	-86%	0.0590	0.0354	-40%	0.0045	0.0024	-47%
2009	0.6457	0.2754	-57%	0.2550	0.1530	-40%	0.0194	0.0102	-47%
2010	0.5112	0.1046	-80%	0.0960	0.0576	-40%	0.0073	0.0038	-47%
2011	0.6138	0.2215	-64%	0.2013	0.1208	-40%	0.0153	0.0081	-47%
2012	1.1732	0.9378	-20%	0.8417	0.5050	-40%	0.0640	0.0337	-47%
2013	0.3890	0.1517	-61%	0.1351	0.0811	-40%	0.0103	0.0054	-47%
2014	0.5774	0.1077	-81%	0.0959	0.0575	-40%	0.0073	0.0038	-47%
2015	0.6483	0.1987	-69%	0.1763	0.1058	-40%	0.0134	0.0071	-47%
2016	0.5359	0.0990	-82%	0.0874	0.0525	-40%	0.0066	0.0035	-47%
2017	0.5952	0.1688	-72%	0.1488	0.0893	-40%	0.0113	0.0060	-47%
2018	0.5875	0.1411	-76%	0.1242	0.0745	-40%	0.0094	0.0050	-47%
2019	0.6883	0.2640	-62%	0.2311	0.1387	-40%	0.0176	0.0092	-47%
2020	0.6225	0.2703	-57%	0.2363	0.1418	-40%	0.0180	0.0095	-47%
2021	0.4511	0.0913	-80%	0.0795	0.0477	-40%	0.0060	0.0032	-47%

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]		PM_{10} [lt]		CHANGE
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	PREVIOUS	REVISED	
1990	0.0100	0.0046	-53%	1.2084	0.2629	1.4769	0.3213	-78%
1991	0.0089	0.0042	-53%	0.9863	0.2389	1.2054	0.2920	-76%
1992	0.0204	0.0095	-53%	1.2329	0.5542	1.5068	0.6774	-55%
1993	0.0496	0.0231	-53%	2.0939	1.3834	2.5592	1.6909	-34%
1994	0.0016	0.0008	-53%	0.7679	0.0466	0.9385	0.0570	-94%
1995	0.0030	0.0014	-53%	0.8988	0.0893	1.0985	0.1091	-90%
1996	0.0092	0.0043	-53%	1.1557	0.2778	1.4125	0.3395	-76%
1997	0.0015	0.0007	-53%	1.0033	0.0459	1.2262	0.0561	-95%
1998	0.0014	0.0006	-53%	0.9870	0.0428	1.2064	0.0523	-96%
1999	0.1074	0.0499	-53%	4.5351	3.4272	5.5429	4.1888	-24%
2000	0.0399	0.0185	-53%	2.5277	1.3296	3.0894	1.6251	-47%
2001	0.0068	0.0032	-53%	1.4117	0.2310	1.7254	0.2824	-84%
2002	0.0256	0.0119	-53%	2.0560	0.8813	2.5128	1.0771	-57%
2003	0.0674	0.0314	-53%	3.6250	2.3420	4.4305	2.8625	-35%
2004	0.0060	0.0028	-53%	1.6272	0.2105	1.9888	0.2573	-87%
2005	0.0227	0.0106	-53%	2.7482	0.8123	3.3590	0.9929	-70%
2006	0.0077	0.0036	-53%	1.8814	0.2789	2.2994	0.3409	-85%
2007	0.0292	0.0136	-53%	2.7204	1.0705	3.3250	1.3083	-61%
2008	0.0051	0.0024	-53%	2.0030	0.1885	2.4481	0.2304	-91%
2009	0.0219	0.0102	-53%	2.6198	0.8262	3.2020	1.0098	-68%
2010	0.0083	0.0038	-53%	2.2820	0.3139	2.7891	0.3836	-86%
2011	0.0173	0.0081	-53%	2.5639	0.6644	3.1336	0.8121	-74%
2012	0.0724	0.0337	-53%	3.9580	2.8135	4.8376	3.4387	-29%
2013	0.0116	0.0054	-53%	1.6043	0.4552	1.9609	0.5563	-72%
2014	0.0082	0.0038	-53%	2.5966	0.3231	3.1736	0.3949	-88%
2015	0.0152	0.0071	-53%	2.7729	0.5962	3.3890	0.7287	-78%
2016	0.0075	0.0035	-53%	2.4115	0.2971	2.9474	0.3631	-88%
2017	0.0128	0.0060	-53%	2.5707	0.5065	3.1420	0.6190	-80%
2018	0.0107	0.0050	-53%	2.5841	0.4232	3.1583	0.5172	-84%
2019	0.0199	0.0092	-53%	2.8467	0.7920	3.4793	0.9680	-72%

YEAR	NH_3 [kt]			$PM_{2.5}$ [kt]		PM_{10} [lt]		CHANGE
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	PREVIOUS	REVISED	
2020	0.0203	0.0095	-53%	2.5166	0.8109	3.0758	0.9910	-68%
2021	0.0068	0.0032	-53%	2.0152	0.2740	2.4630	0.3349	-86%

YEAR	TSP [kt]		BC [kt]		CHANGE	CO [lt]		
	PREVIOUS	REVISED	PREVIOUS	REVISED		PREVIOUS	REVISED	CHANGE
1990	2.2825	0.4966	0.1088	0.0237	-78%	10.0561	3.1254	-69%
1991	1.8630	0.4512	0.0888	0.0215	-76%	8.3155	2.8402	-66%
1992	2.3287	1.0468	0.1110	0.0499	-55%	11.5156	6.5889	-43%
1993	3.9551	2.6131	0.1884	0.1245	-34%	21.5050	16.4474	-24%
1994	1.4505	0.0881	0.0691	0.0042	-94%	5.8654	0.5543	-91%
1995	1.6978	0.1687	0.0809	0.0080	-90%	7.0204	1.0616	-85%
1996	2.1829	0.5247	0.1040	0.0250	-76%	9.7495	3.3027	-66%
1997	1.8951	0.0868	0.0903	0.0041	-95%	7.5989	0.5460	-93%
1998	1.8644	0.0808	0.0888	0.0038	-96%	7.4655	0.5085	-93%
1999	8.5662	6.4736	0.4082	0.3084	-24%	48.6625	40.7458	-16%
2000	4.7745	2.5114	0.2275	0.1197	-47%	24.5811	15.8074	-36%
2001	2.6665	0.4364	0.1271	0.0208	-84%	11.4402	2.7466	-76%
2002	3.8835	1.6647	0.1850	0.0793	-57%	19.1032	10.4777	-45%
2003	6.8471	4.4238	0.3262	0.2108	-35%	37.2131	27.8442	-25%
2004	3.0735	0.3976	0.1464	0.0189	-87%	12.9374	2.5023	-81%
2005	5.1911	1.5344	0.2473	0.0731	-70%	23.9004	9.6578	-60%
2006	3.5537	0.5269	0.1693	0.0251	-85%	15.1211	3.3163	-78%
2007	5.1386	2.0220	0.2448	0.0963	-61%	24.8635	12.7266	-49%
2008	3.7834	0.3560	0.1803	0.0170	-91%	15.6118	2.2409	-86%
2009	4.9486	1.5606	0.2358	0.0744	-68%	23.0307	9.8227	-57%
2010	4.3105	0.5929	0.2054	0.0283	-86%	18.2343	3.7318	-80%
2011	4.8429	1.2550	0.2307	0.0598	-74%	21.8906	7.8992	-64%
2012	7.4763	5.3143	0.3562	0.2532	-29%	41.8448	33.4491	-20%
2013	3.0304	0.8598	0.1444	0.0410	-72%	13.8755	5.4117	-61%
2014	4.9047	0.6102	0.2337	0.0291	-88%	20.5945	3.8410	-81%
2015	5.2376	1.1262	0.2496	0.0537	-78%	23.1228	7.0887	-69%
2016	4.5550	0.5612	0.2170	0.0267	-88%	19.1125	3.5321	-82%
2017	4.8558	0.9567	0.2314	0.0456	-80%	21.2289	6.0215	-72%
2018	4.8810	0.7993	0.2326	0.0381	-84%	20.9524	5.0310	-76%
2019	5.3771	1.4960	0.2562	0.0713	-72%	24.5492	9.4157	-62%
2020	4.7536	1.5316	0.2265	0.0730	-68%	22.2010	9.6402	-57%
2021	3.8065	0.5176	0.1814	0.0247	-86%	16.0882	3.2578	-80%

YEAR	PCDD/F [g I-TEQ]		PAHs [t]		HCB [kg]		PCB [kg]		CHANGE
	P	R	P	R	P	R	P	R	
1990	0.6713	0.1460	0.1322	0.0288	0.0118	0.0026	0.0806	0.0175	-78%
1991	0.5479	0.1327	0.1079	0.0261	0.0096	0.0023	0.0658	0.0159	-76%
1992	0.6849	0.3079	0.1349	0.0607	0.0121	0.0054	0.0822	0.0369	-55%
1993	1.1633	0.7686	0.2292	0.1514	0.0205	0.0135	0.1396	0.0922	-34%
1994	0.4266	0.0259	0.0840	0.0051	0.0075	0.0005	0.0512	0.0031	-94%
1995	0.4993	0.0496	0.0984	0.0098	0.0088	0.0009	0.0599	0.0060	-90%
1996	0.6420	0.1543	0.1265	0.0304	0.0113	0.0027	0.0770	0.0185	-76%
1997	0.5574	0.0255	0.1098	0.0050	0.0098	0.0004	0.0669	0.0031	-95%
1998	0.5484	0.0238	0.1080	0.0047	0.0097	0.0004	0.0658	0.0029	-96%
1999	2.5195	1.9040	0.4963	0.3751	0.0443	0.0335	0.3023	0.2285	-24%

YEAR	PCDD/F [g I-TEQ]		PAHs [t]		HCB [kg]		PCB [kg]		CHANGE
	P	R	P	R	P	R	P	R	
2000	1.4043	0.7387	0.2766	0.1455	0.0247	0.0130	0.1685	0.0886	-47%
2001	0.7843	0.1283	0.1545	0.0253	0.0138	0.0023	0.0941	0.0154	-84%
2002	1.1422	0.4896	0.2250	0.0965	0.0201	0.0086	0.1371	0.0588	-57%
2003	2.0139	1.3011	0.3967	0.2563	0.0354	0.0229	0.2417	0.1561	-35%
2004	0.9040	0.1169	0.1781	0.0230	0.0159	0.0021	0.1085	0.0140	-87%
2005	1.5268	0.4513	0.3008	0.0889	0.0269	0.0079	0.1832	0.0542	-70%
2006	1.0452	0.1550	0.2059	0.0305	0.0184	0.0027	0.1254	0.0186	-85%
2007	1.5113	0.5947	0.2977	0.1172	0.0266	0.0105	0.1814	0.0714	-61%
2008	1.1128	0.1047	0.2192	0.0206	0.0196	0.0018	0.1335	0.0126	-91%
2009	1.4555	0.4590	0.2867	0.0904	0.0256	0.0081	0.1747	0.0551	-68%
2010	1.2678	0.1744	0.2498	0.0344	0.0223	0.0031	0.1521	0.0209	-86%
2011	1.4244	0.3691	0.2806	0.0727	0.0251	0.0065	0.1709	0.0443	-74%
2012	2.1989	1.5630	0.4332	0.3079	0.0387	0.0275	0.2639	0.1876	-29%
2013	0.8913	0.2529	0.1756	0.0498	0.0157	0.0045	0.1070	0.0303	-72%
2014	1.4426	0.1795	0.2842	0.0354	0.0254	0.0032	0.1731	0.0215	-88%
2015	1.5405	0.3312	0.3035	0.0653	0.0271	0.0058	0.1849	0.0397	-78%
2016	1.3397	0.1651	0.2639	0.0325	0.0236	0.0029	0.1608	0.0198	-88%
2017	1.4282	0.2814	0.2813	0.0554	0.0251	0.0050	0.1714	0.0338	-80%
2018	1.4356	0.2351	0.2828	0.0463	0.0253	0.0041	0.1723	0.0282	-84%
2019	1.5815	0.4400	0.3116	0.0867	0.0278	0.0077	0.1898	0.0528	-72%
2020	1.3981	0.4505	0.2754	0.0887	0.0246	0.0079	0.1678	0.0541	-68%
2021	1.1196	0.1522	0.2206	0.0300	0.0197	0.0027	0.1343	0.0183	-86%

P-Previous, R-Revised

7.4 OTHER NATURAL EMISSIONS (NFR 11C)

7.4.1 Overview of the category

No other natural emissions occur in the Slovak Republic, therefore notation key NO was used.

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CHAPTER 8: RECALCULATIONS AND IMPROVEMENTS

Last update: 15.3.2024

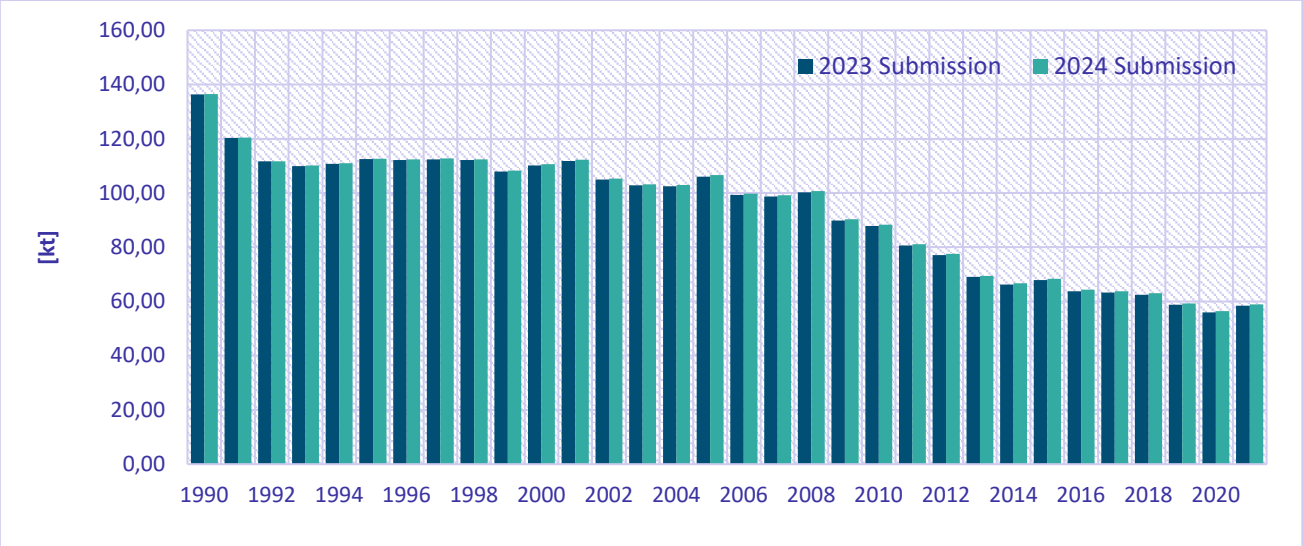
8.1 OVERVIEW BY GASES

Sector specific-recalculations are described within each of the relevant chapters. These chapters should be referred to for details of recalculations and method changes. This chapter summarises the impact of these changes on the emissions totals of final versions of the submissions and highlights the largest changes for each pollutant.

8.1.1 NOx (as NO2)

The impact of recalculations on the NOx emission total in this submission is shown in ***Figure 8.1***.
Minor changes in the whole period were caused as a result of the implementation of the IPCC 2019 Refinement and Implementation of EMEP/EEA GB_{2023} in **3B3**, **3B1**, **3B4** and **3Da2a** categories. Activity data of fuel consumption changed in categories **1A4bi** and **1A3dii**.

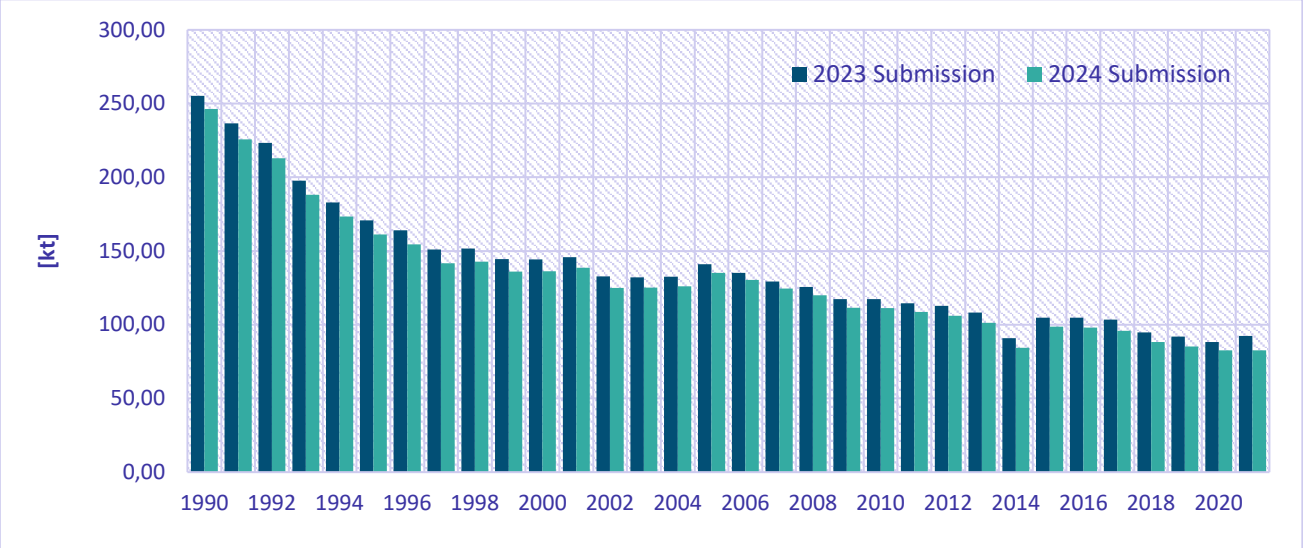
Figure 8.1: *Comparison of NOx emission total between the 2023 final submission and 2024 final submission*



8.1.2 NMVOC

The decrease in emissions for the historical years 1990–1999 was caused by activity data updade in **2H2** which resulted in recalculations of emissions of NMVOC. Category **3B1** was recalculated based on recommendation number **SK-3B1-2023-0001**. In the category **3B4h** was implemented new methodology based on a Tier 1 method available in the EMEP/EEA GB_{2023}. Categories **5A** and **5B2** were recalculated due to the addition of the new activity data to the calculation based on the change of the EMEP/EEA GB to version 2023. (***Figure 8.2***).

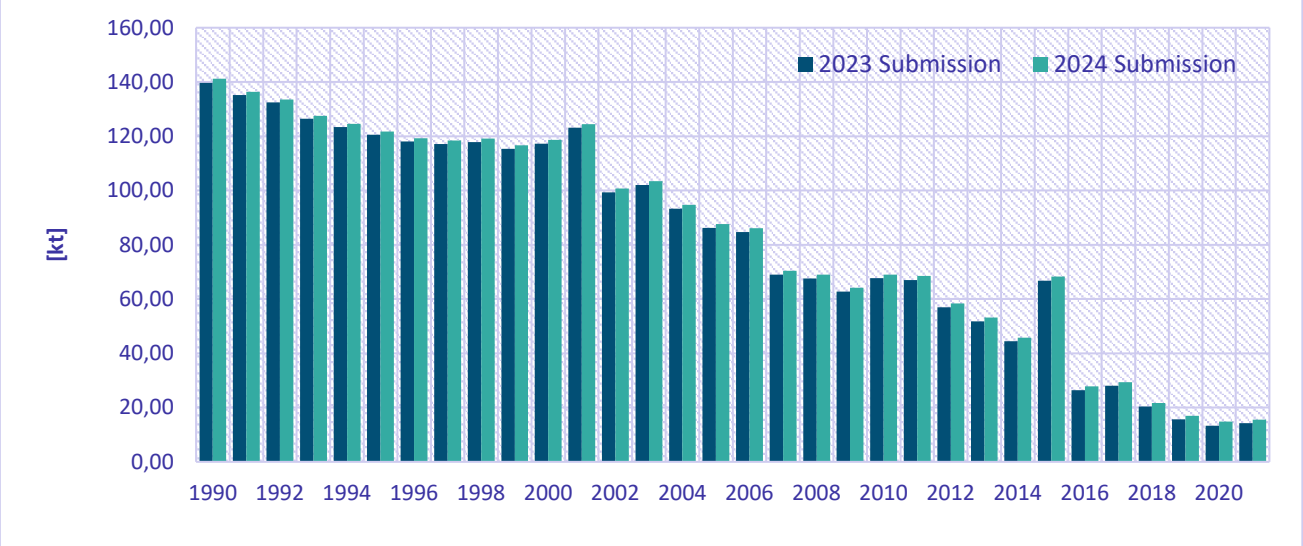
Figure 8.2: Comparison of NMVOC emission total between the 2023 final submission and 2024 final submission



8.1.3 SOx (as SO_2)

The impact of recalculations on the SOx emission total in this submission is shown in ***Figure 8.3***.
Changes in the whole period were caused by the update of activity data for fuel consumption in **1A3dii**, **1A3di** (ii) and **1A4bi**.

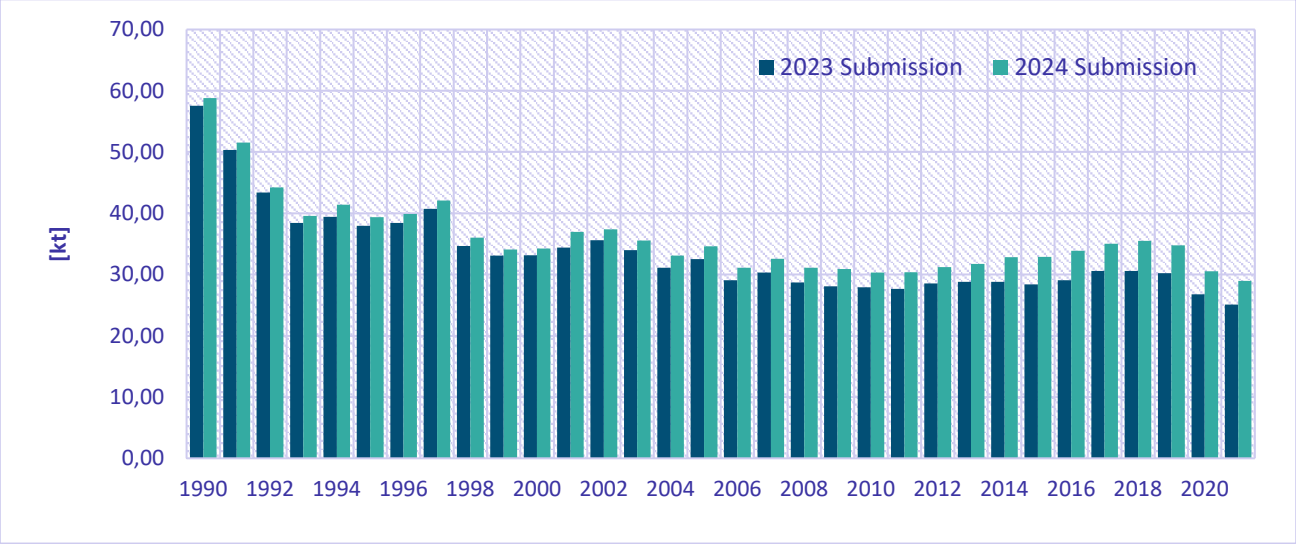
Figure 8.3: Comparison of SOx emission total between the 2023 final submission and 2024 final submission



8.1.4 NH_3

Emissions increased as a result of Implementation of the IPCC 2019 Refinement and Implementation of EMEP/EEA GB_{2023} in Agriculture sector. Emission of NH_3 were recalculated in categories **3B3**, **3B1**, **3B2**, **3B4gi** and **3Da2a**.

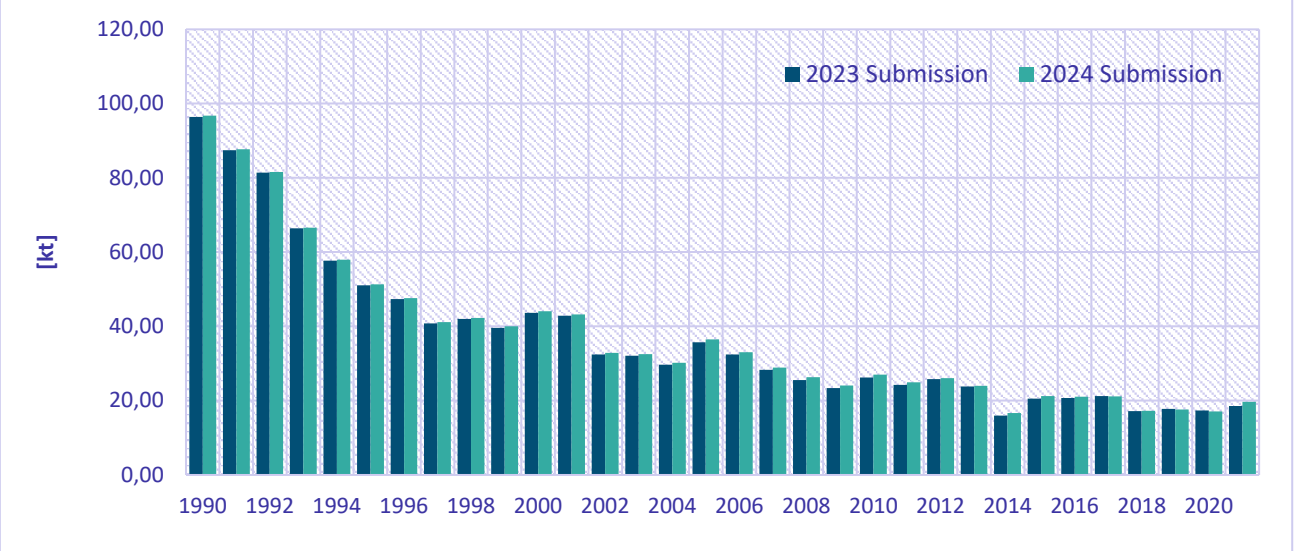
Figure 8.4: *Comparison of NH_3 emission total between the 2023 final submission and 2024 final submission*



8.1.5 $PM_{2.5}$

Slight changes in emissions in the whole time series were caused by the revision of activity data and value of emission factor in EMEP/EEA GB_{2023} in **1A3dii** and **1A4bi**, by the implementation of new methodology in **3B3** based on the Tier 1 method available in the EMEP/EEA GB_{2023}. Due to changes in methodology in **1B1a**. And by the implementation of the Tier 2 methodology for category **5A**. An overview of the changes is shown in ***Figure 8.5***.

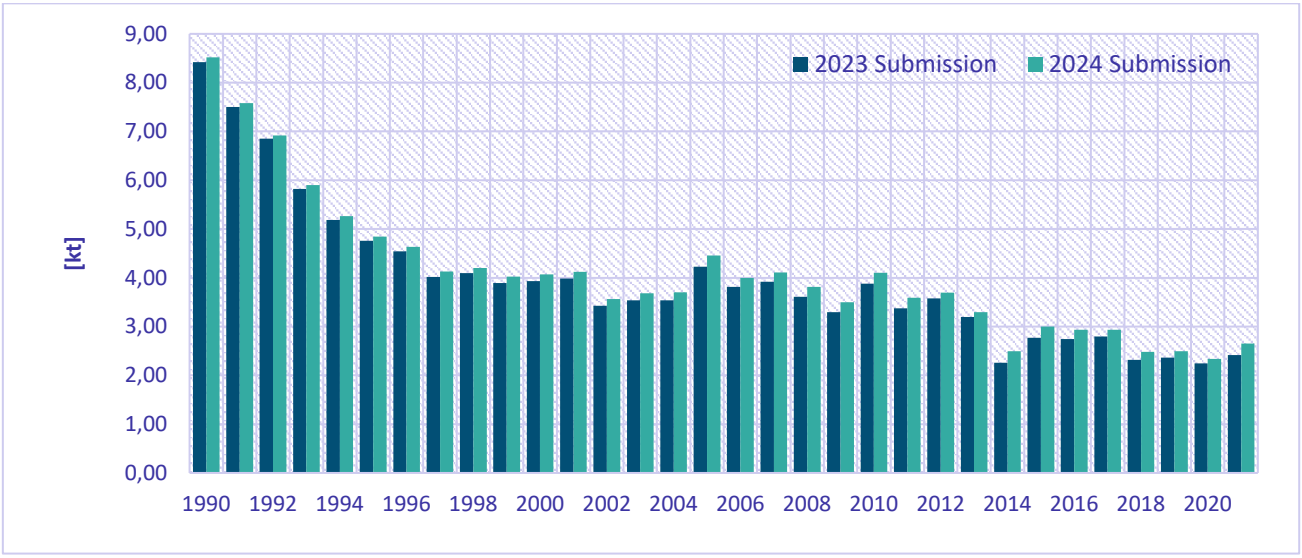
Figure 8.5: *Comparison of $PM_{2.5}$ emission total between the 2023 final submission and 2024 final submission*



8.1.6 TSP, PM_{10}, BC

Emissions increased due to recalculations in **1A1a** and **1A3dii** based on changes in activity data and value of emission factor in EMEP/EEA GB_{2023} and recalculation of the activity data in category **1A4bi.** An overview of the changes is shown in ***Figure 8.6***.

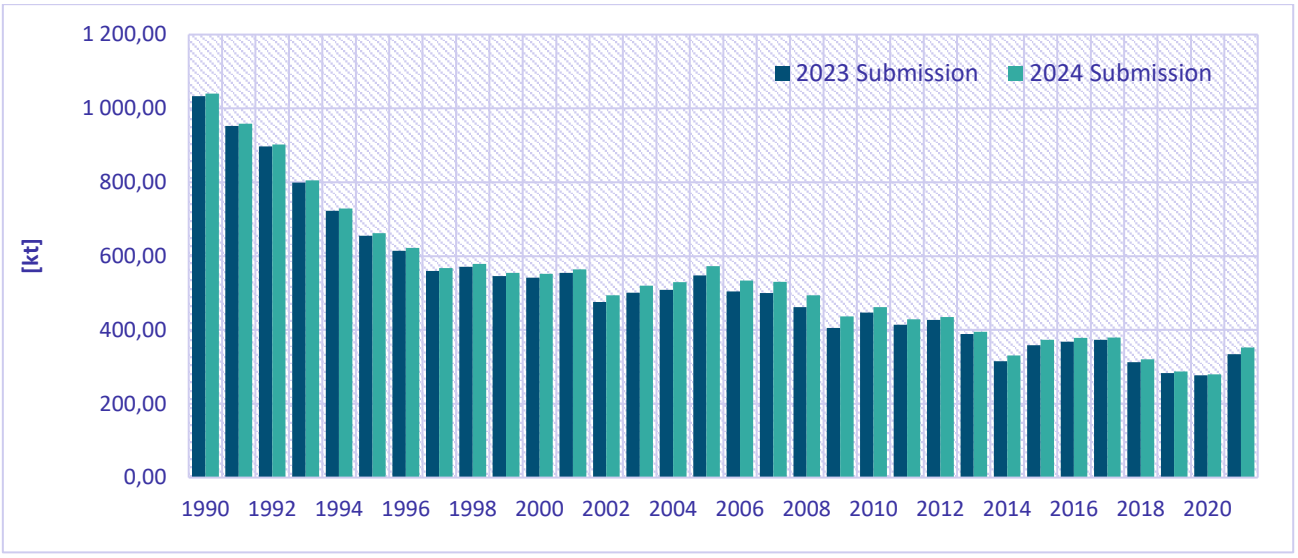
Figure 8.6: *Comparison of BC emission total between the 2023 final submission and 2024 final submission*



8.1.7 CO

Emission changed in the whole time series due to introduction additional emissions in charcoal production activities in **1B1b**. Changes in the period 2012-2020 were caused by activity data recalculation in the category **1A4bi**. An overview of the changes is shown in ***Figure 8.7***.

Figure 8.7: *Comparison of CO emission total between the 2023 final submission and 2024 final submission*



8.1.8 Priority heavy metals (Pb, Cd, Hg)

Emissions changed due to recalculations in **1A1a**, **1B2aiv** and **1A3dii** based on changes in activity data and value of emission factor in EMEP/EEA GB2023 and recalculation of the activity data in category **1A4bi**, due to the correction of activity data and change of abatement technology efficiencies in new EMP/EEA GB_{2023} in **5C1biii**. (***Figure 8.8*** – ***Figure 8.10***).

Figure 8.8: *Comparison of Pb emission total between the 2023 final submission and 2024 final submission*

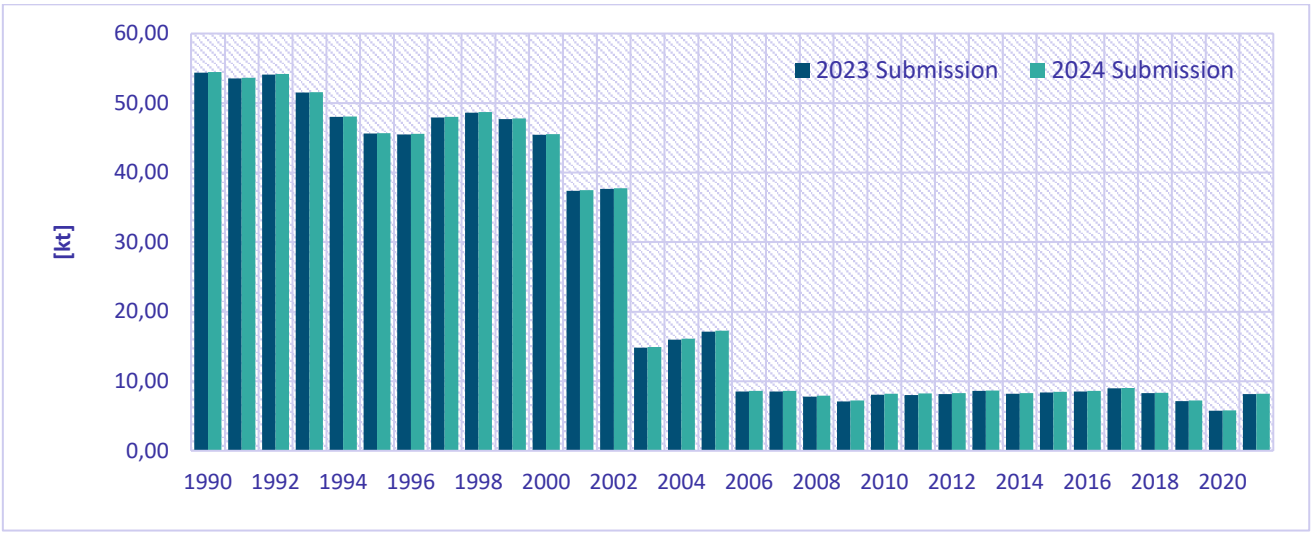


Figure 8.9: *Comparison of Cd emission total between the 2023 final submission and 2024 final submission*

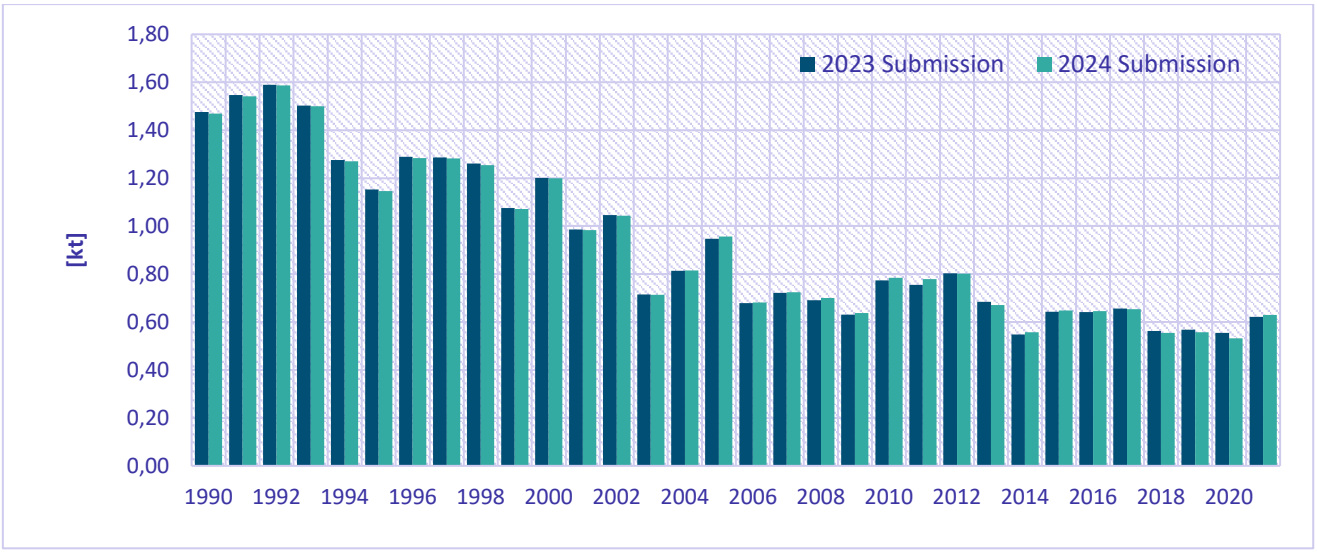
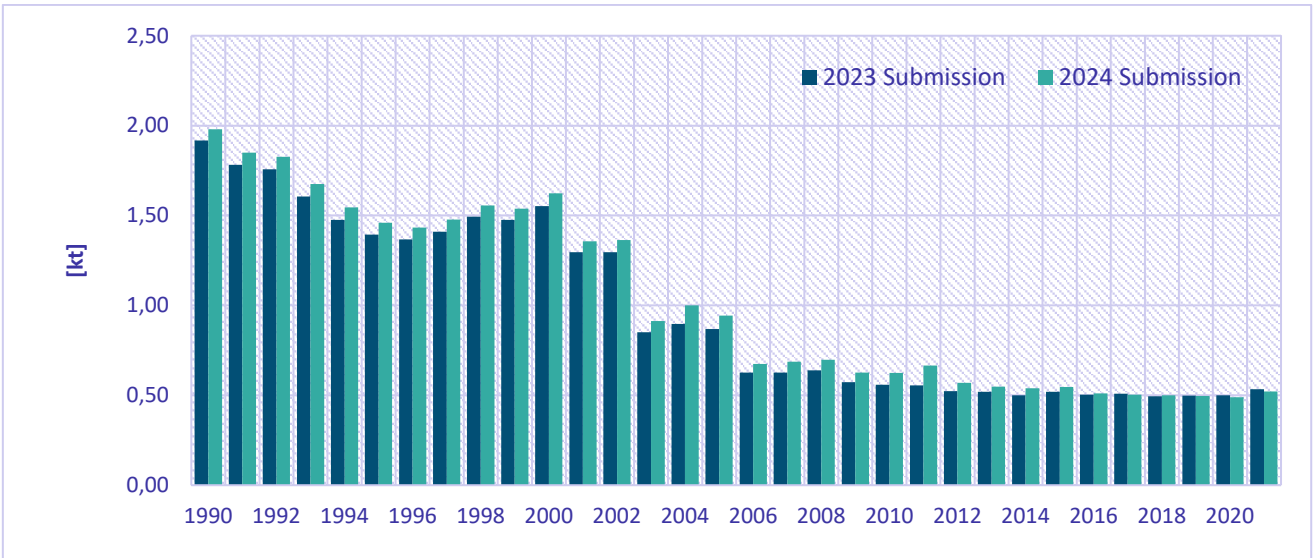


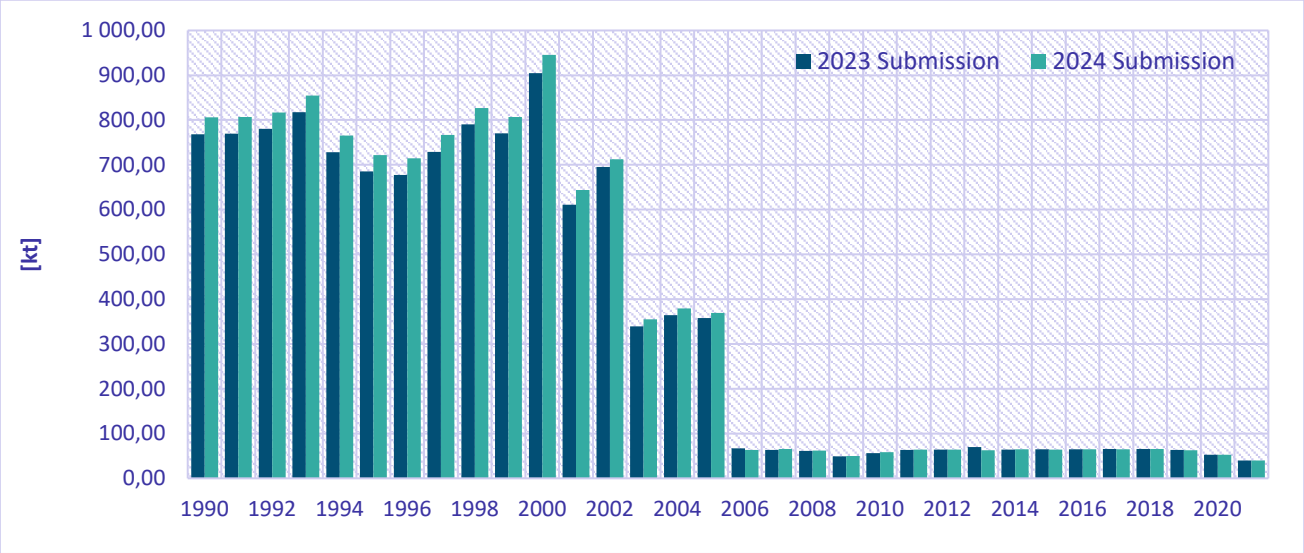
Figure 8.10: *Comparison of Hg emission total between the 2023 final submission and 2024 final submission*



8.1.9 POPs

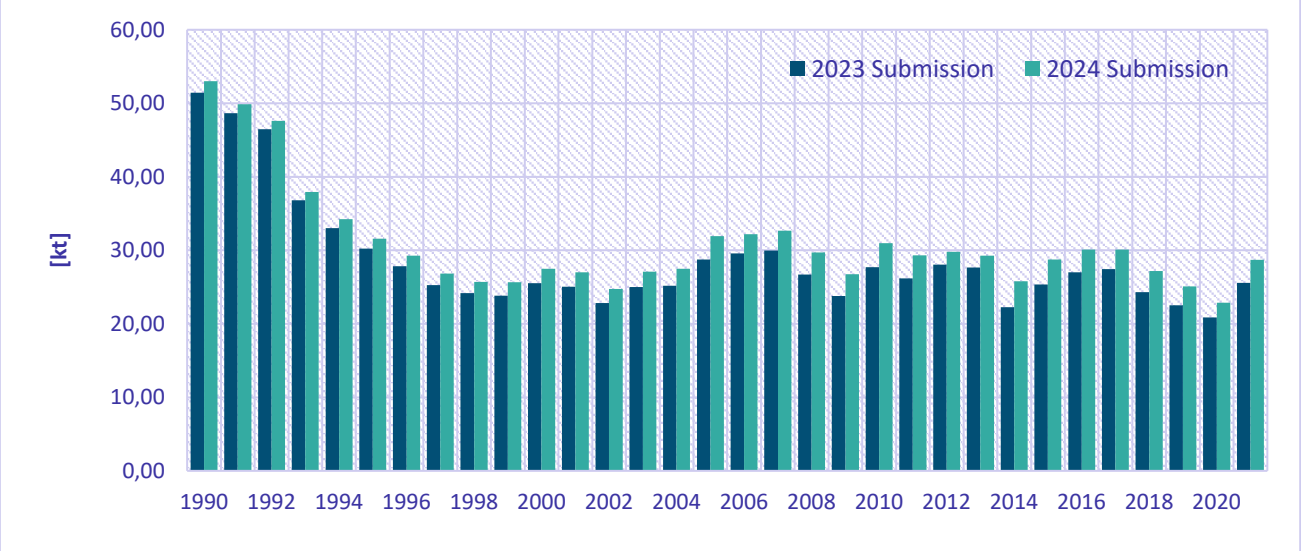
Emissions of PCDD/PCDF changed due to the recalculations in **1A1b** and **1B2aiv** based on changes in emission factor in EMEP/EEA GB$_{2023}$ and recalculation of the activity data for fuel consumption in **1A4bi**, due to the correction of activity data and change of abatement technology efficiencies in new EMEP/EEA GB2023 in **5C1biii**. Changes in the period 1990-1990 were also caused by emission factor recalculaation in category **2C7a**.

Figure 8.11: *Comparison of PCDD/F emission total between the 2023 final submission and 2024 final submission*



Emissions of PAHs increased due to recalculations in **1A1a** based on changes in activity data and value of emission factor in EMEP/EEA GB$_{2023}$ and recalculation of the activity data for fuel consumption in **1A4bi**.

Figure 8.12: *Comparison of PAHs emission total between the 2023 final submission and 2024 final submission*



Emissions of HCB increased due to recalculations in **1A1a** based on changes in activity data and value of emission factor in EMEP/EEA GB$_{2023}$ and recalculation of the activity data for fuel consumption in **1A4bi** and

due to the correction of activity data and change of abatement technology efficiencies in new EMEP/EEA GB$_{2023}$ in **5C1biii**.

Figure 8.13: *Comparison of HCB emission total between the 2023 final submission and 2024 final submission*

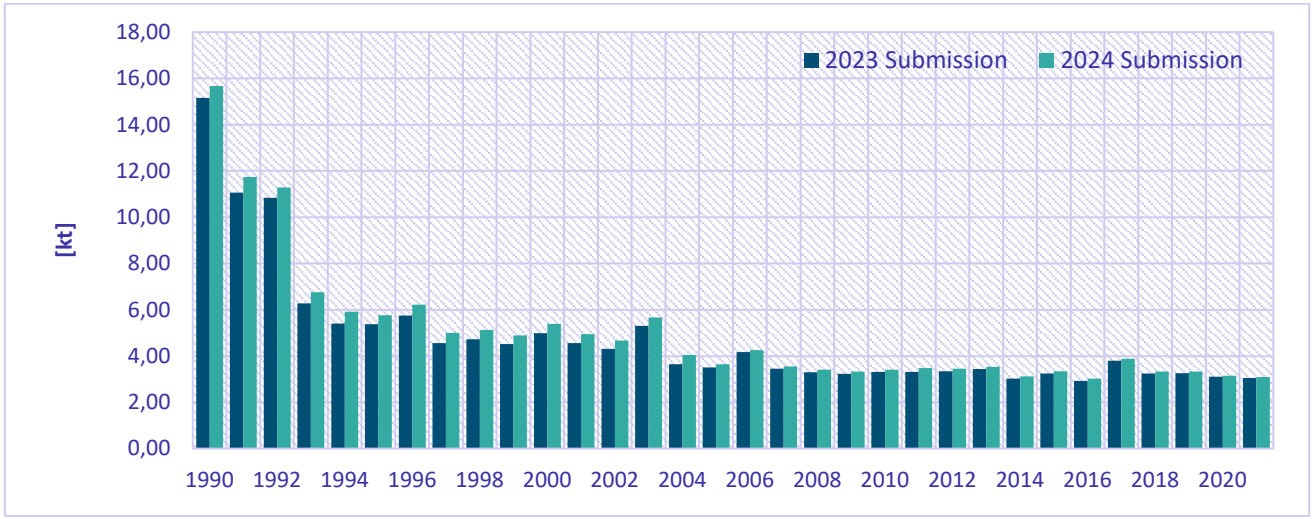
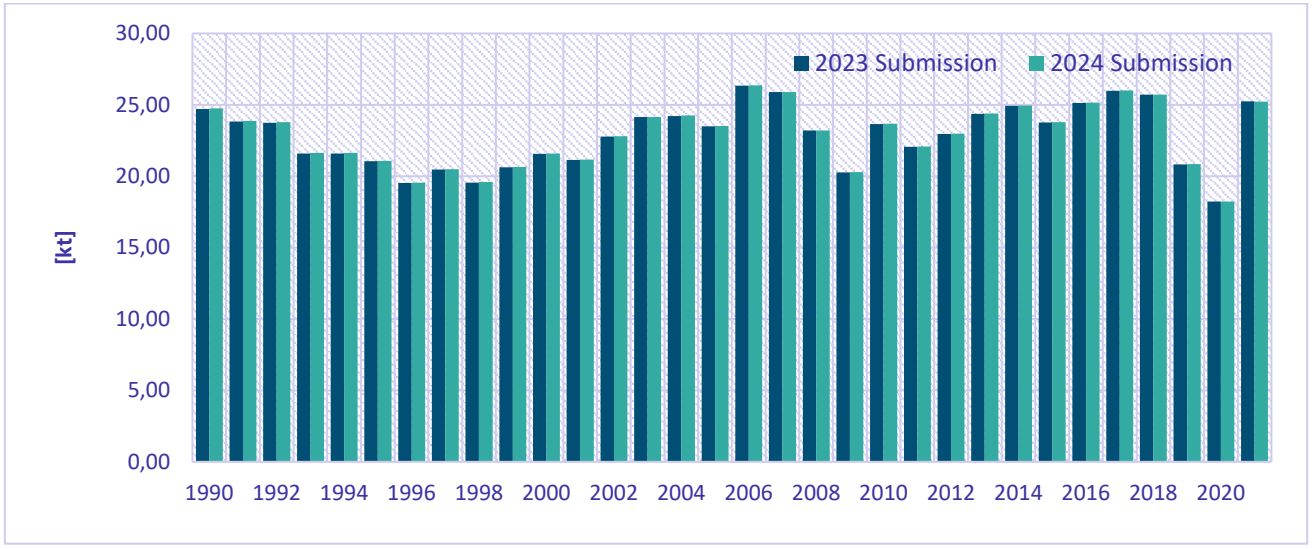


Figure 8.14: *Comparison of PCBs emission total between the 2023 final submission and 2024 final submission*



CHAPTER 9: PROJECTIONS OF EMISSIONS

Last update: 15.4.2023

The general methodology of the emission projections calculations was based on the same structure as the national emissions inventory of Air pollutants. The data structure for activities, input data, emission factors and emission calculations is based on the Nomenclature for Reporting (NFR). The outputs are aggregated.
Dynamic changes in global politics as well as economic developments in recent years and months have also significant impact and they were complications for the preparation of AP emission projections, especially given the constant changes in the estimated development of macroeconomic indicators for the near future.
Despite the existing constraints resulting from dynamic changes in critical parameters, it is possible to reach a state of actual compliance with the emission reduction targets, as well as to create the conditions for further emission reductions after 2023.
The modelling of emission projections was provided consistent with the GHG emission projections reported on 15th March 2023 under Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on Energy Union Governance and Climate Action.
Even use of a wide range of input data and improvement of methodological approach at activity projection in relevant sectors, the results are influenced by the uncertainties of future development, preferably in the case of the macro-economic data and elasticity of the final energy consumption. These uncertainties are predominantly related to the process of economic transformation and privatization and historical data can be hardly used for future development extrapolation.
The year 2019 was determined as the base year for modelling of emissions projections for the actualized scenario for which verified data sets were available from the national emission inventory reported in March 2023.

Table 9.1: *Main parameters applied in emission projections*

Item	Units	2019	2020	2025	2030	2035	2040
Gross domestic product: Constant prices	EUR million	89 677	86 650	98 663	107 598	116 760	124 636
Population	1000 people	5 458	5 458	5 468	5 441	5 385	5 312
EU ETS carbon price	EUR/EUA	25	24	80	80	82	85
International coal import prices	EUR/MWh	2.1	1.6	3.1	3.1	3.1	3.3
International oil import prices	EUR/MWh	10.2	6.4	15.4	15.4	15.4	16.3
International gas import prices	EUR/MWh	4.5	3.1	13.2	11.3	11.3	11.3

Even use of a wide range of input data and improvement of methodological approach at activity projection in relevant sectors, the results are influenced by the uncertainties of future development, preferably in the case of the macro-economic data and elasticity of the final energy consumption. These uncertainties are predominantly related to the process of economic transformation and privatization and historical data can be hardly used for future development extrapolation. The emission projections from the Energy sector will be influenced by the main pollutant and GHG emission caps in the new EU ETS regime. Decision 406/2009/EC on effort sharing in the sectors not included in the emission trading plays an important role.

9.1 TOOLS AND METHODS

This chapter describes the methodology for calculating emission projections from NFR categories, which includes public heat and electricity production, including industrial energy, emissions from households and processing of fuels. This chapter excludes emissions from fuel consumption in transport. Emissions from small households not connected to a District heating network (DHN) were modelled separately and a description of the procedure is given at the end of this chapter.
The long-term development of emissions also depends on other parameters, such as energy market developments, technological developments and the trading of CO_2 emission allowances. The ETS is one of the measures that was implemented before the projected base year, but the new trading period will continue to

have an impact in the future, not only on GHG but also on AP emissions. Nevertheless, the additional impact of this measure is limited due to the technical and economic potential.
Emission projections in the Energy sector were calculated separately for large and medium-sized energy appliances, households, transport and fugitive emission categories.
As in the previous emission projections, we also used the data based on the results from the CPS model (Compact-PRIMES for Slovakia). This model was directly developed, modified and operationalised by the Ministry of the Environment of the Slovak Republic, Institute for Environmental Policy. A description of this model and its use can be found in the previous report on emission projections (2021). The data from the CPS model were fed into the more structured TIMES model, which was developed and used by SHMI. The TIMES model is suitable for the projection reporting structure and greater detail. Along with the Energy sector, TIMES also calculates emissions from the industry sector which falls under the ETS.

9.1.1 Energy and Industry

9.1.1.1 Energy and Industry Model: TIMES

Input data for the calculation of GHG projections in TIMES, from industry and energy are provided by the CPS + Macro economical model (IEP), which was developed for the needs of the Low Carbon Strategy. Other input data consist of EU ETS reports, National Energy statistics, NEIS and the NIMS.
Fuels data are provided by (ÚRSO) - prices of tradable fuels, if possible also separately for sectors such as industry, households and others: Natural gas EUR/GJ, Heating oils, Brown coal, Black coal, Coke, Fuel wood, waste wood, wood chips EUR/ton or EUR/GJ;
RES technologies (Ministry of Economy or with the association of operators of renewable resources) – available input data on RES, their structure and time development. For individual types of resources, the following data are preliminary:

- Photovoltaics - the estimated potential of electricity production in MWh/year in topographic distribution, i.e. by districts or regions,
- Annual distribution of production - when it can be divided into hours, days, weeks and months, as the case may be, in a different arrangement than this production is balanced;
- Investment costs EUR/kW.
- Wind power plants - similar to photovoltaics:
- Investment costs EUR/kW.
- Annual power distribution as in the case of photovoltaics.
- Biomass - biomass potential in TJ/year according to its type - wood, wood chips, etc.
- Geothermal - Potential TJ/year in geographical distribution, investment costs EUR/GW.

As a first step for the preparation of projections in the TIMES model, energy and industrial resources included in the EU ETS were analysed. The reasons for this procedure are as follows:

• Sources included in this group are the most significant stationary sources of GHG emissions, primarily CO_2.
• The new sets of NIMS tentatively show this trend, especially for sources that will switch from carbon leakage (CL) to nonCL.
• The analysis is based on the data of 2018, for which there are data from files processed for the preparation of NIMS after 2020. These files contain data not only on fuel consumption and CO_2 emissions, but also on the production of electricity, heat, and benchmark commodities necessary for setting free emission allowances.

The main goal of the model is to find an energy system, that meets all demands over the entire time period at the lowest costs. The scenarios are used specifically for regional needs based on the possibilities of energy supplies, energy trade and technology availability. The configuration of production and consumption of commodities and their prices is performed.
The optimization is done across all sectors as well as across time periods. The result is an optimal mix of technologies and fuels for the specific time period including emissions produced.

Once all the inputs, constraints and scenarios have been put in place, the model will attempt to solve and determine the energy system that meets the energy service demands over the entire time horizon at least cost. It does this by simultaneously making equipment investment decisions and operating, primary energy supply, and energy trade decisions, by region. TIMES assumes perfect foresight, which is to say that all investment decisions are made in each period with full knowledge of future events. It optimizes horizontally (across all sectors) and vertically (across all time periods for which the limit is imposed). The results will be the optimal mix of technologies and fuels at each period, together with the associated emissions to meet the demand. The model configures the production and consumption of commodities (i.e. fuels, materials, and energy services) and their prices; when the model matches supply with demand, i.e. energy producers with energy consumers, it is said to be in equilibrium.

Calculation includes various policies and measures (in numerical formulation) defined according to the WEM and WAM.

The model itself operates with several sectors:

- POWER (Public electricity and heat production)
- IRON (Iron and Steel)
- FAT (Food and Tobacco)
- CHE (Chemicals)
- NMM (Non Metallic mineral)
- NFM (Non Ferrous metal)
- PPP (Pulp paper and print)
- OTH (Other)
- SUPP (Refinery and Petrochemicals)

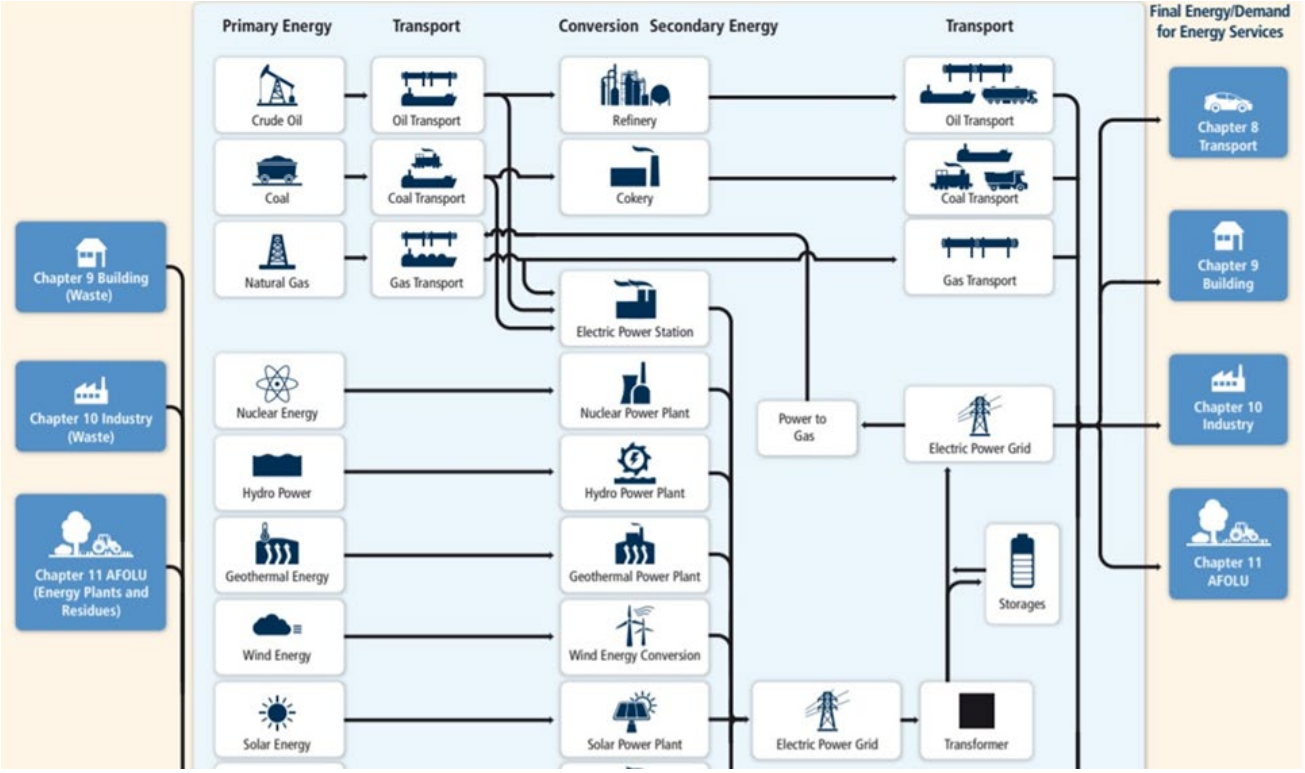
Table 9.2: *Main parameters applied in emission projections*

Strengths	Opportunities
• Compatibility with emission model for emission inventories • Detailed data break down • The database used is compatible with EU data and national data • Detailed sectoral break down • Available Emission trading system • Finding Objective function (optimal solution) • Stochastic modelling • Seasonal availability • User constraint options (environmental, energy, monetary, supply, production, subsidies…)	• Incorporate into the model new technologies (CHP,HP, ELE) • Attach transport (all transport categories) • Versatile use on different geographical levels (Regional break down of energy demand) • Versatile use of time series (Day, Night and Peak availability) • Modelling of particulate matter (PM) • Stochastic modelling of RES • Trading between regions
Treats	**Weakness**
• Maintenance fee • Infeasibility due to lack of macro economical and technological data • GAMS solvers need to be paid separately	• Disconnected from macroeconomic models • Too many pre-calculations needed • Lack of economic data • Lack of technology data (Investment cost for new technology) • The whole structure needed to be built up from scratch

The projections should provide the decision-making authorities with answers to the following questions:

- Will it really be economically and technically possible to achieve carbon neutrality in 2050?
- What political, economic and technical measures will have to be applied?
- Will the technical measures considered so far be sufficient, such as changes in the fuel base, the use of biomass and other renewable energy sources, and measures on the side of consumption and reduction of energy intensity?
- Is it realistic to apply the CCS system in the conditions of Slovakia?
- What preliminary costs would the considered measures represent?

Figure 9.1: *Different elements of the TIMES model*



9.1.1.2 Emission projections in households – Excel sheet model

Emission from combustion in households was modelled separately in the MS Excel sheet model, where was taken into account improving efficiency, equipment status and structure and good practice.
Information was obtained from the questionnaire surveys in households, new implemented and planned measures were taken into account. Based on this information datasets were improved together with estimations of natural improvement in the structure of households and heating equipment was implemented.
Main characteristic:

- Based on emission inventory methodology – excel model,
- Estimation of total energy demand per m2 of living space in the household sector,
- Number of flats - a living area of flats, flats under DH, age and renewal of flats,
- Structure of heating equipment, method of heating,
- Climatic conditions.

9.1.2 Transport

COPERT is the EU standard vehicle emissions calculator. It uses vehicle population, mileage, speed and other data such as ambient temperature and calculates emissions and energy consumption for a specific country or region. Also, COPERT is a technologically advanced, transparent and internationally recognised research tool.

9.1.2.1 Methodology, key assumptions and trends

The fleet database for emission projections consists of two main parts. The historical time series, which is based on the Information System of Vehicle Registration of the Police Presidium of the Slovak Republic (IS EVO) and future-modelled estimates of the development of the vehicle fleet. The data of the historical time series are prepared annually for the needs of emission inventories of Slovakia according to COPERT (version 5) model. The development of the time series until 2050 is projected according to the methodology based on the Sybil model and calculated in COPERT.
Estimates up to 2050 are made on the knowledge of historical time-series, newly registered vehicles, annually scrapped vehicles and the survival rate of vehicles within individual vehicle segments. The assumption is that

there will be no vehicle older than 30 years. Thanks to these data, it is possible to create a general matrix of the age structure of the vehicle fleet and apply and adapt it to any development of the vehicle fleet within Slovakia. Creating an age structure for each year until 2050 is the most important part of model preparation.
The basic development of the vehicle fleet according to the methodology mentioned above forms a baseline for the WEM scenario. If the baseline is applied directly to the calculation of the model, can be obtained projections for the emission with existing measures (WEM scenario). The total of the vehicle fleet is not changing in the WAM, but only the technological structure according to implemented measures.

9.1.2.2 Methodology

The methodology for the calculation of the projections is based on COPERT calculation. The most important data for calculations are:

1. Development of the national vehicle fleet
2. Development of annual mileage for each vehicle category
3. Technology changes
4. Science-based expert judgment of new technology emission factors

The calculation itself is done by the model COPERT through CLI (Command-line interface), which allows introducing into the model of any new vehicle category and technology. It is necessary to implement all the basic data for these categories as emission factors, energy consumption and circulation data. After input, the model calculates the consumption and emissions in the same way as for the emission inventories. The outcome emissions are afterwards recalculated by the technological efficiency factor. This factor indicates the technological evolution of vehicles until 2050. This factor also reduces the emission factor as required by legislation.
A detailed description of methodology in the Transport sector was described in 8. National communication of the SR on climate change in chapter 6.2.

9.1.3 Agriculture

Activity data: Research Institute of Agriculture and Food Economics in Bratislava prepared parameters for emission projections in the exponential balancing model - SAS 9.3 for the period 2021–2040 (NPPC-VÚEPP) (NPPC, 2017). Projections of input parameters such as livestock numbers and amounts of applied organic and mineral fertilizers and cropped area were subsequently calculated at the Slovak Hydrometeorological Institute (SHMÚ) by 2050 using the exponential balancing function MS Excel, in the Forecast tool. The number of cattle, sheep and goats has increased due to planned subsidies from the Common Agriculture Policy. Accurate prediction of the number of livestock mentioned policies not bringing. Therefore, SHMÚ established cooperation through the collaborating institution NPPC directly with cattle and sheep breeders associations. Directly associations proposed possible target values for the number of livestock.
The principle of exponential smoothing is based on adaptive methods for time series parameters projections—the projections of parameters made according to exponential smoothing. Exponential smoothing is the weighted average of the past data, with the recent data points given more weight than earlier data points. The weights decay exponentially towards the earlier data points (NPPC, 2017).
The whole model of calculating emissions from livestock breeding is based on regional differences, which means that the input parameters and stocks of animals had to be re-modelled at the level of smaller territorial units - regions. Projections of the number of livestock, which were delivered to NPPC- VÚEPP only at the level of the Slovak summary, were distributed by the SHMÚ to the regional level and only after this re-division were they implemented into the calculations of emission projections.
At the time of preparation of projections of emissions from agriculture, there was no national strategic document, except for a case study prepared by the NPPC-VÚEPP, which would model the development of livestock numbers and consumption of fertilizers in the Slovak Republic.

Emission calculation: The Slovak Hydrometeorological Institute compiles an annual emissions balance and uses emission factors according to the EMEP/EEA GB_{2019}.

The NH_3, NOx emission projections were estimated according to the EMEP/EEA GB_{2019} Guidebook methodologies, the Slovak Republic did not use the specific model for forecasting emissions. NH_3 and NOx emission projections were modelled following the Tier 2 approach based on analysing the nitrogen cycle. The algorithm in the system Python was developed, which is an automated version of the N-Tool, developed following the methodology EMEP/EEA GB_{2019}. The nitrogen flow as an available national parameter was taken into account for more accurate emissions estimations. During the preparation of projected emissions of ammonia were considered the same input data and policies and measures as in the preparation of projected GHG emissions. Emissions of NOx and NH_3 from manure storage and application were estimated taking into account the abatements requirements to reduce emissions from livestock farms.

$PM_{2.5}$, emissions from manure management and agricultural soils were calculated using the default Tier 1 emissions factors for each category of farm animals. $PM_{2.5}$ from 3.D Agricultural soils are calculated with Tier 2 methodology and emission factors for wet climate outlined in EMEP/EEA $GB_{2019.}$ The same emissions factors were used for all years.

Estimation of NMVOC was completed by the available parameters time of housing feeding situation – the amount of silage in the ration and gross feed intake. Dairy cattle and non-dairy cattle have been calculated using Tier 2 methodology by EMEP/EEA GB_{2019}. NMVOC emissions from other animal categories were calculated using the Tier 1 methodology and emission factors outlined in the EMEP/EEA GB_{2019}. NMVOC emissions from Agricultural soils were calculated using the Tier 1 methodology and emission factors outlined in EMEP/EEA GB_{2019}

9.1.4 Waste

In general, the more waste we produce, the more we have to get rid of. Some waste disposal methods release both pollutants and greenhouse gases into the air. Recycling is one method of reducing the impact of waste disposal on the air and the climate. However, there are also ways of managing waste that are more environmentally friendly.

The waste management sector consists of the following categories:

- 5.A Solid waste Disposal Sites
- 5.B Biological Treatment of Solid Waste
- 5.C Waste Incineration
- 5.D Wastewater Treatment

A detailed description of methodology in the Waste sector was described in 8. National communication of the SR on climate change in chapter 6.6.

9.2 KEY CHANGES IN UPDATED PROJECTIONS

Energy and Industry – The most important change was the wider implementation of the TIMES model in the calculation of emissions in these sectors. Changes were also driven based on new information from producers.

Transport – Actualization based on new methodology with model COPERT using new assumptions and data.

Agriculture – Changes were driven by the improvement of methodology

WAM scenario for NMVOC was included. Published policies and measures after 2020 from the national strategies were considered in the **WAM** scenario.

Waste – New calculations, and improved methodology together with GHG emission projections estimations

9.3 POLICIES AND MEASURES

Projections of air pollutant emissions were prepared with the base year 2019 for the years 2020-2050 within the following scenarios:

With measures scenario (WEM) – projections reflect all measures implemented or adopted before the date of preparation of the projections (31 December 2021).

With additional measures scenario (WAM) – projections include WEM policies and measures and all other measures planned for an increase of air quality according to the national air pollution control program.

9.3.1 ENERGY and INDUSTRY

List of Policies and measures which have been taken into account in the scenario with measures (WEM):

In TIMES model is equivalent to the Reference Scenario of the CPS-PRIMES model. It includes policies and measures (PAMs) adopted and implemented at the EU and national levels by the end of 2021 and the measures being in place to achieve the national renewables (RES) and energy efficiency targets for the year 2021. Following parameters and PAMs on the EU level were used in the projections of the Energy sector:

- Eco-design Framework Directive (Directive 2005/32/EC);
- Energy Labelling Directive (Directive 2010/30/EU);
- Energy Performance of Buildings Directive, Energy Efficiency Directive (Directive 2012/27/EU);
- Completion of the internal energy market, including provisions of the 3rd package (Directive 2009/73/EC, Directive 2009/72/EC) - Regulation (EC) No 715/2009, Regulation (EC) No 714/2009;
- Directive on the promotion of the use of energy from renewable sources - "RES Directive"- incl. amendment on ILUC (Directive 2009/28 EC as amended by Directive (EU) 2015/1513);
- EU ETS Directive 2003/87/EC as amended by Directive 2004/101/EC (international credits), Directive 2008/101/EC (aviation), Directive 2009/29/EC (revision for 2020 climate and energy package), Regulation (EU) No 176/2014 (back-loading), Decision (EU) 2015/1814 (Market Stability Reserve), and implementing Decisions, in particular 2010/384/EU, 2010/634/EU, 2011/389/EU, 2013/448/EU (cap), 2011/278/EU, 2011/638/EU (benchmarking and carbon leakage list);
- Industrial emissions (Recast of Integrated Pollution and Prevention Control Directive 2008/1/EC and Large Combustion Plant Directive 2001/80/EC) - Directive 2010/75/EU.
- Increasing energy efficiency with a number of measures in force since 2014 on the energy consumption side, according to which energy savings are reflected as a reduction in final energy consumption. These measures are broken down by sector (buildings, industry, public sector, transport and appliances). In the buildings sector, it is mainly about improving the thermal technical performance of buildings by carrying out cost-effective deep renovation. Legislation and changes to national technical standards since 2012 have introduced conditions for progressively stricter energy performance requirements for new and substantially renovated buildings, which are regularly reviewed. Measures in the buildings sector represent the most important source of potential energy savings by 2030.
- Optimisation of district heating systems - switching from fossil fuels to biomass and natural gas and installation of combined heat and power (CHP) units in district heating systems. Industrial cogeneration plants produce industrial steam, which can also be used for district heating or is a secondary use of industrial steam. Other measures are also taken into account (e.g. improving the efficiency of the District heating network (DHN), installing innovative district heating technologies, improving the supply of heat from combined heat and power plants)

- Specific emissions limits and specific technical conditions for MCP and LCP - Setting limits on concentration for specific air pollutants for particular combustion plants.
- **National Air Pollution Control Program (NAPCP) –** sectoral measures in from NAPCP:
- **Support for the replacement of old solid fuel boilers with low-emission ones -** Replacement of old non-ecological solid fuel boilers with new ones, low-emission and more energy-efficient boilers in Households.
- **The transition of households using solid fuel for heating to another low-emission heat source (eg natural gas) -** The aim of the measure is to support the transition to low-emission methods of household heating. The measure assumes that households currently using solid fuel will be connected to a low-emission heat source.
- **Awareness campaign and education on good practice in coal and biomass combustion -** Raising people's awareness of the importance and risks of poor air quality. And also raising information on the possibilities and simple measures to improve proper heating methods, use of wood, etc.
- **Transformation or phase-out of fossil fuel-fired power plants -** transition to low-emission fuels. Phase-out of Novaky and Vojany Coal power plants

With Additional Measures scenario (WAM) – is equivalent to scenario Dcarb2 of the CPS-PRIMES model. This is consistent with the results presented in the LCDS of Slovakia; however, the scenario was updated based on the latest input data and parameters assumption (including consideration of development with the COVID19 situation).

WAM scenario have been designed as contrasting combinations of energy efficiency and renewable targets, representing the trade-offs between targets. The scenario includes Slovakia's participation in the EU ETS, and median targets for renewable energy efficiency involving the construction of new nuclear electricity-generation capacity, which will ensure continuity of the higher share of nuclear energy in the generation mix. To shape a range of possible contributions by the Slovak Republic in the achievement of the EU targets for 2030, at first a summary of possible flexibilities in targets using several trend-variants was quantified by using the CPS-PRIMES model. The Basic, Median and Ambitious categorisations refer to the possible intensiveness of the policy targets for the year 2030. The specification of the WAM scenario relies on the logic of the design of the EU scenarios and in particular, the EUCO30 scenario, which sets the 2030 targets at the EU level as follows:

- GHG emissions reduction: -40% in 2030 and -80 to -85% in 2050, compared to 1990;
- EU ETS CO_2 emissions reduction: -43% in 2030 and -90% in 2050, compared to 2005, but this is resulting from the EU ETS carbon price trajectories as an outcome of the EU ETS market regulations including the market stability reserve as adopted;
- Non-EU ETS GHG emissions reduction: -30% in 2030 compared to 2005, with specific obligations per country;
- RES share: 27% of gross final energy demand in 2030;
- Energy efficiency: reduction of primary energy by 30% (1 321 Mtoe – excluding non-energy consumption of energy products) in 2030 compared to the 2007 baseline.
- Continuing to reduce final energy consumption in all sectors after 2020. The measure puts emphasis on policies supporting the acceleration of the renewal of the building stock (residential and non-residential, public and private), with a focus on carrying out cost-effective in-depth renovations and applying minimum energy performance requirements for near-zero energy buildings after 2020 for new buildings.

In addition to the national policies included in the **WAM** scenario, the following national policies are also included:

- Earlier decommissioning of solid-fired utility power plants: Vojany and Nováky power plants are assumed to decommission in 2025 and 2023 respectively;

- RES support scheme in power generation: Eligible RES technologies are Solar PV, wind onshore turbines and biomass. The scenarios assume support of 50MW in the period 2021 – 2025, followed by the support of another 500 MW based on auctions;
- Further development of nuclear energy is possible based on economic optimality;
- Carbon capture and storage are excluded.
- Assessment of the future structure of appliances used for domestic heating based on survey data
- Support for the replacement of old solid fuel boilers in households with low-emission systems.
- Support for insulation of family houses - Programme Slovakia, Green renovation.
- Awareness campaign and education on good coal and biomass combustion practices.
- Commissioning of new nuclear power sources: Mochovce unit 3 in 2023 and Mochovce unit 4 after 2025;
- Installation of 2 Electric Arc Furnace (EAF) processing iron scrap;
- Decommissioning of Coke oven battery;
- Decommissioning of Sinter installation;
- Continuous Casting;
- Decommissioning of two blast and oxygen furnaces;
- Reduction of energy coal consumption.

9.3.2 TRANSPORT

For the **WEM** and **WAM** scenarios, existing measures in the transport sector and other sectoral information from the Ministry of Economy and the Ministry of Transport and Construction of the Slovak Republic have been taken into account. The transport projections were prepared according to the COPERT model, which is based on data from the SYBIL database. Data for the projected transport parameters were obtained from the CPS-PRIMES model and the Low Carbon Strategy of the Slovak Republic. Transport emissions projections have been prepared with the following assumptions:

- Act No. 277/2020, which is a partial national transposition of Directive (EU) 2018/2001 of the European Parliament and of the Council (RED II) on the promotion of the use of energy from renewable sources.
- Impact of EU legislation - Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO_2 emission performance standards for new passenger cars and light commercial vehicles.
- Impact of EU legislation - Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO_2 emission performance standards for new heavy-duty vehicles.
- Impact of EU legislation - Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and climate action.
- Continuation of direct support for the use of low-emission vehicles on the basis of the Action Plan for the Development of Electric Vehicles in Slovakia.
- The long-term financial mechanism to support the development of charging infrastructure is based on the Action Plan for the Development of Electric Vehicles in the Slovak Republic.
- Setting stricter requirements for periodic technical inspections of vehicles.
- Vehicle registration fee based on g CO_2/km emissions.
- The modal shift in passenger transport.
- The modal shift in the transport of goods.
- Introduction and promotion of hydrogen-powered vehicles (FCEV).
- Mixing biomethane into CNG and LNG.

9.3.3 AGRICULTURE

A review of actual and planned policies and measures was done. The forthcoming EU food strategy aims to reduce the use of pesticides, fertilizers and antibiotics in agriculture. By 2030, the consumption of hazardous pesticides should be reduced by 50 % and the consumption of inorganic fertilizers should decrease by 20 %. Targets are set for the entire European Union, the Slovak Republic does not set binding reduction resulting from the Farm to Fork strategy.

The Low Carbon Strategy aims to identify measures, including achieving climate neutrality in the Slovak Republic in 2050 and achieving a 55 % emission reduction in 2030 compared to 1990. This ambitious goal was formally defined in the last stage of the Low Carbon Strategy. Other less ambitious emission reduction scenarios (MŽP SR, 2020) were analysed in detail.

In preparing projections, measures were selected and analysed to detectable impact on the estimated emissions and their quantified impact on the greenhouse gas inventory and inventory of pollutants as possible. All other measures proposed in the Low Carbon Strategy are not implemented in the projections due to a lack of measurable effect on inventory but have an impact on the whole concerning the environment.

Based on the qualification of the probable impact of mitigation measures on emission inventories, we distinguish:

1. Measures having an identifiable impact on emissions. This impact can be specifically attributed to the implementation of mitigation measures. These measures are measurable and effective, this type of measure has been used in the preparation of emission projections.
2. Measures that have an impact on emissions are reported in inventories, but this impact cannot be specifically attributed to a specific mitigation measure. This includes measures that are difficult to measure and have different often synergistic ý or antagonistic effects.
3.°Measures whose impact on emissions reported in inventories is possible because emission reductions are visible. The effect of these measures depends on other factors.
4. Measures that do not have a direct impact on emissions but which may have a positive impact on farmers' behaviour or the environment in the sector.

In the context of this document were prepared two scenarios:

The **WEM** scenario is a measures scenario that includes projections of anthropogenic emissions from agricultural sources, taking into account the effects of policies and measures adopted by the end of 2020. The measures considered in the **WEM** scenario prevent NH_3 emissions by storing manure and manure more efficiently by isolating them from the environment. This measure can be found in several strategic documents, especially in the Decree of the Ministry of the Environment of the Slovak Republic no. 410/2012 Coll., Which implements certain provisions of the Air Act. The implementation of this measure has an impact on NH_3 and NOx from category 3B Manure and slurry management

The **WEM** scenario takes into account the estimated consumption trend of nitrogenous organic and inorganic fertilizers based on exponential equalization by analysing previous emission trends. The **WEM** scenario has an increasing trend of nitrogen oxide emission projections, mainly due to the expected continued revival of crop production in Slovakia. After 2020, the consumption of inorganic fertilizers is expected to increase by 50% compared to 2005. We assume that the consumption of inorganic fertilizers will increase, which will be necessary to compensate for the lack of organic nitrogen due to the decrease in the number of farm animals until 2050. The increase will be caused mainly by the growth in the number of grazing animals (meat species of cattle, sheep and goats). The increase in emissions projections in the **WEM** scenario is also visible in the category of applied other organic waste, namely compost and digestate. The amount of applied matter from cultivated plants to the soil will also increase.

The measure, taken from the Farm to Fork strategy, is to limit the use of pesticides, fertilizers and antibiotics in agriculture. This strategy was developed in synergy with the European Green Deal, which set itself the goal of reducing the environmental and climate footprint of the European food system. Within the **WAM** scenario, a

target of reducing nitrogen fertilizer consumption by 20% by 2030 was implemented. A transition period was implemented in the emission projections, which is in line with the transition period for limiting urea (2020-2025). It is likely that the Slovak Republic will negotiate its own percentage reduction in fertilizer consumption and will claim a transitional period that will be legislated at the national level. After the legislative process, it will be necessary to adjust the emission projections in accordance with the future valid state strategy. Even though planned mitigation measures have been implemented, emissions are projected to increase by 2030 and 2050, creating pressure for much more ambitious measures. The reduction of urea had a gradual trend, which is shown in the Table. Limiting urea also affects CO_2 emissions from agriculture and especially on NH_3 emissions. The **WAM** scenario includes two mitigation measures that have a synergistic effect. The measure adopted from NUS SR [6] recommends a legislative restriction on the application of urea-based nitrogen fertilizers. The implementation of this measure has an impact on the reduction of ammonia emissions, mainly due to the high volatility of ammonia from urea fertilizers. By limiting the consumption of urea, nitrogen oxide emissions will also be prevented based on the reduction of the total consumption of inorganic fertilizers in the resulting sum of consumption. Detailed information on when the legislative framework should apply was not available, so an expert estimate was used. The **WAM** scenario is a scenario with additional measures containing projections of emissions from agricultural sources, which include the effects of policies and measures adopted and implemented after 2020. The **WAM** scenario was modelled on strategic documents prepared by the Ministry of Environment of the Slovak Republic in cooperation with the Ministry of Agriculture and rural development of the Slovak Republic.

The **WAM** scenario contains measures that are in synergy and can be implemented in the calculation model. This is the use of amino acids in the ration reducing the nitrogen excretion of animals, it was implemented in the model through a more precise optimization of nitrogen substances in the ration. The measure was used in the estimation of nitrogen excretion per 1 animal per year in cattle. Based on the meta-analysis, the estimate of the mitigation potential compared to the reference value was in the range of 17±6% N_{ex}.

Emissions of NOx and NH_3 from manure and manure storage in the WAM scenario were modelled taking into account the measure of introducing requirements to reduce emissions from livestock farms classified as a medium source of emissions to air. This measure was proposed in the National Air Emission Control Programme and implemented into the calculation of NH_3 and NOx emissions by implementing low-emission systems for manure and manure storage. This measure has an impact on category 3B Manure and slurry management.

Another implemented measure (MŽP SR, 2020), which has an impact on NH_3 and NOx emissions in category 3B Manure and manure management, was the use of manure as a feedstock into biogas plants. The impact on reducing emissions in two main ways - reducing carbon emissions from fossil fuels through the production of energy sources and reducing direct emissions of methane and nitrous oxide from manure and sludge storage. Although anaerobic digestion does produce methane, it is captured and used in energy production, which has a positive impact on increasing the share of energy from renewable sources.

Emissions of NH_3 and NOx from the application of inorganic nitrogen fertilizers (category **3D** Agricultural soils) were modelled in the **WAM** scenario based on a measure implemented from the Low Carbon Strategy of the Slovak Republic. This measure recommends the transition or legislative restriction on the application of nitrogen fertilizers to urea bases. The implementation of this measure has an impact on the reduction of NH_3 and NOx emissions, mainly due to the high volatility of ammonia from urea fertilizers. At the same time, limiting urea consumption will prevent carbon dioxide emissions. Nitrous oxide emissions are limited based on the reduction of the total consumption of inorganic fertilizers in the resulting consumption summary.

The last implemented measure was taken from the European Green Deal and mentioned in the Farm to Fork strategy. This measure recommended a 20% reduction in inorganic fertilizers consumption by 2030. This measure has an impact on NH_3 and NOx.

The list of policies and measures that have been taken into account in the emission projections according to the individual scenarios and their effect is given in ***Table 9.3***.

Table 9.3: *List of implemented policies and measures into projections according to the scenarios*

STRATEGIC DOCUMENT LEGISLATION	SCENARIO	GAS / CATEGORY	MEASURE	EFFECT OF THE MEASURE
Code of good agricultural practice National Emission Reduction Program Low carbon strategy Decree of the Ministry of the Environment of the Slovak Republic no. 410/2012 Coll.	WEM	NH_3, NOx- 3.B Manure management	Efficient storage of animal waste, specifically storage of liquids in isolated tanks from the environment or in tanks with access to oxygen and storage of manure in plastic bags without or with minimal addition of water	synergistic
Code of good agricultural practice	WAM	NH_3, NOx – Manure management	Application of amino acids into feeding doses	synergistic
National Air Pollution Control Programme	WAM	NH_3,NOx - agricultural land	Obligation to comply with measures to reduce ammonia emissions even at medium sources of pollution	synergistic
Low carbon strategy	WAM	NH_3, NOx - storage of manure and manure	Effectively process animal waste and use biogas, especially as a local energy source	synergistic
Low carbon strategy	WAM	NH_3,NOx - agricultural land	Intensification of the use of nitrogen fertilizers with stabilized nitrogen at the expense of the use of urea	synergistic
Farm to fork strategy	WAM	NH_3,NOx - agricultural land	Reduction of inorganic nitrogen fertilizers by 20 % compared to 2030	synergistic

9.3.4 WASTE

Emissions projections are based on the assumption of demographic development of the Slovak population according to the EU Reference Scenario sent in 2022 (EU REF 2022), according to EUROPOP2019 projections (***Table 9.4***).

Table 9.4: *Projections of demographic development in Slovakia up to 2050*

YEAR	SOURCE	SCENARIO	2020	2025	2030	2035	2040	2050
Total (median state)	EÚ REF 2022	**WEM**	5 460 136	5 467 891	5 440 730	5 384 612	5 312 439	5 147 215

Municipal solid waste (MSW) production per capita/year in kg - to calculate the specific municipal solid waste production, the standard OECD model of the annual municipal waste increment (0.69% of GDP) was used. The MSW metrics for the projections are shown in ***Table 9.5***.

Table 9.5: *Specific production of MSW in Slovakia by 2050*

YEAR	UNIT	2020	2030	2040	2050
Unit production MSW	*kg/capita*	446	484	547	608

Share of landfilled municipal solid waste in total MSW production - Slovakia is gradually reducing the share of landfilled MSW in total municipal waste production by introducing waste management policies. According to the targets set by the EU Landfill Directive, a maximum of 10% of MSW produced in Slovakia should be landfilled in 2035 (***Table 9.6***).

Table 9.6: *Projections of the development of the MSW landfill fraction in Slovakia until 2050*

YEAR	2020	2030	2040	2050
The proportion of landfilling from MSW	48.4%	22,4%	10%	10%

MSW composition and degradable organic carbon (DOC) content of landfilled waste - based on the available data on the representation of these components in MSW in Slovakia as well as the trend of increasing separate collection and thus the diversion of some components (kitchen waste, textiles), the expected DOC values for the next period were determined. The calculated DOC values are presented in ***Table 9.7***.

Table 9.7: Projections of the development of the MSW landfill fraction in Slovakia until 2050

YEAR	2020	2030	2040	2050
DOC value	0.120	0.103	0.094	0.088

When projecting methane emissions from landfilling of ISW waste in Slovakia, the key calculation parameters are defined by the following indicators:

GDP (economic development of a country as an indicator of waste production) - trend in GDP is generally considered to be a basic indicator of waste production - as GDP increases, the amount of waste increases.

A detailed description of used PAMs in the Waste sector was described in 8. National communication of the SR on climate change in chapter 6.6.

9.4 GENERAL RESULTS AND COMMITMENTS

The actualization of the emission projection led to some changes in comparison with previously reported projections. In the table below are presented national totals of air pollutant emissions and a comparison to the absolute values of emission targets.

Table 9.8: WEM scenario emission projection trends and targets

TOTAL EMISSIONS OF SLOVAKIA (KT)	2005	2015	2020	2025	2030	TARGET 2020	TARGET 2030
NO_X	106.06	63.79	56.00	57.46	50.57	67.88	53.03
NMVOC	141.03	104.88	88.37	85.57	77.66	115.64	95.90
SO_X	86.22	66.79	13.30	14.28	12.92	37.07	15.52
NH_3	32.50	28.41	26.77	26.28	26.12	27.62	22.75
$PM_{2.5}$	35.76	20.58	17.34	15.22	13.24	22.89	18.24

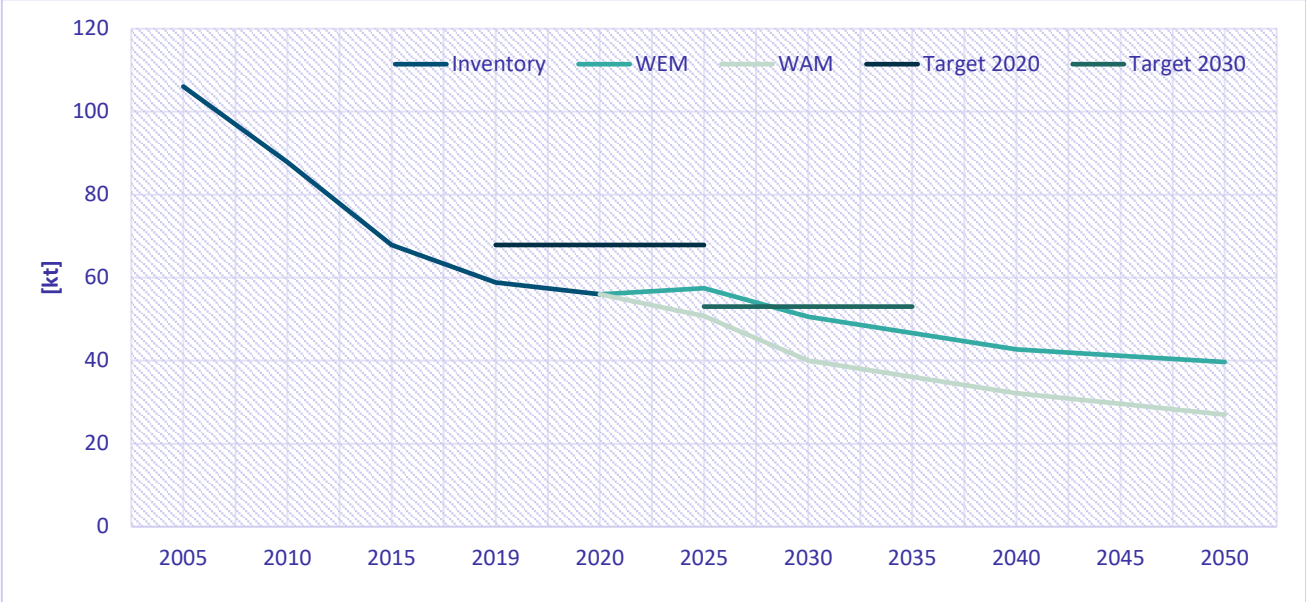
Table 9.9: WAM scenario emission projection trends and targets

TOTAL EMISSIONS OF SLOVAKIA (KT)	2005	2015	2020	2025	2030	TARGET 2020	TARGET 2030
NO_X	106.06	63.79	56.00	50.72	40.01	67.88	53.03
NMVOC	141.03	104.88	88.37	96.15	84.01	115.64	95.90
SO_X	86.22	66.79	13.30	13.56	8.81	37.07	15.52
NH_3	32.50	28.41	26.77	21.80	21.57	27.62	22.75
$PM_{2.5}$	35.76	20.58	17.34	15.83	13.26	22.89	18.24

9.4.1 NOx emissions

Figure 9.2 shows a general view of trends of emissions NOx and estimated emissions projections based on encountered measures. Emissions slightly decrease and adopted and planned measures should be sufficient to meet the 2030 target will be very tight even in the WAM scenario.

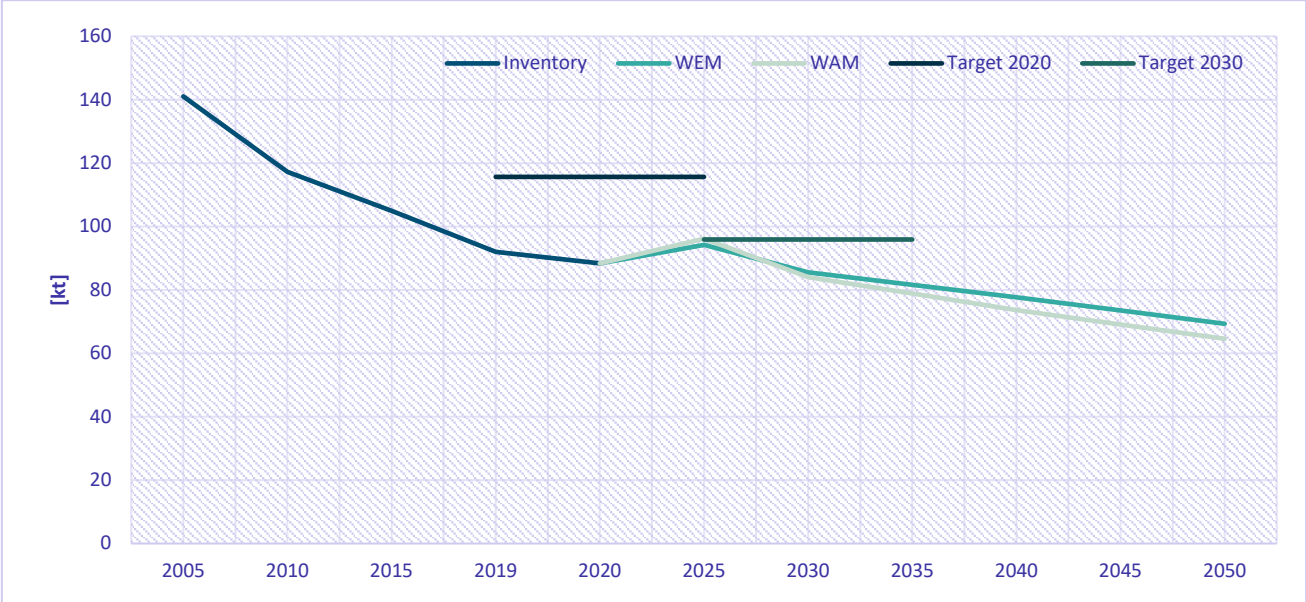
Figure 9.2: Emission projections trends for pollutant NOx



9.4.2 NMVOC emissions

Figure 9.3 shows a general view of trends of NMVOC emissions and estimated emissions projections based on encountered measures. Emissions show an overall decreasing trend and the 2030 target should be achieved in both scenarios.

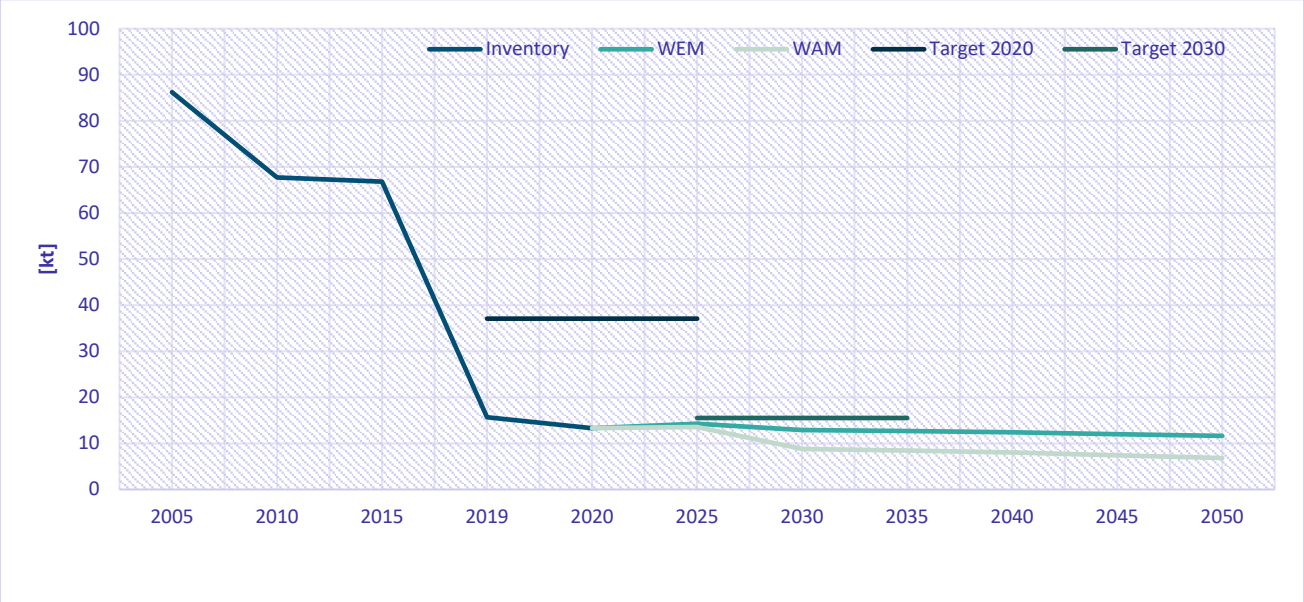
Figure 9.3: Emission projections trends for pollutant NMVOC



9.4.3 SOx emissions

Figure 9.4 shows the general view on trends of SOx emissions. After implementing strong measures in the energy sector Slovakia should achieve the 2030 target in the WAM scenario.

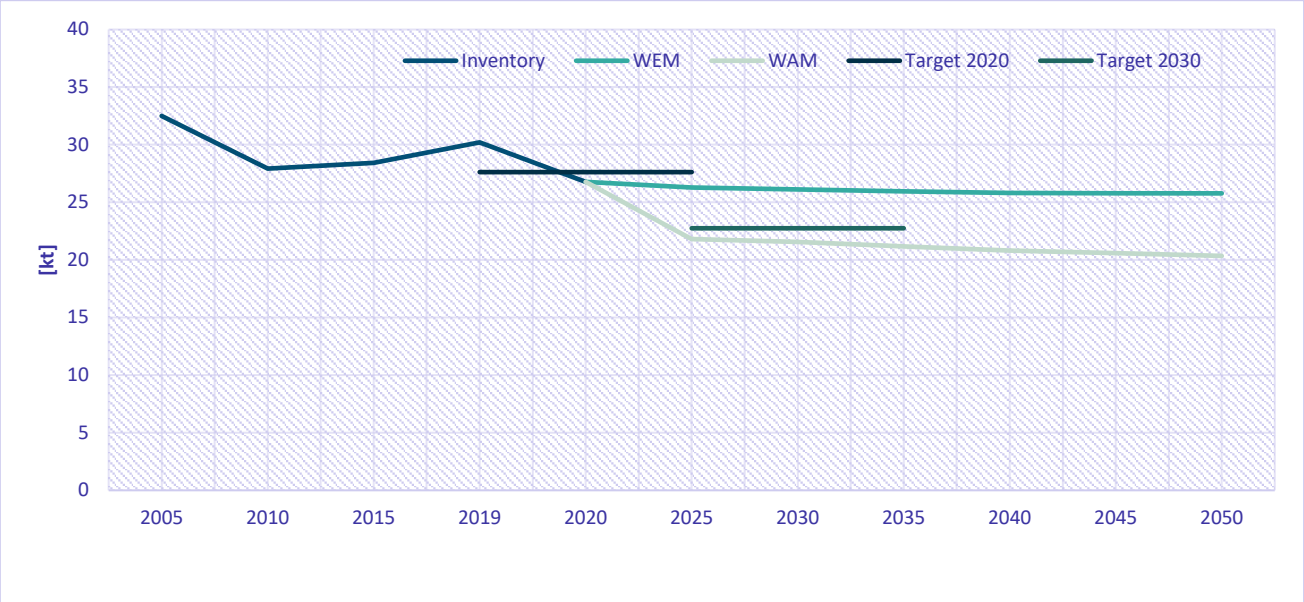
Figure 9.4: *Emission projections trends for pollutant SOx*



9.4.4 NH_3 emissions

Figure 9.5 shows a general view of trends in NH_3 emissions. According to the measures contained in both scenarios will be very hard to achieve the 2030 target. After implementing strong measures in the agriculture sector Slovakia should achieve the 2030 target in the WAM scenario.

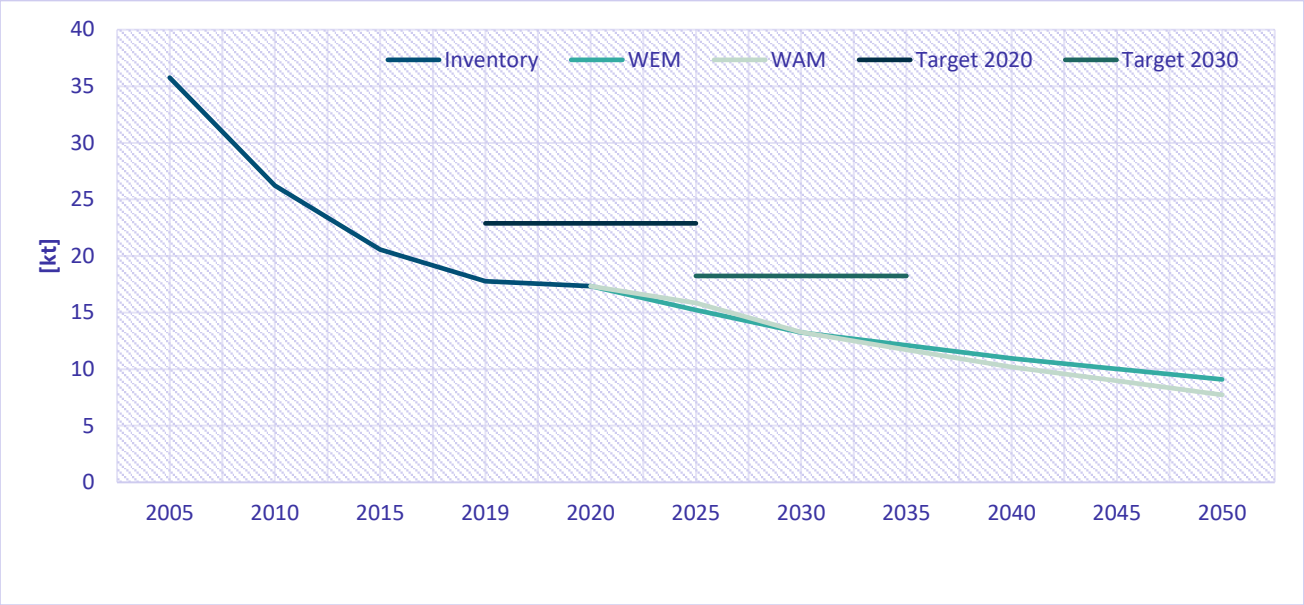
Figure 9.5: *Emission projections trends for pollutant NH_3*



9.4.5 $PM_{2.5}$ emissions

Figure 9.6 shows the estimated trend of $PM_{2.5}$ emissions. This is a key pollutant and the future target achievement mainly depends on development in the household and transport sector. For now, trends of emissions seem to be in the margin of the target 2030.

Figure 9.6: *Emission projections trends for pollutant $PM_{2.5}$*



9.5 SECTORAL RESULTS – ENERGY

The modelling of emission projections in the Energy sector was based on sectoral trends and development from the CPS model and actualization was made by taking into account the results of model TIMES in the category of Public electricity and heat production (**1A1a**). The outputs from modelling were determined also by the reduction potential of measures to reduce emissions.
The next tables show trends of emissions for individual pollutants.

NOx emissions

Table 9.10*: NOx emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	19.10	13.04	8.49	5.47	3.64	3.23	3.03	2.93
1A2	15.32	11.74	10.85	8.41	10.60	9.65	9.28	9.04
1A4	9.19	8.89	8.90	8.48	8.62	8.10	7.46	7.04
1A5	0.20	0.13	0.48	0.45	0.58	0.59	0.59	0.56
1B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**43.81**	**33.80**	**28.72**	**22.81**	**23.44**	**21.57**	**20.36**	**19.57**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	19.10	13.04	8.49	5.47	3.62	1.50	1.35	1.19
1A2	15.32	11.74	10.85	8.41	9.11	7.99	7.44	5.37
1A4	9.19	8.89	8.90	8.48	8.46	8.08	7.41	6.96
1A5	0.20	0.13	0.48	0.45	0.58	0.59	0.59	0.56
1B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**43.81**	**33.80**	**28.72**	**22.81**	**21.77**	**18.16**	**16.80**	**14.08**

NMVOC emissions

Table 9.11*: NMVOC emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	2.68	1.92	1.83	1.19	1.12	0.99	0.92	0.86
1A2	5.33	4.91	5.72	5.69	7.43	6.96	6.94	6.63
1A4	49.24	47.58	38.40	33.92	30.37	26.26	21.32	17.30

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A5	0.47	0.57	0.82	0.55	0.71	0.72	0.72	0.69
1B	12.98	12.77	11.72	8.71	15.38	13.43	12.52	10.83
1 Energy	**70.71**	**67.74**	**58.48**	**50.06**	**55.01**	**48.37**	**42.42**	**36.31**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	2.68	1.92	1.83	1.19	1.13	0.99	0.92	0.78
1A2	5.33	4.91	5.72	5.69	7.06	6.64	6.62	6.16
1A4	49.24	47.58	38.40	33.92	33.92	29.04	22.98	18.02
1A5	0.47	0.57	0.82	0.55	0.71	0.72	0.72	0.69
1B	12.98	12.77	11.72	8.71	15.38	13.43	12.52	10.83
1 Energy	**70.71**	**67.74**	**58.48**	**50.06**	**58.21**	**50.83**	**43.76**	**36.47**

SOx emissions

Table 9.12: *SOx emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	60.82	52.75	52.04	3.22	2.26	2.03	1.89	1.83
1A2	10.01	4.94	3.29	1.47	1.85	1.67	1.59	1.55
1A4	3.40	2.34	1.94	1.60	1.67	1.54	1.38	1.25
1A5	0.32	0.10	0.21	0.19	0.25	0.25	0.25	0.24
1B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**74.55**	**60.13**	**57.48**	**6.48**	**6.02**	**5.49**	**5.11**	**4.87**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	60.82	52.75	52.04	3.22	2.21	0.79	0.72	0.67
1A2	10.01	4.94	3.29	1.47	1.50	1.28	1.16	0.73
1A4	3.40	2.34	1.94	1.60	1.67	1.39	1.00	0.79
1A5	0.32	0.10	0.21	0.19	0.25	0.25	0.25	0.24
1B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**74.55**	**60.13**	**57.48**	**6.48**	**5.63**	**3.72**	**3.13**	**2.43**

NH_3 emissions

Table 9.13: *NH_3 emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	0.08	0.03	0.05	0.02	0.02	0.01	0.01	0.01
1A2	0.02	0.02	0.04	0.07	0.10	0.09	0.09	0.08
1A4	2.06	2.09	1.63	1.52	1.36	1.20	1.00	0.82
1A5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
1 Energy	**2.17**	**2.15**	**1.72**	**1.62**	**1.48**	**1.30**	**1.10**	**0.92**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	0.08	0.03	0.05	0.02	0.02	0.01	0.01	0.00
1A2	0.02	0.02	0.04	0.07	0.09	0.08	0.08	0.08
1A4	2.06	2.09	1.63	1.52	1.41	1.26	1.08	0.88
1A5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
1 Energy	**2.17**	**2.15**	**1.72**	**1.62**	**1.52**	**1.36**	**1.18**	**0.96**

$PM_{2.5}$ emissions

Households (**1A4**) are a dominant contributor to $PM_{2.5}$ emissions.

Table 9.14: *$PM_{2.5}$ emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	8.08	0.89	0.67	0.27	0.26	0.22	0.21	0.20
1A2	0.72	0.41	0.23	0.25	0.31	0.27	0.24	0.24
1A4	22.44	20.99	16.44	14.34	12.73	10.99	8.87	7.09
1A5	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02
1B	0.21	0.19	0.17	0.11	0.05	0.01	0.01	0.01
1 Energy	**31.47**	**22.49**	**17.54**	**14.98**	**13.37**	**11.52**	**9.35**	**7.56**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A1	8.08	0.89	0.67	0.27	0.26	0.13	0.12	0.09
1A2	0.72	0.41	0.23	0.25	0.30	0.27	0.24	0.23
1A4	22.44	20.99	16.44	14.34	13.05	10.81	8.08	5.86
1A5	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02
1B	0.21	0.19	0.17	0.11	0.05	0.01	0.01	0.01
1 Energy	**31.47**	**22.49**	**17.54**	**14.98**	**13.68**	**11.25**	**8.47**	**6.21**

9.6 SECTORAL RESULTS – TRANSPORT

NOx emissions

Table 9.15: *NOx emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	43.27	36.84	22.89	18.23	17.06	12.29	5.46	3.18
1A3acde non road	5.82	4.71	2.68	2.06	2.24	2.30	2.38	2.46
1A3	**49.09**	**41.55**	**25.58**	**20.29**	**19.30**	**14.59**	**7.84**	**5.64**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	43.27	36.84	22.89	18.23	13.55	8.81	2.49	0.70
1A3acde non road	5.82	4.71	2.68	2.06	2.24	2.30	2.38	2.46
1A3	**49.09**	**41.55**	**25.58**	**20.29**	**15.78**	**11.11**	**4.87**	**3.16**

NMVOC emissions

Table 9.16: *NMVOC emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	19.83	11.79	4.72	3.15	4.22	4.11	3.28	1.99
1A3acde non road	0.39	0.36	0.40	0.35	0.16	0.17	0.18	0.19
1A3	**20.23**	**12.14**	**5.12**	**3.50**	**4.38**	**4.28**	**3.46**	**2.18**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	19.83	11.79	4.72	3.15	4.00	3.37	1.35	0.63
1A3acde non road	0.39	0.36	0.40	0.35	0.16	0.17	0.18	0.19
1A3	**20.23**	**12.14**	**5.12**	**3.50**	**4.16**	**3.54**	**1.53**	**0.81**

SOx emissions

Table 9.17: *SOx emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	0.19	0.03	0.03	0.03	0.04	0.05	0.04	0.03
1A3acde non road	0.01	0.22	0.19	0.13	0.15	0.13	0.13	0.10
1A3	**0.21**	**0.25**	**0.22**	**0.17**	**0.20**	**0.18**	**0.17**	**0.13**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	0.19	0.03	0.03	0.03	0.04	0.03	0.01	0.01
1A3acde non road	0.01	0.22	0.19	0.13	0.15	0.13	0.13	0.10
1A3	**0.21**	**0.25**	**0.22**	**0.17**	**0.19**	**0.17**	**0.15**	**0.11**

NH_3 emissions

***Table 9.18**: NH_3 emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	0.53	0.47	0.35	0.34	0.44	0.45	0.43	0.31
1A3acde non road	0.00	0.00	0.00	0.00	NE	NE	NE	NE
1A3	**0.53**	**0.47**	**0.35**	**0.34**	**0.44**	**0.45**	**0.43**	**0.31**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	0.53	0.47	0.35	0.34	0.39	0.35	0.17	0.08
1A3acde non road	0.00	0.00	0.00	0.00	NE	NE	NE	NE
1A3	**0.53**	**0.47**	**0.35**	**0.34**	**0.39**	**0.35**	**0.17**	**0.08**

$PM_{2.5}$ emissions

***Table 9.19:** $PM_{2.5}$ emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	2.24	2.18	1.27	0.98	0.54	0.44	0.36	0.32
1A3acde non road	0.05	0.10	0.08	0.07	NE	NE	NE	NE
1A3	**2.29**	**2.28**	**1.35**	**1.05**	**0.54**	**0.44**	**0.36**	**0.32**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
1A3b road	2.24	2.18	1.27	0.98	0.85	0.74	0.49	0.33
1A3acde non road	0.05	0.10	0.08	0.07	NE	NE	NE	NE
1A3	**2.29**	**2.28**	**1.35**	**1.05**	**0.85**	**0.74**	**0.49**	**0.33**

9.7 SECTORAL RESULTS – INDUSTRY

The modelling of emission projections in the Energy sector was based on sectoral trends and development from the CPS model and actualization was made by taking into account results of model TIMES and new information from producers. Significant impact has planned new installations in steel production.

NOx emissions

***Table 9.20:** NOx emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	6.70	5.91	6.48	5.74	7.07	6.60	6.52	6.09
2D, 2G	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.01
2 Industry	**6.71**	**5.92**	**6.50**	**5.75**	**7.08**	**6.61**	**6.53**	**6.11**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	6.70	5.91	6.48	5.74	6.85	4.41	4.28	3.86
2D, 2G	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.01
2 Industry	**6.71**	**5.92**	**6.50**	**5.75**	**6.86**	**4.42**	**4.30**	**3.87**

NMVOC emissions

Table 9.21: *NMVOC emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	7.32	5.32	6.23	5.88	7.38	7.02	6.93	6.48
2D, 2G	30.76	22.46	25.68	20.89	19.58	18.23	17.82	17.50
2 Industry	**38.08**	**27.78**	**31.91**	**26.77**	**26.97**	**25.25**	**24.75**	**23.98**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	7.32	5.32	6.23	5.88	7.17	4.73	4.63	4.24
2D, 2G	30.76	22.46	25.68	20.89	19.49	18.05	17.47	16.98
2 Industry	**38.08**	**27.78**	**31.91**	**26.77**	**26.65**	**22.78**	**22.10**	**21.22**

SOx emissions

Table 9.22: *SOx emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	11.43	7.30	9.05	6.63	8.03	7.23	7.10	6.61
2D, 2G	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02
2 Industry	**11.45**	**7.33**	**9.09**	**6.65**	**8.05**	**7.25**	**7.12**	**6.63**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	11.43	7.30	9.05	6.63	7.71	4.89	4.74	4.26
2D, 2G	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02
2 Industry	**11.45**	**7.33**	**9.09**	**6.65**	**7.74**	**4.91**	**4.76**	**4.28**

NH_3 emissions

Table 9.23: *NH_3 emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	0.24	0.09	0.13	0.24	0.24	0.25	0.24	0.23
2D, 2G	0.03	0.04	0.04	0.03	0.04	0.03	0.03	0.03
2 Industry	**0.27**	**0.12**	**0.17**	**0.27**	**0.28**	**0.28**	**0.27**	**0.26**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	0.24	0.09	0.13	0.24	0.24	0.24	0.23	0.22
2D, 2G	0.03	0.04	0.04	0.03	0.04	0.03	0.03	0.03
2 Industry	**0.27**	**0.12**	**0.17**	**0.27**	**0.28**	**0.27**	**0.27**	**0.25**

$PM_{2.5}$ emissions

Table 9.24: *$PM_{2.5}$ emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	1.30	0.71	0.95	0.62	0.63	0.64	0.63	0.60
2D, 2G	0.18	0.24	0.23	0.21	0.23	0.21	0.21	0.20
2 Industry	**1.48**	**0.96**	**1.18**	**0.83**	**0.86**	**0.85**	**0.84**	**0.81**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
2A,B,C,H,I,J,K,L	1.30	0.71	0.95	0.62	0.63	0.63	0.62	0.59
2D, 2G	0.18	0.24	0.23	0.21	0.23	0.21	0.21	0.20
2 Industry	**1.48**	**0.96**	**1.18**	**0.83**	**0.86**	**0.84**	**0.82**	**0.79**

9.8 SECTORAL RESULTS – AGRICULTURE

Sector agriculture is a dominant contributor to NH_3 emissions and also a significant contributor to NOx and NMVOC emissions.

NMVOC emissions

NMVOC emission projections were prepared using the WEM scenario. The emission projections decreased mainly due to a decrease in the projected number of livestock and intensive feeding with active substances in dairy cattle, sheep and swine categories. Predictions by the WEM scenario were following the Ordinance of the Government of the Slovak Republic No 410/2012 Coll.

Figure 9.7: *Emission projections trends for pollutant NMVOC in sector Agriculture*

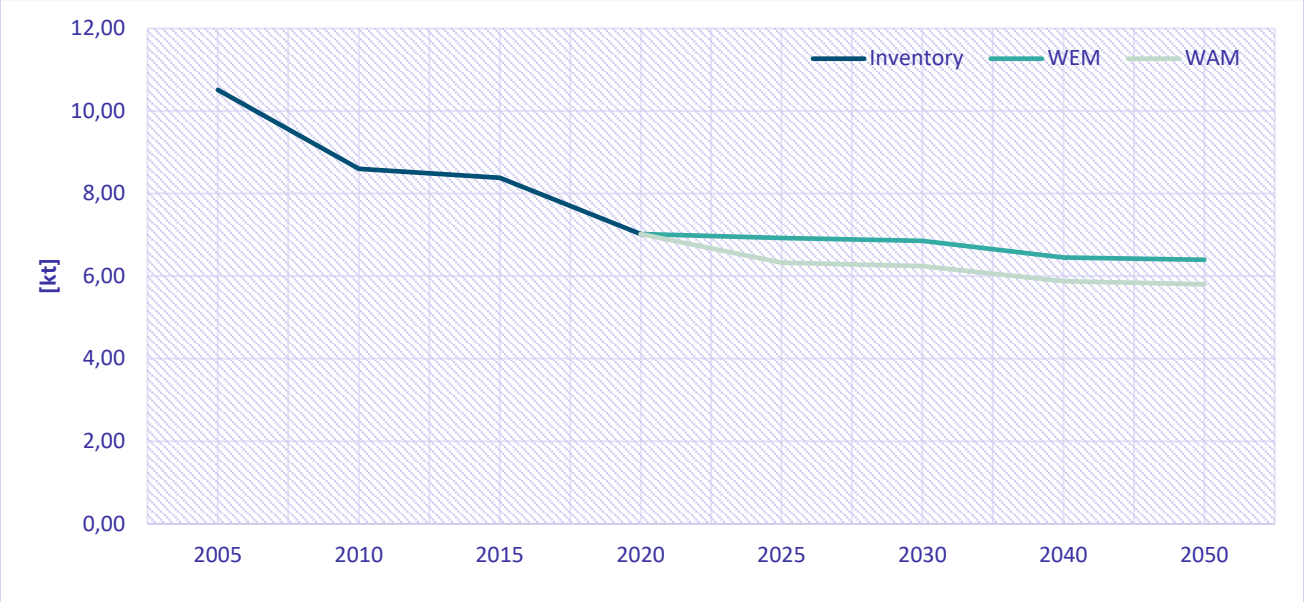


Table 9.25*: NMVOC emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
3B	10.35	8.44	8.22	6.86	6.78	6.72	6.31	6.26
3D	0.16	0.16	0.16	0.16	0.14	0.14	0.14	0.14
3 Agriculture	**10.51**	**8.60**	**8.38**	**7.02**	**6.92**	**6.86**	**6.45**	**6.40**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
3B	10.35	8.44	8.22	6.86	6.19	6.10	5.74	5.66
3D	0.16	0.16	0.16	0.16	0.14	0.14	0.14	0.14
3 Agriculture	**10.51**	**8.60**	**8.38**	**7.02**	**6.33**	**6.24**	**5.88**	**5.80**

NH_3 emissions, NOx emissions

Sector agriculture is a dominant contributor to NH_3 emissions, approximately 90% share of the national total. The largest share of ammonia emissions was generated by 3D Agricultural soils, which produced approximately 70% of NH_3 within the sector. The key source in Agricultural Soils in the Animal manure applied to soils where were implemented abatements (Incorporation within 12, 24 hours, deep injection of manure), followed by the category Inorganic N-fertilizers representing approximately 20% of the total NH_3 emissions, there are no abatements were implemented, due to missing policies. Emissions from 3B1 Cattle, 3B3 Swine and 3B2 Sheep are key emission sources of NH_3.

Projections of NH_3 and NOx emissions from manure and manure management and agricultural soils were prepared in the WEM and WAM scenarios.

The WEM scenario is identical to the WEM scenario for NH_3 and NOx emission projections. The WEM scenario is conservative and does not envisage further measures to reduce emissions. The emission trend is relatively stable (***Figure 9.8***).

Figure 9.8: *Emission projections trends for pollutant NH_3 in sector Agriculture*

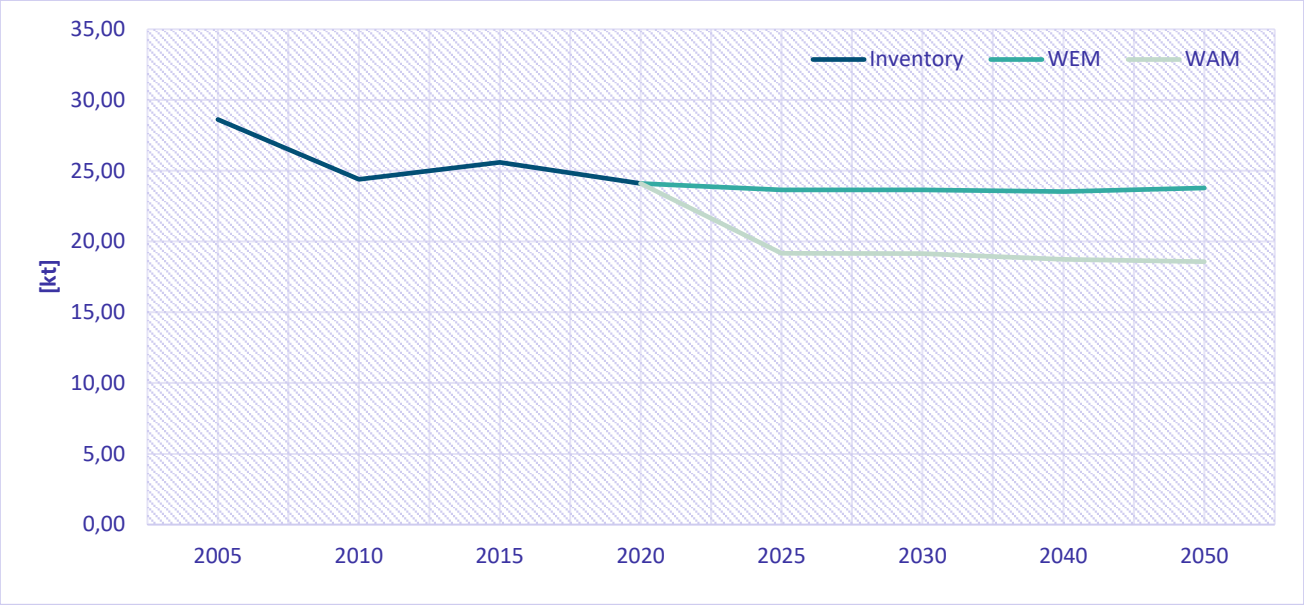


Table 9.26: *NH_3 emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
3B	8.90	7.21	6.98	5.96	5.98	5.85	5.66	5.51
3D	19.72	17.19	18.62	18.14	17.67	17.79	17.88	18.29
3 Agriculture	**28.62**	**24.40**	**25.60**	**24.10**	**23.65**	**23.64**	**23.53**	**23.80**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
3B	8.90	7.21	6.98	5.96	5.31	5.23	5.03	4.87
3D	19.72	17.19	18.62	18.14	13.86	13.92	13.71	13.71
3 Agriculture	**28.62**	**24.40**	**25.60**	**24.10**	**19.18**	**19.15**	**18.75**	**18.58**

Agricultural NOx emissions have increased. The NOx emissions from agricultural soils especially Inorganic N-fertilizers application is a key source of emission. The emission projections increased due to the increasing consumption of nitrogen N-fertilizers, which will be needed to replace the lack of organic nitrogen in soils due to livestock decreasing. Agriculture is an insignificant source of NOx emissions and no policies and measures are available.

Figure 9.9 Emission projections trends for pollutant NOx in sector Agriculture

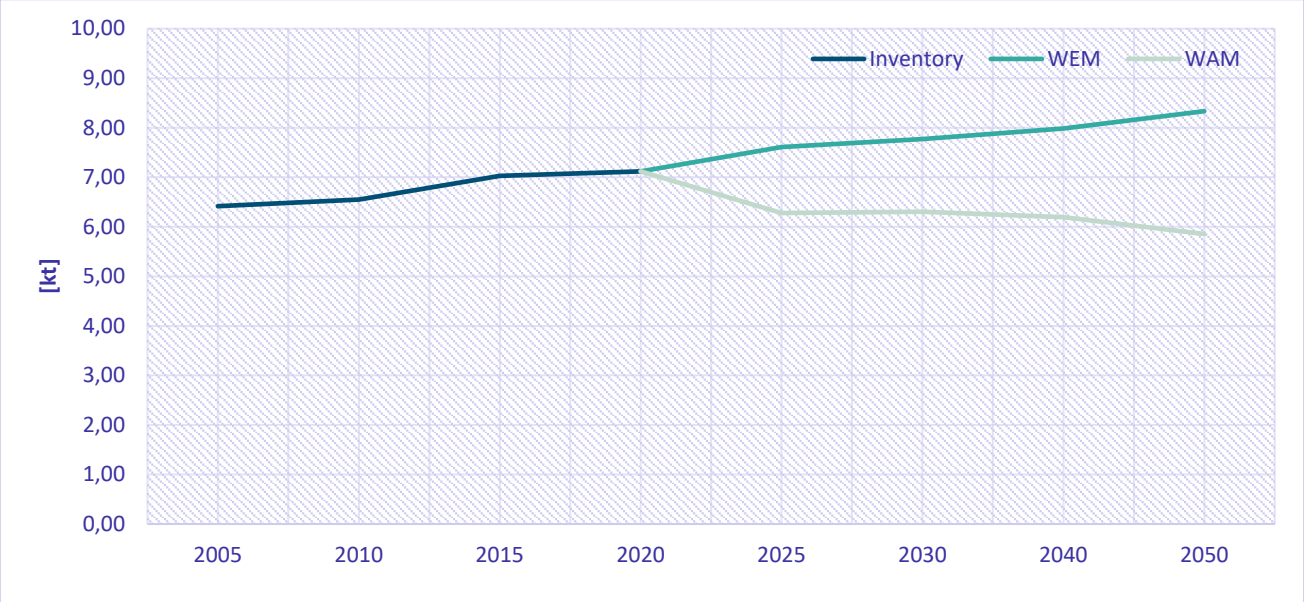


Table 9.27: NOx emissions in sector Agriculture

WEM	2005	2010	2015	2020	2025	2030	2040	2050
3B	0.18	0.15	0.15	0.14	0.13	0.13	0.12	0.12
3D	6.24	6.40	6.89	6.98	7.48	7.64	7.86	8.21
3 Agriculture	**6.42**	**6.55**	**7.03**	**7.12**	**7.61**	**7.77**	**7.99**	**8.33**

WAM	2005	2010	2015	2020	2025	2030	2040	2050
3B	0.18	0.15	0.15	0.14	0.10	0.10	0.10	0.10
3D	6.24	6.40	6.89	6.98	6.18	6.20	6.09	5.76
3 Agriculture	**6.42**	**6.55**	**7.03**	**7.12**	**6.28**	**6.30**	**6.19**	**5.85**

Table 9.28: Proportion of farms (in %) used mitigation on all farms

YEAR	MITIGATION	A	B	C	D	E	F	G	H	I
		%								
2019	fixed hatch or roof	5.4	5.1	0.3	1.4	0.0	6.5	11.1	14.8	2.6
	covering the surface with peat, straw, oil or other material	1.0	1.2	1.9	0.7	1.9	0.0	0.9	2.0	0.0

A Cattle - dairy cows, **B** Cattle - other cattle, **C** Poultry - broilers, **D** Poultry - laying hens, **E** Poultry - other poultry, **F** Horses, **G** Pigs - sows, **H** Pigs - fattening, **I** Sheep

The decrease in emissions by 2040 in the WEM scenario compared to 1990 is at the level of -51.6% and compared to 2005 at the level of -7%.

The WAM scenario was prepared based on the National Air Pollution Program with the inclusion of measures from the program Introduction of requirements for the reduction of NH_3 emissions from livestock for medium farms (application of the Code of Best Agricultural Practice). The measure includes a set of techniques (***Table 9.28***) to reduce the release of ammonia emissions from agricultural activities during the storage of organic waste from animal production (manure, slurry). The measure aims to extend the obligation to comply with the requirements concerning the reduction of ammonia emissions from large sources to medium sources set out in the Decree of the Ministry of the Environment of the Slovak Republic No. 410/2012 Coll. The trend of NH_3 and NOx projections emissions in the WAM scenario has a decreasing and a sharp decrease is visible especially after 2019 due to implementing the measures. The WAM scenario contains two mitigation measures that have a synergistic effect. The implemented measure taken from the Low Carbon Strategy recommends the transition or legislative restriction on the application of urea-based nitrogen fertilizers. The implementation of this measure has an impact on the reduction of ammonia emissions, mainly due to the high volatility of ammonia

from urea fertilizers. Limiting the consumption of urea also avoids NOx emissions by reducing the total consumption of inorganic fertilizers in the resulting consumption summary. Detailed information on when the legislative framework should apply was not available, so an expert estimate was used. The reduction of urea had a gradual course, which is shown in ***Table 9.29.***

Table 9.29: *Limitation of urea consumption from 2025 to 2050 according to the WAM scenario*

YEAR OF IMPLEMENTATION	PERCENT OF UREA CONSUMPTION REDUCTION
2020-2025	The transition period, time to implement legislation
2026-2030	10 %
2031-2035	20 %
2036-2040	30 %
2041-2045	50 %
2046-2050	70 %

The Farm to Fork strategy was also considered in the WAM scenario. The Strategy aims to reduce the use of pesticides, fertilizers and antibiotics in agriculture and mitigate the environmental and climate footprint of the European food system. Within the WAM scenario, the goal of reducing the consumption of nitrogen fertilizers by 20% by 2030 was implemented. A transitional period was implemented in the emission projections, which is in line with the transitional period for limiting urea (2020-2025). It is probable that the Slovak Republic will negotiate its percentage reduction in fertilizer consumption and will claim a transitional period, which will also be enshrined in legislation. Following the legislative process, it will be necessary to adjust the emission projections in line with the future valid state strategy.

The WAM scenario also contains measures of increased processing of animal waste in biogas plants to produce biogas, which can be used as a local energy source. This measure included in the Low Carbon Strategy of the Slovak Republic does not contain details such as animal species, percentages of recovered waste and others that would provide measurable indicators potentially usable in the calculation of emission projections. As part of the preparation of emission projections, this information was additionally expertly estimated. For this analysis, it was considered that 10% of organic manure from cattle and pigs would be recovered in biogas plants. Cattle and pigs are key categories of animals with the highest emission recovery potential, the 10% potential was chosen as expert judgement. Biogas from stations is a promising source of renewable electricity and heat, which can be used at the local level. The decrease in emissions by 2050 in the WAM scenario compared to 1990 is at the level of -68% and then decreases by 39% compared to 2005.

$PM_{2.5}$ emissions

The agricultural $PM_{2.5}$ emissions have decreased trend from 2005 to 2020 due to a decrease in cropped areas of oat, barley and rye. Agriculture is an insignificant source of $PM_{2.5}$ emissions and no policies and measures are available

Table 9.30*: $PM_{2.5}$ emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
3B	0.15	0.13	0.12	0.10	0.10	0.10	0.10	0.10
3D	0.20	0.18	0.18	0.18	0.16	0.16	0.14	0.14
3 Agriculture	**0.35**	**0.31**	**0.30**	**0.28**	**0.26**	**0.26**	**0.24**	**0.24**

9.9 SECTORAL RESULTS – WASTE

Emissions from the Waste sector do not have a key impact on overall emissions. Projection emissions are estimated based on new calculations for GHG emissions projections in this sector. A significant share of total emissions is for NMVOC and NH_3 emissions.

NOx emissions

Table 9.31 *NOx emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

WAM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02

NMVOC emissions

Table 9.32: *NMVOC emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	1.51	1.01	0.98	1.01	0.91	0.81	0.58	0.45

WAM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	1.51	1.01	0.98	1.01	0.81	0.61	0.37	0.27

SOx emissions

Table 9.33: *SOx emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00

WAM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00

NH_3 emissions

Table 9.34: *NH_3 emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.91	0.77	0.58	0.45	0.43	0.44	0.47	0.49

WAM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.91	0.77	0.58	0.45	0.43	0.43	0.45	0.48

$PM_{2.5}$ emissions

Table 9.35: *$PM_{2.5}$ emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.17	0.20	0.21	0.19	0.18	0.18	0.17	0.17

WAM	2005	2010	2015	2020	2025	2030	2040	2050
5 Waste	0.17	0.20	0.21	0.19	0.18	0.17	0.17	0.17

CHAPTER 10: LARGE POINT SOURCES

Last update: 15.3.2021

10.1 METHODOLOGICAL ISSUES

After the NECD review in 2020, the old LPS methodology was revised following the recommendations of the TERT in "Final Review Report 2020".
All LPS represent E-PRTR facilities as defined in the EMEP reporting guidelines. Only the facilities reported to the E-PRTR with pollutant releases into the air over threshold values specified in Annex II to the E-PRTR Regulation are included. If the threshold value was exceeded for at least one pollutant, the non-zero emissions of other relevant pollutants were also included in the LPS.
Facilities in E-PRTR which have non-relevant pollutants only (in the view of NECD: GHGs, some heavy metals etc.) are not included in LPS.
Some LPS have more than one GNFR. The reason is that more activities can be performed in the facilities (the main activity and also secondary activities, which have a technical connection). For example, in large farms, in addition to animal husbandry, fuel combustion (breeding hall heating) sometimes occurs - in which case the emissions are divided into GNFR C_OtherStationaryComb and K_AgriLivestock.
Two separate databases were used for LPS processing:

- National PRTR
- NEIS (detailed specification in Annex IV)

The National PRTR contains only the total emissions of the facility, therefore the source of metadata was NEIS. NEIS has much more detailed records than National PRTR. Detailed information about the NEIS is described in IIR **ANNEX IV, Chapter A4.2 SYSTEM CHARACTERISTICS**.
The allocation of emissions into stack height categories also comes from the NEIS.
The data in the National PRTR (as well as E-PRTR) and the NEIS are consistent because the data reported to the NRZ by the operators are validated according to the NEIS.
Possible discrepancies between LPS (Annex VI) and CLRTAP data (Annex I):
Heavy metals, POPs, PCDD/PCDF, HCB, PCB

- Annex I: specific-sector calculation methodology for the CLRTAP report following the EMEP Guidebook
- Annex VI: various types of applied methodology (the data are based on the reporting obligation of individual operators). More information about applied quantification methodologies is written in IIR **ANNEX IV, Chapter A4.2 SYSTEM CHARACTERISTICS**.

Possible discrepancies between LPS (Annex VI) and E-PRTR data:
PM_{10}

- The emissions of PM_{10} are not reported in the E-PRTR. The operators are obliged to monitor only TSP emissions and not the individual fractions of PM.

Annex VI: Emissions are estimated by an internal algorithm considering the amount of TSP and the type of combustion plant or technology in the NEIS central database.

CHAPTER 11: NATIONAL GRIDDED EMISSIONS DATA

Last update: 15.3.2021

11.1 OVERVIEW

Convention on Long-Range Transboundary Air Pollution obliges countries to report gridded emissions and large point sources (LPS) data. Both datasets shall be reported every four years from 2017 onwards for the year x-2. This chapter includes basic information on data reported in the year 2017 for the year 2015.
Only data for the year 2015 is available in increased spatial resolution of the EMEP grid 0.1° x 0.1°. The data for previous years 1990, 1995, 2000, 2005 and 2010 was reported in submission in the year 2012.
In order to improve the quality of reporting Slovakia planned to report all milestone years in higher spatial resolution in the next report in May 2021.

11.2 METHODOLOGY AND DATA SOURCES FOR GRIDDED EMISSIONS

Gridded data were reported in line with the EMEP/EEA GB_{2016}, part Spatial mapping of emissions in GNFR categories. Emissions from inventory were spatially distributed using GIS methods. Gridded emissions for 2015 are consistent with reporting in 2017. LPS data were included within the submission of the gridded data. Gridded data were based on fuel sold methodology.

Table 11.1: *The basic methodology used in each GNFR sector*

GNFR SECTOR	THE PROXY USED FOR DISTRIBUTION OF NON-POINT SOURCES (PLEASE SPECIFY BY NFR CODE WHERE RELEVANT)
A_PublicPower	LPS and point sources are not included in LPS. Data from the National emission information system.
B_Industry	LPS data, Industry areas from Corine landcover.
C_OtherStatComb	Corine landcover - inhabited areas, information from census 2011 - a type of fuel for households, data from National emission information system, LPS
D_Fugitives	Five areas were identified as sources of Fugitive emissions - manually identification, LPS, population density map for distributing of NMVOC emissions from petrol stations
E_Solvents	Population density, Corine landcover
F_RoadTransport	Information about transport intensity
G_Shipping	Information from ports, and distribution to river lines
H_Aviation	Point sources - international and inland airports
I_OtherMobile	Railroads emissions – non-electrify railroads map and information from railway depots. Forest and agricultural offroads - Corine landcover. LPS - compressor stations
J_Waste	Population density, Corine landcover, LPS
K_AgriLivestock	Corine landcover
L_AgriOther	Corine landcover

Additional information based on questions in the NECD review 2020:
GNFR sector C_OtherStationaryComb
The most emissions in sector C_OtherStationaryComb comes from combustion in households for heating and hot water. Emissions from national inventory in the households sector were spatially distributed based on data from the census 2011 to inhabited areas from Corine landcover. Census 2011 was the source of information about fuels which is primarily used for heating (gas, solid, electricity, liquid). Spatially we have information on the level of small municipality units. We could calculate the share of fuel used in each unit. Data contain many gaps, but we were able to use it for spatial disaggregation of emissions.

The most significant contribution to $PM_{2.5}$ emissions is from firewood combustion in family houses. In urban areas, people use natural gas or a combination of natural gas and wood to a much greater extent than in rural areas. This caused emissions in rural areas to be significantly higher than in urban areas. It also depends on the region. The share of natural gas (NG) use is higher in the lowlands and in the western part of Slovakia. Also because NG is more expensive. This assumption was also shown by data from the 2011 census, but also by data from the 2018 household survey.

GNFR sectors K_AgriLivestock and L_AgriOther

For the distribution of NH_3 emissions was used tier 1 methodology was recommended in the EMEP guidebook chapter 7 spatial mapping. We used data from Corine land cover for arable land. And base on the area of arable land we distribute emissions to each cell.

11.3 PLANNED IMPROVEMENTS

Slovakia planned to improve the methodology and completeness of reporting in the next submission of gridded data in May 2021, with a focus on the key source categories.

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ANNEXES

ANNEX I: KEY CATEGORY ANALYSIS

Key categories were calculated on a detailed level for HMs and POPs in sectors of Energy, Industry and Waste. Uncertainty analysis was also included in the calculation for the first time. The tables below show the result of the analysis for the particular NFR categories.

Table A1.1: *Level assessment of the key categories analysis of air pollutants in the Slovak Republic in 2021 in %(cumulative total at least 80%)*

NOx	3Da1 (28)	1A3bi (11)	1A4cii (10)	3Da2a (5)	3Da3 (4)	1A3bii (4)	1A3c (3)	1A4di(ii) (2)	1A2f (2)	2C1 (2)		
NMVOC	1B2av (26)	1B2b (11)	1B1a (10)	1A4bi (10)	2H2 (8)	1B2ai (6)	3B1a (3)	3B1b (3)	2D3d (3)	1A3bv (2)		
SOx	2C1 (21)	2C3 (13)	1A1a (11)	1A1b (7)	2B10a (7)	1A2a (4)	2C7c (4)	1A4bi (4)	1A2f (3)	2A6 (2)	1A4ai (2)	1A2gviii (2)
NH_3	3Da2a (49)	3B4gii (9)	3Da3 (7)	3B1b (6)	3B1a (6)	3B3 (6)						
$PM_{2.5}$	1A4bi (59)	1A3bvi (3)	1A3bi (3)	3Dc (2)	1B1a (2)	3B1b (2)	1A3bvii (2)	1B1b (2)	3B1a (2)	1A4cii (2)	5E (1)	
PM_{10}	1A4bi (26)	3Dc (22)	2A5b (9)	1B1a (6)	3B4gii (4)	3B4gi (4)	1A3bvi (3)	1B1b (2)	3B3 (2)	1A3bvii (2)	3B1b (2)	
TSP	2A5b (16)	1A4bi (15)	3B4gi (11)	3Dc (10)	3B3 (8)	1B1a (8)	3B4gii (5)	1B1b (3)	1A3bvi (3)	1A3bvii (2)		
BC	1A4bi (44)	1A3bi (14)	1A4cii (6)	1A3bii (5)	2G (4)	1A2gviii (3)	1A3bvi (2)	1A3biii (2)				
CO	1A4bi (56)	2C1 (9)	1A4bii (8)	1A3bi (4)	1A2gvii (2)	1A1c (2)						
Pb	1A3bvi (46)	2C1 (25)	1B1b (7)	2G (6)								
Cd	1A4ai (26)	1A4bi (26)	2G (8)	1A2a (6)	2C1 (3)	1B2aiv (3)	1B1b (3)	1A5a (3)	1A3bvi (2)			
Hg	1A2f (25)	2K (18)	5C1bv (16)	1A2a (11)	1A2d (7)	1A3bi (5)						
As	2C1 (30)	1B1b (9)	1A2f (8)	1A2d (8)	1A3bvi (8)	1A4ai (5)	1B2aiv (4)	1A3di(ii) (3)	1A4bi (3)	1A2a (3)	1A1a (2)	
Cr	1A3bvi (44)	2C7a (18)	1A4ai (7)	2C1 (5)	1B1b (5)	1A4bi (4)						
Cu	1A3bvi (93)											
Ni	1A3di(ii) (36)	1A3dii (12)	1A3bvi (11)	2C1 (10)	1B1b (7)	1A2f (6)						
Se	2C1 (34)	1A2a (15)	1B1b (14)	1A1a (7)	1A2f (7)	1A3bvi (6)						
Zn	2D3i (41)	2C1 (25)	1A3bvi (17)									
PCDD/F	1A2f (79)	1A1b (8)										
PAHs	2C1 (55)	1B1b (22)	1A4bi (8)									
HCB	1A1a (56)	1A4bi (13)	2C1 (12)									
PCB	2C1 (71)	1A3c (8)	1A1a (7)									

Table A1.2: *Trend assessment of the key categories analysis with uncertainty of air pollutants in the Slovak Republic in 2021 in % (cumulative total at least 80%)*

NOx	1A4cii (16)	1A3biii (13)	3Da1 (11)	1A3bi (9)	1Agvii (6)	1A1a (5)	1A3dii (5)	1Adi(ii) (4)	1A3c (3)	1A3bii (2)	2C1(2)	1A4bi (2)	3Da2a (2)	1A2f (2)
NMVOC	1B2av (28)	1A4bi (24)	2H2 (9)	1A3bi (6)	3B1b (3)	1B1a (2)	1B2ai (2)	1A2gviii (2)	1B2b (2)	2D3d (1)	3B1a (1)			
SOx	1A1a (22)	1A4bi (20)	2C1 (13)	2C3 (10)	1A2d (6)	2B10a (5)	2C7c (3)	2A6 (2)	1A2f (2)					
NH_3	3Da2a (46)	3B3 (19)	3B1b (9)	3B4gii (7)										
$PM_{2.5}$	1A4bi(69)	1A3bvii (3)	1A1a (2)	3Dc (2)	1A3bvii (1)	1A3biii (1)	1A3bi (1)	1A2a (1)						
PM_{10}	1A4bi (44)	3Dc (17)	2A5b (8)	3B4gii (3)	1A3bvi (3)	1B1a (2)	1A3bvii (2)	1B1b (2)	1A1a (2)					
TSP	1A4bi (33)	2A5b (17)	3Dc (9)	3B4gi (5)	3B4gii (5)	1A3bvi (3)	1B1b (3)	3B3 (3)	1A3bvii (2)	1B1a (2)				
BC	1A4bi (54)	1A3biii (7)	1A3bi (7)	2G (4)	1A2gvii (3)	1A3bii (2)	1A4cii (2)	1A3bvi (2)						
CO	1A4bi (57)	1A3bi (9)	1A4cii (5)	1A4bii (5)	2C1 (4)									
Pb	1A3bi (29)	1A3bvi (21)	1A1a (14)	2C1 (15)										
Cd	1A1a (24)	1A4bi (18)	1A4ai (16)	2G (6)	2C7a (5)	1A2a (4)	1A2d (3)	1A5a (2)	2C1 (1)					
Hg	1A2f (17)	1A1a (14)	1A2a (14)	5C1bv (13)	2K (12)	1A2d (6)	1A3bi (4)							
As	1A1a (21)	2C1 (16)	1A4bi (9)	1A3bvi (6)	1A2d (6)	1A2f (5)	2C7a (4)	1B1b (4)	1A4ai (3)	1B2aiv (2)	1A3di(ii) (2)	1A2a (2)		
Cr	1A3bvi (31)	2C7a (19)	1A4bi (13)	1A1a (8)	1A4ai (6)	1A3biii (2)	2C1 (1)							
Cu	1A3bvi (54)	1A3biii (11)	2C1 (10)	1A3bi (8)										
Ni	1A3di(ii) (32)	1A1a (12)	1A3bvi (9)	1A3dii (8)	1A2f (5)	1B1b (5)	1A2a (4)	2C1 (3)	1A2d (3)					
Se	1A1a (33)	2C1 (23)	1A2a (11)	1B1b (7)	1A2f (4)	1A3bvi (4)								
Zn	2D3i (34)	1A3bvi (15)	2C1 (7)	1A3biii (6)	1A1a (4)	1A4ai (4)	1A4bi (3)	1A3biv (2)	1A3cii (2)					
PCDD/F	1A2f (75)	1B1b (6)												
PAHs	2C1 (49)	1A4bi (24)	1B1b (10)											
HCB	1A1a (51)	1A4bi (14)	2C1 (9)	5C1biii (5)	1A4ai (2)									
PCB	1A3c (51)	2C1 (22)	1A2c (4)	1A1a (3)										

Note: Different colours used to highlight sectors - 1, 2, 3, 5

ANNEX II: INCLUSION/EXCLUSION OF CONDENSABLE COMPONENT OF PARTICULATE MATTER IN EMISSION FACTORS

The table below shows individual NFR categories, which were balanced using emission factors that include/exclude condensable components of particulate matter. Green cells represent emission factors that include condensable components and purple cells that exclude condensable components. Grey cells represent categories with notation keys and blue cells categories are unknown in using the condensable component in emission factors of particulate matter.

Table A2.1: *Inclusion/exclusion of the condensable component from the PM_{10} and $PM_{2.5}$ emission factors*

	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
1A1a	Public electricity and heat production		X	Measured emissions
1A1b	Petroleum refining		X	Measured emissions
1A1c	Manufacture of solid fuels and other energy industries		X	Measured emissions
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel		X	Measured emissions
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals		X	Measured emissions
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals		X	Measured emissions
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print		X	Measured emissions
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco		X	Measured emissions
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals		X	Measured emissions
1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)			
1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)		X	Measured emissions
1A3ai(i)	International aviation LTO (civil)	X		Eurocontrol [1]
1A3aii(i)	Domestic aviation LTO (civil)	X		Eurocontrol
1A3bi	Road transport: Passenger cars			Unkown - Model Copert
1A3bii	Road transport: Light duty vehicles			Unkown - Model Copert
1A3biii	Road transport: Heavy duty vehicles and buses			Unkown - Model Copert
1A3biv	Road transport: Mopeds & motorcycles			Unkown - Model Copert
1A3bv	Road transport: Gasoline evaporation			Unkown - Model Copert
1A3bvi	Road transport: Automobile tyre and brake wear			Unkown - Model Copert
1A3bvii	Road transport: Automobile road abrasion			Unkown - Model Copert
1A3c	Railways		X	Halder (2005) [2]
1A3di(ii)	International inland waterways		X	Entec (2007) [3]
1A3dii	National navigation (shipping)		X	Entec (2007) [3]
1A3ei	Pipeline transport		X	Measured emissions
1A3eii	Other (please specify in the IIR)			
1A4ai	Commercial/institutional: Stationary		X	Measured emissions
1A4aii	Commercial/institutional: Mobile			
1A4bi	Residential: Stationary	X		Life project
1A4bii	Residential: Household and gardening (mobile)			
1A4ci	Agariculture/Forestry/Fishing: Stationary		X	Measured emissions
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	X		EEA/EMEP GB$_{2023}$
1A4ciii	Agriculture/Forestry/Fishing: National fishing			
1A5a	Other stationary (including military)		X	Measured emissions
1A5b	Other, Mobile (including military, land based and recreational boats)	X		EEA/EMEP GB$_{2023}$

	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
1B1a	Fugitive emission from solid fuels: Coal mining and handling		X	EPA (1998) [4]
1B1b	Fugitive emission from solid fuels: Solid fuel transformation		X	EPA (1998) [4]
1B1c	Other fugitive emissions from solid fuels			
1B2ai	Fugitive emissions oil: Exploration, production, transport			
1B2aiv	Fugitive emissions oil: Refining / storage			
1B2av	Distribution of oil products			
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)			
1B2c	Venting and flaring (oil, gas, combined oil and gas)			
1B2d	Other fugitive emissions from energy production			
2A1	Cement production		X	Measured emissions
2A2	Lime production		X	Measured emissions
2A3	Glass production		X	Measured emissions
2A5a	Quarrying and mining of minerals other than coal		X	Measured emissions
2A5b	Construction and demolition		X	Wrap (2006) [5]
2A5c	Storage, handling and transport of mineral products			
2A6	Other mineral products (please specify in the IIR)		X	Measured emissions
2B1	Ammonia production			
2B2	Nitric acid production			
2B3	Adipic acid production			
2B5	Carbide production		X	Measured emissions
2B6	Titanium dioxide production			
2B7	Soda ash production			
2B10a	Chemical industry: Other (please specify in the IIR)		X	Measured emissions
2B10b	Storage, handling and transport of chemical products (please specify in the IIR)		X	Measured emissions
2C1	Iron and steel production		X	Measured emissions
2C2	Ferroalloys production		X	Measured emissions
2C3	Aluminium production			
2C4	Magnesium production		X	Measured emissions
2C5	Lead production		X	Measured emissions
2C6	Zinc production			
2C7a	Copper production			
2C7b	Nickel production			
2C7c	Other metal production (please specify in the IIR)		X	Measured emissions
2C7d	Storage, handling and transport of metal products (please specify in the IIR)			
2D3a	Domestic solvent use including fungicides			
2D3b	Road paving with asphalt		X	Measured emissions
2D3c	Asphalt roofing			
2D3d	Coating applications			
2D3e	Degreasing			
2D3f	Dry cleaning			
2D3g	Chemical products			
2D3h	Printing			
2D3i	Other solvent use (please specify in the IIR)			
2G	Other product use (please specify in the IIR)	X*		Schauer et al. (1998)[5]

	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
2H1	Pulp and paper industry		X	Measured emissions
2H2	Food and beverages industry			
2H3	Other industrial processes (please specify in the IIR)		X	Measured emissions
2I	Wood processing		X	Measured emissions
2J	Production of POPs		X	Measured emissions
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)			
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)			
3B1a	Manure management - Dairy cattle		X	
3B1b	Manure management - Non-dairy cattle		X	
3B2	Manure management - Sheep		X	
3B3	Manure management - Swine			
3B4a	Manure management - Buffalo		X	
3B4d	Manure management – Goats		X	
3B4e	Manure management - Horses		X	
3B4f	Manure management - Mules and asses			
3B4gi	Manure management - Laying hens		X	
3B4gii	Manure management - Broilers		X	
3B4giii	Manure management - Turkeys		X	
3B4giv	Manure management - Other poultry		X	
3B4h	Manure management - Other animals (please specify in IIR)			
3Da1	Inorganic N-fertilizers (includes also urea application)			
3Da2a	Animal manure applied to soils			
3Da2b	Sewage sludge applied to soils			
3Da2c	Other organic fertilisers applied to soils (including compost)			
3Da3	Urine and dung deposited by grazing animals			
3Da4	Crop residues applied to soils			
3Db	Indirect emissions from managed soils			
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products		X	EEA/EMEP GB$_{2023}$
3Dd	Off-farm storage, handling and transport of bulk agricultural products			
3De	Cultivated crops			
3Df	Use of pesticides			
3F	Field burning of agricultural residues			
3I	Agriculture other (please specify in the IIR)			
5A	Biological treatment of waste - Solid waste disposal on land		X	
5B1	Biological treatment of waste - Composting		X	
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities			
5C1a	Municipal waste incineration			
5C1bi	Industrial waste incineration		X	US EPA (1996) [6]
5C1bii	Hazardous waste incineration			
5C1biii	Clinical waste incineration			
5C1biv	Sewage sludge incineration			
5C1bv	Cremation			Unknown

	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
5C1bvi	Other waste incineration (please specify in the IIR)			
5C2	Open burning of waste			
5D1	Domestic wastewater handling			
5D2	Industrial wastewater handling			
5D3	Other wastewater handling			
5E	Other waste (please specify in IIR)			
6A	Other (included in national total for entire territory) (please specify in IIR)			

*for tobacco combustion, for fireworks use unknown

Note:

[1] Kugele A., Jelinek F., Gaffal R. (2005): Aircraft Particulate Matter Emission - Estimation through all Phases of Flight

[2] Halder M., Löchter, A. (2005): Status and future development of the diesel fleet'. Rail diesel study, WP1 final report

[3] Entec UK Limited (2007) Ship Emissions Inventory – Mediterranean Sea, Final Report for Concawe

[4] US EPA (1998). AP42, Compilation of air pollutant emission factors, Vol. 1: Stationary point and area sources, fifth edition, Vol. 1, chapter 11.9 Western surface coal mining

[5] Wrap (2006): Fugitive Dust Handbook, Chapter 3. Construction and Demolition, Western Regional Air Partnership (WRAP)

[6] US EPA (1996). Compilation of Air Pollutant Emission Factors Vol.1. Stationary, Point and Area Sources. Report AP-42 (5th ed.).

ANNEX III: ENERGY BALANCE OF THE SLOVAK REPUBLIC

Table A3.1: *Energy balance of the Slovak Republic in 2022 in TJ*

	Anthra-cite	*Coking Coal*	*Other Bituminous Coal*	*Brown Coal and Lignite*	*Hard Coal Coke*	*Brown Coal and Peat Briquettes*	*Patent Fuel*	*Coal Tar*	*Coke Oven Gas*	*Blast Furnace Gas*	*Oxygen Steel Furnace Gas*
Primary Production	-	-	-	9 620	-	-	-	-	-	-	-
Import	2 284	69 590	13 720	5 468	4 556	1 105	112	-	-	-	-
Export	-	-	-	-	534	-	-	1 909	-	-	-
Stock Changes	51	-529	-365	-188	-3 656	-	-	-	-	-	-
Gross Inland Consumption	**2 335**	**69 061**	**13 355**	**14 900**	**366**	**1 105**	**112**	**-1 909**	**-**	**-**	**-**
Transformation Input	**744**	**69 061**	**5 686**	**14 016**	**38 642**	**-**	**-**	**-**	**929**	**1 105**	**314**
Electricity Production - Thermal Equipment	744	-	5 686	13 983	-	-	-	-	929	1 098	299
of which: Public	744	-	4 017	13 983	-	-	-	-	-	-	-
Autoproducers	-	-	1 669	-	-	-	-	-	929	1 098	299
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	56 831	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	12 230	-	-	38 614	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	33	28	-	-	-	-	7	15
Transformation Output	**-**	**-**	**-**	**-**	**41 426**	**-**	**-**	**1 909**	**10 539**	**17 056**	**2 710**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	41 426	-	-	1 909	10 539	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	17 056	2 710
Refineries	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Product Transferred	-	-	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3 266**	**5 847**	**-**
Distribution Losses	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**107**	**1 139**	**375**

1st continuation

	Anthra-cite	*Coking Coal*	*Other Bituminous Coal*	*Brown Coal and Lignite*	*Hard Coal Coke*	*Brown Coal and Peat Briquettes*	*Patent Fuel*	*Coal Tar*	*Coke Oven Gas*	*Blast Furnace Gas*	*Oxygen Steel Furnace Gas*
Final Consumption	**1 591**	**-**	**7 669**	**884**	**3 150**	**1 105**	**112**	**-**	**6 237**	**8 965**	**2 021**
Final Non - Energy Consumption	**1 001**	**-**	**-**	**-**	**731**	**-**	**-**	**-**	**-**	**-**	**-**
of which: Chemical Industry	**-**	**-**	-	-	-	-	-	-	-	-	-
Final Energy Consumption	**590**	**-**	**7 669**	**884**	**2 419**	**1 105**	**112**	**-**	**6 237**	**8 965**	**2 021**
Industry	**590**	**-**	**6 756**	**110**	**1 435**	**-**	**-**	**-**	**6 237**	**8 965**	**2 021**
of which: Iron and steel	539	-	5 608	-	366	-	-	-	6 233	8 965	2 021
Non - ferrous metals	-	-	-	-	84	-	-	-	-	-	-
Chemical	-	-	-	-	28	-	-	-	-	-	-
Non - metallic minerals	51	-	1 148	55	873	-	-	-	4	-	-
Mining and quarrying	-	-	-	-	-	-	-	-	-	-	-
Food, beverages and tobacco	-	-	-	-	84	-	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	-	-	-	-	-	-	-	-	-
Mach. and transport equipment	-	-	-	55	-	-	-	-	-	-	-
Not elsewhere specified	-	-	-	-	-	-	-	-	-	-	-
Transport	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Other Sectors	**-**	**-**	**913**	**774**	**984**	**1 105**	**112**	**-**	**-**	**-**	**-**
of which: Households	-	-	652	697	56	710	-	-	-	-	-
Agriculture	-	-	-	11	-	-	-	-	-	-	-
Commercial and public services	-	-	261	66	928	395	112	-	-	-	-

2nd continuation

	Natural Gas	*Crude Oil and NGL*	*Refinery Feedstock*[1/]	*Refinery Gas*	*LPG*	*Naphta*	*Gasoline*	*Kerosene*
Primary Production	1 943	126	7 895	-	-	-	-	-
Import	217 948	229 283	175	-	2 530	3 212	7 511	346
Export	-	84	-	-	598	572	38 126	2 165
Stock Changes	-61 136	-2 688	-	-	46	-308	747	-
Gross Inland Consumption	**158 755**	**226 637**	**8 070**	**-**	**1 978**	**2 332**	**-29 868**	**-1 819**
Transformation Input	**29 640**	**226 637**	**30 464**	**84**	**-**	**-**	**-**	**-**
Electricity Production - Thermal Equipment	21 559	-	-	84	-	-	-	-
of which: Public	20 538	-	-	-	-	-	-	-
Autoproducers	1 021	-	-	84	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	226 637	30 464	-	-	-	-	-
Heat Production	8 081	-	-	-	-	-	-	-
Transformation Output	**-**	**-**	**-**	**14 787**	**5 612**	**19 360**	**54 949**	**3 248**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	-	-	14 787	5 612	19 360	54 949	3 248
Heat Production	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-6 355**	**-**	**22 394**	**-**	**-2 438**	**-5 324**	**-**	**-**
Product Transferred	-6 355	-	14 632	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	7 762	-	-2 438	-5 324	-	-
Consumption of the Energy Sector	**3 675**	**-**	**-**	**11 299**	**-**	**-**	**-**	**-**
Distribution Losses	**3 314**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

3rd continuation

	Natural Gas	*Crude Oil and NGL*	*Refinery Feedstock[1/]*	*Refinery Gas*	*LPG*	*Naphta*	*Gasoline*	*Kerosene*
Final Consumption	**115 425**	**-**	**-**	**3 404**	**5 152**	**16 368**	**25 081**	**1 429**
Final Non - Energy Consumption	**13 622**	**-**	**-**	**-**	**2 622**	**16 368**	**-**	**-**
of which: Chemical Industry	13 622	-	-	-	2 622	16 368	-	-
Final Energy Consumption	**101 803**	**-**	**-**	**3 404**	**2 530**	**-**	**25 081**	**1 429**
Industry	**32 089**	**-**	**-**	**3 404**	**276**	**-**	**44**	**-**
of which: Iron and steel	5 629	-	-	-	-	-	-	-
Non - ferrous metals	1 283	-	-	-	46	-	-	-
Chemical	3 720	-	-	3 404	46	-	-	-
Non - metallic minerals	4 495	-	-	-	92	-	-	-
Mining and quarrying	1 358	-	-	-	-	-	-	-
Food, beverages and tobacco	4 200	-	-	-	46	-	-	-
Textile and leather	440	-	-	-	-	-	-	-
Pulp, paper and print	1 401	-	-	-	-	-	-	-
Mach. and transport equipment	5 995	-	-	-	46	-	44	-
Not elsewhere specified	3 568	-	-	-	-	-	-	-
Transport	**339**	**-**	**-**	**-**	**1 564**	**-**	**25 037**	**1429**
Other Sectors	**69 375**	**-**	**-**	**-**	**690**	**-**	**-**	**-**
of which: Households	46 376	-	-	-	322	-	-	-
Agriculture	1 319	-	-	-	184	-	-	-
Commercial and public services	21 680	-	-	-	184	-	-	-

1/ include Additives, Oxygenates and Other Hydrocarbons

4th continuation

	Diesel Oil	*Light Fuel Oil*	*Heavy Fuel Oil - Low Sulphur (<1%)*	*Heavy Fuel Oil - High Sulphur (>=1%)*	*White Spirit SBP*	*Lubricants*	*Bitumens*	*Paraffin Waxes*	*Petroleum Coke*	*Other Products*
Primary Production	-	-	-	-	-	-	-	-	-	-
Import	36 466	1 746	525	2 949	516	2 297	7 155	173	2 962	3 088
Export	66 152	1 381	4 242	7 837	387	376	683	-	-	14 891
Stock Changes	-2 695	-41	-323	121	-	-	-	-	103	254
Gross Inland Consumption	**-32 381**	**324**	**-4 040**	**-4 767**	**129**	**1 921**	**6 472**	**173**	**3 065**	**-11 549**
Transformation Input	**42**	-	**81**	**3 353**	**-**	**-**	**-**	**-**	**-**	**-**
Electricity Production - Thermal Equipment	42	-	81	3 353	-	-	-	-	-	-
of which: Public	-	-	81	-	-	-	-	-	-	-
Autoproducers	42	-	-	3 353	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-
Transformation Output	**117 692**	**528**	**4 121**	**15 352**	**-**	**-**	**-**	**-**	**1 997**	**14 172**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	117 692	528	4 121	15 352	-	-	-	-	1 997	14 172
Heat Production	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Product Transferred	-	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1 997**	**-**
Distribution Losses	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

5th continuation

	Diesel Oil	*Light Fuel Oil*	*Heavy Fuel Oil - Low Sulphur (<1%)*	*Heavy Fuel Oil - High Sulphur (>=1%)*	*White Spirit SBP*	*Lubricants*	*Bitumens*	*Paraffin Waxes*	*Petroleum Coke*	*Other Products*
Final Consumption	**85 269**	**852**	**-**	**7 232**	**129**	**1 921**	**6 472**	**173**	**3 065**	**2 623**
Final Non - Energy Consumption	**-**	**690**	**-**	**-**	**129**	**1 921**	**6 472**	**173**	**930**	**2 623**
of which: Chemical Industry	-	690	-	-	-	-	-	-	-	2 623
Final Energy Consumption	**85 269**	**162**	**-**	**7 232**	**-**	**-**	**-**	**-**	**2 135**	**-**
Industry	**379**	**-**	**-**	**7 232**	**-**	**-**	**-**	**-**	**2 135**	**-**
of which: Iron and steel	-	-	-	-	-	-	-	-	-	-
Non - ferrous metals	-	-	-	-	-	-	-	-	-	-
Chemical	-	-	-	7 232	-	-	-	-	-	-
Non - metallic minerals	-	-	-	-	-	-	-	-	2 135	-
Mining and quarrying	84	-	-	-	-	-	-	-	-	-
Food, beverages and tobacco	42	-	-	-	-	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	-	-	-	-	-	-	-	-
Mach. and transport equipment	-	-	-	-	-	-	-	-	-	-
Not elsewhere specified	253	-	-	-	-	-	-	-	-	-
Transport	**82 911**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Other Sectors	**1 979**	**162**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
of which: Households	-	-	-	-	-	-	-	-	-	-
Agriculture	1 979	-	-	-	-	-	-	-	-	-
Commercial and public services	-	162	-	-	-	-	-	-	-	-

6th continuation

	Nuclear Heat	*Solar Heat*	*Geo-thermal Heat*	*Ambient heat*	*Heat*	*Wood and Charcoal*	*Municipal Solid Wastes*	*Biogas*	*Industrial Wastes*	*Wind energy*	*Hydro Energy*	*Solar Electricity*	*Electricity*	*Liquid Biofuels*	*Total*
Primary Production	166 072	384	378	3 582	-	57 906	2 576	4 295	8 141	14	13 241	2 340	-	7 408	285 921
Import	-	-	-	-	65	205	-	-	218	-	-	-	60 275	5 498	681 978
Export	-	-	-	-	-	590	-	-	-	-	-	-	55 192	4 633	200 352
Stock Changes	-	-	-	-	-	-463	-	-	-51	-	-	-	-	4	-71 117
Gross Inland Consumption	**166 072**	**384**	**378**	**3 582**	**65**	**57 058**	**2 576**	**4 295**	**8 308**	**14**	13 241	2 340	**5 083**	**8 277**	**696 430**
Transformation Input	**164 236**	**-**	**348**	**-**	**-**	**17 629**	**1 803**	**3 474**	**701**	**-**	**-**	**-**	**-**	**-**	**608 989**
Electricity Production - Thermal Equipment	-	-	-	-	-	14 809	1 803	3 403	500	-	-	-	-	-	68 373
of which: Public	-	-	-	-	-	8 265	-	1 122	500	-	-	-	-	-	49 250
Autoproducers	-	-	-	-	-	6 544	1 803	2 281	-	-	-	-	-	-	19 123
Nuclear Plants	164 236	-	-	-	-	-	-	-	-	-	-	-	-	-	164 236
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56 831
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50 844
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257 101
Heat Production	-	-	348	-	-	2 820	-	71	201	-	-	-	-	-	11 604
Transformation Output	**-**	**-**	**-**	**-**	**26 852**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**79 996**	**-**	**432 306**
Electricity Production - Thermal Equipment	-	-	-	-	16 804	-	-	-	-	-	-	-	22 684	-	39 488
of which: Public	-	-	-	-	14 831	-	-	-	-	-	-	-	13 648	-	28 479
Autoproducers	-	-	-	-	1 973	-	-	-	-	-	-	-	9 036	-	11 009
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-	-	57 312	-	57 312
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53 874
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19 766
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	251 818
Heat Production	-	-	-	-	10 048	-	-	-	-	-	-	-	-	-	10 048
Exchanges and Transfers, Backflows	**-1 836**	**-2**	**-**	**-3 582**	**5 420**	**-**	**-**	**-**	**-**	**-14**	-13 241	**-2 340**	**15 595**	**-8 277**	**0**
Product Transferred	-1 836	-2	-	-3 582	-5 420	-	-	-	-	-14	-13 241	-2 340	15 595	-8 277	0
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Consumption of the Energy Sector	**-**	**2**	**-**	**-**	**3 103**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**13 585**	**-**	**42 774**
Distribution Losses	**-**	**-**	**-**	**-**	**3 262**	**30**	**-**	**-**	**-**	**-**	**-**	**-**	**4 756**	**-**	**12 983**

End of table

	Nuclear Heat	*Solar Heat*	*Geo-thermal Heat*	*Ambient heat*	*Heat*	*Wood and Charcoal*	*Municipal Solid Wastes*	*Biogas*	*Industrial Wastes*	*Wind energy*	*Hydro Energy*	*Solar Electricity*	*Electricity*	*Liquid Biofuels*	*Total*
Final Non - Energy Consumption	**-**	**380**	**30**	**-**	**25 972**	**39 399**	**773**	**821**	**7 607**	**-**	**-**	**-**	**82 333**	**-**	**463 644**
of which: Chemical Industry	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	0	**-**	**47 282**
Final Energy Consumption	**-**	**-**	**-**	**-**	-	**-**	**-**	-	-	-	-	-	0	**-**	35 925
Industry	**-**	**380**	**30**	**-**	**25 972**	**39 399**	**773**	**821**	**7 607**	**-**	**-**	**-**	**82 333**	**-**	**416 362**
of which: Iron and steel	**-**	**-**	**-**	**-**	**2 723**	**13 859**	**-**	**8**	**7 607**	**-**	**-**	**-**	**35 729**	**-**	**131 599**
Non - ferrous metals	-	-	-	-	30	123	-	-	-	-	-	-	6 181	**-**	35 695
Chemical	-	-	-	-	82	-	-	-	-	-	-	-	4 586	**-**	6 081
Non - metallic minerals	-	-	-	-	391	8	-	-	957	-	-	-	2 581	**-**	18 367
Mining and quarrying	-	-	-	-	186	43	-	-	6 584	-	-	-	2 682	**-**	18 348
Food, beverages and tobacco	-	-	-	-	2	-	-	-	-	-	-	-	166	**-**	1 610
Textile and leather	-	-	-	-	229	186	-	7	-	-	-	-	2 002	**-**	6 796
Pulp, paper and print	-	-	-	-	30	1	-	-	-	-	-	-	511	-	982
Mach. and transport equipment	-	-	-	-	1167	11 592	-	1	-	-	-	-	3 355	-	17 516
Not elsewhere specified	-	-	-	-	374	361	-	-	66	-	-	-	9 187	-	16 128
Transport	-	-	-	-	232	1 545	-	-	-	-	-	-	4 478	-	10 076
Other Sectors	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2 401**	-	**113 681**
of which: Households	**-**	**380**	**30**	**-**	**23 249**	**25 540**	**773**	**813**	**-**	**-**	**-**	**-**	**44 203**	-	**171 082**
Agriculture	-	342	-	-	17 196	24 919	-	-	-	-	-	-	21 208	-	112 478
Commercial and public services	-	-	30	-	68	345	-	548	-	-	-	-	706	-	5 190
Obchod a služby	-	38	-	-	5 985	276	773	265	-	-	-	-	22 289	-	53 414

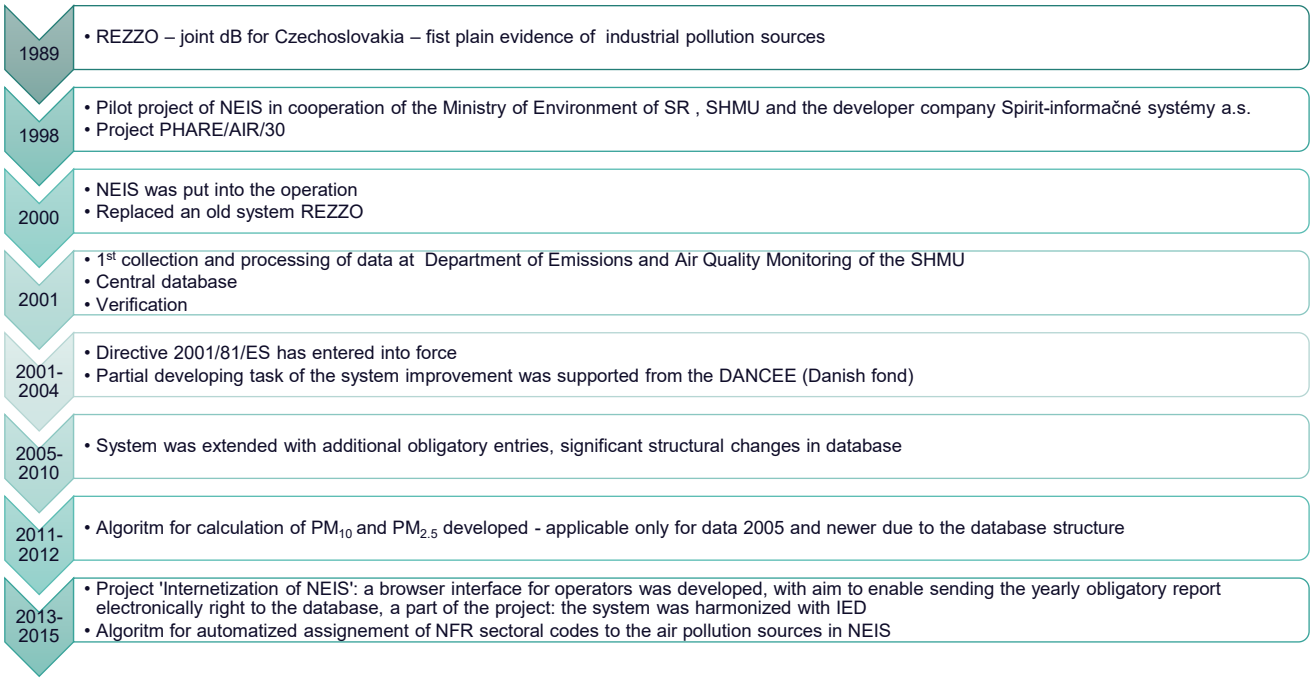
ANNEX IV: ADDITIONAL INFORMATION ON METHODOLOGY

ANNEX IV includes additional information on the methodology used in the NEIS database.

NEIS database is the National Emission Information System for air pollutants (NO_X, SOX, NMVOC, NH3, HM and TSP). Information System NEIS was established in 1998. The database was developed to fulfil the national legislation in air quality and the requirements for pollutants fees decisions (Act No 401/1998 on air pollution charges as amended). Since 2000, when the NEIS was set into operation, the emissions are directly collected consistently and verified on more levels. This database replaced an old system REZZO (Emission and Air Pollution Source Inventory). The first collection and processing of data by NEIS were realized in 2001. The Department of Emissions and Biofuels of the SHMÚ is in charge of the processing of final data in the central database. The following scheme represents the formation of the database in time with important dates.

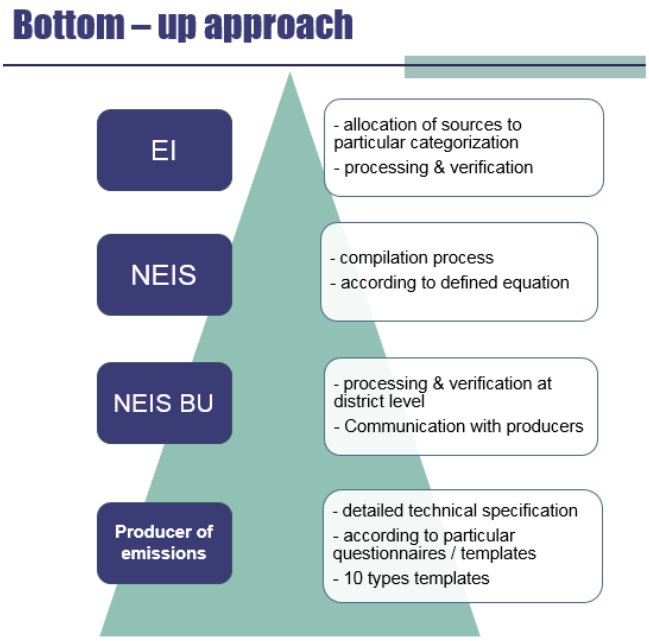
The last changes within the improvement of the NEIS were carried out from December 2013 until August 2015. Within the scope of the recent Project 'Internetization of NEIS, a browser interface was developed. The aim was to enable sending the yearly obligatory report electronically right to the database NEIS PZ WEB. The module NEIS BU on district offices is connected to this database and data is synchronized.

Figure A4.1: *Milestones in the development NEIS database*



The emissions of air pollutants (NOx, SOx, NMVOC, NH_3, TSP, PMs and HM) are recorded and calculated on yearly basis in the NEIS database. The data collection of air pollutants and emission inventory preparation is performed by a standardized procedure. For the international emission inventory requirements, the bottom-up approach has been introduced for the basic pollutants

Figure A4.2: Scheme of bottom-up approach built-in database NEIS



A4.1 DATA COLLECTION

Annual data is collected from energy and industry sources following Act on air protection No 137/2010 Coll. as amended and related regulations. The collection of annual activity data is performed through the 10 types of questionnaires (forms), where specific data is required from operators and recorded in the NEIS. In the following table is presented the complete list of forms with the name and content of surveyed data. Forms 1-5 require identification data of operators, a sum of emissions and fees for the operator and individual sources of an operator in each district, data on calculation of fees and data on quality and parameters of combusted fuels and waste. The data has to be updated annually. Forms 6 – 10 require relatively steady data. Data is updated if the change has been made (for instance reconstruction of source, change of technology, change in source categorization and the size of source etc.).

All annual sets of input data involving fuel amounts (according to the types, and quality marks) necessary for the emission balance are obtained from the district offices using the NEIS BU module. Activity data collected in the NEIS central database are allocated according to the NFR categorization for solid, liquid, gaseous fuels, biomass and other fuels. The emissions balances of air pollutants in the range from 2000–2021 were processed in the NEIS CU module by the same way of calculation.

Table A4.1: Overview of data forms required from operators of air pollution sources

FORM TYPE	NAME	CONTENT
T1	Operator of the air pollution sources	Annual data on emissions and fees
T2	Air pollution source (APS)	Annual data on source - parameters
T3	Combustion parts of APS combusting fuels/waste	Annual data on emissions and fee calculation
T3a	Technological parts of APS combusting fuels/waste - direct process heating	Annual data on emissions and fee calculation
T4	Technological parts of source including surface and fugitive emissions	Annual data on emissions and conditions of fee calculation
T4a	Technological parts of source	Calculations of ammonia in livestock farming
T4b	Technological parts of source	Calculations for storage and handling of organic liquids
T4c	Balance sheet of organic solvents	Annual data on emissions and conditions of fee calculation
T5	Fuels and combusted waste	Annual data on amounts and parameters of fuels
T5a	Fuels in LCP	Annual data on amounts and parameters of fuels

FORM TYPE	NAME	CONTENT
T6	Source of air pollution	Steady data about the source
T7	Location of discharge and release of AP	Base data on stacks, exhausts and defined area
T8	Energy facility - combustion unit	Technical parameters
T9	Technological parts of APS	Base data on technological lines except the direct contact of flue gas with heating medium
T9a	Technological parts of APS	Facility using the organic solvents
T9b	Technological parts of APS	Refuelling gas station
T9c	Technological parts of APS	Distribution storages of gasoline
T9d	Technological parts of APS	Waste incinerations and co-incineration plants
T9e	Technological parts of APS combusting fuels/waste - direct process heating	Technological parts where flue gas is used for direct process heating and drying - technical parameters
T10	Abatement technologies	Base data for energy and technological parts of air pollution sources
-	Fuel sellers	data on fuel sold

A4.2 SYSTEM CHARACTERISTICS

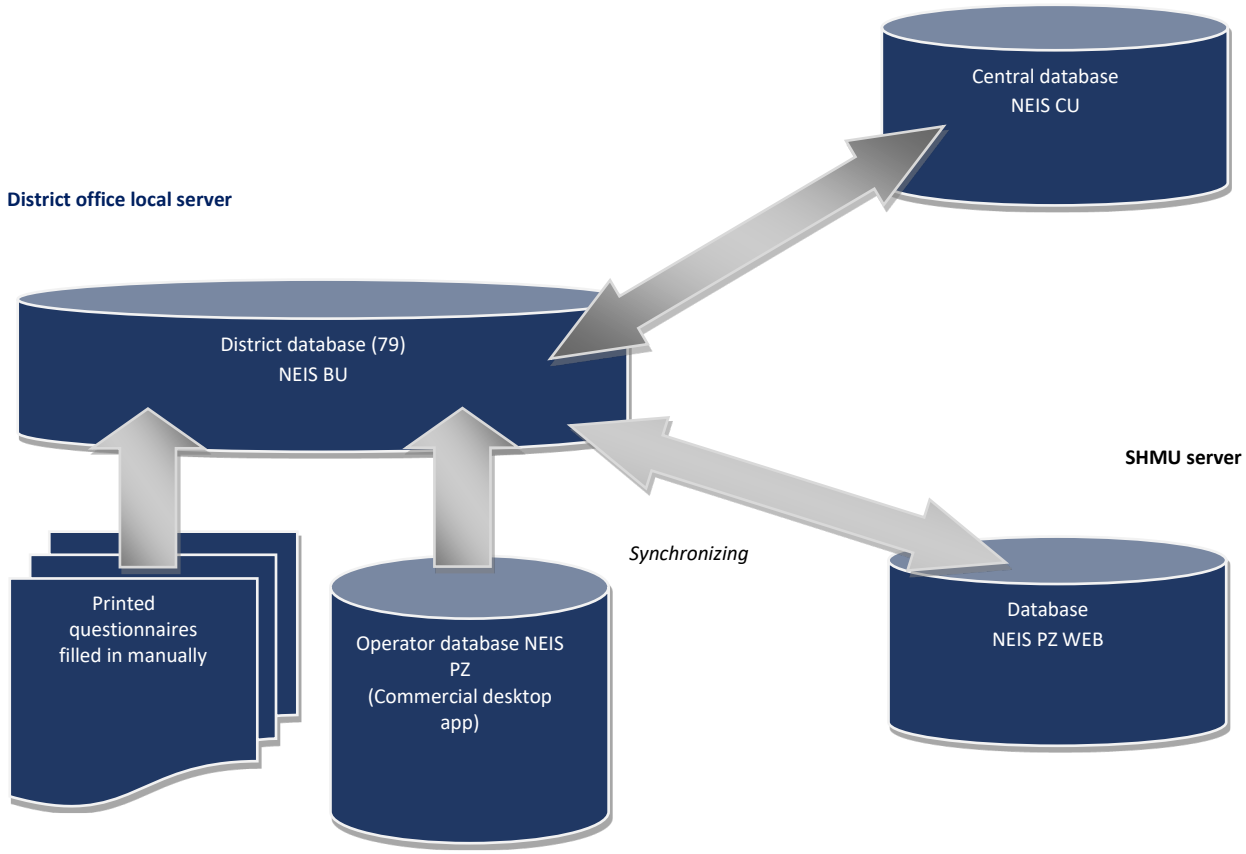
Database NEIS includes about 13000 sources of air pollution per year. The sources are categorized by activity and projected capacity as large or medium (Decree No 410/2012 Coll.) as follow:

- Large sources:
  - Technological units containing combustion plants having a total rated thermal input of more than 50 MW and other technological units with a capacity above the defined limit
- Medium sources:
  - Technological units containing combustion plants having total rated thermal input between 0.3 – 50 MW and other technological units with a capacity under the defined limit for the large sources but over the defined limit for the medium sources

Operators of large and medium sources are obliged to annually report specific datasets about the operation (e.g. quantity of emissions and calculation of the air pollution fee). The reported data is gathered in NEIS. Sources below the relevant projected capacity are defined as small and these are not included individually in this system. However, the emission balance of small sources is being processed at the district level.

Emissions are summarized on the level of the sources releasing pollutants into the air. The term ‘source’ is defined in the national Act No 137/2010 as a stationary technological unit (including storage of fuels, raw materials or products, quarries and other areas or objects), plant or activity, which is polluting or can pollute the air; delimited is as a functional and spatial complexity of all plants and activities. In some cases, this definition overlaps the definition of the ‘installation’ in IED, but mainly ‘source’ is a part of the ‘installation’. Another IED term ‘plant’ is also mainly a part of the ‘source’ or identical to it.

Figure A4.3: *The scheme of the connection of individual databased in NEIS*



Each source can contain one or more combustion plants and/or one or more technology. The quantifying of the yearly emissions is executed on the plant/technology level. The applicable methods for the quantifying are enacted in Decree No 411/2012 on emission monitoring in stationary sources of air pollution:

- prescribed technical balance approach,
- explicit emission-dependence approach,
- continuous measurement,
- calculation using representative individual emission factor or representative individual mass flow,
- calculation using emission factor evaluated by periodic measurement,
- calculation using mass flow or mass concentration evaluated by periodic measurement,
- general emission-dependence approach,
- default emission factor approach[1],
- calculation using an emission-dependence approach or EF published in technical standards, directives, guidelines or another official document of a competent authority, EU and related organizations,
- other suitable approaches to filling given requirements,
- combination of previous approaches.

Possibly activity data is the operation hours, fuel consumption, volume of the waste gases, amount of produced energy or other relevant product.

Due to the NFR sectoral code changes, it was necessary to recalculate the accessible timeline. Revision of all sources expected the development of the methodology for automatized re-assignment of sectoral codes to the individual sources. The accessible timeline in NEIS (2000-2020) was revised: emissions from individual air pollution sources were reallocated according to revised sectoral codes.

[1] General relations, as well as default EF, are published in Bulletin of the Ministry of the Environment No 410/2012 Coll.

The methodology for automatized re-assignment is based on the following key data:

- Air pollution source category (Decree No 410/2012 Coll.)
- SK NACE rev.2 code of the operator

The developed algorithm checks the key data, compare this with the assignment rules and due to the result executes the assignment of the relevant NFR sectoral code. The procedure is iterated for every source record in the chosen year. It is also possible to add an exception.

- Small sources:
  - Stationary equipment – domestic heating equipment for the combustion of solid fuels and natural gas with a total rated thermal input of less than 0.3 MW

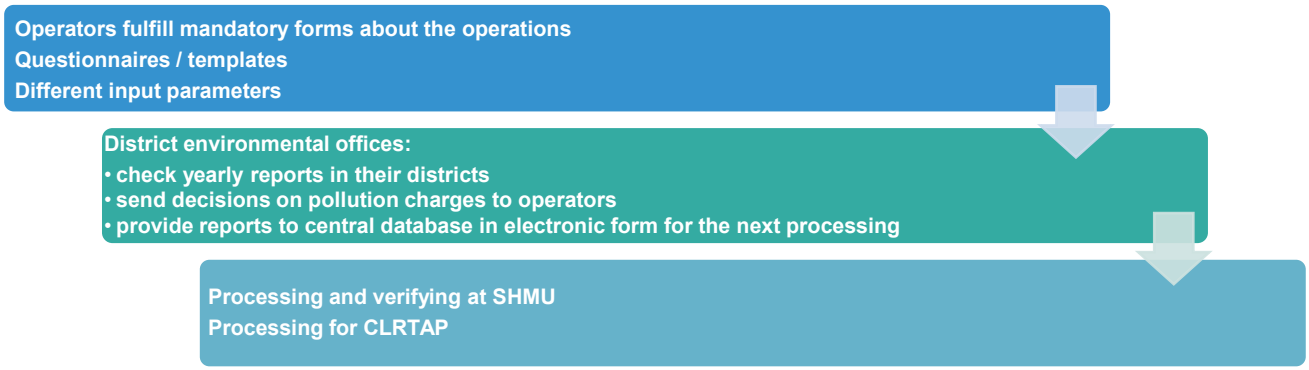
The sources below 0.3 MW (category **1A4bi** – Residential: Stationary plants) are defined as small sources. These are not registered as individual point sources. The emission balance is being processed centrally (NEIS CU - central unit) and it is based on:

- Solid fossil fuels sold (data on district level) for the operator of fuel combustion plants with RTI up to 0,3 MW (households)
  - in 2001–2003 according to Decree No 144/2000
  - in 2004–2009 according to Decree No 53/2004
  - since 2010 according to Decree No 362/2010
  - Consumption of natural gas for the inhabitants and the annual market share on the gas sale in SR
  - Consumption of electric energy in the households
  - Annually specified emission factor

A4.3 DATAFLOW AND PROCESSING

According to Act No 137/2010 Coll. as amended by Act No 318/2012 Coll. operators of large and medium sources are obliged to annually report specific datasets about the operation. The main data is the amount of released emissions, the pollutant fee and fuel consumption. The dataset contains also the amount of various metadata. This reporting obligation since 1/2016 can be fulfilled by using the browser-interfaced tool NEIS PZ WEB, which was developed for the operators as a result of the project 'Internetization of the National emission information system'. Data from operators are collected and verified by the district offices using the SW module NEIS BU. District environmental offices are obliged to prepare the annual dataset containing operational characteristics of air pollution sources in their districts and provide this to the SHMÚ central database in the specified format (79 district databases) for the next processing.

Figure A4.4: *Scheme of the process of emissions inventory compilation using the NEIS database*



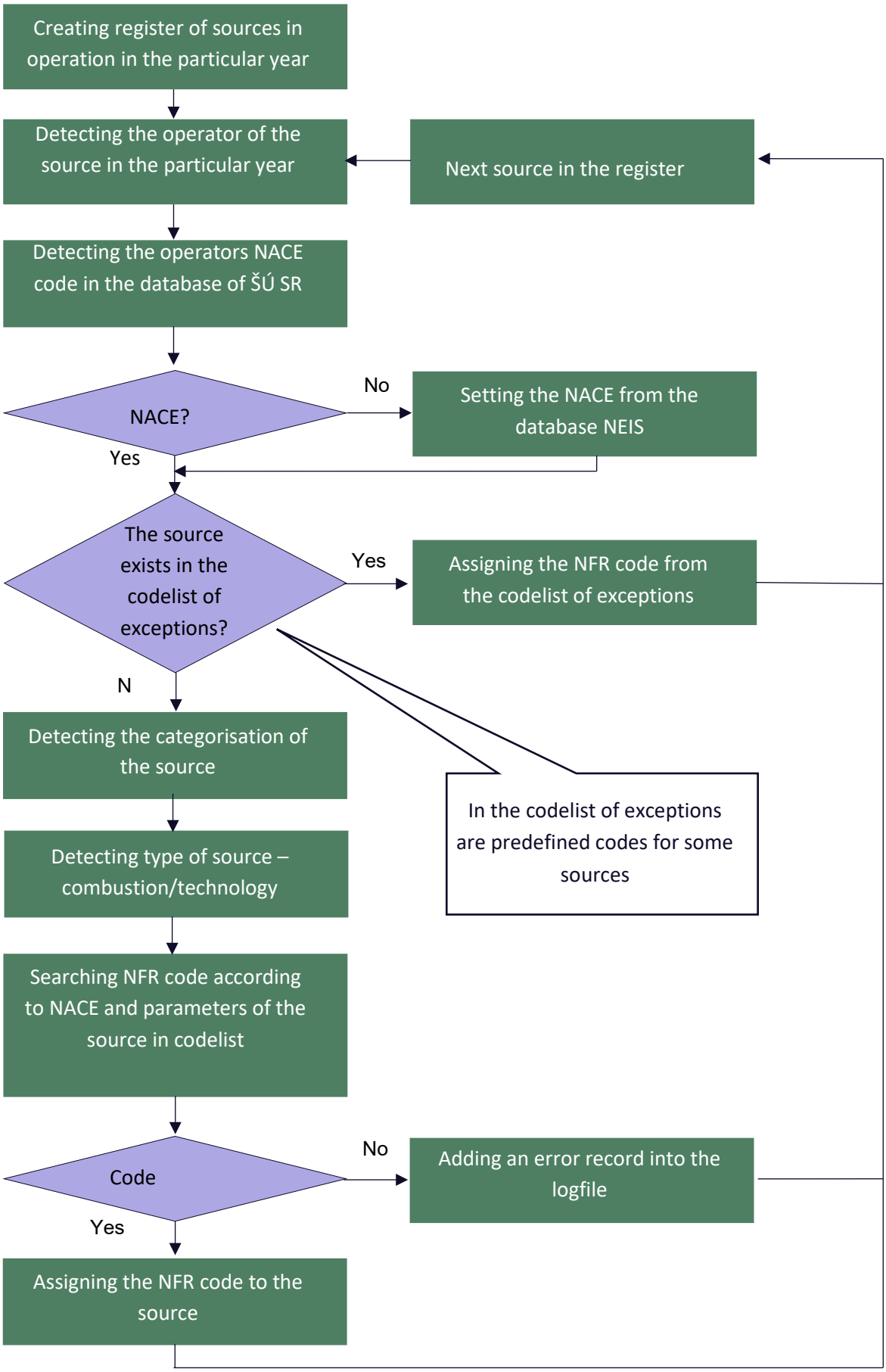
A4.4 VERIFICATION PROCESS OF NEIS DATA

Verification of input data is on a yearly basis. After the legislative deadline for operators to deliver the mandatory questionnaires with data either electronically – direct input to the database or in written form to the district offices, the data are imported and firstly verified on the level of districts (79 district offices responsible for the related pollution sources in the territory of individual districts). Verification is performed partly by automatized inbuilt check-up mechanisms for illogical and missing key data, and partly by the specialist for environmental issues at the district environmental offices. In cases when the data are not clear, the operator or responsible contact persons are contacted for the verification and explanation of their input data.

The second verification level is in a central database in SHMÚ, there is performed also the automatized verification inbuilt check-up mechanisms for illogical and missing key data, and partly by the specialist for environmental issues. In cases when the data are not clear, the operator or responsible district offices are contacted or directly the operators.

A4.5 PROCESS OF CODE MATCHING IN NEIS DATABASE

Figure A4.5: *Flowchart of code matching process*



The sources, having the national categorization, included in the Energy sector are linked to NFR according to the system of NFR code assignment:
However, this definition of energy units is wider and insufficient. For distinguishing into individual NFRs is used also the specification according to NACE.
The collected data are processed to calculate definite emissions for a particular year for each source in a registry. NEIS is highly variable for the determination of emissions according to approved permission on the operation and technical condition of the installation. There are several manners for the compilation of combustion emissions.
Emission compilations for energy in NEIS:

1.	Continuous measurement
2.	Calculation using representative concentration and volume of flue gas

$$Em[t] = (1 - \eta/100) \times c[mg/m^3] \times V[th.m^{-3}] \times 10^{-6}$$

Where
η = Effectiveness of abatement technology or separator
c = concentration of air pollutant

V = quantity/volume of released waste gas3.	Calculation using representative individual mass flow and number of operating hours

$$Em[t] = (1 - \eta/100) \times q[kg/hour] \times 10^{-3}$$

Where
η = Effectiveness of abatement technology or separator
q = mass flow
t = number of operational hours for the related year

4.	Calculation using emission factor and amount of fuel

$$Em[t] = (1 - \eta/100) \times EF[kg/t] \times AD[t] \times 10^{-3}$$
$$Em[t] = (1 - \eta/100) \times EF[kg/mil.m^3] \times AD[th.m^3] \times 10^{-6}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
AD = Quantity of fuel

5.	Calculation using emission factor and amount of related quantity other than fuel

$$Em[t] = (1 - \eta/100) \times EF\ [kg/GJ \times AD\ [GJ] \times 10^{-3}$$
$$Em[t] = (1 - \eta/100) \times EF\ [kg/kWh] \times AD\ [kWh] \times 10^{-3}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
AD = Activity Data (Quantity of related Activity Data)

6.	Calculation using emission factor related to the content of AP in fuel and amount of fuel

$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/t] \times AP[\%] \times AD\ [t] \times 10^{-3}$$
$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/mil.m^3] \times AP[\%] \times AD\ [th.m^3] \times 10^{-6}$$
$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/t] \times AP\ [mg/kg] \times AD\ [t] \times 10^{-9}$$
$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/mil.m^3] \times AP\ [mg/kg] \times AD\ [th.m^3] * 10^{-12}$$

Where

η = Effectiveness of abatement technology or separator
EF = Emission Factor
AP = Content of Air Pollutant expressed as a percentage

AD = Activity Data (Quantity of related Activity Data)7.	Calculation using content of ash, sulphur or other compound in dry matter and emission factor related to content of AP in fuel and amount of fuel

$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/t] \times AP\ [\%\ in\ dry\ matter] * 1 - W/100 \times AD\ [t] * 10^{-3}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
AP = Content of ash, sulphur or other compound in dry matter expressed as a percentage
W = humidity of the material
AD = Quantity of fuel

8.	Calculation using emission factor related to calorific value

$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/GJ] \times NCV\ [GJ/t] \times AD\ [t] * 10^{-3}$$
$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/GJ] \times NCV\ [GJ/th.m^3] \times AD\ [th.m^3] \times 10^{-3}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
NCV = Net Calorific Value
AD = Activity Data (Quantity of related Activity Data)

9.	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel

$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/GJ] \times AP\ [\%] \times NCV\ [GJ/t] \times AD\ [t] \times 10^{-3}$$
$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/GJ] \times AP\ [\%] \times NCV\ [GJ/th.m^3 \times AD\ [th.m^3] \times 10^{-6}$$
$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/GJ] \times AP\ [mg/kg] \times NCV\ [GJ/t] \times AD\ [t] \times 10^{-9}$$
$$Em\ [t] = (1 - \eta/100) \times EF\ [kg/GJ] \times AP\ [mg/kg] \times NCV\ [GJ/th.m^3] \times AD\ [th.m^3] \times 10^{-12}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
AP = Content of Air Pollutant expressed as a percentage
AD = Activity Data (Quantity of related Activity Data)

10.	Calculation using content of ash and sulphur in dry matter and emission factor related to content of AP in fuel and related to calorific value and amount of fuel

$$Em\ [t] = \left(1 - \frac{\eta}{100}\right) \times EF\ \left[\frac{kg}{GJ}\right] \times AP\ [\%] \times 1 - W/100 \times NCV\ [GJ/t] \times AD\ [t] \times 10^{-3}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
AP = Content of ash and sulphur in dry matter expressed as a percentage
W = humidity of the material
AD = Quantity of fuel

99.	Other manner of determination

In data processing, is taken specific information on abatement technologies and their effectiveness in a compilation of final emissions. (**ANNEX IV, Chapter A4.7**).

A4.5.1 Calculation of particulate matters

Total Suspended Particles (TSP) emissions are provided directly by operators of individual large and medium sources on the base of measurements or more precisely by calculation (in compliance with the air protection legislation of the Slovak Republic). The emission inventory of PM_{10} and $PM_{2.5}$ for the Slovak Republic is elaborated according to the EMEP/EEA GB_{2019} and in compliance with requirements of the respect of a working group for emission inventory (UN ECE Task Force on Emission inventory) and the methodology is based on IIASA's report[2].

Automated calculation of emissions PM_{10} and $PM_{2.5}$ was technically implemented in 2011[3] in db. NEIS according to the study[4]. Emissions PM_{10} and $PM_{2.5}$ were processed with certain sectoral default indicators. In respect of that on the EU level was defined emission ceiling for 2020 based on the GAINS model (from IIASA) so we resolved to the methodology of calculation inventory of PM_{10} and $PM_{2.5}$. National inventory is based on the modelling of national projections

The NEIS database contains a special program that automatically calculates emissions of PM_{10} and $PM_{2.5}$. The outputs from the NEIS database are verified and performed in Excel sheets. The efficiency of the installed separation of fractions is defined and then emissions of PM_{10} and $PM_{2.5}$ behind the separator were calculated. After calculations behind the separator, the calculation of total emissions of PM_{10} and $PM_{2.5}$ is taken to NFR tables

Emissions are distinguished into three fractions: fine ($PM_{2.5}$), coarse (PM_{10} -$PM_{2.5}$) and big (PM>10 µm)

Final emissions are calculated: $PM_{10} = PM_{fine} + PM_{coars.}$

A4.6 ENERGY – GENERAL EMISSION FACTORS

The general emission factors are valid for emissions from combustion before the use of abatement technologies or additives. The final amount of released air pollutants demands the effectiveness of abatement or degree of DESOX after the addition of additives.

Emission factors used in the NEIS Database were updated in 2018 in the final report of the Study Drafting of emission factors for combustion plants for MŽP SR. Updated emission factors are available in ANNEX I and ANNEX II of this study (only in Slovak).

A4.7 ABATEMENT TECHNOLOGIES

Table A4.3: *List Abatement technologies reported to the NEIS database*

TYPE OF SEPARATOR	NAME
F - textile	F - Textile hose
F - textile	F - Textile pocket
F - textile	F - Textile sleeve
F - textile	F - Textile chamber-cassette
F - textile	F - Textile wedge
F - textile	F - Textile non-woven felt
F - textile	F - Textile-woven with woven reinforcement
F - textile	F - Textile other
F - textile	F - Not Specified
E - electric	E - Horizontal
E - electric	E - Vertical

[2] hhttp://www.iiasa.ac.at/web/home/research/researchPrograms/air/ir-02-076.pdf

[3] Správa k riešeniu úlohy „Systém pre prepočet emisií TZL na emisie PM10 a PM2.5, SPIRIT informačné systémy

[4] Návrh výpočtu tuhých znečisťujúcich látok s aerodynamickým priemerom menším ako 10 a 2.5 µm (PM_{10} a $PM_{2.5}$), Slovenský hydrometeorologický ústav v spolupráci s ECOSYS, 2008

TYPE OF SEPARATOR	NAME
E - electric	E - Wet
E - electric	E - Wet with pre-wash
E - electric	E - with EFB bedding
E - electric	E - electric other
E - electric	E - Not Specified
S - dry aeromechanic	S - settling chamber
S - dry aeromechanic	S - anther
S - dry aeromechanic	S - jalousie
S - dry aeromechanic	S - single cyclone
S - dry aeromechanic	S - group of cyclones (parallel)
S - dry aeromechanic	S - group of cyclones (serial)
S - dry aeromechanic	S – multi-cyclone
S - dry aeromechanic	S - unspecified
S - dry aeromechanic	S - swirl counter-current
S - dry aeromechanic	S - grained layer
S - dry aeromechanic	S - rotating
S - dry aeromechanic	S - Drop separators
S - dry aeromechanic	S - Separation of dust unspecified
S - dry aeromechanic	S - other
S - dry aeromechanic	S - unspecified
M - wet	M - spraying without filling
M - wet	M - spraying with refill
M - wet	M - foam without filling
M - wet	M - foam with refill
M - wet	M - combines
M - wet	M - single cyclone
M - wet	M – multi-cyclone
M - wet	M - surge with EO
M - wet	M – Counter-current with gas washer
M - wet	M - other
M - wet absorption	M - level
M - wet absorption	M - current-Venturi
M - wet absorption	M - grained layer
M - wet absorption	M - rotating
M - wet absorption	M - condensing
M - wet absorption	M - with chemical reaction
M - wet absorption	M - with organic solvents
M - wet absorption	M - with recirculation of liquid
M - wet absorption	M - other
AD,SP - absorption and combustion	AD - adsorption of gas-solids bed, instable adsorbent
AD,SP - absorption and combustion	AD - adsorption of gas-fluid. Adsorbent bed
AD,SP - absorption and combustion	AD - gas-continuous adsorption moving bed ad
AD,SP - absorption and combustion	SP - Gas combustion - thermal three-stage (burner, mixer, aggravation), linear. Burner
AD,SP - absorption and combustion	SP - Combustion of gases - thermal three-stage, tunnel incinerator
AD,SP - absorption and combustion	SP - Gas Combustion - thermal three-stage, jet incinerator
AD,SP - absorption and combustion	SP - Combustion of gases - thermal in the sand bed
AD,SP - absorption and combustion	SP - Gas-catalytic combustion - solid bed (tapes, rods, bricks, pellets ...)
AD,SP - absorption and combustion	SP - Combustion of gas-catalytic-fluid bed (metals and their compounds on carriers)
DS - DESOX	DS - DESOX-lime-limestone wet scrubbing-WS
DS - DESOX	DS - DESOX - injection of lime milk into the flue gas-SDA

TYPE OF SEPARATOR	NAME
DS - DESOX	DS - DESOX injection of dry sorbent-DSI, additional
DS - DESOX	DS - DESOX-Wellmann-Lord with Na-WL sulphite
DS - DESOX	DS - DESOX-Walter process with ammonia-WAP
DN - DENOX	DN - DENOX-selective non-catalytic reduction - SNCR
DN - DENOX	DN - DENOX-selective catalytic reduction - SCR
DN - DENOX	RD - Reduction of gas catalytic-solid bed
DN - DENOX	RD - Reduction of catalytic-fluid gas
KMB - combine	KMB - combine-SNOX with separate cathodes, catalytic reduction of NOx, catal.ox.SO_2
KMB - combine	KMB - combine-DESONOX catalysing 1 chamber, NOx catalytic reduction, catal.ox.SO_3
KMB - combine	KMB - combine-AC-dry simultaneous adsorption on moving the activated carbon (coke) to H_2SO_4 and N_2
KMB - combine	KMB - Gas capture by condensation (also cryogenic)
KMB - combine	KMB - Gas capture and disposal not specified
BIO - biological separators	BIO - dry-biofilters
BIO - biological separators	Bio - semi-dry biofilters, with reinforcement
BIO - biological separators	BIO - wet-bioscrubbers, bioskrub

A4.8 VOC CONTENT

Table A4.4: *VOC content - scheme*

SPECIFIC CONTENT OF VOC [W%]*	IITE SPIRIT	PETROLEUM SPIRIT	XYLENE	TOLUENE	STYRENE	ETHYL ACETATE	BUTYL ACETATE	ACETONE	METHYL ACETATE	ETHYL ALCOHOL	BUTYL ALCOHOL	IZOBUTYL	CYCLOHEXANE	KRESOL	MPA	SOLVESO 100	METHYLENE CHLORID	OWANOL
LACQUERS AND VARNISH																		
oil and varnish	X																	
synthetic airborne	X		X															
synthetic burning			X								XX							
epoxid			X								XX							
polyurethane			X				X								XX			
polymerate				X			X	X							XX			
cellulose			X	X		X	X		X	X		XX						X
asphalt	X		X															
estermid			X											X		X		
resole			X								XX							
PAINTS																		
oil and varnish	X																	
synthetic airborne	X		X															
synthetic burning			X	X							XX							
polyurethane 2 K			X				X								X			
polyurethane 1 K			X				X								X			
acrylic			X				X				XX							
cellulose		XX	X	X		X	X			X		X						
resole			X			X	X				XX							
epoxide			X								XX							
high solid paints	X		X															
chlorine rubber paints			X				X											
for print				X		X	X	X		X								
THINNERS																		
synthetic	X		X															

polyurethane			X				X								X			
cellulose				X		X	X		XX	X		X						
other			X	X		X	X		XX	X	XX	X			X			
solvent adhesives		XX		X		X							X					X
RESINS																		
unsaturated polyester					X													
alkyde resins	X		X															
akryl resins			X				X				XX							
other resins											XX	X						
COATING REMOVERS																		
old cover removers				X				X	XX	X							X	

XX-Confidential data

ANNEX V: NECD RECOMMENDATIONS

The Slovak Republic has prioritised its effort to implement the recommendations of the 2023 Comprehensive Technical Review of the National Emission Inventories that might have an impact on the emission estimates as far as possible in the 2024 submission. Recommendations that have been addressed are shaded in grey in Table A5.1. The remaining recommendations are mainly related to transparency and will be implemented in future submissions when resources are available.

Table A5.1: *Status of implementation of the NECD recommendations*

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA[5]	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
SK-1A4ci-2022-0001	Final review Report 2023, Chapter 3, p. 169	T	Yes		**High**	For1A4ci Agriculture/Forestry/Fishing: Stationary, solid biomass, NH3 for all years, the TERT notes that there may be an under-estimate of emissions. The 2019 EEA/EMEP Guidebook includes a methodology for NH3 estimation from solid biomass consumption, but NE is reported instead. This was raised during the 2022 NECD inventory review. In response to a question raised during the review, Slovakia stated that NH3 emissions from solid biomass would be included in the next inventory. The TERT notes that the issue is below the threshold of significance for a technical correction. The TERT recommends that Slovakia include NH3 emissions from solid biomass in the next submission./**Chapter 3.7.6.2**
SK-2D3e-2023-0001	Final review Report 2023, Chapter 4, Table 4.80, p. 253	T	Yes		**High**	The TERT recommends that Slovakia implement additional QA/QC checks for Solvent sector and to review the activity data used for categories under 2D and 2G Other product use in NFR tables and in the IIR before submitting

[5] If is criterion TCCCA, please select option - transparency, consistency, comparability, completeness or accuracy

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA[5]	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
						and to improve the transparency of the NFR tables and IIR by providing this information in the next submission. /**Implemented 4.7.4.1**

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA[6]	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
SK-3B-2023-0001	Final review Report 2023, Annex VI., p. 482	T	Yes		**Low**	TERT notes that there is a lack of transparency regarding a significant decrease in the emissions from 2020 to 2021. In response to a question 13 raised during the review. The TERT recommends that Slovakia include a summary of information on mitigation measures used in Slovakia and include explanation for the decrease in emission in the IIR of the next submission. /**Implemented Annex VI.**
SK-3B1-2023-0001	Final review Report 2023, Chapter 5, p. 310	A	Yes		**High**	For **3B1 Manure management - Cattle NMVOC 1990-2021** the TERT notes that there were inconsistencies in the method used for calculating the emissions, because the methodology

[6] If is criterion TCCCA, please select option - transparency, consistency, comparability, completeness or accuracy

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA[6]	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
						described In the IIR were missing the Frac_silage, store parameter. The TERT recommends that Slovakia include the information in the next submissions.The TERT recommends that Slovakia correct the identified issues and recalculates the emissions in the next submission. /**Implemented 5.8.6.4**
SK-3B1a-2023-0001	Final review Report 2023, Annex VI. and Chapter 5, p. 482 and 291	T			**Low**	The TERT recommends that Slovakia include a description of trends and explain outliers in the next submission. Furthermore, the TERT recommends that Slovakia describe in detail the measures considered and how data on the use has been collected to explain why a measure is suddenly popular for a single year. /**Implemented Annex VI.** and **5.8.2**
SK-3B1a-2023-0002	Final review Report 2023, Annex VI. and Chapter, p. 482 and 291	T			**Low**	The TERT recommends that Slovakia explain the reasons for the uneven trend in the implied emission factor for dairy cattle by explaining which parameters are changed in the IIR of the next submission. /**Implemented Annex VI.** and **5.8.2**

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA[6]	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
SK-3B3-2023-0001	Final review Report 2023, Chapter 5, p. 303	A			**High**	The TERT recommends that Slovakia correct the error in the activity data reported for 2011 in the NFR in the next submission. The TERT notes that there is a lack of transparency regarding the trend of the implied emission factor calculated from data reported in the NFR tables. /**Implemented 5.8.4**
SK-3B4e-2023-0001	Final review Report 2023, Chapter 5, p.291	T			**Low**	The TERT recommends that Slovakia explain the reasons for the uneven trend in the implied emission factor for horses in the IIR of their next submission. /**Implemented 5.8.2**
SK-3B4h-2022-0001	Final review Report 2023, Chapters 5, p. 303, 305, 307, 315	C			**High**	For **3B4h Manure management - Other animals and NOX, NMVOC, NH3, PM2.5, PM10 for all years**, the TERT noted that the notation key 'NA' (not applicable) is used whilst a Tier 1 method is available in the 2019 EMEP/EEA Guidebook. The TERT reiterates the recommendation to calculate the emissions for this NFR code in future submissions to improve completeness of the inventory./**Implemented 5.8.4, 5.8.5, 5.8.6, 5.9.4**

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA[6]	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
SK-3D-2023-0001	Final review Report 2023, Chapter 5, p. 327, 329	T			**Low**	The TERT recommends that Slovakia clarify in the IIR which areas are reported in the NFR as activity data and which areas are used in the calculations of the emissions in the next submission/**Implemented 5.10.1, 5.11.1**
SK-3Da2a-2023-0001	Final review Report 2023, Annex VI./p. 482	T			**Low**	The TERT recommends that Slovakia include a summary of information on mitigation measures used in Slovakia and include explanations for the decrease in emission in the IIR of the next submission. /**Implemented Annex VI.**
SK-3Dc-2023-0001	Final review Report 2023, Chapter 5, p.329	T			**Low**	The TERT recommends that Slovakia report the used emission factors with the same amount of decimal places as given in the 2019 EMEP/EEA Guidebook in the next submission. /**Implemented 5.11.1**
SK-3De-2023-0001	Final Review Report 2023, No implementation, Chapter 5, p.327				**High**	The TERT recommends that Slovakia estimate emissions from barley and oats (as well as any other crops) in the next submission either by using the Tier 1 emission factors or by developing country-specific emission

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA[6]	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
						factors for these crops./ **No implementation 5.10.1**
SK-5A-2023-0001	Final review Report 2023, Chapter 6, p. 344	Accuracy	No	Yes	**High**	**5A Biological treatment of waste - Solid waste disposal on land, PM2.5, PM10, TSP, 1990-2021**: The TERT recommends that Slovakia include all mineral waste handled in the activity data. Moreover, the TERT would like to highlight that the 2023 version of the EMEP/EEA GB has been updated to reflect this AD more consistent with the default emission factors. The TERT notes that the Eurostat Database includes the required data on mineral waste for EU member states./**Implemented 6.4.4**
SK-5C2-2023-0001	Final review Report 2023, Chapter 6, p. 370	Accuracy	No	No	**High**	**5C2 Open burning of waste, SO2, NOX, NMVOC, PM2.5, PM10, 2000-2021**: Based on this description, the TERT recommends that Slovakia allocate emissions from forest residues burning under 5C2 Open burning of waste in the next submission./**Implemented 6.6.5**

ANNEX VI: IMPLEMENTATION OF MITIGATION MEASURES FOR AMMONIA EMISSIONS REDUCTION IN AGRICULTURE

Revision of provided information was done **according to the NECD recommendation No A8/SK-3Da2a-2023-0001of the SVK NECD Final Review Report 2023**. **A8/SK-3Da2a-2023-0001**Mitigation measures were defined as any anthropogenic interventions that can either reduce the sources of GHG emissions to achieve the reduction targets. In the context of the United Nations Framework Convention on Climate Change, a mitigation measure is a national-level analysis of the various technologies and practices that can mitigate climate change or polluted air. The mitigation measures were divided into groups according to the place and time of their application:

- During feeding of the livestock;
- During housing of animals;
- During storage of organic waste;
- During spreading of organic waste into the agricultural soils

A6.1 ANALYSIS OF MITIGATION MEASURES IN THE SLOVAK REPUBLIC

At present, abatements are very difficult to estimate in the condition of the Slovak Republic, due to a lack of official statistical information. The SHMÚ administers the NEIS. NEIS has information about the mitigation measures used by farmers. These data are confidential. The SHMÚ conducts the NEIS under the Act of the Ministry of the Environment of the Slovak Republic No 137/2010[7] Coll. on air and Decree of the Ministry of the Environment of the Slovak Republic No 410/2012 Coll[8]. The farmers, the operators of the source of air pollution, provide "emission confession" of the Environmental District Office. Emission confession contains detailed information about pollution sources, emitted pollution and pollution charges into the relevant district in the prescribed forms, or a portable electronic medium. NEIS has information on livestock numbers of animals, manure management systems and used abatements as well.
The emission from the NEIS database is not possible to fully implement into the national emission inventories due to the validity of the legislation. In addition, ammonia emissions from goats missing entirely in the database due to a lack of law. The best practice for the NH_3 estimation is analysing nitrogen flux in agriculture. Estimation of nitrogen flux is a more complex approach, which was used during NH_3 calculation. During it, nitrogen losses are formed as nitrogen emissions (NH_3, NO, N_2O). Emissions are estimated from each breeding phase. The NEIS calculates only NH_3 emissions. The Slovak Republic shall also report other nitrogen emissions (NO, N_2O). The NH_3 emissions are calculated with a default emissions factor, which is constant during all time-series in the NEIS system. Nevertheless, NEIS is a good source of additional data for the emissions inventory for quality control purposes.

A6.2 METHODOLOGY ISSUE-METHOD

The SHMÚ compiles annually NH_3 balance according to the EMEP/EEA GB_{2019} using country-specific parameters and national input data from the ŠU SR[9]. The ŠU SR does not dispose of official information about abatements. Therefore, in the NEIS, as mentioned above, the abatement information from farms is available from 2006 to the present.

[7] Act of the Ministry of the Environment of the Slovak Republic no.137/2010 Coll. Of 3 March 2010
[8] Decree of the Ministry of the Environment of the Slovak Republic no. 410/2012 Coll. of 30 November 2012 Implementing certain provisions of the Air

Table A6.1: *Efficiency of abatements*

ABATEMENT EFFICIENCY OF MEASURE I	EFFICIENCY OF ABATEMENTS	SOURCE OF EFFICIENT
STORAGE OF MANURE OR SLURRIES		
Fixed hatch or roof	80%	Code Good Agricultural Practice*
Covering the surface of the tank with straw	40%	
Covering the surface of the tanks with foil	60%	
Slurry/liquid with natural crust cover	40%	
APPLICATION OF MANURE OR SLURRIES		
Furrow injection	40%	Code Good Agricultural Practice*
Deep injection	90%	
Incorporation within 12 hours	50%	
Incorporation within 24 hours	30%	

***In Slovak**

The farms from the NEIS were examined analogically in the NEIS and abatements were investigated, for example spreading after 12 and 24 hours and storage for liquid and solid manure from the different livestock species. The results of the research were a list of abatements applied to the emission balance. ***Table A6.2*** and ***A6.3*** provide a share of the abatements per farm. There were calculated for a better interpretation and usability in the NH_3 calculations. NH_3 emissions from Sector 3 Agriculture are estimated according to the EMEP/EEA GB_{2019} as a Tier 3 approach for cattle, sheep, goats, swine, horses and poultry. The nitrogen excretion rate is calculated based on the nitrogen content of the feed according to the IPCC 2006 GL methodology. For the calculation of the tier 3 approach was accepted philosophy for ammonia reduction. Ammonia reduction at the various stages of livestock manure production and handling are interdependent and combinations of measures are not simply additive in terms of their combined emission reduction. Implementation of abatements was done according to Approach 2 presented in the 2021 Task Force on Emission Inventories and Projections as called Approach 2. A single well-mixed system, due to missing detailed information on the number of animals breed cross the systems. Approach 2 model is put together as a single well-mixed system with weighted-average emission factors. Abated emission factors were calculated separately and implemented into the N flow tool in the system python.

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

Where:

$Ef_{average}$ = Abated emission factors, EF_{ref} = unabated/reference emission factors, P_i= Penetration of measure I, AE_i Abatement efficiency of measure i, I type of measure per farm.

Figure A6.1: *Development of abatements since 2006*

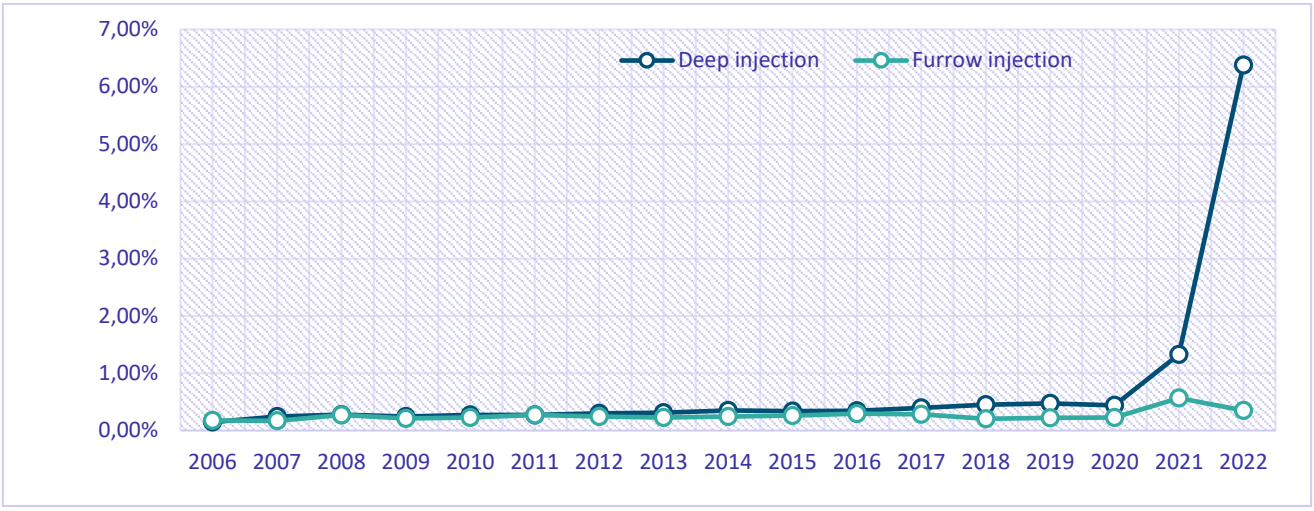


Figure A6.2: *Development of abatements since 2006*

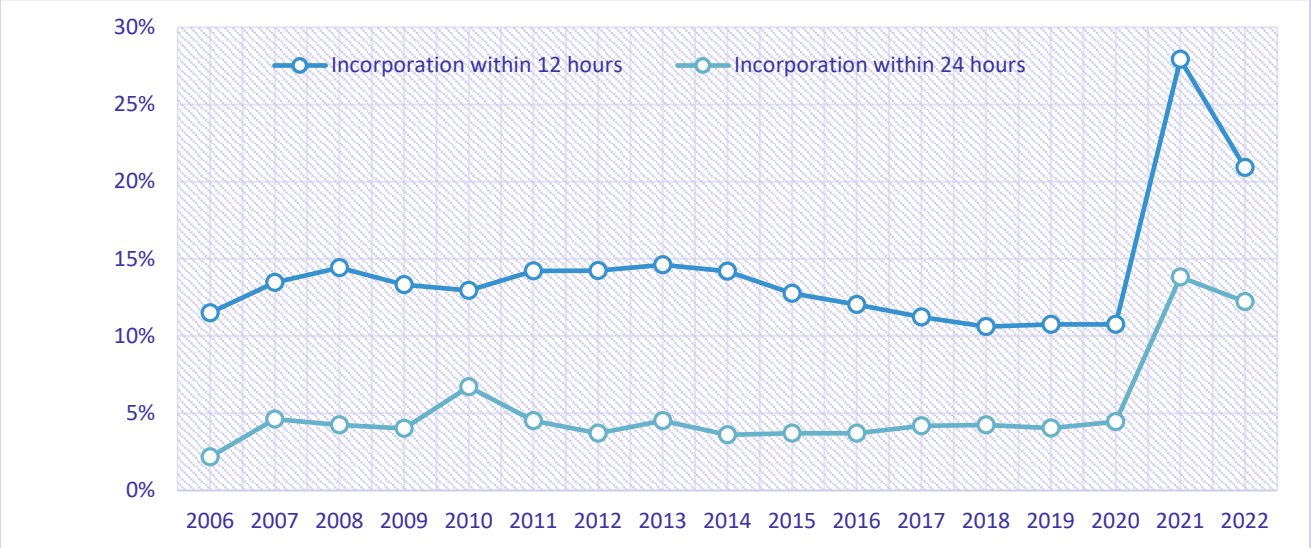
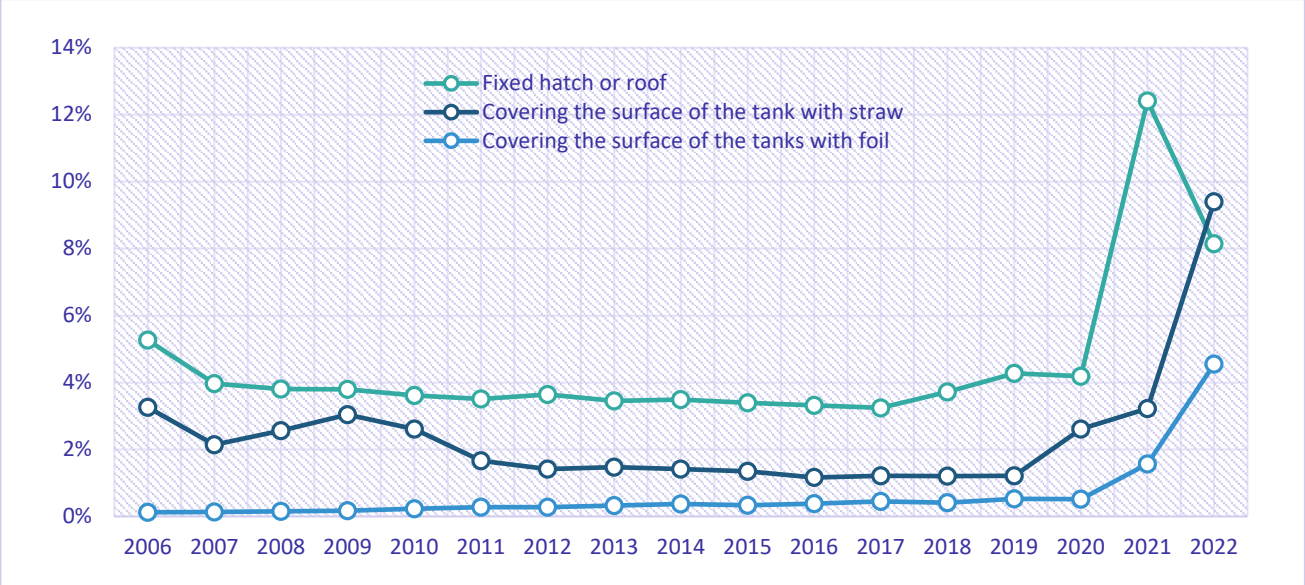


Figure A6.3: *Development of abatements since 2006*



This chapter was included <u>according to the NECD recommendation No A1/SK-3B-2023-0001 of the SVK NECD Final Review Report 2023 and No. A3/SK-3B1a-2023-0001</u>:Trend of abatements: The penetration factors mentioned in the Slovak IIR do not originate from estimated values of future law effectiveness. It is worth noting that in the previous programming period of the common agricultural policy, funding was allocated for ammonia reduction techniques. Additionally, the older version of the Air Act proposed measures to decrease ammonia levels in the air. The SHMÚ is responsible for monitoring and calculating emissions via the National Emission Information System (NEIS). This system collects data on mitigation measures implemented to reduce ammonia emissions, covering the period from 2006 to the present. The national emission factors used in the calculations incorporate some of these measures aimed at reducing emissions. Figures A6.1, A6.2 and A6.3 show a visible increasing trend in 2021 and decreasing in 2022 mainly in fixed hatch or roof and incorporation within 12 and 24 hours. Explanation for this trend may have two reasons, the number of operators may decrease and this may decrease of penetration factor of the storage abatement measure. The second reason for the increase and decrease are very unpredictable trends due to economic issues in the sector.

Table A6.2: *Penetration of storage abatement measure – fixed hatch or roof*

FIXED HATCH OR ROOF											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2006	7%	7%	1%	0%	5%	5%	5%	0%	13%	16%	0%
2007	6%	7%	1%	2%	0%	0%	0%	0%	13%	14%	1%
2008	7%	7%	1%	2%	0%	0%	0%	0%	11%	14%	1%
2009	6%	7%	1%	2%	0%	0%	0%	0%	11%	14%	1%
2010	6%	6%	1%	3%	0%	0%	0%	0%	10%	13%	1%
2011	5%	5%	1%	3%	0%	0%	0%	0%	11%	14%	0%
2012	6%	5%	1%	3%	0%	0%	0%	0%	11%	15%	0%
2013	6%	5%	1%	3%	0%	0%	0%	0%	11%	13%	0%
2014	6%	5%	1%	2%	0%	0%	0%	0%	11%	14%	0%
2015	6%	5%	1%	1%	0%	0%	0%	0%	11%	14%	0%
2016	5%	5%	0%	1%	0%	0%	0%	0%	11%	13%	0%
2017	5%	5%	0%	1%	0%	0%	0%	0%	10%	13%	0%
2018	5%	5%	0%	1%	0%	0%	0%	3%	12%	14%	0%
2019	5%	5%	0%	1%	0%	0%	0%	6%	11%	15%	3%
2020	6%	5%	0%	1%	0%	0%	0%	6%	11%	14%	2%
2021	16%	15%	1%	4%	0%	0%	0%	20%	31%	38%	11%
2022	16%	14%	2%	23%	0%	0%	0%	2%	17%	10%	5%

Table A6.3: *Penetration of storage abatement measure – covering the surface of the tank with straw*

COVERING THE SURFACE OF THE TANK WITH STRAW											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2006	1%	1%	1%	2%	10%	10%	10%	0%	1%	1%	0%
2007	1%	1%	2%	1%	6%	6%	6%	0%	1%	1%	0%
2008	1%	2%	2%	1%	7%	7%	7%	0%	1%	1%	0%
2009	2%	2%	2%	1%	8%	8%	8%	0%	1%	1%	0%
2010	2%	2%	2%	1%	7%	7%	7%	0%	1%	2%	0%
2011	2%	2%	2%	1%	3%	3%	3%	0%	1%	2%	0%
2012	1%	1%	2%	1%	3%	3%	3%	0%	1%	1%	0%
2013	1%	1%	1%	1%	3%	3%	3%	0%	1%	1%	0%
2014	1%	1%	2%	1%	3%	3%	3%	0%	1%	1%	0%
2015	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2016	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2017	1%	1%	2%	1%	2%	2%	2%	0%	1%	1%	0%
2018	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2019	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2020	2%	2%	2%	1%	7%	7%	7%	0%	1%	2%	0%
2021	3%	4%	4%	1%	5%	5%	5%	0%	3%	5%	0%
2022	3%	4%	1%	3%	7%	7%	7%	0%	32%	40%	0%

Table A6.4: *Penetration of storage abatement measure -covering the surface of the tanks with foil*

COVERING THE SURFACE OF THE TANKS WITH FOIL											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2006	1%	1%	1%	2%	10%	10%	10%	0%	1%	1%	0%
2007	1%	1%	2%	1%	6%	6%	6%	0%	1%	1%	0%
2008	1%	2%	2%	1%	7%	7%	7%	0%	1%	1%	0%
2009	2%	2%	2%	1%	8%	8%	8%	0%	1%	1%	0%
2010	2%	2%	2%	1%	7%	7%	7%	0%	1%	2%	0%

COVERING THE SURFACE OF THE TANKS WITH FOIL											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2011	2%	2%	2%	1%	3%	3%	3%	0%	1%	2%	0%
2012	1%	1%	2%	1%	3%	3%	3%	0%	1%	1%	0%
2013	1%	1%	1%	1%	3%	3%	3%	0%	1%	1%	0%
2014	1%	1%	2%	1%	3%	3%	3%	0%	1%	1%	0%
2015	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2016	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2017	1%	1%	2%	1%	2%	2%	2%	0%	1%	1%	0%
2018	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2019	1%	1%	2%	1%	2%	2%	2%	0%	1%	2%	0%
2020	2%	2%	2%	1%	7%	7%	7%	0%	1%	2%	0%
2021	3%	2%	0%	0%	0%	0%	0%	0%	6%	7%	0%
2022	5%	3%	0%	0%	0%	0%	0%	0%	21%	21%	0%

Table A6.5: *Penetration of storage abatement measure - Slurry/liquid with natural crust cover*

SLURRY/LIQUID WITH NATURAL CRUST COVER											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2009	2%	2%	2%	1%	8%	8%	8%	0%	1%	2%	0%
2010	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2011	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2012	13%	14%	4%	4%	9%	9%	9%	4%	12%	10%	1%
2013	11%	12%	3%	3%	6%	6%	6%	4%	10%	7%	1%
2014	40%	11%	12%	2%	1%	5%	5%	5%	0%	11%	8%
2015	12%	12%	2%	1%	2%	2%	2%	3%	11%	8%	0%
2016	12%	12%	2%	1%	2%	2%	2%	3%	12%	8%	0%
2017	12%	12%	2%	0%	2%	2%	2%	4%	13%	8%	1%
2018	12%	13%	2%	0%	2%	2%	2%	6%	13%	8%	4%
2019	12%	13%	2%	1%	2%	2%	2%	6%	12%	7%	4%
2020	12%	13%	2%	1%	2%	2%	2%	6%	11%	7%	5%
2021	35%	38%	8%	2%	5%	5%	5%	20%	31%	20%	16%
2022	40%	37%	1%	1%	0%	0%	0%	72%	26%	17%	22%

Table A6.6: *Penetration of application abatement measure – furrow injection*

FURROW INJECTION											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2006	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2007	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2008	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
2010	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%
2011	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%
2012	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2013	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2014	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2015	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%
2016	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%
2017	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2018	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2019	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%

FURROW INJECTION											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2020	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2021	1%	0%	0%	0%	0%	0%	0%	0%	3%	2%	0%
2022	1%	0%	0%	0%	0%	0%	0%	2%	1%	0%	0%

Table A6.7: *Penetration of application abatement – deep injection*

DEEP INJECTION											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2006	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2007	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2008	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2009	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2010	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2011	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2012	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2013	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2014	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2015	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2016	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2017	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
2018	1%	0%	0%	0%	0%	0%	0%	0%	2%	2%	0%
2019	1%	0%	0%	0%	0%	0%	0%	0%	2%	2%	0%
2020	1%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%
2021	4%	1%	0%	0%	0%	0%	0%	0%	4%	5%	0%
2022	7%	1%	0%	0%	0%	0%	0%	30%	32%	0%	0%

Table A6.8: *Penetration of application abatement - incorporation within 12 hours*

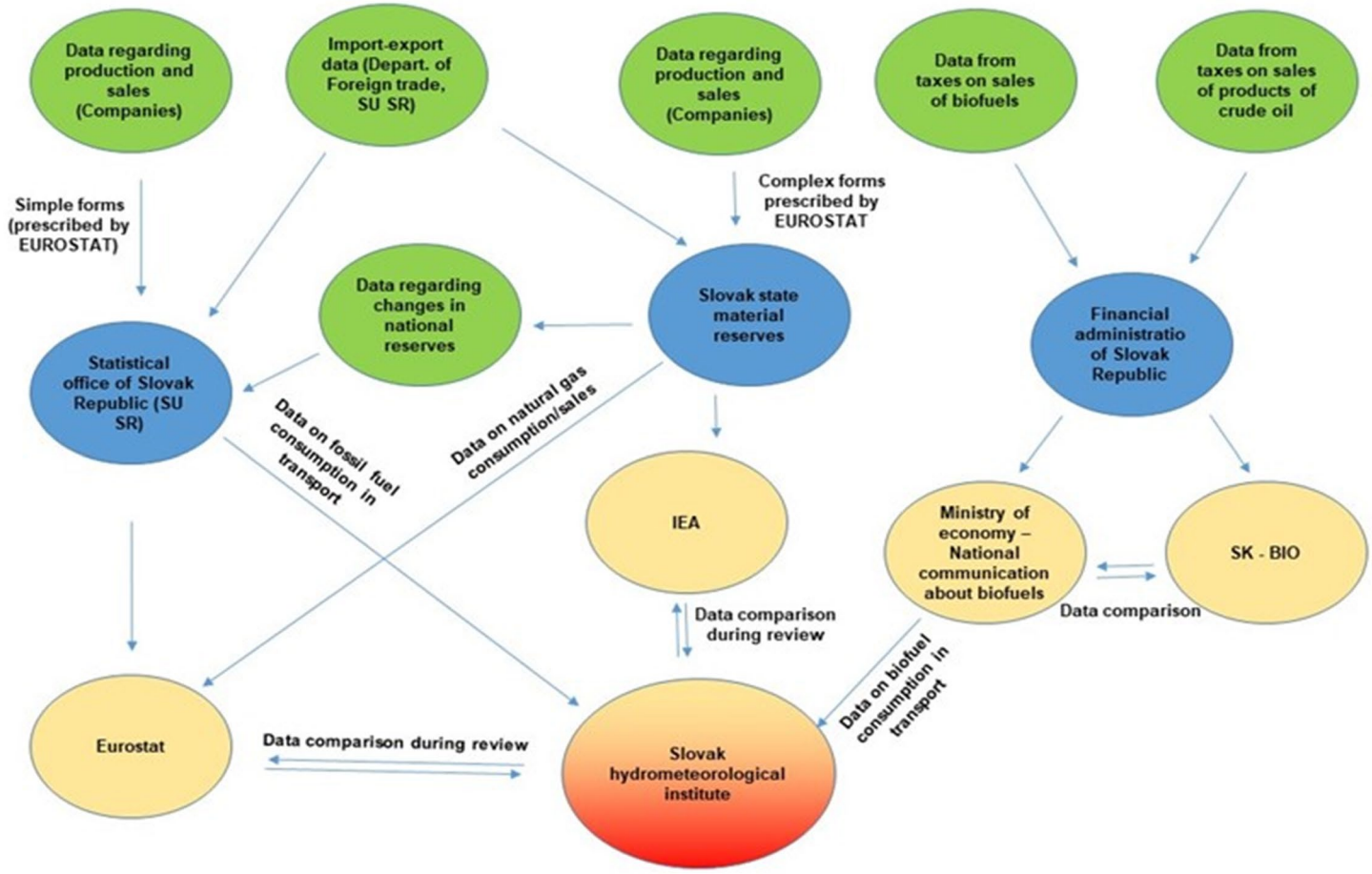
INCORPORATION WITHIN 12 HOURS											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2006	18%	18%	8%	4%	14%	14%	14%	0%	17%	17%	0%
2007	17%	18%	6%	4%	11%	11%	11%	21%	16%	16%	16%
2008	19%	19%	6%	4%	13%	13%	13%	21%	17%	17%	16%
2009	19%	19%	6%	4%	8%	8%	8%	21%	18%	18%	16%
2010	19%	19%	6%	3%	7%	7%	7%	20%	20%	18%	18%
2011	18%	18%	5%	5%	10%	10%	10%	22%	20%	18%	19%
2012	18%	18%	6%	5%	8%	8%	8%	25%	20%	18%	23%
2013	18%	18%	6%	7%	9%	9%	9%	27%	19%	17%	22%
2014	18%	18%	6%	7%	8%	8%	8%	29%	18%	16%	23%
2015	17%	17%	5%	5%	5%	5%	5%	28%	18%	15%	22%
2016	17%	17%	5%	4%	4%	4%	4%	26%	17%	15%	21%
2017	16%	16%	5%	4%	4%	4%	4%	20%	16%	14%	20%
2018	15%	16%	5%	4%	4%	4%	4%	16%	16%	15%	18%
2019	15%	15%	5%	3%	7%	7%	7%	13%	16%	15%	16%
2020	15%	15%	5%	3%	7%	7%	7%	13%	16%	15%	16%
2021	41%	42%	14%	9%	21%	21%	21%	18%	42%	42%	41%
2022	44%	45%	3%	10%	38%	34%	0%	11%	11%	26%	8%

Table A6.9: *Penetration of application abatement - incorporation within 24 hours*

INCORPORATION WITHIN 24 HOURS											
CATEGORY	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
2009	5%	5%	5%	2%	0%	0%	0%	4%	4%	0%	0%
2010	6%	6%	4%	2%	0%	0%	0%	14%	5%	4%	11%
2011	6%	5%	2%	1%	0%	0%	0%	14%	5%	3%	10%
2012	6%	5%	2%	1%	0%	0%	0%	14%	5%	3%	8%
2013	6%	6%	2%	2%	7%	7%	7%	20%	4%	4%	10%
2014	6%	6%	2%	1%	0%	0%	0%	17%	4%	3%	10%
2015	6%	6%	2%	2%	0%	0%	0%	10%	4%	3%	8%
2016	6%	6%	3%	3%	3%	3%	3%	8%	4%	3%	8%
2017	6%	7%	2%	2%	0%	0%	0%	8%	4%	4%	7%
2018	7%	7%	2%	1%	0%	0%	0%	10%	4%	4%	6%
2019	7%	7%	2%	1%	0%	0%	0%	10%	4%	4%	6%
2020	8%	8%	2%	1%	0%	0%	0%	12%	4%	4%	8%
2021	22%	23%	8%	2%	0%	0%	0%	45%	13%	14%	25%
2022	18%	20%	2%	1%	0%	60%	0%	0%	4%	22%	7%

ANNEX VII: DATA FLOW OF FUEL

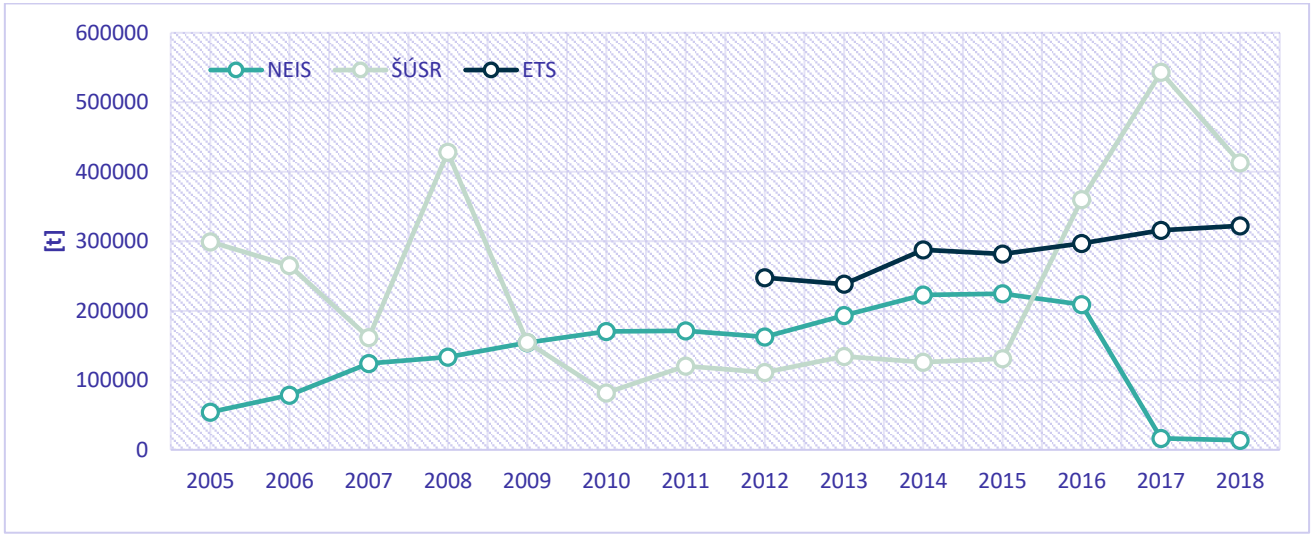
Figure A7.1: *Flowchart of data reporting and utilisation (green – original data, blue – primary users, yellow – secondary users, red – tertiary users)*



ANNEX VIII: JUSTIFICATION OF THE ACTIVITY DATA SOURCE FOR WASTE INCINERATION

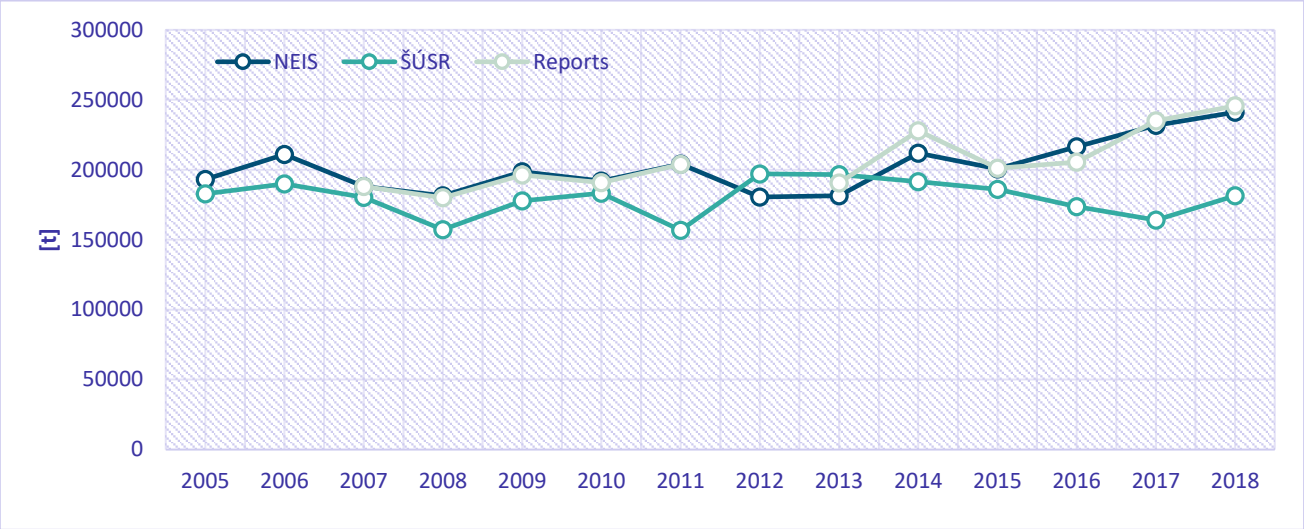
In the previous submission, activity data for industrial and clinical waste incineration were used from the yearbook Waste in the Slovak Republic. These data are collected by the Slovak Ministry of Environment MŽP SR) on a yearly basis. According to information provided by MŽP SR, these data are based only on waste production and also only the first take-over of waste is recorded. Further flows of the waste are unknown.
Operators of waste incineration and waste co-incineration plants are also obligated to provide information on the waste burned to the NEIS database as part of reporting for air pollution taxes. Detailed information on the type of waste incinerated is available in the database from the year 2005.
By comparison of the statistical, NEIS and ETS data for the incineration of waste with energy recovery (co-incineration in cement and lime production plants), significant differences were recorded. The amounts of industrial waste incinerated according to statistical data are much higher compared to ETS or waste data. ETS (available since 2012) and NEIS data are similar in trend and absolute amounts (see ***Figure A8.1***). This can be caused by a different definition of waste in national legislation or the same waste can be recorded more than once after some sort of pre-treatment (for example sterilisation) under another waste catalogue number. The NEIS database also contains sources that are not obliged to report to ETS which can cause slight differences between the data.

Figure A8.1: *Comparison of data of industrial waste incinerated (with energy recovery) from ŠÚ SR, NEIS database and ETS*



There are two Municipal waste incineration plants – OLO in Bratislava and KOSIT in Košice. These plants report data about burned waste to the Statistical Office of the Slovak Republic, the NEIS database and also in their yearly reports of operation. Comparing these three sources, data from reports and NEIS shows more similarity than the data from national statistics (see ***Figure A8.2***).

Figure A8.2: *Comparison of data of municipal waste incinerated (with energy recovery) from ŠÚ SR and NEIS database*



A comparison of the data from the NEIS database and national statistics for IWI (without energy recovery) and CWI (without energy recovery) is shown in the following *Figures A8.3 and A8.4.*

The figures below show a significant difference in amounts of incinerated clinical and industrial waste. For clinical waste, in national statistics also veterinary waste is included.

Figure A8.3: *Comparison of data of industrial waste incinerated (without energy recovery) from ŠÚ SR and NEIS database*

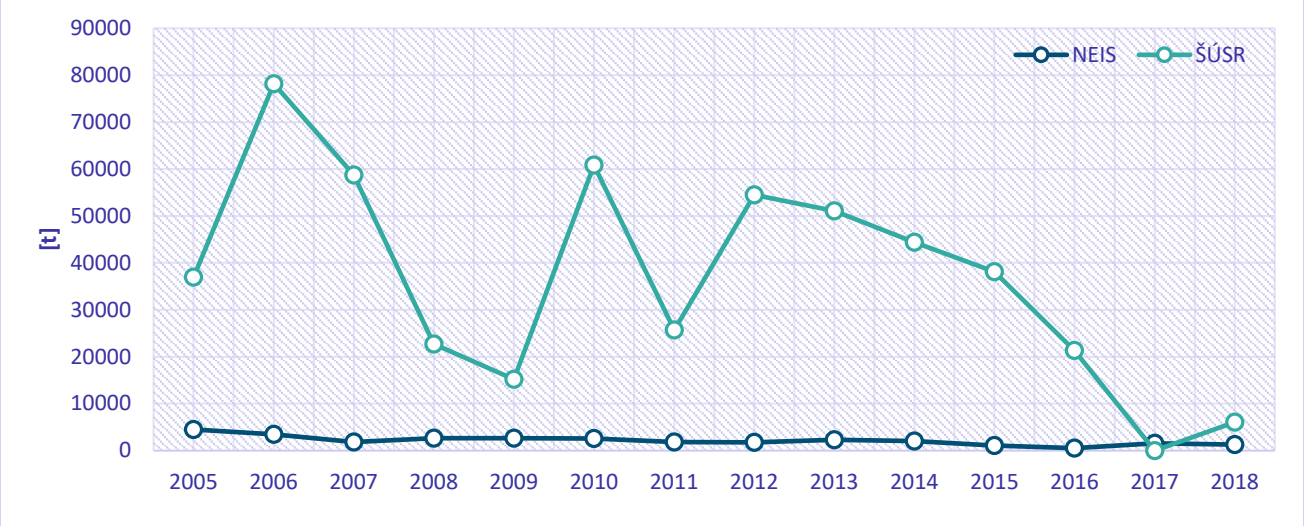
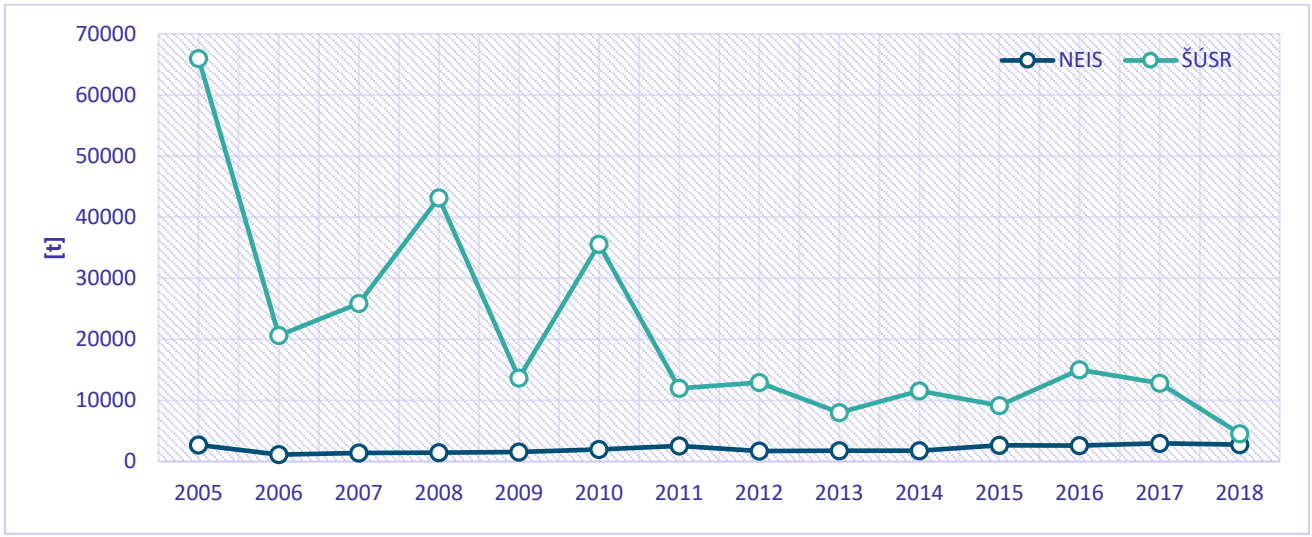


Figure A8.4: *Comparison of data of clinical waste incinerated (without energy recovery) from ŠÚ SR and NEIS database*



For the sake of consistency of using one source of activity data for all waste incineration plants, it was considered to use activity data from the NEIS database, as they are comparable with other sources of data as well as they are regularly checked in.

ANNEX IX: UNCERTAINTY ANALYSIS

Uncertainty assessment is an important part of compiling an emissions inventory and assessing how uncertainties evolve over time. It is considered best practice that emissions inventories contain neither over- nor under-estimates as far as can be judged, and for which uncertainties are reduced as far as practicable.
Uncertainty in emission estimates is a function of the uncertainty of input data i.e. activity or emission factors, used to compile the inventory. Hence, data collection and uncertainty evaluation are strongly linked, and all data contributing to the estimation of emissions should have an associated uncertainty assessment.

A9.1 UNCERTAINTY OF ACTIVITY DATA

Activity data are usually derived from (economic) statistics, including energy statistics and balances, economic production rates, population data, etc. These agencies may have already assessed the uncertainties associated with their data as part of their data collection procedures. These uncertainties can be used to construct probability density functions.
In some cases, uncertainty data for activity rates are not easily available. Since any uncertainty analysis needs quantitative input, quantitative uncertainty ranges are needed.
For activity data uncertainty analysis, uncertainty values from GHG uncertainty analysis were used. When the value was not available, default values from Table 2-1 from the Chapter Uncertainty analysis of EMEP/EEA GB_{2019} were used.

A9.2 UNCERTAINTY OF EMISSION FACTORS

For the purpose of analysis of the uncertainty of emission factors, the data from the CEIP's Uncertainty analysis tool were used for sectors energy, industry, solvents and waste.
For sectors transport and agriculture, the arithmetic means values of the proposed upper and lower emission factor uncertainty from Table 2-2 from the Chapter Uncertainty analysis of EMEP/EEA GB_{2019} were calculated and used for the calculation.
For the sector of residential heating, the value of uncertainty was obtained from the VEC VŠB[10].
Emission factors and measurement uncertainty for emissions from the NEIS database (main pollutants) were established by Decree 410/2012 Coll[11].
The table below represents an example of the uncertainty analysis calculation.

[10] https://powietrze.malopolska.pl/en/life-project/

[11] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/410/#prilohy

Table A9.1: *Example of the uncertainty analysis of NOx*

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A1a	NOx	NEIS	NA	20.87	2.63	4	20	20.30	0.84	-0.05	0.02	-0.93	0.10	0.88
1A1b	NOx	NEIS	NA	3.80	1.82	5	20	20.62	0.41	0.00	0.01	0.03	0.09	0.01
1A1c	NOx	NEIS	NA	0.43	0.70	5	20	20.62	0.06	0.00	0.01	0.08	0.04	0.01
1A2a	NOx	NEIS	NA	5.13	2.09	4	20	20.43	0.54	0.00	0.02	-0.02	0.09	0.01
1A2b	NOx	NEIS	NA	0.00	0.01	4	20	20.43	0.00	0.00	0.00	0.00	0.00	0.00
1A2c	NOx	NEIS	NA	0.72	0.21	4	20	20.42	0.01	0.00	0.00	-0.01	0.01	0.00
1A2d	NOx	NEIS	NA	3.30	1.31	4	20	20.37	0.21	0.00	0.01	-0.02	0.05	0.00
1A2f	NOx	NEIS	NA	5.67	4.29	2	20	20.10	2.19	0.01	0.03	0.27	0.09	0.08
1A2gvii	NOx	NA	NA	0.50	0.89	5	200	200.06	9.31	0.00	0.01	0.99	0.05	0.99
1A2gviii	NOx	NEIS	NA	2.58	1.15	3	20	20.26	0.16	0.00	0.01	0.01	0.04	0.00
1A3ai(i)	NOx	Please Select	Jet Gasoline and Aviation Gasoline	0.10	0.04	1	40	40.01	0.00	0.00	0.00	0.00	0.00	0.00
1A3aii(i)	NOx	Please Select	Jet Gasoline and Aviation Gasoline	0.08	0.00	1	40	40.01	0.00	0.00	0.00	-0.01	0.00	0.00
1A3bi	NOx	Passenger cars	Petrol	11.01	9.83	1	40	40.01	45.64	0.04	0.07	1.50	0.10	2.27
1A3bii	NOx	Light commercial vehicles	Diesel	4.45	3.28	1	40	40.01	5.08	0.01	0.02	0.40	0.03	0.16
1A3biii	NOx	Please Select	Please Select	28.26	4.30	1	40	40.01	8.72	-0.06	0.03	-2.31	0.04	5.33
1A3biv	NOx	Please Select	Please Select	0.09	0.02	1	40	40.01	0.00	0.00	0.00	-0.01	0.00	0.00
1A3c	NOx	Rail Cars	Gas Oil/Diesel	1.79	0.44	1	89	88.75	0.45	0.00	0.00	-0.22	0.00	0.05
1A3c	NOx	Line-haul locomotives	Gas Oil/Diesel	4.40	1.08	1	98	97.75	3.29	-0.01	0.01	-0.58	0.01	0.34
1A3di(ii)	NOx	NA	Marine diesel oil/marine gas oil (MDO/MGO)	0.00	0.43	1	200	200.00	2.21	0.00	0.00	0.64	0.00	0.41
1A3dii	NOx	Please Select	Please Select	1.63	0.15	1	200	200.00	0.26	0.00	0.00	-0.81	0.00	0.66
1A3ei	NOx	NEIS	NA	3.11	0.13	1	20	20.02	0.00	-0.01	0.00	-0.18	0.00	0.03
1A4ai	NOx	NEIS	NA	2.75	2.72	4	20	20.36	0.90	0.01	0.02	0.23	0.11	0.06
1A4aii	NOx	Please Select	Please Select	0.11	0.10	5	200	200.06	0.11	0.00	0.00	0.07	0.01	0.01
1A4bi	NOx	Overfire boilers-low heat input	biomass dry	0.08	0.35	3	30	30.15	0.03	0.00	0.00	0.07	0.01	0.00
1A4bi	NOx	Overfire boilers-normal heat input	biomass dry	0.02	0.15	3	30	30.15	0.01	0.00	0.00	0.03	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	biomass wet	0.02	0.08	3	30	30.15	0.00	0.00	0.00	0.02	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	biomass wet	0.00	0.03	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	wood briquettes	0.00	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	wood briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A4bi	NOx	Overfire boilers-low heat input	hard coal	0.12	0.04	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	hard coal	0.03	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	brown coal	1.39	0.01	3	30	30.15	0.00	0.00	0.00	-0.13	0.00	0.02
1A4bi	NOx	Overfire boilers-normal heat input	brown coal	0.38	0.01	3	30	30.15	0.00	0.00	0.00	-0.03	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	Coal briquettes	0.00	0.03	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	Coal briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	Coke	0.20	0.00	3	30	30.15	0.00	0.00	0.00	-0.02	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	Coke	0.05	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	biomass dry	0.03	0.08	3	30	30.15	0.00	0.00	0.00	0.02	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	biomass dry	0.01	0.04	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	biomass wet	0.01	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	biomass wet	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	wood briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	wood briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	hard coal	0.05	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	hard coal	0.01	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	brown coal	0.83	0.01	3	30	30.15	0.00	0.00	0.00	-0.08	0.00	0.01
1A4bi	NOx	Underfire boilers-normal heat input	brown coal	0.19	0.00	3	30	30.15	0.00	0.00	0.00	-0.02	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	Coal briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	Coal briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	Coke	0.08	0.00	3	30	30.15	0.00	0.00	0.00	-0.01	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	Coke	0.02	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	hard coal	0.12	0.04	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	hard coal	0.03	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	brown coal	1.39	0.01	3	30	30.15	0.00	0.00	0.00	-0.13	0.00	0.02
1A4bi	NOx	Overfire boilers-normal heat input	brown coal	0.38	0.01	3	30	30.15	0.00	0.00	0.00	-0.03	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	Coal briquettes	0.00	0.03	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	Coal briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	Coke	0.20	0.00	3	30	30.15	0.00	0.00	0.00	-0.02	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	Coke	0.05	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	biomass dry	0.03	0.08	3	30	30.15	0.00	0.00	0.00	0.02	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	biomass dry	0.01	0.04	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A4bi	NOx	Underfire boilers-low heat input	biomass wet	0.01	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	biomass wet	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	wood briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	wood briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	hard coal	0.05	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	hard coal	0.01	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	brown coal	0.83	0.01	3	30	30.15	0.00	0.00	0.00	-0.08	0.00	0.01
1A4bi	NOx	Underfire boilers-normal heat input	brown coal	0.19	0.00	3	30	30.15	0.00	0.00	0.00	-0.02	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	Coal briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	Coal briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underfire boilers-low heat input	Coke	0.08	0.00	3	30	30.15	0.00	0.00	0.00	-0.01	0.00	0.00
1A4bi	NOx	Underfire boilers-normal heat input	Coke	0.02	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-low heat input	biomass dry	0.00	0.06	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Gasification boilers-normal heat input	biomass dry	0.00	0.04	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Gasification boilers-low heat input	biomass wet	0.00	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-normal heat input	biomass wet	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-low heat input	wood briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-normal heat input	wood briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-low heat input	hard coal	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-normal heat input	hard coal	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-low heat input	brown coal	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-normal heat input	brown coal	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-low heat input	Coal briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-normal heat input	Coal briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-low heat input	Coke	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification boilers-normal heat input	Coke	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-low heat input	biomass dry	0.00	0.06	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	biomass dry	0.00	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-low heat input	biomass wet	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	biomass wet	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-low heat input	wood briquettes	0.00	0.03	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	wood briquettes	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A4bi	NOx	Automatic boilers-low heat input	hard coal	0.00	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	hard coal	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-low heat input	brown coal	0.12	0.00	3	30	30.15	0.00	0.00	0.00	-0.01	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	brown coal	0.02	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-low heat input	Coal briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	Coal briquettes	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-low heat input	Coke	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	Coke	0.00	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Fireplaces-low heat input	biomass dry	0.05	0.21	3	150	150.03	0.30	0.00	0.00	0.21	0.01	0.05
1A4bi	NOx	Fireplaces-normal heat input	biomass dry	0.01	0.08	3	150	150.03	0.04	0.00	0.00	0.08	0.00	0.01
1A4bi	NOx	Fireplaces-low heat input	biomass wet	0.01	0.05	3	150	150.03	0.02	0.00	0.00	0.05	0.00	0.00
1A4bi	NOx	Fireplaces-normal heat input	biomass wet	0.00	0.02	3	150	150.03	0.00	0.00	0.00	0.02	0.00	0.00
1A4bi	NOx	Fireplaces-low heat input	wood briquettes	0.00	0.01	3	150	150.03	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Fireplaces-normal heat input	wood briquettes	0.00	0.00	3	150	150.03	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Fireplaces-low heat input	hard coal	0.02	0.01	3	75	75.06	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Fireplaces-normal heat input	hard coal	0.00	0.00	3	75	75.06	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Fireplaces-low heat input	brown coal	0.21	0.00	3	75	75.06	0.00	0.00	0.00	-0.05	0.00	0.00
1A4bi	NOx	Fireplaces-normal heat input	brown coal	0.04	0.00	3	75	75.06	0.00	0.00	0.00	-0.01	0.00	0.00
1A4bi	NOx	Fireplaces-low heat input	Coal briquettes	0.00	0.01	3	75	75.06	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Fireplaces-normal heat input	Coal briquettes	0.00	0.00	3	75	75.06	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Fireplaces-low heat input	Coke	0.02	0.00	3	75	75.06	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Fireplaces-normal heat input	Coke	0.00	0.00	3	75	75.06	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Modern stoves-low heat input	biomass dry	0.00	0.06	3	125	125.04	0.02	0.00	0.00	0.06	0.00	0.00
1A4bi	NOx	Modern stoves-normal heat input	biomass dry	0.00	0.02	3	125	125.04	0.00	0.00	0.00	0.02	0.00	0.00
1A4bi	NOx	Modern stoves-low heat input	biomass wet	0.00	0.01	3	125	125.04	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Modern stoves-normal heat input	biomass wet	0.00	0.00	3	125	125.04	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Modern stoves-low heat input	wood briquettes	0.00	0.00	3	125	125.04	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Modern stoves-normal heat input	wood briquettes	0.00	0.00	3	125	125.04	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	NA	Natural Gas	1.09	1.97	3	30	30.15	1.04	0.01	0.01	0.33	0.06	0.11
1A4bi	NOx	Please Select	Fuel oil	0.07	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bii	NOx	Please Select	Please Select	0.06	0.17	5	200	200.06	0.35	0.00	0.00	0.22	0.01	0.05

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A4ci	NOx	NEIS	NA	0.11	0.25	4	63	62.62	0.07	0.00	0.00	0.10	0.01	0.01
1A4cii	NOx	Please Select	Please Select	8.55	1.79	5	200	200.06	37.89	-0.01	0.01	-2.77	0.09	7.70
1A5a	NOx	NEIS	NA	0.18	0.38	5	20	20.52	0.02	0.00	0.00	0.04	0.02	0.00
1A5b	NOx	NA	Please Select	0.00	0.05	5	200	200.06	0.03	0.00	0.00	0.07	0.00	0.01
1B1b	NOx	Please Select	NA	0.00	0.00	5	256	256.05	0.00	0.00	0.00	0.00	0.00	0.00
2A5a	NOx	Please Select	NA	0.01	0.03	2	20	20.10	0.00	0.00	0.00	0.00	0.00	0.00
2A6	NOx	NA	NA	0.34	0.29	2	20	20.10	0.01	0.00	0.00	0.02	0.01	0.00
2B1	NOx	NA	NA	0.21	0.16	2	20	20.10	0.00	0.00	0.00	0.01	0.00	0.00
2B2	NOx	Please Select	NA	0.17	0.29	2	20	20.10	0.01	0.00	0.00	0.03	0.01	0.00
2B5	NOx	Please Select	NA	0.00	0.06	2	20	20.10	0.00	0.00	0.00	0.01	0.00	0.00
2B10a	NOx	NA	NA	0.70	0.51	2	20	20.10	0.03	0.00	0.00	0.03	0.01	0.00
2B10b	NOx	NA	NA	0.00	0.00	2	20	20.10	0.00	0.00	0.00	0.00	0.00	0.00
2C1	NOx	NEIS	NA	3.27	3.83	7	20	21.36	1.97	0.02	0.03	0.36	0.30	0.22
2C2	NOx	NA	NA	0.43	0.00	3	20	20.22	0.00	0.00	0.00	-0.03	0.00	0.00
2C3	NOx	NEIS	NA	0.23	0.49	2	20	20.10	0.03	0.00	0.00	0.06	0.01	0.00
2C5	NOx	NEIS	NA	0.00	0.00	1	20	20.02	0.00	0.00	0.00	0.00	0.00	0.00
2C7a	NOx	NEIS	NA	0.02	0.06	2	20	20.10	0.00	0.00	0.00	0.01	0.00	0.00
2C7c	NOx	0	NA	1.41	1.06	2	20	20.10	0.13	0.00	0.01	0.07	0.02	0.00
2G	NOx	Other, Tobacco combustion	NA	0.00	0.02	2	53	52.82	0.00	0.00	0.00	0.01	0.00	0.00
2G	NOx	Other, Use of Fireworks	NA	0.00	0.00	2	100	100.02	0.00	0.00	0.00	0.00	0.00	0.00
2H3	NOx	NA	NA	0.00	0.00	2	20	20.10	0.00	0.00	0.00	0.00	0.00	0.00
2I	NOx	NA	NA	0.31	0.27	2	20	20.10	0.01	0.00	0.00	0.02	0.01	0.00
3B1a	NOx	Dairy cattle	Slurry	0.09	0.04	25	200	201.56	0.02	0.00	0.00	0.00	0.01	0.00
3B1b	NOx	Please Select	Please Select	0.16	0.04	25	200	201.56	0.02	0.00	0.00	-0.05	0.01	0.00
3B2	NOx	Sheep	Please Select	0.02	0.01	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3B3	NOx	Please Select	Please Select	0.02	0.00	25	200	201.56	0.00	0.00	0.00	-0.01	0.00	0.00
3B4d	NOx	Goats	Please Select	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3B4e	NOx	Horses	Please Select	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3B4gi	NOx	Laying hens (laying hens and parents)	Please Select	0.01	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3B4gii	NOx	Please Select	Please Select	0.03	0.03	25	200	201.56	0.01	0.00	0.00	0.02	0.01	0.00
3B4giii	NOx	Turkeys	Please Select	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
3B4giv	NOx	Please Select	Please Select	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3Da1	NOx	Please Select	Please Select	8.89	5.10	25	200	201.56	311.55	0.01	0.04	1.89	1.33	5.33
3Da2a	NOx	Please Select	Please Select	2.73	0.95	25	200	201.56	10.71	0.00	0.01	-0.33	0.25	0.17
3Da2b	NOx	NA	NA	0.01	0.00	25	200	201.56	0.00	0.00	0.00	-0.01	0.00	0.00
3Da2c	NOx	NA	NA	0.03	0.15	25	200	201.56	0.27	0.00	0.00	0.21	0.04	0.04
3Da3	NOx	Please Select	Please Select	1.56	0.77	25	200	201.56	7.12	0.00	0.01	0.15	0.20	0.06
3Da4	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3Db	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3Dc	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3Dd	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3De	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3Df	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3F	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
3I	NOx	NA	NA	0.00	0.00	25	200	201.56	0.00	0.00	0.00	0.00	0.00	0.00
5C1bi	NOx	NA	NA	0.01	0.00	5	500	500.02	0.00	0.00	0.00	-0.01	0.00	0.00
5C1bii	NOx	NA	NA	0.00	0.00	5	500	500.02	0.00	0.00	0.00	0.01	0.00	0.00
5C1biii	NOx	Controlled air incineration	NA	0.00	0.00	5	58	58.55	0.00	0.00	0.00	0.00	0.00	0.00
5C1bv	NOx	NA	NA	0.00	0.03	5	500	500.02	0.05	0.00	0.00	0.09	0.00	0.01
5D1	NOx	NEIS	NA	0.00	0.01	4	20	20.49	0.00	0.00	0.00	0.00	0.00	0.00
5D2	NOx	NEIS	NA	0.00	0.00	4	20	20.49	0.00	0.00	0.00	0.00	0.00	0.00
		Total	**135.56**	**58.24**					**452.17**					**25.13**
		Total Uncertainties		**-57.04**			**Uncertainty in total inventory %:**		**21.26**			**Trend uncertainty %:**		**5.01**

A-NFR category, **B**-Pollutant, **C**-Base year emissions, **D**-Year T emissions, **E**-Activity data uncertainty, **F**-Emission factor uncertainty, **G**-Combined uncertainty, **H**-Combined uncertainty as % of total national emissions in year t, **I**-Type A sensitivity, **J**-Type B sensitivity, **K**-Uncertainty in trend in national emissions introduced by emission factor uncertainty, **L**-Uncertainty in trend in national emissions introduced by activity data uncertainty, **M**-Uncertainty introduced into the trend in total national emissions

ANNEX X: TIMETABLE FOR METHODOLOGY IMPROVEMENT OF REPORTING OF HEAVY METALS AND PERSISTENT ORGANIC POLLUTANTS IN SECTORS INDUSTRY AND ENERGY

Due to the implementation of uncertainty analysis into the key category analysis, the list of priority key categories was changed. New methodologies need to be developed for the categories which were not key until now. Also, uncertainty analysis will be further developed and improved. The plan to improve the key categories and uncertainties for the next 3 years is listed in ***Table A10.1***.

Table A10.1: *Plan of improvements*

TASK	OUTCOME	TIME SCHEDULE	STATUS OF IMPLEMENTATION
Uncertainty analysis with detailed data for sectors energy, industry and waste	Uncertainty analysis on tier 1	Submission 2022	**Implemented**
Key category analysis with uncertainties	Identification of key categories with uncertainty	Submission 2022	**Implemented**
Analysis of available methodology and emission data for key categories	List of categories possible to improve	Submission 2025	**To be implemented**
Uncertainty analysis with detailed data for sectors agriculture, transport and residential heating	Uncertainty analysis on tier 1	Submission 2025/2026	**To be implemented**
Improvement of priority categories to Tier 2	Emissions of priority key categories reported using Tier 2	Submission 2025/2026	**To be implemented**
Further analysis of available sources of methodology/Activity data	Emissions of non-priority key categories using Tier 2	Submission 2025/2026	**To be implemented**

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